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WORKPLAN. pdf.

Benchmark
Environmental
Engineering &
Science, PLLC

May 19, 2000

Mr. Joseph Moloughney
Environmental Engineer
Bureau of Western Remedial Action
Division of Environmental Remediation
New York State Department of
Environmental Conservation
50 Wolf Road
Albany, New York 12233

Re: Urbana Landfill - NYSDEC Site No. 8-51-007

Dear Mr. Moloughney:

Per our discussions, enclosed for your review is a copy of a revised Remedial Action Work Plan for the above-referenced site. In addition, per the draft Consent Order we have prepared a Contingency Plan (copy enclosed) describing actions to be taken in the event the remedial measures fail to meet performance objectives.

I will contact you early next week to discuss distribution of the Work Plan and Contingency Plan to other individuals within the Department.

Sincerely,
Benchmark Environmental Engineering & Science, PLLC

Thomas H. Forbes, P.E.
Project Manager

file: 0001-001-100, CG

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REMEDIAL ACTION WORK PLAN
for
THE URBANA LANDFILL SITE

NYSDEC SITE NO. 8-51-007
URBANA, NY

June 1998
Revised July 1998
Revised May 2000

0001-001-100

Prepared for:
Mercury Aircraft, Inc.
Hammondsport, NY

Prepared by:

Benchmark Environmental Engineering & Science, PLLC

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REMEDIAL ACTION WORK PLAN FOR
URBANA LANDFILL SITE

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URBANA LANDFILL SITE

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1.0 INTRODUCTION

1.1 Site Description/History

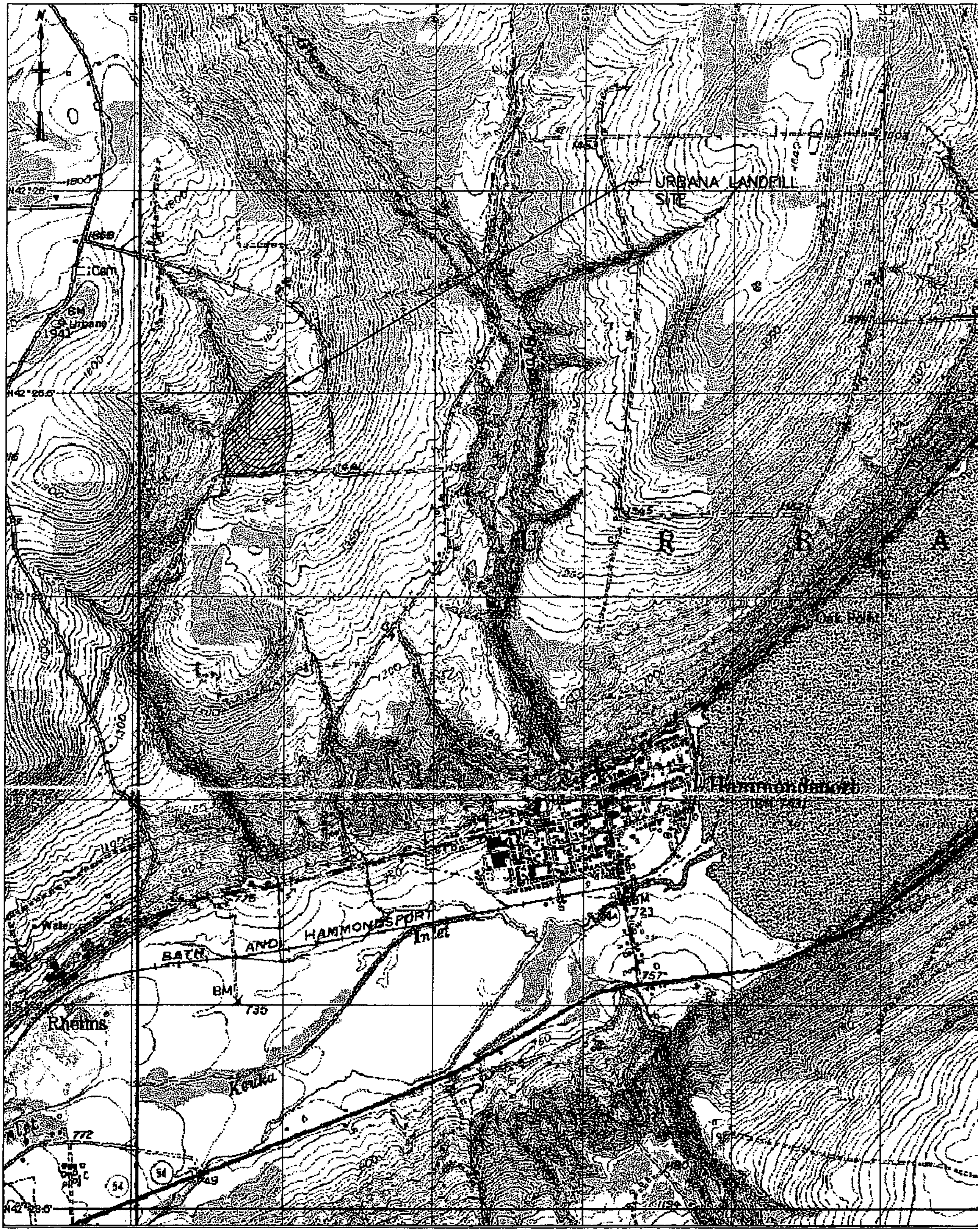
The Urbana Landfill is located on Crows Nest Road, approximately one mile northeast of the Village of Hammondsport, New York in Steuben County (see Figures 1-1 and 1-2). The landfill, which encompasses approximately 10 acres, is owned and was operated by Francis Smith for the disposal of municipal and industrial solid wastes from the Town of Urbana and the Village of Hammondsport from 1968 to 1978. The largest identified industrial waste source was Mercury Aircraft, Inc. who voluntarily reported the disposal of small quantities of chlorinated solvent still bottoms and paint sludge at the landfill.

1.2 Regulatory History

The New York State Department of Environmental Conservation (NYSDEC) has listed the site on the State Registry of Inactive Hazardous Waste Disposal Sites as a Class 2 site, indicating that it poses a potential threat to public health and the environment. The NYSDEC performed a Remedial Investigation/ Feasibility Study (RI/FS) at the site in 1997 to: define the nature and extent of contamination at the site; evaluate human and environmental exposure pathways; and evaluate feasible remedies to mitigate the potential threats. A Proposed Remedial Action Plan (PRAP) for the site was developed by the NYSDEC based on the RI/FS. Written technical comments on the RI/FS and PRAP were submitted by Mercury Aircraft, Inc. as a potential responsible party (PRP). Mercury Aircraft and/or their technical representatives subsequently met with NYSDEC on several occasions to discuss planned remedial actions at the site. The NYSDEC subsequently issued a Record of Decision (ROD) dated March 1998 documenting their selected remedial action for the site. The components of the remedy selected in the ROD included:

- A remedial design program to verify the components of the conceptual design and provide the details necessary for the construction, operation and

FIGURE 1-1



Benchmark Environmental Engineering & Science, PLLC

URBANA, NEW YORK

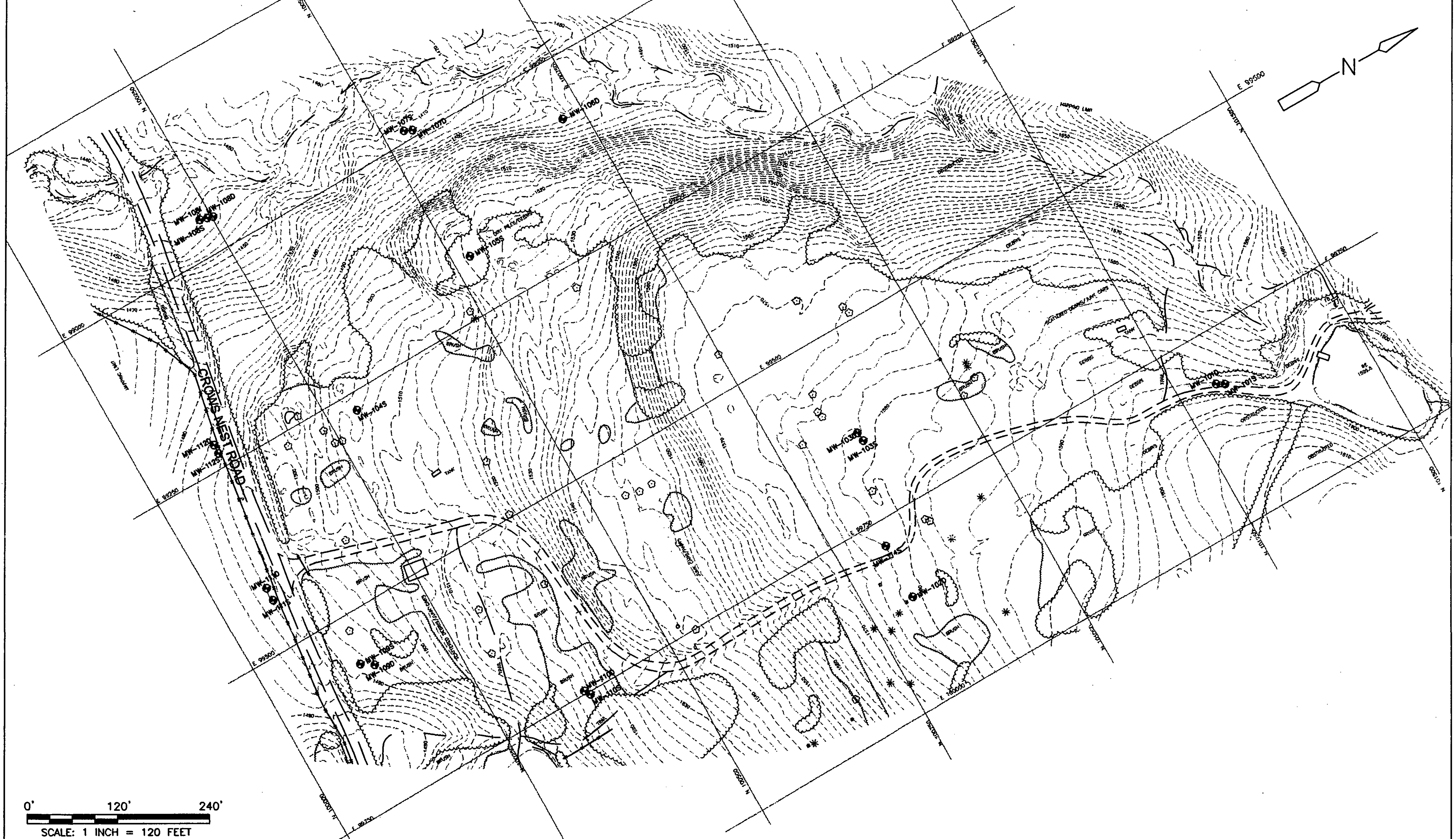
REMEDIAL ACTION WORK PLAN FOR URBANA LANDFILL SITE

MARCH 2000

URBANA LANDFILL SITE LOCATION MAP

APPROXIMATE SCALE: 1" = 2000'

FIGURE 1-2



Benchmark Environmental Engineering & Science, PLLC		REVISIONS	DES / DWN / CKD	URBANA, NEW YORK REMEDIAL ACTION WORK PLAN FOR URBANA LANDFILL SITE NYSDEC SITE NO. 8-51-007	REMEDIAL ACTION WORK PLAN EXISTING SITE PLAN	DATE MARCH 2000 SHEET ___ OF ___ CAD REF. NO. Figure 1-2.DWG

maintenance, and monitoring of the remedial program. Uncertainties identified during the RI/FS would also be resolved.

- A landfill cover system designed to meet the substantive requirements of 6NYCRR Part 360.

- Determination of the extent of waste consolidation during the design of the remedy. The primary factors to consider during design would include the extent to which consolidation would minimize the potential for future releases of hazardous waste constituents to the environment and the beneficial impacts of consolidaton on the long-term operation and maintenance of the remedy.

- Removal/treatment (likely by soil vapor extraction) of VOC contaminants from the upper terrace of the landfill.

- Since the remedy results in some untreated hazardous waste remaining at the site, a long-term monitoring program would be instituted. A number of existing monitoring wells along with nearby residential wells would be monitored to confirm that the off-site groundwater quality does not deteriorate. In the unlikely event that off-site groundwater quality does deteriorate, additional corrective measures will need to be evaluated.

Mercury Aircraft reviewed the State's approach and subsequently volunteered to perform the landfill remediation using an alternative remedial approach having equivalent performance in reducing risk to human health and the environment as the remedy outlined in the ROD. This approach, hereafter referred to as the preferred remedial approach, consists of the following major components:

- An enhanced landfill final cover system.

- Groundwater remediation.

- Hot Spot 5 Remediation.

- Stream Bank Stabilization.

Details of the preferred remedial approach were initially presented to NYSDEC in conceptual form in June 1998 and subsequently revised and resubmitted in a July 1998 version of this Remedial Action Work Plan, which was approved by NYSDEC in August 1998. The July 1998 Remedial Action Work Plan also outlined a series of pre-design field investigations that would be required to provide necessary data for design of the preferred remedial approach. These included:

- A cover system investigation to determine, in greater detail, the thickness of the existing cover system and the aerial limits of the landfill.

- A groundwater pump test to better establish contaminated groundwater flow patterns and provide design data for the proposed groundwater collection system, such as the well radius of influence, required well spacing and steady-state groundwater flow patterns.

- Groundwater treatability testing to assist in equipment sizing and verifying treatment efficiency of the proposed groundwater treatment technology.

- A soil vapor extraction (SVE) system pilot test to provide design criteria for the spacing of SVE extraction wells, sizing of the SVE mechanical equipment, and type of air emissions controls, if required, suitable to the SVOC off-gas.

These pre-design field investigations were completed by Mercury Aircraft in Fall 1998 - Spring 1999.

1.3 Purpose and Scope

This final Remedial Action Work Plan supplements the initial (July 1998) remedial approach for the Urbana Landfill with incorporation of the pre-design testing results described above. This document is to be attached to and become part of the Remedial Action Consent Order.

This Remedial Action Work Plan demonstrates that the preferred remedial approach is consistent with the ROD and will provide equal or better performance, as defined by the release of hazardous waste constituents to the environment, than the generic Part 360 cover system. This document, as approved by the NYSDEC, will serve as the basis for and become part of the remedial design with the following additional components (see Section 4.0):

- design plans and specifications as necessary to adequately convey the preferred remedial approach.
- a Construction Quality Assurance Plan governing cover system placement activities
- a site Health and Safety Plan

In addition, a post-closure operations and maintenance plan will be prepared within 45 days of completion of the remedial construction to identify operations and maintenance requirements for the groundwater and SVE remediation equipment, and post-closure maintenance of the cover system and appurtenances. The O&M Plan will also describe continued monitoring requirements for the preferred alternative, including monitoring to verify the effectiveness of the remedial measures in providing equivalent performance to the Part 360 alternative. The O&M Plan will reference a Contingency Plan to be implemented if the remedial measures fail to meet equivalent performance criteria.

2.0 DESIGN CONCEPT - PREFERRED REMEDIAL APPROACH

2.1 General

The preferred remedial approach consists of the following major components:

- An enhanced landfill final cover system.
- Groundwater remediation.
- Hot Spot 5 remediation.
- Stream bank protection.

The preferred remedial approach, compared to a generic Part 360 cover system with waste consolidation, minimizes excavation and consolidation of waste, significantly reduces truck traffic and noise, substantially reduces the duration of the construction project, provides a positive and measurable means of controlling off-site groundwater contaminant migration, and minimizes disturbances to the existing cover system and trees, thereby minimizing the potential for erosion while maintaining the site aesthetics.

Details of the preferred remedial approach are provided in the sections that follow.

2.2 Enhanced Final Cover System

The enhanced final cover system will incorporate placement of supplemental soil cover materials on an area-specific basis and the installation of deep gas well venting system. As previously presented to NYSDEC, Mercury Aircraft performed initial test pit investigations and Shelby tube sampling at the site in January 1998 (see Appendix A1). This investigation indicated that much of the existing landfill cover system has sufficient thickness and low permeability to provide an effective hydraulic barrier against infiltration consistent with the substantive requirements of 6NYCRR Part 360. Several areas of the site were found to already contain upwards of 48-inches of soil cover material, with all existing cover soils characterized by low (i.e. $<1.4 \times 10^{-6}$ cm/s) permeabilities. However, additional data was needed to more accurately define the extent and thickness of existing soil cover. This additional data was collected in November 1998 as part of the pre-design work activities for the site. Appendix A2 provides a summary of this pre-design cover investigation data, including a summary map showing test pit locations and the thickness of cover soils.

To preclude contact with the waste and limit leachate generation, areas of the site where sufficient cover soil is not already present will be enhanced with additional soil cover to provide a minimum of 24 inches of soil cover. Where supplemental cover is placed it will consist of up to 18 inches of barrier layer and 6 inches of topsoil. New topsoil will be subject to the quality control criteria described in the specification presented in Appendix A3, which will be incorporated in the site Construction Quality Assurance Plan. Regrading will also be performed as necessary to facilitate cover system placement and achieve desired grades.

A gas venting system consisting of deep gas venting wells will be installed at a minimum density of one per acre. The deep gas venting wells will consist of 8-inch diameter boreholes constructed to fully penetrate the cover system and unsaturated fill material. Gas will be collected in the boreholes with perforated 4-inch diameter HDPE or PVC pipe and backfilled with select granular backfill material. Deep gas venting wells will be completed with solid riser pipe extending a minimum of three feet above the final cover system.

Along the southwest portion of the site adjacent to the stream bank, special precautions will be taken to ensure the protection of the stream. Specifically, large debris along the western bank of the site will be removed and placed in areas requiring fill and/or buried on-site such that it is ultimately covered with 18-inches of barrier soil and 6-inches of topsoil. Tires and/or metal debris may be scrapped or recycled off-site. Remaining covered wastes will then be pushed back and regraded, or the stream will be re-routed, such that wastes will not be located within 30 feet of the stream bank. Section 2.5 provides additional detail concerning the proposed stream protection measures.

Plates 1 and 2, attached to this Work Plan, illustrate planned subgrade and final grading contours relative to existing contours and test pit investigation findings. As shown on Plates 1 and 2, existing landfill cover soils will be supplemented or replaced in areas where test pit data indicates insufficient cover, or where additional cover materials are necessary to achieve a 4% minimum grade. Areas where sufficient cover already exists will be cleared of brush and initially mowed to facilitate future site maintenance. In spots where vegetative growth is not currently being sustained, existing cover will be cleared, raked, reseeded and fertilized to facilitate re-vegetating with the desired grass mixture. If the absence of vegetation appears attributable to poor soil quality (eg., gravelly or clayey soils), supplemental topsoil will be placed prior to seeding.

The proposed subgrade and final grading plans presented on Plates 1 and 2 will be modified to remove test pit data and supplemented with additional information, including highlighting of sub-areas to show general cut and fill, gas vent construction requirements, monitoring well extension details, stream bank protection details, and notes to the contractor. These plans, combined with the site-specific Construction Quality Assurance/Quality Control (QA/QC) Plan, site Health and Safety Plan and construction specifications will form the remedial design manual for the cover system construction contract.

A discussion of the specific performance criteria and methodology used to evaluate the effectiveness of these measures in comparison to the generic Part 360 cover system approach is presented in Sections 3.2 and 3.3.

2.3 Groundwater Control

2.3.1 Hydrogeology

To supplement existing Remedial Investigation data concerning contaminant fate and transport in the southeastern portion of the landfill, a total of six (6) piezometers were installed at the site in Fall 1998 (see Appendix B-1). The piezometers were strategically located to serve dual purpose as indicators of existing hydrogeologic conditions, as well as monitoring points for the pump test and full-scale collection system. Three geologic units were identified during the piezometer boring program: a fill unit consisting of soil cover material, disturbed soil and/or waste material; a till unit consisting of fine grained soil matrix (predominantly silt) with fine to coarse gravel; and a weathered bedrock unit consisting of soft, laminated fissile shale. A cobble-rich zone was also encountered above the bedrock unit in the southwest corner of the site in the vicinity of MW-108S/I. The cobble-rich zone was likely deposited in a glaciofluvial environment similar to fluvial conditions currently existing in the adjacent creek.

Saturated conditions were not encountered in the till. Occasional wet sand stringers or partings were identified, however these are small and isolated and do not represent a significant source of water. Therefore, the till in the southeast portion of the landfill is considered non-water bearing due to its fine-grained matrix and low permeability. Groundwater occurs in semi-confined conditions in the weathered bedrock, which is considered the upper water-bearing zone at the Urbana Landfill site. Preliminary testing indicated that the glaciofluvial deposits surrounding MW-108 are in hydraulic communication with the weathered bedrock. Accordingly, contaminated groundwater in the glaciofluvial deposits is the result of discharge from the weathered bedrock.

Shallow groundwater levels observed in the upper areas of the landfill are the result of mounding in the landfill waste, as discussed in Appendix B-1. The low-permeability till outside the fill areas along Crow's Nest Road inhibits lateral groundwater flow and induces groundwater in the fill material to migrate downward into weathered bedrock and laterally to the west (i.e., toward the stream). This is supported by contouring of the potentiometric surface of the upper water-bearing zone and the lack of volatile organic compounds (VOCs) detected in the wells south of Crow's Nest Road. Appendix B-1 presents a groundwater contour map showing upper water bearing zone migration toward the un-named stream.

2.3.2 Groundwater Recovery

Contaminated groundwater will be recovered along the western perimeter of the landfill between Crow's Nest Road and MW-107 using vertical recovery wells. A pump test was performed at the site in April 1999 in accordance with the NYSDEC-approved scope of work (see Attachment B-2). Three (3) 6-inch stainless steel wells were installed at the approximate locations shown in Attachment B-2. The wells were constructed as full-scale recovery wells with 10-foot screens intercepting the weathered rock and extending into the overlying till. Sumps five (5) feet deep were installed beneath the screens to provide a submerged operating location for the collection pump. At PW-2 and PW-3 the sand pack was extended a minimum of 2 feet above the well screen to collect any water present in coarser grain layers within the dry till. At PW-1, the sand pack was extended to 20 feet above the well screen to intercept water present within a thin stringer of wet sand identified in the till at a depth of approximately 22 feet below grade. Geologic units and groundwater conditions encountered during pumping well installation were consistent with those described in Section 2.3, above.

Results of the pump test are presented in Appendix B-3. In general, the wells exhibited overlapping areas of influence during the test, indicating the existing well system will be adequate for full-scale groundwater recovery. Wells PW-2 and PW-3 exhibited radii of influence of approximately 90 feet and 60 feet, respectively. At well PW-1, a radius of influence over 250 feet (beyond the southern side of Crow's Nest Road past MW-112) was observed.

Based on the results of the pump test, the full-scale steady state groundwater production rate is estimated to be approximately 5-10 gpm, with approximately 80% of the flow collected from PW-1, 15% from PW-2, and the remaining 5% of the flow collected from PW-3.

Groundwater samples were collected from each of the recovery wells following the pump test and analyzed for chlorinated volatile organic compounds (VOCs). Analytical results are summarized below.

URBANA LANDFILL - PUMP TEST VOC SAMPLE RESULTS			
PARAMETER	CONCENTRATION (ug/L)		
	PW-1	PW-2	PW-3
TCE	210	120	9
Cis-1,2-DCE	760	310	9
Vinyl Chloride	130	ND (<25)	ND (<1)

As indicated, the only parameters detected in the groundwater were trichloroethylene (TCE) and two breakdown products, cis-1,2 dichloroethylene (cis-1,2-DCE) and vinyl chloride. Total VOC levels are highest at PW-1, and descend to the north toward PW-3.

2.3.3 Groundwater Treatment

Recovered groundwater will be discharged to a common force main leading to an on-site groundwater treatment system. The treatment process will incorporate advanced oxidation technology (AOT). AOT is a destructive process incorporating ultraviolet light and hydrogen peroxide to form hydroxyl radicals, which are powerful oxidizers that convert the chlorinated organics to carbon dioxide, water and chloride salts. AOT is particularly effective for double and triple-bonded alkenes, such as the parameters detected in the groundwater at the Urbana Landfill site.

AOT offers several advantages over reactive (zero-valence) iron, which Mercury Aircraft previously presented to NYSDEC as a candidate groundwater treatment technology. Specifically, AOT affords greater protection of human health and the environment than reactive iron in that the associated reaction is not limited to dechlorination; rather, the process destroys the organic contaminants at the bond level. Unlike reactive iron, this destruction extends to other organic constituents present in the groundwater, reducing oxygen demand of the treated effluent. Some oxidation and settling of inorganics present in the groundwater may also be occur, further improving the quality of the groundwater prior to re-infiltration. In addition, AOT is a proven technology having well-defined maintenance needs and reliable, long-term effectiveness (major AOT system manufacturer's offer performance guarantees based on treatability test results). Reactive iron, though a promising treatment technology, has little operational history to support estimates of maintenance needs. This is particularly true for landfill settings, where the technology has had minimal application. Furthermore, Mercury Aircraft is experienced in AOT operations, facilitating the company's role in post-closure operations, maintenance and monitoring of this equipment.

A composite groundwater sample was collected from wells PW-1, PW-2 and PW-3 proportional to estimated full-scale production rates in May 1999. The sample was submitted to Calgon Carbon Corporation's Oxidation Technology Division for bench-scale AOT treatability testing to determine unit sizing and peroxide/power needs. A summary of the AOT treatability test and results are presented in Appendix B-4. The results of the AOT testing indicate that the VOCs of concern will be readily destroyed to non-detectable concentrations using a 30-KW AOT system.

As indicated in the AOT test report, Benchmark required that the analysis of raw water samples be expanded to include Target Analyte List (TAL) inorganics as well as a number of leachate indicator parameters. This was performed to provide an indication of the potential for AOT interference (viz., due to hydroxyl scavengers, inorganic oxidation, etc.), and to establish the overall quality of the groundwater with respect to thesee parameters, which are not targeted for direct treatment. The results of this testing show that no significant AOT interference/efficiency reduction is expected, and that the overall groundwater quality leaving the reactor will be similar or better for some parameters than background concentrations.

The groundwater treatment system process train will incorporate an influent day tank to temporarily store groundwater and facilitate batch process treatment, if desired. Groundwater will be pumped from the day tank through the AOT unit. A hydrogen peroxide storage tank (less than 185 gallon capacity) and metering pumps will be furnished with the AOT unit. Although the concentrations of suspended solids in the untreated influent are expected to be low, a filtration system (e.g., bag or cartridge filters) will be incorporated ahead of the day tank to mitigate solids build-up in the tank and increase AOT efficiency. Treated groundwater will be gravity-discharged to an infiltration gallery located downgradient of the recovery wells. Treatment equipment will be housed in a pre-cast concrete building or similar structure, and will be located near Crow's Nest Road to mitigate potential vandalism. The system will be furnished with automatic controls and safety interlocks to provide for automatic operation. An auto-dialer will also be installed to alert Mercury Aircraft personnel in the event of a process failure or building environmental problem (fire/freeze). Figure 2-1 presents a process flow schematic for the groundwater treatment system.

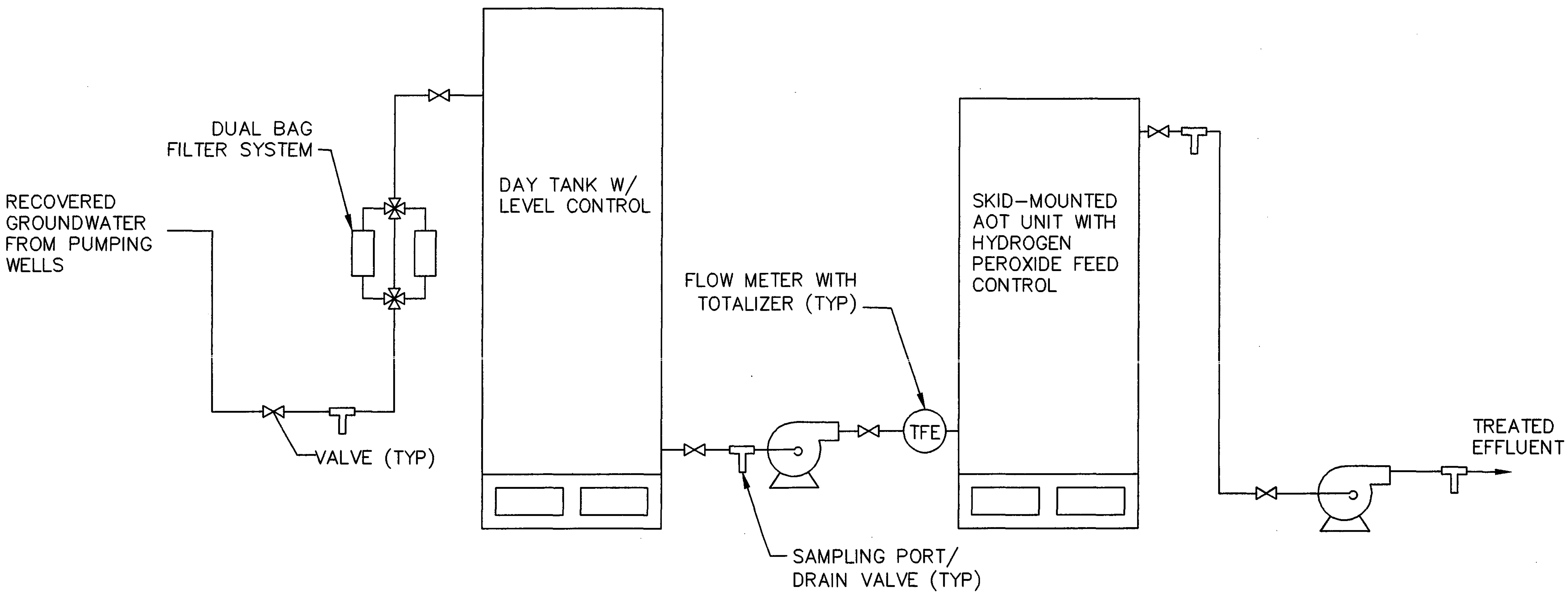
In addition to the groundwater recovery and treatment system, poplar trees will be planted along the southwestern perimeter of the landfill to provide further treatment of groundwater by phytoremediation and to serve as a natural, visual barrier to the landfill. Poplar trees are fast-growing, deep-rooted trees which, in combination with soil micoorganisms, remove groundwater contaminants by uptake and in-plant degradation and/or by enhancing microbial degradation in the rhizosphere of the poplar trees. The location and extent of poplar plantings will be shown on design plans for NYSDEC approval.

The approximate location of the groundwater recovery wells, the treatment system, and the groundwater infiltration trench are shown on Figure 2-2.

2.4 Hot Spot 5 Remediation

Hot Spot 5, located in the upper terrace of the landfill, will undergo soil vapor extraction (SVE) remediation. The SVE system will be comprised of a series of vertical extraction wells piped to an appropriately sized blower. Vertical SVE wells provide a construction advantage over horizontal collection laterals in that they can be installed with less disruption of existing vadose zone soils at a lower cost. In addition, a collection system

FIGURE 2-1



Benchmark Environmental Engineering & Science, PLLC

URBANA, NEW YORK

REMEDIAL ACTION WORK PLAN FOR URBANA LANDFILL SITE

NYSDEC SITE NO. 8-51-007

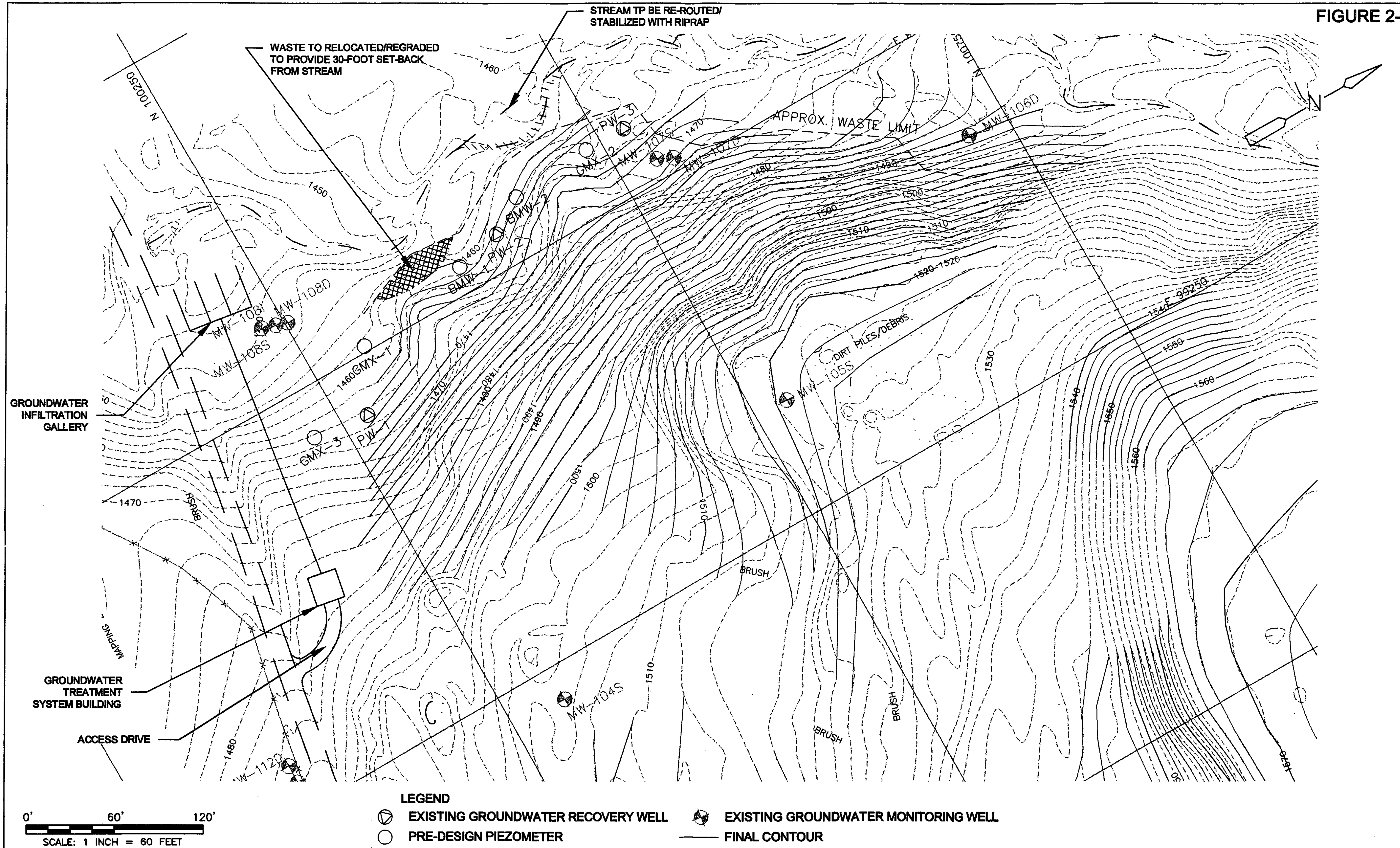
REMEDIAL ACTION WORK PLAN
PRELIMINARY TREATMENT PROCESS SCHEMATIC

DATE MAY 2000

SHEET ___ OF ___

CAD REF. NO. Flow Schematic.dwg

FIGURE 2-2



LEGEND

- EXISTING GROUNDWATER RECOVERY WELL
- PRE-DESIGN PIEZOMETER
- EXISTING GROUNDWATER MONITORING WELL
- FINAL CONTOUR

Benchmark Environmental Engineering & Science, PLLC

REVISIONS			
NO.	BY	DATE	REMARKS

DES ____
DRN ____
CKD ____

URBANA, NEW YORK
REMEDIAL ACTION WORK PLAN FOR URBANA LANDFILL SITE
NYSDEC SITE NO. 8-51-007

REMEDIAL ACTION WORK PLAN

PROPOSED PARTIAL SITE PLAN

DATE MARCH 2000
SHEET ___ OF ___
CAD REF. NO. FIG2_1.DWG

Mon. Wells
Downgradient
of Inf.
Gallery.

comprised of vertical SVE wells is more readily supplemented with additional collection points than a horizontal collection system would be if post-closure results indicate the need for SVE treatment outside the proposed hot-spot 5 limits.

An SVE pilot test was performed in hot spot 5 (i.e., on the upper terrace of the landfill) in February 1999 per the NYSDEC-approved work plan (see Appendix C-1). The test involved installation of a single, vertical SVE extraction well and four (4) monitoring piezometers in the southern portion of hot spot 5. The pilot test extraction well was located within 6 feet of RI soil gas monitoring location B-14. Based on the results of soil gas sampling performed during the remedial investigation (RI) at the site, monitoring location B-14 was the only soil gas monitoring location where vinyl chloride was detected. As vinyl chloride emissions will have significant impact on the need for and size of emission control equipment, installation and sampling of gas from an SVE well located within the vicinity of B-14 was performed to provide more representative emissions data for this parameter.

The extraction well and piezometers were installed to depths of approximately 10 feet below grade based on water table fluctuations as reported in the RI. Piezometers were located away from the SVE extraction well at distances of approximately 5.5 feet, 6.4 feet, 9.1 feet and 15.7 feet. The wells were installed using an air rotary drill rig to minimize the potential for smearing of the borehole sidewalls.

The SVE pilot test results are presented in Appendix C-2. Based on pilot test performance and conservative estimates of full-scale SVE system effectiveness, a radius of influence of 50 feet is expected from the extraction wells. Assuming four to six extraction wells having overlapping areas of influence are installed within the 150' x 200' hot spot, the SVE blower will need to extract approximately 300 scfm at an applied vacuum of 15-inches water column (WC).

Samples of the extracted soil gas were collected at approximately the mid-point and end of the SVE pilot test. Analytical results are presented with the pilot test report in Appendix C-2. No vinyl chloride was detected in either of the soil gas samples. However, the potential for elevated concentrations of other chlorinated and aromatic constituents in the soil gas will necessitate emission controls on the SVE blower exhaust. To assist in the selection of a suitable soil gas control technology, a conservative estimate of full-scale vapor concentrations in the SVE exhaust was calculated. Individual parameter concentrations were estimated as the average of values detected in the RI soil gas samples within Hot Spot 5, excluding samples from location B-14; maximum concentrations as determined from the SVE pilot test samples were substituted for this location. Where sampling occurred at the same location more than once (viz., where soil gas sampling was repeated during a second round), maximum concentrations detected at the sample location were used. The analytical detection limit was substituted where parameters were reported as non-detectable.

The resulting calculated concentrations and the estimated full-scale air flow rate of 300 SCFM were provided to suppliers of granular activated carbon (GAC) for evaluation (see Table 2-1). Information provided by the suppliers indicates that a 2,200-lb GAC treatment bed will effectively treat the soil gas without break-through for approximately 4-5 months before requiring regeneration. This is based on the conservative assumption that soil gas concentrations remain steady and do not decline with time. Capital and operating costs for initial vapor-phase carbon supply and regeneration for a three-year period will be significantly less than alternative technologies such as conventional thermal or catalytic oxidation, or photocatalytic oxidation. Vapor-phase GAC will therefore be used to treat the SVE system emissions.

Site work will occur after the cover system is in place to mitigate damage to the collection wells by heavy equipment. It is anticipated that the SVE equipment (blower, knock-out tank, instrumentation, etc.) will be housed in a mobile trailer to allow for quick set-up and relocation of the system, if desired. Relocation to remediate other landfill hot spots (upon completion of the remediation at hot spot 5) may be considered as a means of further reducing the potential for groundwater contaminant loading. The SVE system will be operated on a seasonal basis, with temporary shut-down and relocation of the trailer off-site during the period of November through March. This manner of operation eliminates potential freeze-up of the SVE equipment and collection wells, and mitigates the significant

TABLE 2-1
URBANA LANDFILL -REMEDIAL ACTION WORK PLAN

ESTIMATED SOIL GAS CONCENTRATIONS AT SVE SYSTEM START-UP

PARAMETERS	RI SOIL GAS Conc (PPBV)										SVE PILOT TEST Conc (PPBV)	AVERAGE Conc (PPBV)	AVERAGE ug/m3
	A25	A26	A29	A32	B11	B12	B13	B15	B17	B18	STEP 1		
Chloroethane	1	1	1	1	1	1	1	1	1	1	49.7	5.4	14.45
1,1- DCE	12	12	12	8928	12	12	3224	12	12	12	12	1114.5	4495.07
1,1- DCA	12	12	12	12	12	12	75	12	12	12	12	17.7	71.38
c 1,2-DCE	12	12	12	170	12	12	6200	12	12	12	12	588.9	2375.1
1,1,1-TCA	4	4	4	21624	4	4	6307	4	4	4	4	2542.5	14166.1
TCE	4	4	4	38452	4	4	3479	4	4	4	4	3815.2	20781.3
PCE	19	3	3	3	3	6	3	3	30	3	3	7.2	49.69
Dichlorodifluoromethane (Freon 12)	1	1	1	1	1	1	1	1	1	1	792	72.9	366.47
Trichlorofluromethane (Freon 11)	1	1	1	1	1	1	1	1	1	1	54.4	5.9	33.65
Trichlorotrifluoroethane (Freon 113)	1	1	1	370	1	1	1	1	1	1	1	34.5	268.25
Benzene	31	31	31	31	31	31	31	31	31	31	31	31.0	100.54
Toluene	52	52	52	52	52	52	52	52	52	52	15.9	48.7	186.49
Chlorobenzene	1	1	1	1	1	1	1	1	1	1	1	1.0	4.69
Ethylbenzene	45	45	45	45	45	45	45	45	45	45	20.9	42.8	188.99
M&P xylene	45	45	45	45	45	45	45	45	45	45	38.8	44.4	196.06
o-xylene	45	45	45	45	45	45	45	45	36	36	45	43.4	191.64

potential for vandalism of the trailer during popular hunting seasons. (The area immediately surrounding the landfill is used extensively as hunting grounds; Town of Urbana officials indicated that several incidents of intentional gunshot damage to unguarded structures are reported each year during deer hunting season). Cycling of the SVE system in this manner has been shown in many instances to be more efficient than continuous operation.

Based on typical SVE remediation times for the VOCs of concern at Hot Spot 5, the estimated time for completion of soil remediation in this area, assuming seasonal operation, is approximately 2-3 years. Monitoring of influent soil gas concentrations during the course of the SVE operation will be used to establish the completion date. Pulsing of the system (i.e., short-term shutdown and start-up) will be performed toward the end of the operating period, with final shutdown criteria based on evaluation of the pulse data. Following SVE shutdown, extraction wells and piezometers will be removed, and cover system penetrations will be repaired with 18-inches of barrier soil and 6-inches of topsoil.

Condensate from the SVE knockout tank will be pumped through GAC and re-infiltrated to the subsurface (greater than 2-feet below grade) within Hot Spot 5.

2.5 Stream Bank Protection

~~An unnamed stream flows along the western boundary of the site (see Figure 2-2).~~ Two sections of the stream pass within 15 feet of the limits of waste, one approximately 30 feet in length (i.e., at approximate grid coordinates N100340, E98945) and the other approximately 50 feet in length (at grid coordinates N100450, E98930). Near the 30-foot section, waste materials are intermingled with fill in a large mound that, regardless of proximity to the stream, will require re-grading to facilitate cover construction and blend with the remainder of the Western slope. Therefore, to protect against future erosion or sloughing of these wastes into the stream, they will be relocated/regraded to provide a 30-foot set-back from the toe of the subgrade slope to the stream bank. Near the 50-foot section of the stream, waste materials generally exist in a layer on top of the native soils that form the western side slope of the landfill. Thus, relocation of these wastes would require significant regrading of the western slope, with associated short-term risks for odors and releases of waste materials into the stream. In lieu of relocation/regrading, an approximately 100-foot section of the stream incorporating the 50-foot section near the landfill will be re-routed to straighten the stream channel (see Figure 2-2). The re-routing will again provide an approximately 30-foot buffer between the stream bank and the toe of the landfill subgrade. The re-routed section of the stream will be protected with riprap to protect against eroding back to its original configuration. The stream bank protection will be installed in the stream bed and approximately 10 feet east and west of the stream.

The U.S. Army Corps of Engineers (ACOE) will be contacted prior to construction. If necessary, a USACOE stream bank disturbance permit will be applied for by Mercury Aircraft. In accordance with NYSDEC requirements, stream work will conform to the following general guidelines and requirements:

- Riprap will be placed (not dumped) to minimize disruption. Stone size will need to be evaluated by the Department based on site-specific conditions, but 4-inch angular riprap is anticipated. Chink stone will also be placed between riprap to lock the larger stones and prevent slippage.

- The maximum bank slope in stabilized areas east and west of the re-routed section will be 1V:2H. Thus, bank soils in stabilized areas that are steeper than 1V:2H will be regraded as necessary.

- "Transition zones" will be constructed on the upstream and downstream sides of the bank where riprap is placed. The transition zones will involve excavating into the sides of the stabilization areas so as to blend the riprap into the unprotected bank, thereby preventing erosion due to turbulence where the stone and bank soils meet. Transition zones will be a minimum of 6-feet long.

- Stream work will not be performed during the period of March 1st-June 15th (spawning season), unless otherwise approved by the Department.

- The work will be performed in a manner that minimizes the stream disruption period. Accordingly, the new stream section will be constructed and stabilized with rip-rap, then tied-in with the stream. This will be followed by damming and fill-in of the old section with low permeability soil and topsoil, seeded to promote vegetation. The stream work be performed in a single, continuous operation.

- Other areas of disturbed bank soils will be re-vegetated following construction.

Additionally, a visual demarcation barrier consisting of fluorescent polyethylene ribbon will be placed below any new soils or stabilized areas of the bank to provide for future identification of erosion problems. The barrier will be placed in a direction parallel to the stream flow at approximately 5-foot intervals.

3.0 PERFORMANCE EVALUATION

3.1 General

This section presents a technical summary of the anticipated performance of the preferred remedial approach in comparison to the conventional approach suggested by NYSDEC. As discussed in the Feasibility Study report, potential off-site impacts due to soil gas and contaminated groundwater migration were primary considerations in selection of the presumptive remedy (i.e., generic 6NYCRR Part 360 cover system) as the final remedial solution for the Urbana Landfill site. The purpose of the performance evaluation is to illustrate that, in addition to the inherent constructability and short-term benefits of the preferred approach discussed in Section 2.0, this approach is provides equal or better overall protection of human health and the environment than the presumptive remedy approach.

3.2 Performance Criteria

3.2.1 Gas Venting System

The generic 6NYCRR Part 360 landfill cover system includes a 12-inch thick gas venting layer installed directly above the waste material which is vented by one shallow vent per acre. The purpose of the gas venting system is to collect gases from under the barrier layer to prevent pressurization of landfill gas which can cause upheaval of the final cover system and to prevent gases from migrating off-site.

The Feasibility Study report proposed constructing a gas-venting layer on top of existing cover soils. In order for a gas venting layer to be effective, the existing three to four feet of landfill cover would have to be scraped off the entire landfill surface, exposing waste and creating potentially significant negative short-term impacts to the environment, neighbors, and remediation construction workers resulting from uncontrolled volatile organic emissions, odors, dust, and contaminated surface water runoff.

The proposed gas venting system will effectively collect and vent landfill gas and will not require the removal of the existing cover soils. Deep gas venting wells effectively collect the landfill gas within the waste material providing a less disruptive means for reducing the likelihood of off-site migration of landfill gas.

6NYCRR Part 360 contains a procedure for obtaining variances from specific requirements of the regulations. Variances from the 6NYCRR Part 360 gas venting layer requirements have been issued by the NYSDEC at many landfills including the New Bath Landfill in Steuben County, the Old Bath Landfill in Steuben County, and the Squaw Island Landfill in Buffalo. These variances were typically granted on the basis of demonstrated equivalent performance. The Old Bath Landfill is an inactive hazardous waste disposal site with significantly greater quantities of wastes and solvents than at the Urbana Landfill.

3.2.2 Cover System with Groundwater Remediation

The purpose of a cover system is to mitigate the potential for direct contact with waste and/or contaminated media, and minimize infiltration and inflow by promoting precipitation runoff and evapotranspiration. The generic 6NYCRR Part 360 Cover System incorporates a synthetic liner, barrier protection layer soils, and vegetated topsoil cover system to meet these criteria. However, the Part 360 regulations allow for variances from the generic Part 360 landfill cover system if "equivalent performance" can be demonstrated by an alternative cover system. Equivalent performance may include equivalent reductions in surface water infiltration, and/or mitigation of impacts on groundwater quality. The preferred remedial approach described in the following sections will meet this equivalent performance requirement through placement of the proposed alternative cover system in combination with in-situ groundwater remediation measures.

3.3 Methodology

3.3.1 Cover System Analysis

To evaluate the difference in groundwater generation under the generic Part 360 cover system and the preferred cover system described above, these cover systems were simulated using USEPA's Hydrologic Evaluation of Landfill Performance (HELP) Model

(Version 3.07, November 1997). HELP model simulations were also performed for the existing landfill cover to establish baseline conditions. Specifically, cover system performance, as measured by annual average percolation/leakage through the barrier layer soils during the first five (5) years of placement, was evaluated on an area-specific basis for both the existing and preferred cover system approach and compared to placement of a generic 6 NYCRR Part 360 cover system across the landfill site. Evaluations of the existing and preferred approaches are required on an area-specific basis due to the differences in existing barrier layer soil cover thicknesses and hydraulic conductivity values. Areas of the site evaluated under the existing and preferred approaches included the upper terrace, the two lower terraces, the middle terrace and the western terrace. These terraces are shown on Plate 3. The terrace boundaries are approximated based on test pit findings and the proposed grading plans.

The HELP Model can be operated to incorporate a number of default values for precipitation, evapotranspiration, and atmospheric conditions. However, a number of inputs and cover system features, including configuration, slope, materials of construction and soil properties, are largely at the discretion of the user. Selection of "best case" or "worst case" values for any of these data significantly impact program output. To provide the most realistic comparison of the existing and preferred cover system approaches to the generic Part 360 cover system, a series of assumptions was made which took into account measured site-specific characteristics and best professional judgment. Where possible, these assumptions were applied universally to both systems. A list of key assumptions is provided in Table 3-1. The rationale for these assumptions is described below.

- **Precipitation, Atmospheric and Evapotranspiration Data:** This information was entered for the existing, preferred, and generic Part 360 cover systems using identical default values for Ithaca, NY, as derived from the HELP model database. Ithaca is approximately 30 miles from the Urbana Landfill, and is the closest location to the site for which a default database exists.

TABLE 3-1
URBANA LANDFILL -REMEDIAI ACTION WORK PLAN

SUMMARY OF HELP MODEL INPUT DATA

Cover Type	Area (acres)	Final Cover Layers	Slope	Slope Length (ft)	Porosity (vol/vol)	Field Cap. (vol/vol)	Wilt. Pt. (vol/vol)	Sat. Hyd Cond. (cm/s)
Preferred Cover:								
Upper Terrace: supplement 12"	4	Topsoil - 6"	4%	390	0.457	0.131	0.058	1.0×10^{-3}
exist BL w/ addnl. 12" BL +		Exist BL - 12"			0.473	0.22	0.104	NA
6" topsoil.		New BL - 12"			0.473	0.22	0.104	2×10^{-6}
Lower Terrace 1 (southwest):	1.62	Topsoil - 6"	8%	220	0.457	0.131	0.058	1.0×10^{-3}
supplement 24" exist BL w/ addnl.		Exist BL - 24"			0.473	0.22	0.104	NA
6" BL + 6" topsoil.		New BL - 6"			0.473	0.22	0.104	1×10^{-6}
Lower Terrace 2 (southeast):	0.42	Topsoil - 6"	9%	100	0.457	0.131	0.058	1.0×10^{-3}
supplement 4.5" exist BL w/ addnl.		Exist BL - 4.5"			0.473	0.22	0.104	1.0×10^{-6}
13.5" BL + 6" topsoil.		New BL - 13.5"			0.473	0.22	0.104	1×10^{-7}
Middle Terrace - same for	1.72	Topsoil - 6"	12.8%	195	0.457	0.131	0.058	1.0×10^{-3}
existing and preferred		Exist BL - 30"			0.473	0.22	0.104	1.5×10^{-6}
Western Terrace	2.05	Topsoil - 6"	23%	260	0.457	0.131	0.058	1.0×10^{-3}
add 18" BL + 6" topsoil		New BL - 18"			0.473	0.22	0.104	1×10^{-7}
Existing Cover System:								
Upper Terrace: 12" exist BL	4	Topsoil - 6"	4%	390	0.457	0.131	0.058	1.0×10^{-3}
6" topsoil		Exist BL - 12"			0.473	0.22	0.104	3.5×10^{-6}
Lower Terrace 1 (southwest):	1.62	Topsoil - 6"	8%	220	0.457	0.131	0.058	1.0×10^{-3}
24" exist BL, 6" topsoil		Exist BL - 24"			0.473	0.22	0.104	1×10^{-6}
Lower Terrace 2 (southeast):	0.42	Topsoil - 6"	9%	100	0.457	0.131	0.058	1.0×10^{-3}
24" exist BL, 6" topsoil		Exist BL - 4.5"			0.473	0.22	0.104	1×10^{-7}
Middle Terrace - same for exist. &	1.72	Topsoil - 6"	12.8%	195	0.457	0.131	0.058	1.0×10^{-3}
preferred = 30" BL, 6" topsoil		Exist BL - 30"			0.473	0.22	0.104	1.5×10^{-6}
Western Terrace - 6" exist topsoil	2.05	Topsoil - 6"	23%	260	0.457	0.131	0.058	1.0×10^{-3}
Part 360 Cover- 6" topsoil, 24"	10	Topsoil - 6"	10%	370	0.457	0.131	0.058	1.0×10^{-3}
barrier protection layer (BPL), 60		BPL - 24"			0.473	0.22	0.104	1×10^{-6}
mil HDPE over geotextile.		60 mil HDPE						2.0×10^{-13}

Notes:
1. All scenarios were run using HELP model default climatological and evapotransformation data for Ithaca, NY.
2. All covers assume a fair stand of grass.
3. Barrier layer porosity, field capacity and wilting point taken from default values for silty/sandy soils (HELP Model Type #7). Saturated hydraulic conductivity values for existing soils were assumed for the upper and lower areas as the avg of those measured from the area-specific shelby-tube samples; hydraulic conductivity values for existing soils in other areas of the site represent the site-wide average. For the preferred alternative, hydraulic conductivity values were set the same as existing or new (1×10^{-7}), or an average thereof, based on relative amounts of existing vs new cover to be placed.
4. Part 360 HDPE membrane assumes 1 pinholes/acre each for installation and manufacturing defects, and placement over a geotextile layer.

- **Landfill Area, Slope and Slope Length:** As indicated above, this information was derived through scale measurements made from Plate 3, which presents terrace boundaries based on November 1998 test pit work. For the existing and preferred approaches, the information was entered on a terrace-specific basis. For the generic Part 360 cover, an average existing landfill side-slope of approximately 10% was used in combination with a total landfill area of approximately 9.8 acres and a slope length of 770 feet.

- **Cover Soil layers and Physical Properties - Existing Alternative:** This information was derived based on November 1998 test pit measurements and hydraulic conductivity testing of existing cover soils performed by Malcolm Pirnie, Inc. in January 1998. November 1998 test pit work provided information on the type and thickness of existing soil covers present in each of the landfill terraces. Permeability tests were performed on Shelby tube samples collected from various locations across the existing landfill cover. Permeability sample results are presented in Appendix A1.

  For the existing cover evaluation, average existing cover soil thicknesses were used in the Model. For the preferred alternative, these were supplemented with additional cover as necessary to provide a total of at least 18-inches of barrier layer and 6-inches of topsoil. In instances where existing slopes are less than 4% (e.g., Upper Terrace), additional barrier soils will be brought in to achieve this minimum grade.

  As the current cover soils are supporting vegetation, it was conservatively assumed for all terraces that the top 6-inches of existing cover material simulates topsoil (HELP model database Soil Type #5), and values for porosity, field capacity, wilting point and hydraulic conductivity were obtained from this default soil type. The remainder (if any) was considered barrier soil having porosity, field capacity and wilting point properties identical to those for silty/sandy soils (as recorded by Malcolm Pirnie's field geologist in January 1998 and Benchmark's field crew in November 1998). Default values for porosity, field capacity, and wilting point for barrier soils were therefore obtained from the HELP model database for silty/sandy soil (Soil Type #7). The hydraulic conductivity values for the existing barrier soils, however, were entered for the lower and upper terraces as the average of actual measurements from Shelby tube samples collected within these areas. For the middle terrace, hydraulic conductivity of existing barrier soil was assumed equal to the overall average of the samples collected from the site (i.e., 1.5×10^{-6} cm/s), as no Shelby tube samples were collected from this specific area. For the Western Terrace, wastes are generally shallow (within 6-inches of grade), therefore no existing barrier soil layer was incorporated in the model.

- **Cover Soil Layers and Physical Properties - Preferred Alternative:** For the preferred alternative, topsoil and barrier soil properties were again considered identical to default Soil Types No. 5, and No. 7, respectively. Barrier soil hydraulic conductivity, however, was established based on the existing barrier soil permeability and the new barrier soil permeability, which will be targeted to 1 x 10^{-7} cm/s or better. As the Middle Terrace will require no supplemental cover, the preferred and existing alternatives are identical. The Western Terrace and Lower Terrace 2 will require approximately 18-inches of new barrier soil, therefore hydraulic conductivities for these terraces were set at 1 x 10^{-7} cm/s. Lower Terrace 1 will receive only partial supplemental cover along the east and west sides, therefore the hydraulic conductivity of barrier soils was set equal to the existing soils (i.e., 1 x 10^{-6} cm/s). The Upper Terrace currently has approximately 1-foot of barrier soil coverage and 6-inches of topsoil (average), but will require an additional 1-foot of barrier soils to achieve minimum grades. Thus, the hydraulic conductivity for the barrier soils under the preferred alternative was set at 2 x 10^{-6} cm/s, representing the average of existing plus new cover.

- **Soil/Geomembrane Layers and Physical Properties - Generic Part 360 Cover:** Soil properties for the generic Part 360 Cover were assumed to be similar to those described above. Topsoil properties were entered as the default values for HELP Model Soil Type #5. Barrier protection layer soils, although not regulated under Part 360 in terms of required hydraulic conductivity, were conservatively assumed to have properties identical to the default values for Soil Type #7, with a hydraulic conductivity equivalent to the average of measured values for existing soil cover (i.e., 1.5x 10^{-6} cm/s). Geomembrane properties were entered as the HELP Model default values for HDPE. Membrane integrity properties, including average installation and manufacturing defect rates of 1 pin-hole per acre each, placement over a geotextile/geonet gas venting layer, and average/typical manufacturing defects were also selected from the HELP Model menu.

3.3.2 Off-Site Groundwater Contaminant Loading Analysis

To determine the impact of infiltration on contaminant loading to the groundwater under the preferred cover system approach, a basic water balance was performed for the site. The water balance takes into consideration not only leachate generation due to infiltration/leakage through the cover, but also considers the effects of groundwater infiltration under both the existing, preferred, and generic Part 360 cover system alternatives. The results of the water balance, in combination with the groundwater sampling results obtained from recovery wells PW-1, PW-2 and PW-3 were used to determine the off-site loading of volatile organic compounds. The detailed methodology used in this analysis is described below.

- **Recharge** - First, as described in Section 3.3.1, the HELP model was employed to simulate the movement of precipitation and recharge to the water-bearing zone at the landfill site. Infiltration was estimated using the HELP model for the existing cover system, the generic 6NYCRR Part 360 cover system, and the preferred cover system. Assumed infiltration values are summarized in the table below:

Cover System	Estimated Annual Infiltration (cf/year)	Average Daily Infiltration (cf/day)
Existing	337, 491	925
Generic Part 360	122,830	337
Preferred	228,672	626

- **Groundwater Outflow** - Groundwater outflow from the site under the existing site conditions was estimated by Darcy's Law which is expressed as:

$$Q = KiA$$

where:

K = average hydraulic conductivity
i = horizontal hydraulic gradient
A = cross-sectional area of the overburden water bearing zone

To calculate the groundwater outflow, the perimeter of the site was divided into 2 segments defined as follows: Segment 1 (Unnamed Stream to well PW-2) and Segment 2 (well PW-2 to Crows Nest Road). The hydraulic conductivity of Segment 1 was calculated as the arithmetic average hydraulic conductivity of BMW-2, BMW-1, and GMX-2. The hydraulic conductivity of Segment 2 was calculated as the arithmetic average hydraulic conductivity of BMW-1, PW-1, and GMX-3. The upper water bearing zone isopotential surface prepared from water level data recorded on 11/13/98 and 21/2/98 was used to estimate the hydraulic gradient of each Segment. Groundwater elevations measured during the Pre-Design Boring/Piezometer Installation Program at the monitoring wells and piezometers and boring log information were used to determine the saturated weathered bedrock cross-sectional area of each Segment. The following values were assumed to calculate the groundwater outflow from the site:

Segment	K (ft/min)	i (ft/ft)	A (square feet)	Q (cubic feet/day)
1	5.2×10^{-4}	0.26	67	13
2	1.96×10^{-2}	0.12	465	1,575

- **Groundwater Inflow** - The groundwater inflow/release from storage component was estimated by subtracting the estimated existing cover system infiltration component from the total groundwater outflow estimated for the existing site conditions. It was assumed that this groundwater inflow/release from storage component of groundwater flow will be constant under all three cover system scenarios.

- **Groundwater Outflow For Cover System Alternatives** - The total groundwater outflow for the generic Part 360 cover and the modified cover systems were then estimated by adding the estimated groundwater inflow value as described above to the estimated, alternative-scenarios infiltration values.

- **Groundwater Concentration** – Under a worst-case scenario, the groundwater VOC concentration of Segment 1 was assumed to be the VOC concentration of PW-2. The groundwater VOC concentration of Segment 2 was assumed to be the VOC concentration measured at PW-1 only due to the high estimated production of this well. The groundwater concentrations estimated for each of these segments under the existing cover system scenario are summarized in the table below:

Constituent	Segment 1 Groundwater Concentration (ppb)	Segment 2 Groundwater Concentration (ppb)
Vinyl Chloride	0	130
Trichloroethene	120	210
1,2-Dichloroethene	310	760

- **Off-Site Contaminant Loading** - Given the groundwater outflow rate and the estimated groundwater concentration for the landfill segment, the off-site contaminant loading was estimated for each of the three landfill cover system alternatives.

- **Off-Site Contaminant Loading with Controls** - Finally, assuming a full-scale steady state production rate of the groundwater recovery system of between 5 gpm (4 gpm at PW-1, 0.75 gpm at PW-2, and 0.25 gpm at PW-3) and 7 gpm (5.6 gpm at PW-1, 1.05 gpm at PW-2, and 0.35 gpm at PW-3) and that treated groundwater would meet Class GA groundwater quality standards for the individual VOC contaminants (a readily-achieved treatment efficiency based on the AOT treatability test results, the off-site contaminant loading for the modified cover system with controls was estimated. The off-site loading with groundwater controls was calculated as the sum of contaminant mass leaving the AOT unit and non-collected contaminant mass bypassing the recovery wells.

3.4 Summary of Results

3.4.1 HELP Model Analysis

Results of the HELP Model simulations for the preferred and generic Part 360 cover systems are summarized in Table 3-2. As indicated, approximately 337,000 cubic feet of precipitation per year infiltrate the existing cover system. Detailed output from each of the model runs is included in Appendix D. As indicated in Table 3-2, the annual average infiltration/leakage value for the preferred approach following the first five years of cover system placement is conservatively estimated at 229,000 cubic feet per year, and the five year average infiltration/leakage value for the generic Part 360 cover system is approximately 123,000 cubic feet per year. Thus, the increased rate of leakage/infiltration is 106,000 cubic feet per year under the preferred approach.

3.4.2 Off-Site Groundwater Contaminant Loading Analysis

The results of the off-site groundwater contaminant loading analysis are summarized in Table 3-3. As shown in Table 3-3, under existing site conditions the off-site groundwater contaminant loading is estimated to be approximately 0.108 lbs of chlorinated VOCs per day.

TABLE 3-2
URBANA LANDFILL
REMEDIAL ACTION WORK PLAN

COMPARISON OF INFILTRATION/LEAKAGE UNDER
PREFERRED COVER SYSTEM TO
6 NYCRR PART 360 COVER SYSTEM APPROACH

Area	Average Annual Infiltration (cubic ft/year)	(gal/year)	(gal/day)
Existing Cover System:			
Upper	154,187	1,153,319	3,160
Lower 1	39,307	294,016	806
Lower 2	2,559	19,141	52
Middle	49,339	369,056	1,011
Western	92,099	688,901	1,887
TOTAL	337,491	2,524,433	6,916
Preferred Cover System:			
Upper	129,542	968,974	2,655
Lower 1	38,833	290,471	796
Lower 2	1,863	13,935	38
Middle	49,339	369,056	1,011
Western	9,094	68,023	186
TOTAL	228,671	1,710,459	4,686
Part 360 Cover System	122,830	918,768	2,517
Vol. Difference (Preferred - Part 360)	**105,841**		

TABLE 3-3
URBANA LANDFILL
REMEDIAL ACTION WORK PLAN

SUMMARY OF OFF-SITE CONTAMINANT MIGRATION ANALYSIS

Description	Groundwater Flow Rate (cubic ft/day)	Off-Site Contaminant Loading without Controls (lbs/day)	Contaminant Loading Reduction (with Controls) (lbs/day)	Final Estimated Off-Site Contaminant Loading (lbs/day)
Existing Cover System	1,588	0.108	-	0.108
Modified Cover System	1,289	0.088	-	0.088
Part 360 Cover System	1,000	0.068	-	0.068
Modified Cover System w/ Groundwater Controls	1,289	0.088	0.056	0.032

40-hour
training
necessary?

OK?

The proposed enhancements to the existing cover system are predicted to reduce the off-site groundwater contaminant loading to approximately 0.088 lbs of chlorinated VOCs per day, a net decrease in off-site loading of approximately 19 percent. The off-site groundwater contaminant loading of a synthetic, generic Part 360 cover system is estimated to be 0.068 lbs of chlorinated VOCs per day, a net decrease in off-site loading of approximately 37 percent. The proposed enhancements to the existing cover system, when used in conjunction with groundwater controls, are predicted to reduce off-site groundwater contaminant migration to between 0.0095 and 0.032 lbs of chlorinated VOCs per day, depending on the full-scale steady state production rate of the groundwater recovery system (estimated at between 5 gpm and 7 gpm), a net decrease in off-site loading of between 70 and 91 percent. The preferred approach is therefore predicted to result in nearly twice the reduction in off-site groundwater contaminant loading as the generic Part 360 cover system. The minimum performance objective of the preferred approach will be equivalent VOC reduction to a Part 360 Cover System.

The modified cover system with groundwater controls approach will provide immediate reduction in off-site loading and chlorinated VOCs which are in the groundwater prior to installation of the final cover system will be treated. While the modified cover system with groundwater controls approach will provide immediate results, the full effects of the generic Part 360 cover system approach in reducing off-site contaminant loading are not likely to be observed (based on the average groundwater flow velocity between wells 103 and 108 which was estimated during the Remedial Investigation to be 0.4 ft/day) for at least 6 years, if at all, since contaminated groundwater already present beneath the existing cover system must leave the site before improvements in groundwater quality will be observed.

4.0 REMEDIATION APPROACH

4.1 Remedial Design and Construction

The remediation work at the Urbana Landfill site will be completed on a design-build basis, with the cover system remediation contractor hired directly by Benchmark Environmental Engineering & Science, PLLC. Detailed plans with notes will be prepared to support bids by reputable firms having experience with landfill cover system construction in New York State. A Construction Quality Assurance (CQA) Plan will also be prepared and incorporated into the construction contract. The CQA plan will contain detailed requirements for cover soil placement, compaction and testing, and will establish lines of communication for the project. The CQA Plan will be supplemented with construction specifications as necessary to detail physical requirements for cover soils as well as general construction requirements to be followed by the contractor (e.g., protection of adjacent properties, temporary facilities, etc.). In addition, a site-specific Health and Safety Plan (HASP) will be developed by Benchmark for its employees, and will be included for reference in the project manual. The contractor will be required to develop a HASP as stringent or more stringent than Benchmark's HASP.

The soil vapor extraction system and groundwater remediation system subsurface work will be subcontracted to local drillers and firms qualified to perform remedial construction work. Plans identifying specific requirements and sizes for equipment, piping and appurtenances will be prepared to facilitate construction of these systems. Mercury Aircraft personnel will perform above-grade construction, including piping and electrical/instrumentation installations, with assistance from outside contractors as necessary.

4.2 Post-Closure Operations and Maintenance

Post-closure operations and maintenance (O&M) requirements and responsibilities will be detailed in a Post-Construction O&M Plan to be reviewed and approved by NYSDEC. The O&M Plan will address operations and maintenance requirements for the groundwater and SVE remediation equipment, and post-closure maintenance of the cover system and related structures (i.e., access road, gas vents, monitoring wells, etc.). The O&M Plan will also describe continued monitoring requirements for the preferred alternative, including monitoring to verify the effectiveness of the remedial measures in providing equivalent performance to the generic Part 360 alternative. The O&M Plan will reference a Contingency Plan identifying steps to be implemented if the remedial measures fail to meet this criteria.

Mercury Aircraft or its designee will assume all post-construction operations, maintenance and monitoring responsibilities at the Urbana Landfill with the exception of the following tasks to be performed by the Town of Urbana:

- Annual cover system mowing
- Repair of minor cover system damage, drainage structure damage, and performance of riprap repairs.
- Poplar tree repair and replacement, if required.
- Maintenance and plowing of access road as necessary to facilitate site access.
- Access road gate repairs, if required.
- Furnishing and paying for soil vapor extraction system and groundwater collection/treatment system power.

5.0 REFERENCES

1. Camp Dresser & McKee, March 1997. Draft Remedial Investigation Report, Urbana Landfill.

2. Camp Dresser & McKee, September 1997. Phase II Investigation Report, Urbana Landfill.

3. Camp Dresser & McKee, October 1997. Final Feasibility Study Report, Urbana Landfill.

4. NYSDEC, March 1999. Record of Decision - Urbana Landfill Site.

APPENDIX A

Appendix A1 - Test Pit Investigations and Shelby Tube Sampling
Appendix A2 - Cover System Investigation Summary
Appendix A3 - New Topsoil Specification

Appendix A1 - Test Pit Investigations and Shelby Tube Sampling

EXHIBIT NO. 1

Urbana Landfill
Test Pit Excavation and Shelby Tube Collection
January 9, 1998

Test Pit Excavation		
Location	**Test Pit No.**	**Test Pit Depth (feet bgs)**
Lower Terrace	TP-1	4.0
	TP-2	4.0
	TP-11	4.0
	TP-12	2.3
Middle Terrace	TP-3	0.33 *
	TP-4	0.25 *
	TP-5	1.0 *
	TP-6	3.0
Upper Terrace	TP-7	3.5 *
	TP-8	3.5
	TP-9	3.5 **
	TP-10	3.5
Western Portion	TP-1 (CDM)	1.0
	TP-5 (CDM)	1.0
	TP-6 (CDM)	2.0

Notes:
* *Waste was encountered at this depth.*
** *Waste was encountered at 1.0 foot.*

Shelby Tube Permeability and Gradation				
Location	**Test Pit No.**	**Sampling Interval**	**Permeability (cm/s)**	**% Finer Than No. 200 Sieve**
Lower Terrace	TP-1	0-2.0	1.0E-07	27.7%
	TP-2	0-2.0	2.0E-07	26.4%
	TP-2	2.0-4.0	4.0E-08	28.6%
	TP-11	0-1.0	6.5E-07	46.2%
	TP-11	1.0-2.0	4.0E-08	43.7%
	TP-12	0-1.0	4.0E-06	20.2%
	TP-12	1.0-2.0	1.4E-06	27.3%
Upper Terrace	TP-9	0-1.0	3.0E-07	19.6%
	TP-10	0-1.0	6.7E-06	29.4%

NOTE: TP-1 TAKEN FROM LOWER AREA 2

Malcolm Pirnie, Inc.

Project: Urbana Landfill

Project No.: 1240-025

Sample	Permeability cm/sec
TP-10 / 0-1'	6.7E-06
TP-11 / 0-1'	6.5E-07
TP-12 / 0-1'	4.0E-06
TP-12 / 1-2'	1.4E-06

Sample	Preliminary Permeability cm/sec
TP-1 / 1-2'	1E-07
TP-2 / 0-2'	2E-07
TP-2 / 2-4'	4E-08
TP-9 / 0-1'	3E-07
TP-11 / 1-2'	4E-08

AVG = 1.5 E-06

Appendix A2 - Cover System Investigation Summary

Benchmark Environmental Engineering & Science, PLLC

January 18, 1999

Mr. Joseph Moloughney
Environmental Engineer
Bureau of Western Remedial Action
Division of Environmental Remediation
New York State Department of
Environmental Conservation
50 Wolf Road
Albany, New York 12233

Re: Urbana Landfill - Test Pit Investigation Findings

Dear Mr. Moloughney:

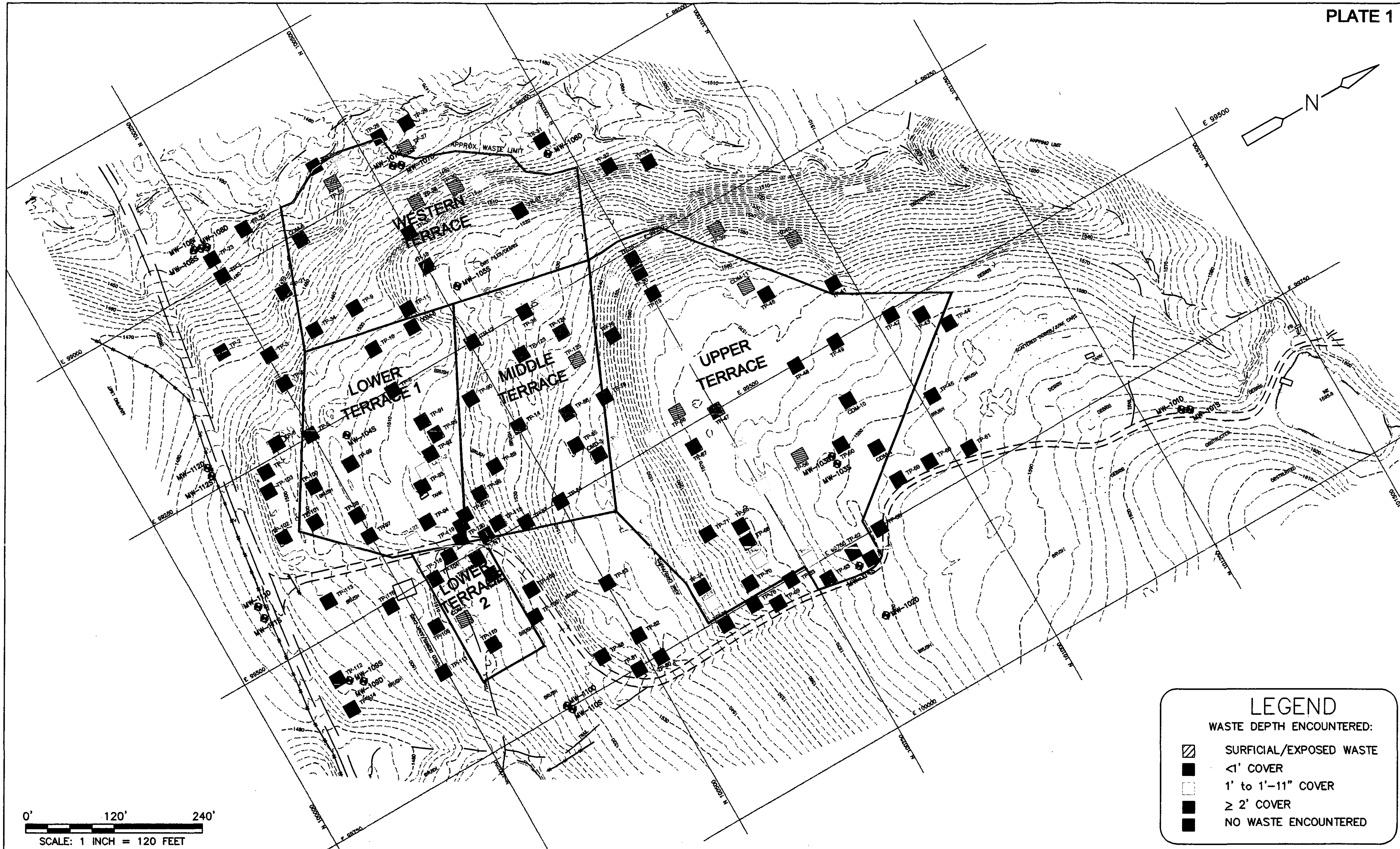
Benchmark Environmental Engineering & Science, PLLC has prepared this correspondence to describe the results of the test pit and stream bank investigations performed at the Urbana Landfill during the week of November 9, 1998. The investigations were performed in accordance with the work plan submitted to the Department in October, 1998 and involved:

- the excavation and recording of waste depth, where encountered, at a total of 125 test pit locations across the site to identify areas requiring supplemental cover.
- estimation of the volume of surface debris along the western slope.
- delineation of areas where buried waste is within 15 feet or less of the stream bank.

TEST PIT FINDINGS

Plate 1, attached, presents the test pit locations and the approximate depth of waste encountered at each of the locations. The test pits were field-located based on measurement from the survey grid, which was re-established by a licensed NY State surveyor prior to initiating field work. Table 1 presents a detailed breakdown of the cover soil depth recorded at each of the test pits. As indicated in Table 1, nearly all of the waste in both Lower Terraces and the Middle Terrace is covered with greater than three feet of soil. In addition, test pit data along the southern boundary of the site adjacent to Crow's Nest Road shows that the waste does not extend as far south as predicted in the RI report. For the Western and Upper Terraces, the extent of soil cover varies with location.

50 FOUNTAIN PLAZA, SUITE 1350 • BUFFALO, NEW YORK 14202
TEL (716) 856-0599 • FAX (716) 856-0583



Benchmark Environmental Engineering & Science, PLLC

REVISIONS			
NO.	BY	DATE	REMARKS

DES ____
DWN ____
CKD ____

URBANA, NEW YORK
REMEDIAL ACTION WORK PLAN FOR URBANA LANDFILL SITE
NYSDEC SITE NO. 8-51-007

REMEDIAL ACTION WORK PLAN

LANDFILL TERRACES

DATE FEBRUARY 1999
SHEET ___ OF ___
CAD REF. NO. PLATE3.DWG

Areas of shallow cover were primarily observed on the slope of the Western Terrace bank and along the southern perimeter of the Upper Terrace. Some surficial debris was also observed in the heavily wooded slope to the west of the Upper Terrace.

In general, cover soil and shallow (0-4' below grade) native soil material encountered at the site are characterized as light brown, silty-sandy till with some cobbles, consistent with previous test pit and shelby tube findings.

STREAM BANK INVESTIGATION

Due to the irregularity and frequency of surface debris along the Western Terrace side slope, a precise estimate of the quantity of this material is difficult to ascertain. Based on field observations, it would appear that approximately 250 cubic yards of debris will need to be cleared from the bank and either buried on-site or otherwise properly disposed. Nearly all this material is characterized as "white good" (i.e., appliance) debris intermingled with soil and other bulk-type wastes, such as mattress springs, sheet metal and demolition debris. Removal of surface debris will be a performance requirement under the remedial construction contract irrespective of debris quantity.

Test pits TP-22 through TP-33, performed along the stream bank, confirmed that limits of buried waste are coincidental with the toe of the Western Terrace side slope. These limits are evident via surface topography. However, the site contour map was performed via aerial survey, which tends to partially mask the topography in this wooded portion of the site. The waste limit along the stream bank was therefore staked and delineated by ground survey. This data is currently being compiled and will be identified on the design plans. Areas of the stream bank where buried waste is present within 15 feet of the stream bank were identified at two (2) locations during the field investigation; approximate coordinates of these locations are N100350, E98860 and N100460, E98935.

We are presently proceeding with the cover system design based on the above findings. Please contact me if you have any questions.

Sincerely,

Thomas H. Forbes, P.E.
Project Manager

C: S. D'Angelo (Mercury Aircraft)
B. Meade (Mercury Aircraft)
W. Helferich (Harter, Secrest)

M. Peachey (NYSDEC Region 8)
G. Bailey (NYSDEC Region 9)
M. Kadlec (NYSDOH)

TABLE 1
URBANA LANDFILL
NOVEMBER 1998 COVER SYSTEM INVESTIGATION
SUMMARY OF TEST PIT OBSERVATIONS

TEST PIT LOCATION	DATE	COVER SOIL THICKNESS	WASTE ENCOUNTERED BELOW COVER
TP-1-98	11/9/98	>3'	N
TP-2-98	11/9/98	>3.5'	N
TP-3-98	11/9/98	>4'	N
TP-4-98	11/9/98	>3.5'	N
TP-5-98	11/9/98	>3.5'	N
TP-6-98	11/9/98	>3.5'	N
TP-7-98	11/9/98	>3.5'	N
TP-8-98	11/9/98	>4'	N
TP-9-98	11/9/98	8"	Y
TP-10-98	11/9/98	>3'	N
TP-11-98	11/9/98	6"	Y
TP-12-98	11/9/98	>4.5'	N
TP-13-98	11/9/98	2'	Y
TP-14-98	11/9/98	3'	Y
TP-15-98	11/9/98	>3.5'	N
TP-16-98	11/9/98	2.5'	Y
TP-17-98	11/9/98	1.5'	Y
TP-18-98	11/9/98	2'	Y
TP-19-98	11/9/98	8"	Y
TP-20-98	11/9/98	6"	Y
TP-21-98	11/10/98	>3'	N
TP-22-98	11/10/98	>4'	N
TP-23-98	11/10/98	>15'	N
TP-24-98	11/10/98	>4.5'	N
TP-25-98	11/10/98	<1"	Y
TP-26-98	11/10/98	<1"	Y
TP-27-98	11/10/98	<1"	Y
TP-28-98	11/10/98	>3'	N
TP-29-98	11/10/98	>3'	N
TP-30-98	11/10/98	<1"	Y
TP-31-98	11/10/98	>3'	N
TP-32-98	11/10/98	>3'	N
TP-33-98	11/10/98	>3'	N
TP-34-98	11/10/98	6"	Y
TP-35-98	11/10/98	6"	Y
TP-36-98	11/10/98	>3.5'	Y
TP-37-98	11/10/98	8"	Y
TP-38-98	11/10/98	1'	Y
TP-39-98	11/10/98	6"	Y
TP-40-98	11/10/98	4"	Y
TP-41-98	11/10/98	>4'	N
TP-42-98	11/10/98	6"	Y

TABLE 1 (cont.)
URBANA LANDFILL
NOVEMBER 1998 COVER SYSTEM INVESTIGATION
SUMMARY OF TEST PIT OBSERVATIONS

TEST PIT LOCATION	DATE	COVER SOIL THICKNESS	WASTE ENCOUNTERED BELOW COVER?
TP-43-98	11/10/98	6"	Y
TP-44-98	11/10/98	>3.5'	N
TP-45-98	11/10/98	>4'	N
TP-46-98	11/10/98	6"	Y
TP-47-98	11/10/98	3.5'	Y
TP-48-98	11/10/98	>4'	N
TP-49-98	11/10/98	6"	Y
TP-50-98	11/10/98	>4'	N
TP-51-98	11/10/98	1'	Y
TP-52-98	11/10/98	1'	Y
TP-53-98	11/10/98	3.5'	Y
TP-54-98	11/10/98	1'	Y
TP-55-98	11/10/98	1'	Y
TP-56-98	11/10/98	4"	Y
TP-57-98	11/10/98	8"	Y
TP-58-98	11/10/98	>3.5'	N
TP-59-98	11/11/98	>4'	N
TP-60-98	11/11/98	>4'	N
TP-61-98	11/11/98	>4'	N
TP-62-98	11/11/98	6"	Y
TP-63-98	11/11/98	>4'	N
TP-64-98	11/11/98	1.5'	Y
TP-65-98	11/11/98	>4'	N
~~TP-66-98~~	~~11/11/98~~	~~4.5'~~	~~Y~~
TP-67-98	11/11/98	4.5'	Y
TP-68-98	11/11/98	4"	Y
TP-69-98	11/11/98	>4'	N
TP-70-98	11/11/98	>4'	N
TP-71-98	11/11/98	>4.5'	N
TP-72-98	11/11/98	1'	Y
TP-73-98	11/11/98	>4'	N
TP-74-98	11/11/98	10"	Y
TP-75-98	11/11/98	1'	Y
TP-76-98	11/11/98	>4'	N
TP-77-98	11/11/98	1'	Y
TP-78-98	11/11/98	1'	Y
TP-79-98	11/11/98	1'	Y
TP-80-98	11/11/98	3'	Y
TP-81-98	11/11/98	>3'	N
TP-82-98	11/11/98	>4'	N
TP-83-98	11/11/98	>4'	N
TP-84-98	11/11/98	>4'	N
TP-85-98	11/11/98	>4'	N
TP-86-98	11/11/98	3'	Y

TABLE 1 (cont.)
URBANA LANDFILL
NOVEMBER 1998 COVER SYSTEM INVESTIGATION
SUMMARY OF TEST PIT OBSERVATIONS

TEST PIT LOCATION	DATE	COVER SOIL THICKNESS	WASTE ENCOUNTERED BELOW COVER?
TP-87-98	11/11/98	>5.5'	N
TP-88-98	11/11/98	>11'	N
TP-89-98	11/11/98	>7'	N
TP-90-98	11/11/98	>8'	N
TP-91-98	11/11/98	4'	Y
TP-92-98	11/11/98	3'	Y
TP-93-98	11/11/98	3'	Y
TP-94-98	11/11/98	>5'	N
TP-95-98	11/11/98	>7'	N
TP-96-98	11/11/98	3'	Y
TP-97-98	11/11/98	>5.5'	N
TP-98-98	11/11/98	2'	Y
TP-99-98	11/11/98	4'	Y
TP-100-98	11/11/98	2'	Y
TP-101-98	11/11/98	2.5'	Y
TP-102-98	11/11/98	6'	N
TP-103-98	11/12/98	6'	N
TP-104-98	11/12/98	3'	Y
TP-105-98	11/12/98	>7'	N
TP-106-98	11/12/98	8"	Y
TP-107-98	11/12/98	8"	Y
TP-108-98	11/12/98	>7'	N
TP-109-98	11/12/98	>5'	N
TP-110-98	11/12/98	2.5'	Y
TP-111-98	11/12/98	>5'	N
TP-112-98	11/12/98	>4.5'	N
TP-113-98	11/12/98	>6'	N
TP-114-98	11/12/98	>6'	N
TP-115-98	11/12/98	>6'	N
TP-116-98	11/12/98	8"	Y
TP-117-98	11/12/98	10"	Y
TP-118-98	11/12/98	>4.5'	N
TP-119-98	11/12/98	8"	Y
TP-120-98	11/12/98	>3'	N
TP-121-98	11/12/98	8"	Y
TP-122-98	11/12/98	1'	Y
TP-123-98	11/13/98	4.5'	Y
TP-124-98	11/13/98	2'	Y
TP-125-98	11/13/98	2'	Y

Appendix A3 - New Topsoil Specification

SECTION 02921

TOPSOIL

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install topsoil Work.
   2. The types of topsoil Work required include the following:

      a. Topsoil stockpiled for reuse under Section 02110, Clearing.
      b. Topsoil from off-site sources.
      c. Topsoil testing to provide certified acceptability of topsoil for landscape Work.
      d. Topsoil admendments, as may be required by test results to provide topsoil acceptable for landscape Work.
      e. Spreading topsoil.

B. Coordination:
   1. Notify other contractors in advance of the installation of the topsoil to provide sufficient time for the installation of other that must be installed before the topsoil.

C. Related Sections:

(TO BE INSERTED)

1.2 QUALITY ASSURANCE

A. Source Quality Control:

1. Off-Site Topsoil: Obtain topsoil only from naturally well- drained sites where topsoil occurs in depth of not less than 4-inches; do not obtain from wetlands.
2. Topsoil Stockpiled for Reuse: Topsoil will be inspected by ENGINEER before reuse. At the time of inspection ENGINEER shall require representative soil samples to be tested for physical properties, hydrogen-ion value organic matter, and available phosphoric acid and potassium. Supply twenty pound samples and make tests at no additional expense to OWNER.
3. Analysis and Standards: Package standard products with manufacturers' certified analysis. For other materials, provide analysis by recognized laboratory made in accordance with methods established by the Association of Official Analytical Chemists wherever applicable or as further specified.

B. Reference Standards: Comply with applicable provisions and recommendations of the following, except where otherwise shown or specified:

1. ASTM C 602, Agricultural Liming Materials.
2. ASTM D 2487, Classifications of Soils for Engineering Purposes.
3. Association of Official Analytical Chemists, Official Methods of Analysis.

1.3 SUBMITTALS

A. Shop Drawings: Submit for approval the following:

1. Before delivery of off-site topsoil, written statement giving the location of the properties from which the topsoil is to be obtained, the names and address of the suppliers, the depth to be stripped and any crops grown or pesticides applied during the past 3 years.

2. Manufacturer's specifications and application instructions for all soil admendments required.

B. Test Reports: Before delivery of off-site topsoil submit for approval a soil analysis made by an approved soil testing laboratory stating porosity, the percentages of silt, clay, sand, and organic matter, the pH and the mineral and plant nutrient content of the topsoil.

C. Certificates: Submit for approval certificates of inspection as may be required by governmental authorities to accompany shipments, and manufacturer's or vendors certified analysis for soil amendments. For standard products submit other data substantiating that materials comply with specified requirements.

1.4 JOB CONDITIONS

A. Environmental Requirements: Do not spread topsoil if condition is unsuitable due to frost, excessive moisture or other conditions. Do not install until the topsoil is in a suitable condition as determined by ENGINEER.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Topsoil:

1. Fertile, friable, natural loam, surface soil, capable of sustaining vigorous plant growth, free of any admixture of subsoil, clods of hard earth, plants or roots, sticks or other extraneous material harmful to plant growth. Supply topsoil with the following analysis:
   a. 3/4-inch mesh: 100 percent passing
      #4 sieve: 90 to 100 percent passing
      #200 sieve: 0 - 10 percent passing
   b. Clay content of material passing #200 sieve not greater than 60 percent, as determined by hydrometer tests.

c. pH 5.0 to pH 6.5. If approved by ENGINEER, natural topsoil not having the hydrogen-ion value specified may be amended by CONTRACTOR as his own expense.
d. Organic content not less than 5 percent, as determined by ignition loss.
e. Free of pests and pest larvae.

B. Soil Amendments:
1. Lime: Natural limestone containing not less than 85 percent of total carbonates, ground so that not less than 90 percent passes a 10-mesh sieve and not less than 50 percent passes a 100-mesh sieve.
2. Ferrous Sulfate: Commercial grade and unadulterated.

PART 3 - EXECUTION

3.1 INSPECTION

A. CONTRACTOR and his installer shall examine the subgrade, verify the elevations, observe the conditions under which Work is to be performed, and notify ENGINEER of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.2 PREPARATION

A. Remove existing grass, vegetation and turf. Dispose of such material outside of OWNER'S property in a legal manner; do not turn over into subgrade unless approved by ENGINEER.

B. Loosen subgrade of areas to receive topsoil to a minimum depth of 4 inches by discing, harrowing or other approved method to permit bonding of the topsoil to the subgrade. Operate the equipment used to scarify the subsoil so the ridges and depressions are parallel to the contours.

C. Remove stones over 1-1/2-inches in any dimension and sticks, roots, debris and other extraneous matter.

3.3 INSTALLATION

A. Place and spread topsoil, over the areas shown, to a minimum depth of 6-inches after natural settlement and light rolling, in a manner that the completed work conforms to the lines and grades shown.

B. Do not spread topsoil while in a frozen condition or when moisture content is so great that excessive compaction will occur nor when so dry that dust will form in the air or that clods will not break readily.

C. Do not compact topsoil.

D. After the topsoil is spread, remove all large, stiff clods, rocks, roots or other foreign matter over 2-inches.

E. Apply soil admendments, as required by machine over all areas receiving topsoil, to bring the soil to a neutral pH. Work lightly into the top 3 inches of topsoil.

F. Manipulate topsoil to attain a properly drained surface.

G. Grade topsoil areas to smooth, even surface with loose, uniform, fine texture.

H. Roll and rake and remove ridges and fill all depressions, ruts, low spots or unsuitable areas which result after settlement so that the area is suitable for subsequent work.

3.4 MAINTENANCE

A. Maintain topsoiled areas by filling in erosion channels and correcting drainage as required.

B. Maintain the topsoil in a loose, friable condition until the Work under other Sections begins.

3.5 CLEAN UP AND PROTECTION

A. During topsoiling Work, store materials and equipment where directed .

B. Protection includes all temporary fences, barriers and signs and other Work incidental to proper protection.

3.6 INSPECTION AND ACCEPTANCE

A. When the topsoil installation Work is completed, including maintenance, ENGINEER will make an inspection to determine acceptability.

B. Where inspected topsoil Work does not comply with the requirements, regrade rejected Work and maintain until reinspected by ENGINEER and found to be acceptable.

++ END OF SECTION ++

APPENDIX B

Appendix B1 - Summary of Existing Groundwater Flow Conditions
Appendix B2 - Groundwater Pump Test Scope of Work
Appendix B3 - Groundwater Pump Test Summary
Appendix B4 - AOT Treatability Test Results

Appendix B1 - Summary of Existing Groundwater Flow Conditions

December 22, 1998

Benchmark Environmental Engineering & Science, PLLC

Mr. Joseph Moloughney
Environmental Engineer
Bureau of Western Remedial Action
New York State Department of
Environmental Conservation
50 Wolf Road
Albany, New York 12233

RE: Urbana Landfill - Pre-design Boring/Piezometer Installation

Dear Mr. Moloughney:

This letter summarizes site characterization data collected during a pre-design boring/piezometer installation program at the Urbana Landfill, as previously discussed with the Department. The purpose of the pre-design study was to: 1.) identify and characterize geologic media to better define hydrostratigraphic zone(s) that may require groundwater collection; and 2.) install observation wells to be utilized for aquifer characterization during upcoming pump tests. These pre-design study activities have improved our understanding of the geologic and hydraulic properties of the overburden and weathered bedrock as it relates to chemical constituent fate and transport at the Urbana Landfill. The improved understanding of the conceptual hydrogeologic model in the vicinity of proposed groundwater collection has allowed us to refine the conceptual remedial plan for impacted groundwater in the southeastern portion of the landfill site. The basis for this refinement is described below.

BOREHOLE/PIEZOMETER INSTALLATION

A total of four (4) borings and piezometers were completed during the week of November 2, 1998 at the Urbana Landfill. Boring locations were selected to provide additional hydrogeologic information for the site in the vicinity of impacted groundwater (i.e., the northeast portion of the site where groundwater collection is proposed). Two (2) additional borings/piezometers were installed during the week of November 30, 1998 to better characterize hydrogeologic conditions near the un-named creek located east of the landfill. Boring/piezometer locations are shown on the attached figure. A stratigraphic summary of geologic units encountered in the borings is provided below:

Boring/ Piezometer	Ground Surface Elevation (fmsl)	Fill Thickness/ Bottom Elevation (ft)/(fmsl)	Till Thickness/ Bottom Elevation (ft)/(fmsl)	Weathered Bedrock Thickness/ Bottom Elevation (ft)/(fmsl)	Depth to Water/ Elevation (ft)/(fmsl)
GMX-1	1458.36	NA	17/ 1441.36 (3)	Unknown	>17/<1442
GMX-2	1463.32	6/1457.32 (1)	7/1450.32	>7/1443.32	3.14/1460.18
GMX-3	1464.91	NA	36/1428.91	>2/1426.91	19.92/1444.99
GMX-4	1496.40	4/1492.40 (2)	23/1469.40	>2/1467.40	>29/<1467
BMW-1	1457.88	NA	22/1435.88	>0.5/1435.38	35.77/1422.11
BMW-2	1461.21	NA	13/1448.21	>6.5/1441.71	13.87/1447.34

(1) Boring completed on waste pile.
(2) Fill consists of soil cover material.
(3) Glaciofluvial deposits below till.
NA – Not Applicable

As shown in the table above, three geologic units were identified during the boring program: a fill unit consisting of soil cover material, disturbed soil, or waste material; a till unit consisting of a fine grained soil matrix (predominantly silt) with fine to coarse gravel; and a weathered bedrock unit consisting of soft, laminated fissile shale.

DATA INTERPRETATION

A relatively thin layer (less than six feet) of unsaturated fill material was encountered in only two of the six borings (i.e, GMX-2 and GMX-4). Till was encountered in all six soil borings. The thickness of the till ranges from approximately 7 feet (GMX-2) to 36 feet (GMX-3). Weathered bedrock ranged in thickness from approximately 0.5 feet (BMW-1) to 9 feet (GMX-2). These data suggest that the thickness of the weathered bedrock unit decreases from north to south along the un-named creek. At piezometer GMX-1, a cobble-rich zone exists at depths greater than 17 feet and the boring could not be advanced further using hollow stem augers. Similar conditions were observed at MW-108S/I (installed during the NYSDEC Remedial Investigation). The cobble-rich zone likely was deposited in a glaciofluvial environment similar to fluvial conditions currently existing in the adjacent creek. The cobble-rich zone was not encountered in borings installed south or east of GMX-1 and does not appear to be laterally extensive on the site.

Saturated conditions were generally not encountered in the till. Occasional wet sand stringers or partings were identified. Since they are small and isolated, they do not represent a significant source of water. Therefore, the till in the northeast portion of the landfill site is considered non-water-bearing due to its fine-grained matrix, hence low permeability. Groundwater occurs under semi-confined conditions in the weathered bedrock. This is considered the upper water-bearing zone at the Urbana Landfill Site. Hydraulic conductivity testing using slug test methods established hydraulic conductivity values of 2.3 X 10^{-5} cm/sec and 1.0 X 10^{-4} cm/sec in piezometers GMX-2 and GMX-3, respectively. However, in the vicinity of MW-108S/I and GMX-1, groundwater occurs under water-table conditions in the cobble-rich glaciofluvial deposits. The hydraulic conductivity of the glaciofluvial deposits is likely to be greater than the hydraulic conductivity values of the weathered bedrock determined during this pre-design study.

To preliminarily establish if hydraulic communication exists between groundwater in the glaciofluvial deposits and the weathered bedrock, approximately 150 gallons of groundwater were pumped into three 55-gallon D.O.T.-approved drums at an approximate rate of 2 gpm from MW-108I (this groundwater will be disposed with pump-test groundwater). Water level measurements were recorded in nearby wells and piezometers. Water levels were not measured in wells BMW-1 and BMW-2 since they were in the process of being drilled and/or installed. A hydraulic response to pumping was identified as water level drawdown in well GMX-3 indicating that the weathered bedrock is in hydraulic communication with the glaciofluvial deposits. As a result, impacted groundwater in the glaciofluvial deposits is derived from impacted groundwater discharge from the weathered bedrock to the glaciofluvial deposits.

Examination of soil moisture conditions during borehole advancement and assessment of groundwater elevations measured in existing monitoring wells and newly installed piezometers support the findings that the till is non-water-bearing. The low permeability till is a natural barrier to lateral overburden groundwater flow in the saturated fill. Stratigraphic summary information for borings/wells completed at MW-104S and MW-105S indicates that the wells are screened in saturated landfill waste material. The depth to groundwater in the monitoring wells is approximately 9 and 12 feet below grade. Mounding of groundwater in the waste-filled portion of the landfill accounts for shallower depths to groundwater in these areas (see attached figure). Piezometer GMX-4 is located less than 80 feet south, less than 10 feet down slope of MW-104S, and is screened in the lower portion of the till and weathered bedrock. Groundwater was not present in the till and only a small amount of water was identified in the weathered bedrock at GMX-4. Depth to water at GMX-4 is over 27 feet below grade. Similar conditions were identified at GMX-3. This information demonstrates that groundwater occurring in the fill material (area of groundwater mounding shown on the figure) does not migrate laterally through the overburden in a southerly direction toward Crows Nest Road. The low permeability till acts as a barrier to lateral groundwater flow and causes groundwater in the fill material to migrate laterally to the west (toward the un-named creek) and possibly downward into the weathered bedrock, where weathered bedrock exists below saturated fill material. Groundwater flow in the weathered bedrock (upper water-bearing zone) is to the west, toward the un-named creek (see attached figure). This is supported by contouring the potentiometric surface of the upper water-bearing zone and the lack of volatile organic compounds (VOCs) detected in monitoring wells installed across Crows Nest Road.

GROUNDWATER COLLECTION APPROACH

Since impacted groundwater occurs primarily in the glaciofluvial deposits, near monitoring wells MW-108S/I and GMX-1, and weathered bedrock in the eastern portion of the landfill, the focus of groundwater remedial action will be to achieve hydraulic control in the weathered bedrock along the un-named creek.

A brief work plan will be submitted to the NYSDEC describing details of remaining groundwater collection system pre-design study activities. These activities will include: slug testing of the two additional piezometers (BMW-1 and BMW-2); further assessment of groundwater elevation data; performance of an aquifer pump tests in the weathered bedrock along the un-named creek; and identification of planned containment and disposal methods for pump test groundwater.

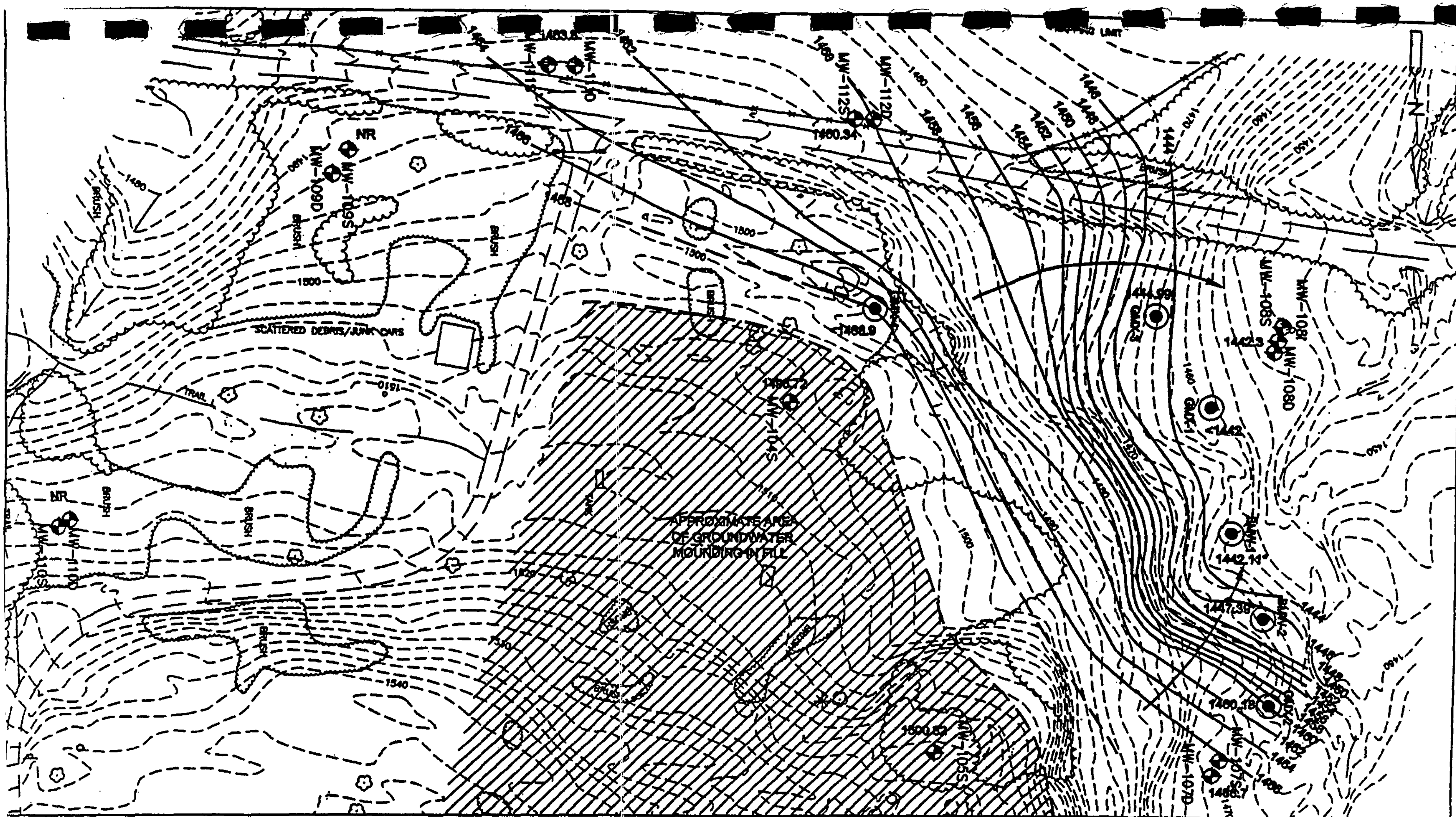
Aquifer pump testing will involve the installation of three, 6-inch diameter pumping wells. Pumping will be spatially located in a general north-south direction along the un-named creek. Pumping well locations will be in proximity to existing piezometer/monitoring wells. Pumping wells will screen the saturated weathered bedrock and lower till (if lower till is saturated). Constant head pumping tests will be conducted to better identify hydraulic boundary conditions encountered during pumping. It is anticipated that pumping rates will be in the range of 0.5 to 1 gallon per minute after well bore and well casing storage are removed. Water levels will be recorded in nearby monitoring wells and piezometers during pumping. It is anticipated that pumping will be maintained for a period of 72-hours.

Please contact me if you have any questions. We are presently assembling the pump test procedures, and look forward to your input on the above information prior to completing the work plan.

Sincerely,

Thomas H. Forbes, P.E.
Project Manager

C: S. D'Angelo (Mercury Aircraft)
G. Hintz (Mercury Aircraft)
B. Meade (Mercury Aircraft)



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SCALE: 1 INCH = 60 FEET

EXPLANATION

MW-12S EXISTING MONITORING WELL

GMX-1 PRE-DESIGN PIEZOMETER

1458 GROUNDWATER CONTOUR (WATER LEVEL RECORDED ON 11/13/98)

* WATER LEVEL RECORDED ON 12-2-98

DIRECTION OF GROUNDWATER FLOW

NR - NO READING

Benchmark Environmental Engineering & Science, PLLC

URBANA LANDFILL UPPER WATER BEARING ZONE POTENTIOMETRIC SURFACE

DATE: DECEMBER 1998

SHEET 1 OF 1

DWG REF. NO. 6001.dwg

Appendix B2 - Groundwater Pump Test Scope of Work

WORK PLAN / SCOPE OF WORK
URBANA LANDFILL - AQUIFER PUMPING TEST DESIGN

1.0 INTRODUCTION

This work plan/scope of work outlines the proposed aquifer pump test design and assessment of hydrogeologic conditions at the Urbana Landfill, Hammondsport, NY.

A pre-design study was completed in November, 1998 to: 1.) identify and characterize geologic media to better define hydrostratigraphic zone(s) that may require groundwater collection; and 2.) install observation wells to be utilized for aquifer characterization involving pump tests. These pre-design study activities have provided better understanding of the geologic and hydraulic properties of the overburden and weathered bedrock as it relates to chemical constituent fate and transport at the Urbana Landfill. The results of the pre-design study were summarized in a letter submitted to the NYSDEC dated December 22, 1998 (See Attachment A).

Hydrogeologic information obtained from the pre-design study in conjunction with information gathered from the aquifer pump test will be used as the basis for design of the groundwater collection system.

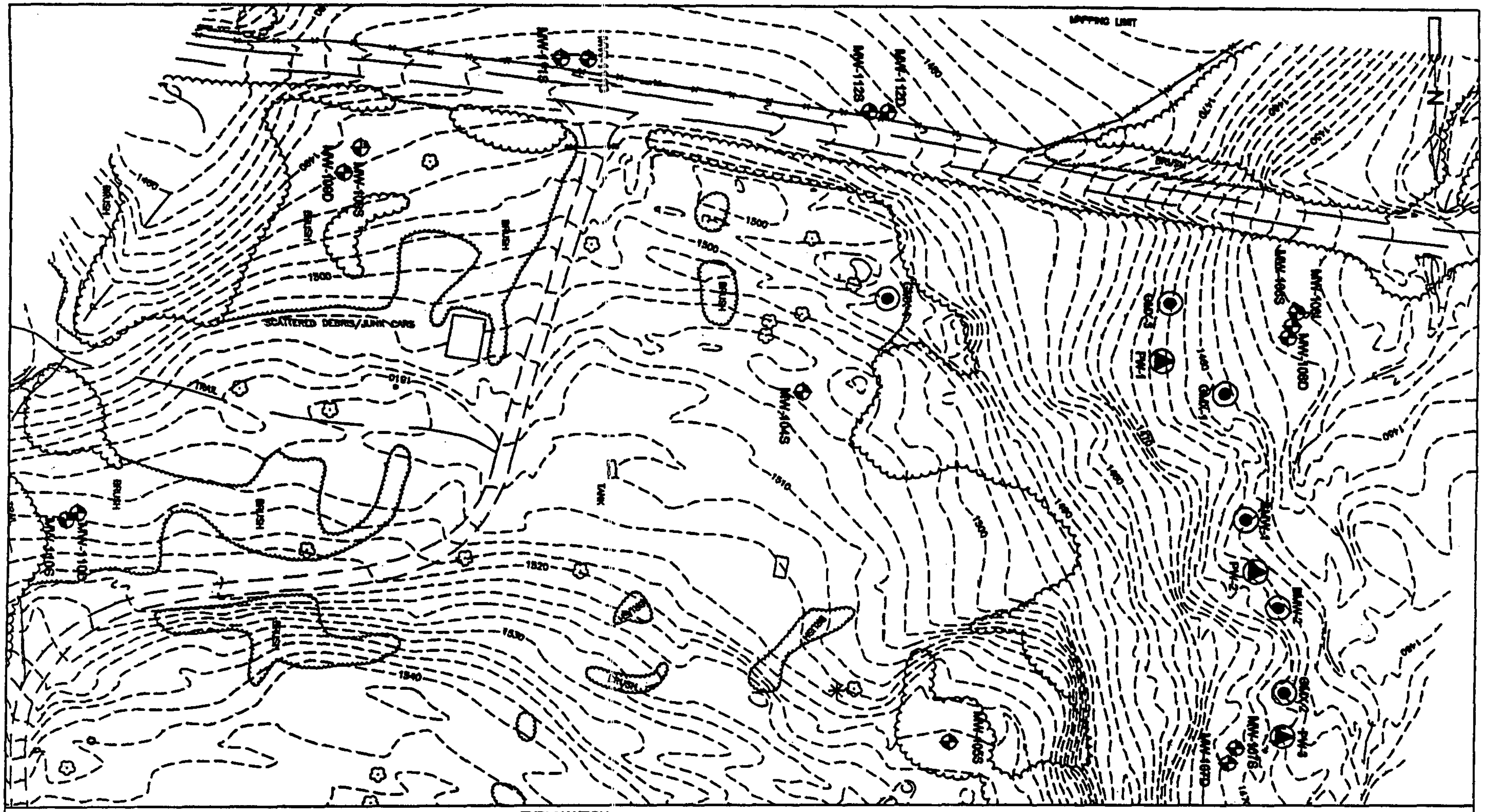
2.0 AQUIFER TEST DESIGN

Groundwater impacted with volatile organic compounds (VOCs) occurs in the glaciofluvial deposits near monitoring wells MW-108S/I and GMX-1, and weathered bedrock in the southwestern portion of the landfill. The glaciofluvial deposits are hydraulically connected to the weathered bedrock. VOC impacted groundwater in the weathered bedrock discharges to the glaciofluvial deposits. The focus of groundwater remedial action will be to achieve hydraulic control in the weathered bedrock/lower till along the un-named creek. This will involve the installation of three 6-inch diameter pumping wells and performance of aquifer pump tests to determine hydraulic areas of influence, potential pumping rates and possible need for additional pump wells.

2.1 Pump Well Installations

Aquifer pump testing and groundwater collection will involve the installation of three, 6-inch diameter stainless steel pumping wells. All wells will be screened with stainless steel #20 (0.020 inches) continuous slot wire-wrap well screens. Borings will be advanced using 8 ¼-inch hollow stem augers (HSA). Subsurface soil samples will be collected continuously using a 2-inch split-spoon sampler, driven with a 140-lb hammer. Samples will be examined by a hydrogeologist and described using the Unified Soil Classification System.

Pumping wells will be spatially located in a general north-south direction along the un-named creek in proximity to existing piezometer/monitoring wells. The attached figure shows the approximate locations of proposed pumping wells PW-1, PW-2 and PW-3.



60' 0' 60' 120'

SCALE: 1 INCH = 60 FEET

EXPLANATION

MW-12S EXISTING MONITORING WELL

GMX-1 PRE-DESIGN PIEZOMETER

PW-1 PROPOSED PUMPING WELL

Benchmark Environmental Engineering & Science, PLLC

URBANA LANDFILL
OBSERVATION WELLS AND PROPOSED PUMPING WELL LOCATIONS

DATE: FEBRUARY 1999

SHEET 1 OF 1

DWG NO. F003.dwg

The wells will screen saturated weathered bedrock and lower till. Pumping wells PW-2 and PW-3 will be fitted with 5-foot long well screens, and PW-1 will be fitted with a 10-foot long well screen.

All pump test wells will be designed for possible use as full-scale pumping wells. The stainless steel riser will initially extend approximately three feet above existing grade and will be fitted with temporary locking covers. The risers will be cut down to final grade elevations and fitted with protective, flush-mount casings as part of the landfill cover system construction.

Upon installation, but not within 24 hours, the pumping wells will be developed. Field parameters including pH, temperature and specific conductance will be measured periodically during development. Measurements will continue until they become stable. Development water will be handled in accordance with Section 2.2.3.

2.2 Aquifer Pumping Test

Constant head pumping tests and recovery tests will be conducted on the three (3) newly installed pumping wells to:

1) estimate lateral hydraulic influence from pumping;
2) identify hydraulic boundary conditions encountered during pumping; and
3) predict flow rates from full scale pumping and treatment.

2.2.1 Pre-Test Phase

Prior to the pump test, static water levels will be measured manually in all pumping wells and observation wells. All measurements will be recorded on an *Aquifer Test Data Form* for the appropriate well (See Attached form).

2.2.2 Pumping Phase

Aquifer testing will be performed concurrently on wells PW-1 and PW-3 because of the anticipated limited area of hydraulic influence from pumping. A separate pumping test will be performed on PW-2 after full recovery of pumping wells PW-1 and PW-3. The following table summarizes observation wells to be monitored during the pumping of each well.

Pumping Well	Corresponding Observation Wells
PW-1	GMX-3, MW-108S, MW-108I, BMW-1
PW-2	BMW-1, BMW-2, GMX-2
PW-3	GMX-2, MW-107S, BMW-2

AQUIFER TEST DATA

GEOMATRIX

Well No.: ________ Project Name: ________ Project No.: ________

Owner ________ Address ________ County ________ State ________

Date ________ Company Performing Test ________ Measured By ________

Well No. ________ Distance from Pumping Well ________ Type of Test ________ Test No. ________

Pumping Well ______ Observation Well ______ Measurement Equipment ________

TIME DATA

Pump on: Date________ Time________ (t_o)

Pump off: Date________ Time________ (t'_o)

Duration of aquifer test:

Pumping ________ Recovery ________

WATER LEVEL DATA

Static Water Level ________

Measuring Point ________

Elevation of Measuring Point ________

DISCHARGE DATA

How Q Measured ________

Depth of Pump/Air Line ________

Previous Pumping? Yes ______ No ______

Duration ________ End ________

Date	Clock Time	Time Since Pump Started t	Time Since Pump Stopped t'	t/t'	Water Level Measurement	Correction or Conversion	Water Level	Water Level Change s or s'	Discharge Measurement	Discharge Rate	Recorded By	COMMENTS ON FACTORS AFFECTING TEST DATA

Wells will be pumped with the Waterra® Hydrolift II system using an HDPE tubing and foot valve configuration. Wells will be pumped at rates allowing maximum drawdown and flow rate, while maintaining a constant head of water in the casing. It is anticipated that pumping rates will be in the range of 0.5 to 1 gallon per minute after well bore and well casing storage is removed. A graduated five- (5) gallon bucket and stop-watch will be used to calculate rate of discharge from the pumping well. Flow rate will be measured and recorded periodically during the pump test. Rate of discharge, cumulative gallons discharged and time of measurement will be recorded during periodic checks of the flow rate. Water generated during pumping will be discharged/containerized in accordance with Section 2.2.4.

During the pumping phase of the aquifer test, the following measurements will be made:

- water levels in the pumped well and surrounding observation wells
- instantaneous and cumulative discharge from the pumped well; and
- time at which measurements are recorded

Water levels will be recorded using downhole pressure transducers in nearby observation wells and piezometers during pumping. Water levels in pumping wells will be recorded manually using a water level indicator to ensure a sustained constant head and flow rate (if possible). Water levels in all observation wells will be measured periodically using a manual water level indicator.

Water levels in the pumping well and observations will be measured on an approximate, pre-determined time schedule. An example time schedule is outlined in the following table.

Time Since Pump Started (min.)	Approximate Time Intervals Between Measurements (min.)	
	Pump Well	Observation Wells
0 - 2	0.25	1
2 - 5	0.5	1
5 - 15	1	1
15 - 60	5	10
60 - Conclusion	60	10

It is anticipated that pumping will be maintained for a period of 72-hours for each of the three (3) pumping wells to allow the influence of local hydraulic boundaries to be observed. If it is apparent that steady-state conditions have been reached, pumping may be terminated before the 72-hour completion time.

2.2.3 Groundwater Characterization

In accordance with the July 1998 Remedial Action Work Plan, a groundwater sample will be collected from PW-3 approximately 48-hours following pump test initiation. The sample will be analyzed for Target Compound List (TCL) chlorinated organics in accordance with USEPA Method 8010. Sample analysis will be performed by an NYSDOH ELAP-Certified laboratory. Sample data will be used to provide an indication of the character of the groundwater along the northern end of the collection trench.

An additional groundwater sample will be collected from PW-1 for treatability testing by Envirometal Technologies, Inc. Correspondence detailing the treatability test protocols will be submitted to the Department under separate cover.

2.2.4 Discharge Water Management

During well development, groundwater will be discharged to ground surface in the immediate vicinity of the pumping well. The rate of development will be controlled to prevent overland migration of development water into the stream. During pump testing, groundwater will be directed into a 55-gallon drum positioned adjacent to the pumping well. An electric submersibe pump with automatic start/stop controls will transfer groundwater from the drum to a 4,000 gallon capacity tanker. Following completion of each pump test, tanker contents will be hauled to the Steuben County leachate pretreatment facility or another off-site watewater treatment facility approved to accept this material.

2.2.5 Recovery Phase

Upon completion of the pumping phase of the aquifer test, the pump will be shut off. Water level recovery measurements will be recorded in the pumped well(s) and observation wells immediately following pump-shut off. Recovery water-level measurements will be monitored periodically in the pumped well and observation wells until one or all of the following has occurred:

- approximately 95% of the induced drawdown has been recovered;
- the water level in the pumped well has changed less than 0.05 feet for at least two hours.
- a period of time equal to the duration of the pumping phase has elapsed since the pump was shut off.

3.0 DATA INTERPRETATION

During the pumping phase, time-drawdown curves for the observation wells may be field-plotted on semi-logarithmic graph paper to evaluate the progress of the test.

At the completion of each pump test, pressure data from each transducer/data logger will be downloaded to a laptop computer. Downloaded pumping data will subsequently be plotted and contoured on a site plan map to determine radii of influence for each of the pumped wells.

Recovery water level data from each pumping well will be used to calculate hydraulic conductivity values of the screened hydrostratigraphic unit. Aquifer testing data will be utilized in the design of the groundwater collection treatment system.

Appendix B3 - Groundwater Pump Test Summary

HYDRAULIC TESTING PROGRAM
Urbana Landfill
Town of Urbana, New York

INTRODUCTION

Geomatrix Consultants, Inc. (Geomatrix) conducted a hydraulic testing program in the southwest portion of the Urbana Landfill site in conjunction with staff from Benchmark Environmental Engineers and Scientists, PLLC (Benchmark). The information provided by this hydraulic testing will be used by Benchmark to design remedial actions involving groundwater collection and treatment at the landfill.

The scope of work for hydraulic testing was described in a letter submitted to the NYSDEC dated December 22, 1998. The letter included a description of hydrogeologic information obtained from the drilling and installation of piezometers utilized as observation wells during this hydraulic testing program and presented a refined interpretation of the conceptual hydrogeologic model for the site. The current conceptual hydrogeologic model for the site provides an improved understanding of the conditions affecting the migration of chemical constituents in the groundwater. The hydraulic testing conducted at the site further supports this refined conceptual model and allows Benchmark to evaluate and design a remedial action that will achieve remedial objectives for the site. The objective of the hydraulic testing program was to establish the spacing of groundwater extraction wells that will be used to mitigate VOC impacted groundwater located in the southeastern portion of the site from migrating off-site.

BACKGROUND

Geologic and hydrogeologic information used to locate groundwater extraction wells and identify critical hydrostratigraphic zones for monitoring was provided in the CDM Remedial Investigation Report and obtained from the Pre-Design Study summarized in the Benchmark letter dated December 22, 1998.

The Pre-Design Study consisted of the completion of six borings and conversion to piezometers. Four borings/piezometers were completed during the week of November 2, 1998 at the Urbana Landfill. Boring locations were selected to provide additional hydrogeologic information for the site in the vicinity of impacted groundwater (i.e., the northeast portion of the site where groundwater collection is proposed). Two (2) additional borings/piezometers were installed during the week of November 30, 1998 to better characterize hydrogeologic conditions near the un-named creek located east of the landfill. Boring/piezometer locations from this investigation are shown on Figure 1. A summary of the well completion details and hydrostratigraphic units screened is presented in Table 1. Groundwater elevation data obtained from these wells during individual pump testing of three pumping wells were used to better characterize the hydrogeologic conditions at the site and provide information for remedial design.

METHODOLOGY

A pump test was conducted in three pumping wells (viz., PW-1, PW-2, and PW-3) installed at locations shown on Figure 1. Groundwater discharged from the pumping wells was filtered through activated carbon to remove volatile organic compounds and any other organic or inorganic compound with strong carbon affinity. The treated groundwater was discharged back into the fill distant from the area of pumping. Water levels were measured either manually or automatically using transducer/data loggers in on-site and off-site monitoring wells during pumping. A summary of wells and piezometers monitored during the hydraulic testing program is presented in Table 2. A description of well installation and water level monitoring information is provided below.

PUMPING WELL DRILLING

A total of three (3) borings/groundwater extraction wells designated PW-1, PW-2, and PW-3 were installed during the week of April 12, 1999 at the Urbana Landfill. Boring/pumping well locations are shown on Figure 1. Each borehole was advanced through unconsolidated overburden using 10-1/4-inch hollow stem augers (HSA). Each borehole was advanced through the weathered bedrock unit and five-feet into the competent bedrock unit. A site map showing the approximate location of new and existing piezometers/monitoring wells is presented in Figure 1. Borehole PW-1 was advanced to a depth of 45.0 feet below ground surface (fbgs), borehole PW-2 was advanced to a depth of 23.2 fbgs and PW-3 was advanced to a depth of 19.6 fbgs. The wells were drilled to depths that would accommodate a five foot well sump below the well screen into bedrock. Each well was installed in close proximity to recently completed observation wells that were logged continuously during borehole advancement. At each pumping well boring location, soil cuttings from HSA advancement were described on field borehole logs. The total volatile organic vapors in the soil cuttings during drilling were measured using a PE Photovac (Model No. 2020) photo-ionization detector (PID) equipped with a 10.2 eV lamp. PID readings for each borehole were collected periodically during the drilling program and recorded on the borehole logs.

PUMPING WELL INSTALLATION

A six-inch diameter pumping well (groundwater extraction well) was installed in each borehole. Each well was constructed with stainless steel continuous slot, wire-wrap well screen (0.020-inch) and riser with a No. 2 silica sand filter pack. A screen measuring 10 feet in length was installed at location PW-1 and screens measuring 5 feet in length were installed at locations PW-2 and PW-3. Each well was equipped with a 5-foot sump below the screened interval. The wells screened the saturated lower portion of the till and weathered bedrock. The sump, well screen and attached riser were placed at the bottom of the borehole and a silica sand filter pack was installed from the bottom of the sump to the following distances above the top of the slotted screen:

Pumping Well	Distance Above Well Screen (feet)
PW-1	20.0
PW-2	6.2
PW-3	4.6

A sand pack extending 20 feet above the top of the well screen was necessary to intercept a saturated sand stringer identified in the till approximately 15 feet above the weathered bedrock. A three to four foot bentonite pellet seal was placed above the sand pack and allowed to hydrate for a minimum of one hour. Each extraction well was then grouted to the surface and a keyed alike, lockable cap installed to complete the installation. Upon curing of the grout, a concrete pad was installed at each well location. Borehole logs presented in Attachment 1 provide well completion details for each pumping well. General well construction details for the pumping wells, monitoring wells, and observation wells are summarized in Table 1.

Each pumping well was developed by using a Grundfos Redi-Flo 2 pump assembly to purge and remove groundwater. Prior to purging, each well was surged by the drill rig utilizing a 6-inch rubber gasket surge block and steel rod assembly for approximately 10 to 15 minutes to pull any fine grained material from the well screen. Purged groundwater was monitored for pH to ensure bentonite-grout did not enter the groundwater. Development continued until visual turbidity was reduced and pH values stabilized.

HYDRAULIC TESTING

Hydraulic tests were conducted in each extraction well to assess the hydraulic influence from pumping. Water levels measured in observation wells and monitoring wells screened in the overburden and the bedrock were used to determine if a hydraulic response from pumping occurred. Water levels were automatically measured by transducers and electronically recorded at five minute intervals in select monitoring wells. Manual water level measurements were periodically recorded as a check to ensure accurate readings were being recorded by the data logger. A summary of observation wells utilized during testing and associated instrumentation is presented in Table 2. A description of testing is presented below.

PUMPING WELL PW-1

Pumping was initiated at pumping well PW-1 (see Figure 1) on April 21, 1999 at 16:35. The pumping test ran concurrently with pumping at PW-3. Drawdown within PW-1 was accomplished utilizing a Waterra Hydrolift II Electric pump (110-volt) with a 1.0-inch outside diameter (O.D.) high-density polyethylene (HDPE) tubing and foot valve attachment. The foot valve was set at a depth of 45.0 feet below the top of riser (fbtor), which is the approximate depth of the bottom of the well screen. A maximum pumping rate of 4.5 gallons per minute (gpm) was established and held constant throughout the duration of the pump test for the Waterra pump assembly. Because the specific capacity of the well was substantially greater than the maximum flow rate of the pump, an additional pump was utilized to increase the rate of drawdown in the well. A Grundfos Redi-Flo 2 pump assembly was used concurrently with the Waterra pump assembly and pumped at a rate of 2.5 gpm. The total combined pumping rate during the pump test for PW-1 was generally consistent at 7.0 gpm for approximately 48 hours. The static water level of PW-1 prior to pumping was manually measured at 17.84 fbtor with an electronic water level indicator. The water level in PW-1 in the upper water bearing zone and bedrock water-bearing zone was measured at 24.82 fbtor for a maximum drawdown of 6.98 feet immediately prior to pumping termination.

The hydraulic response to pumping is presented as a plot of drawdown and recovery water level data. Hydraulic response data are summarized in Attachment 2. The step increases and decreases in drawdown water levels observed on the figure reflect an increase or decrease in the rate of groundwater removal using the Grundfos pump. Start-up and shut-off times of the pumps are identified on the figure. Drawdown and recovery water level data for the monitored observation wells are also presented in Attachment 2. The aerial extent of hydraulic responses (Drawdown > 0.25 feet) to pumping after 48 hours is shown on Figure 2.

PUMPING WELL PW-2

Pumping was initiated at pumping well PW-2 (see Figure 1) on April 26, 1999 at 11:10. Drawdown at PW-2 was accomplished utilizing the Water Hydrolift II Electric pump. The foot valve was set at the bottom of the well screen approximately 14 feet below the static water level. A low pumping rate of approximately 0.5 gpm was sufficient to maintain a constant head level in the well during testing. After approximately 12 hours of pumping, the foot-valve malfunctioned and required replacement. Observation wells did not fully recover during pumping inactivity and the test was restarted and continued for over 24-hours. Because of the low specific capacity of the well, dewatering of the well to pump intake level occurred within 2 hours.

The hydraulic response to pumping is presented as a plot of drawdown and recovery water level data. Hydraulic response data are summarized in Attachment 3. A drop-off in drawdown approximately 12 hours after test startup represents the malfunctioning foot valve that occurred overnight. Start-up and shut-off times of the pumps are identified on the figure. Drawdown and recovery water level data for the monitored observation wells are also presented in Attachment 3. The aerial extent of hydraulic response (drawdown > 0.25 feet) to pumping after nearly 48 hours is shown on Figure 2.

PUMPING WELL PW-3

Pumping was initiated at pumping well PW-3 (see Figure 1) on April 21, 1999 at 9:30. Drawdown at PW-3 was accomplished utilizing the Waterra Hydrolift II Electric pump. The foot valve was set at the bottom of the well screen approximately 19 feet below the top of the riser. A constant head level was maintained in the well during testing by achieving a very low pumping rate of approximately 0.25 gpm.

The hydraulic response to pumping is presented as a plot of drawdown and recovery water level data. Hydraulic response data are summarized in Attachment 4. Start-up and shut-off times of the pumps are identified on the figure in the attachment. Drawdown and recovery water level data for the monitored observation wells are also presented in Attachment 4. The aerial extent of hydraulic responses (drawdown > 0.25 feet) after more than 28 hours of pumping is shown on Figure 2. The response curves for BMW-1 and PW-2 show continued drawdown after pumping termination in PW-3 and continued pumping in PW-1 indicating that the hydraulic responses to in these wells was due to pumping at PW-1. The relatively small area of hydraulic influence from pumping at PW-3 is consistent with the low well yield.

ANALYSIS

PW-1

As shown in Figure 2, a relatively large area of hydraulic influence developed in the saturated overburden and bedrock after 48 hours of pumping at PW-1. The area of hydraulic influence extends south of the site along Crows Nest Road in both the overburden and shallow bedrock (MW-112S and 112D); west of the site beyond monitoring well pair MW-202; north to approximately PW-2; and east toward the landfill waste. The distance-drawdown graph for pumping well PW-1 is presented in Figure 3. Under ideal conditions (homogenous porous media), the distance-drawdown plot should extend in a straight line from the y-axis (pumping well location). However, Figure 3 identifies substantial drawdown in wells screened in the overburden and bedrock within 100 feet of the pumping well PW-1 and substantially less than the drawdown predicted by a straight line drawn beyond observation well BW-1. The anisotropy of the bedrock is partially responsible for the non-uniform spatial distribution in drawdown in the overburden and bedrock water-bearing zones. Fracture orientations in the bedrock possibly creates preferential areas of dewatering in the bedrock and overburden during pumping.

Figure 4 presents residual drawdown data from PW-1 (measure of the rate of recovery). Under ideal conditions, a plot of the best-fit line through the data should extend to the origin in the upper left-hand corner of the plot. However, the linear plot of the recovery data falls well below the origin indicating less recharge to the pumping well than a predicted rate of recovery. The cause of the slower rate of recovery is likely due to dewatering of fractures in the vicinity of the pumping well with slow recharge or dewatering of the glacio-fluvial deposits in the vicinity of monitoring well cluster MW-108. These deposits may become dewatered as groundwater is removed from the deposits, thereby depleting the volume of water held in storage. Due to the very low permeability of the till surrounding the glacio-fluvial deposit, recharge occurs only as fast as the till and weathered bedrock will allow. The slow recovery of the glacio-fluvial deposit also indicates that the unnamed stream running north-south located west of MW-108 (S, I and D) is not hydraulically connected to the glacio-fluvial deposit. A hydraulic connection between the unnamed stream and the glacio-fluvial deposit would have resulted in a slower removal of the groundwater from storage within the deposit and a subsequent quicker recovery of the groundwater level within the monitoring well cluster MW-108 (S, I, D).

PW-2

As shown in Figure 2, a somewhat smaller area of hydraulic influence developed in the saturated overburden and bedrock after nearly 48 hours of pumping at PW-2. The area of hydraulic influence extends south beyond BMW-1 and north of GMX-2. The distance-drawdown graph for pumping well PW-2 is presented in Figure 5. The distance-drawdown plot predicts an area of hydraulic influence that extends approximately 100 feet from the pumping well. Greater drawdown in BMW-2 than BMW-1 demonstrates bedrock anisotropy with non-proportional drawdown (more drawdown in a well farther from the pumping well than a well closer to the pumping well).

Figure 6 presents residual drawdown data from PW-2 plotting recovery water level data measured in the pumping well after pumping. A somewhat faster rate of water level recovery occurred than that predicted under ideal hydraulic conditions. The best-fit line drawn through the residual drawdown data intersects to the right of the origin suggesting recharge to the weathered bedrock water-bearing zone during recovery. Recharge may have occurred either from losing water conditions from the unnamed stream or leaky conditions associated with saturated waste that exists in close proximity to the well.

PW-3

The smallest area of hydraulic influence developed in the saturated overburden and bedrock from the three pumping wells occurred from pumping at PW-3. After more than 24 hours of pumping, the area of hydraulic influence extends beyond monitoring well pair at MW-107 (Figure 2). The distance-drawdown graph for pumping well PW-3 is presented in Figure 7. The distance-drawdown plot predicts an area of hydraulic influence that is less than 100 feet from the pumping well. Drawdown occurs in the overburden and weathered bedrock as well as the competent bedrock (MW-107D).

Figure 8 presents residual drawdown data from PW-3 plotting recovery water level data measured in the pumping well after pumping. Similar to PW-2, a slightly faster rate of water level recovery occurred than that predicted under ideal hydraulic conditions. The line of the residual drawdown plot intersects to the right of the origin suggesting recharge to the weathered bedrock water-bearing zone during recovery. Recharge may have occurred either from losing water conditions from the unnamed stream or leaky conditions associated with the saturated waste that exists in close proximity to the well.

SUMMARY AND CONCLUSION

Hydraulic testing was conducted in three pumping wells located in the southwest corner of the Urbana Landfill. Respective areas of hydraulic influence from pumping at PW-1, PW-2, and PW-3 are approximately 250 feet, 100 feet, and 75 feet from each pumping well with respective pumping rates of 7, 0.5, and 0.25 gallons per minute. Analysis of the pumping test data identifies anisotropic conditions in the weathered bedrock water-bearing zone that produces non-uniform drawdown across the area of hydraulic influence at each pumping well location. The glacio-fluvial deposits located in the vicinity of well cluster MW-108 do not appear to be hydraulically connected to the stream.

As shown on Figure 2, the area of hydraulic influence from each pumping well location overlaps the area of hydraulic influence from the adjacent pumping well. Collective pumping from the three pumping wells will produce an area of hydraulic influence that extends south of Crows Nest Road, northward more than 200 feet beyond well pair MW-107. The combined operation of the existing pumping wells will be sufficient to capture VOC-impacted groundwater and mitigate its migration off-site. The anticipated combined flow to achieve hydraulic capture will be in the range of 5 to 10 gpm.

TABLES

GEOMATRIX

TABLE 1

SUMMARY OF WELL/PIEZOMETER CONSTRUCTION DETAILS

Urbana Landfill
Town of Urbana, New York

Location	Ground Elevation (fmsl)	TOR Elevation (fmsl)	Stick-up (ft)	Depth to Bedrock (fbgs)	Bedrock Elevation (fbgs)	Screened/Open Hole Interval (fbgs)	Screened/Open Hole Interval (fmsl)	Total Depth (fbtor)	Bottom Elevation (fmsl)	Hydrostratigraphic Unit(s) Screened
GMX-1	1458.36	1461.28	2.92	NA	NA	7.00 - 17.00	1451.36 - 1441.36	19.92	1441.36	till
GMX-2	1463.32	1466.15	2.83	13	1450.32	5.00 - 15.00	1458.32 - 1448.32	17.83	1448.32	till / weathered bedrock
GMX-3	1464.91	1468.58	3.67	37	1427.91	26.50 - 36.50	1438.41 - 1428.41	40.17	1428.41	till / weathered bedrock
GMX-4	1496.40	1498.40	*2.00*	27	1469.40	17.50 - 27.50	1478.90 - 1468.90	29.50	1468.90	till / weathered bedrock
BMW-1	1457.88	1460.71	2.83	22	1435.88	7.50 - 22.50	1450.38 - 1435.38	25.33	1435.38	till
BMW-2	1461.21	1463.88	2.67	14	1447.21	9.50 - 19.50	1451.71 - 1441.71	22.17	1441.71	till / weathered bedrock
MW-104 S	1505.90	1507.92	2.02	> 18	NA	5.97 - 15.97	1499.93 - 1489.93	18.19	1489.73	waste / fill
MW-106 D	1486.44	1488.14	1.70	7	1479.44	17.00 - 26.88	1469.44 - 1459.56	28.58	1459.56	bedrock
MW-107 S	1471.74	1473.96	2.22	12	1459.74	5.01 - 15.01	1466.73 - 1456.73	17.43	1456.53	till / weathered bedrock
MW-107 D	1471.66	1473.27	1.61	12	1459.66	20.00 - 24.65	1451.66 - 1447.01	26.26	1447.01	bedrock
MW-108 S	1450.46	1452.90	2.44	29	1421.46	5.94 - 15.94	1444.52 - 1434.52	18.58	1434.32	glaciofluvial
MW-108 I	1451.20	1453.25	2.05	29	1422.20	16.88 - 26.88	1434.32 - 1424.32	29.13	1424.12	glaciofluvial
MW-108 D	1451.87	1453.91	2.04	29	1422.87	36.50 - 40.59	1415.37 - 1411.28	42.63	1411.28	bedrock
MW-112 S	1485.96	1488.21	2.25	32	1453.96	20.11 - 30.11	1465.85 - 1455.85	32.56	1455.65	till
MW-112 D	1485.33	1487.17	1.84	32	1453.33	47.00 - 51.92	1438.33 - 1433.41	53.76	1433.41	bedrock
MW-202 S	1448.69	1450.72	2.03	24	1424.69	13.00 23.00	1435.69 1425.69	25.03	1425.69	till
MW-202 D	1448.83	1450.80	1.97	24	1424.83	30.00 81.50	1418.83 1367.33	83.47	1367.33	bedrock
PW-1	*1462.00*	*1466.88*	4.88	37	1425.00	30.00 - 40.00	1432.00 - 1422.00	49.88	1417.00	till / weathered bedrock
PW-2	*1456.00*	*1459.04*	3.04	17	1439.00	13.20 - 18.20	1442.80 - 1437.80	26.24	1432.80	till / weathered bedrock
PW-3	*1462.00*	*1464.43*	2.43	13	1449.00	9.60 - 14.60	1452.40 - 1447.40	22.03	1442.40	till / weathered bedrock

Notes:
fmsl = feet above mean sea level
fbgs = feet below ground surface
fbtor = feet below top of riser
Italicized values are estimates.

TABLE 2

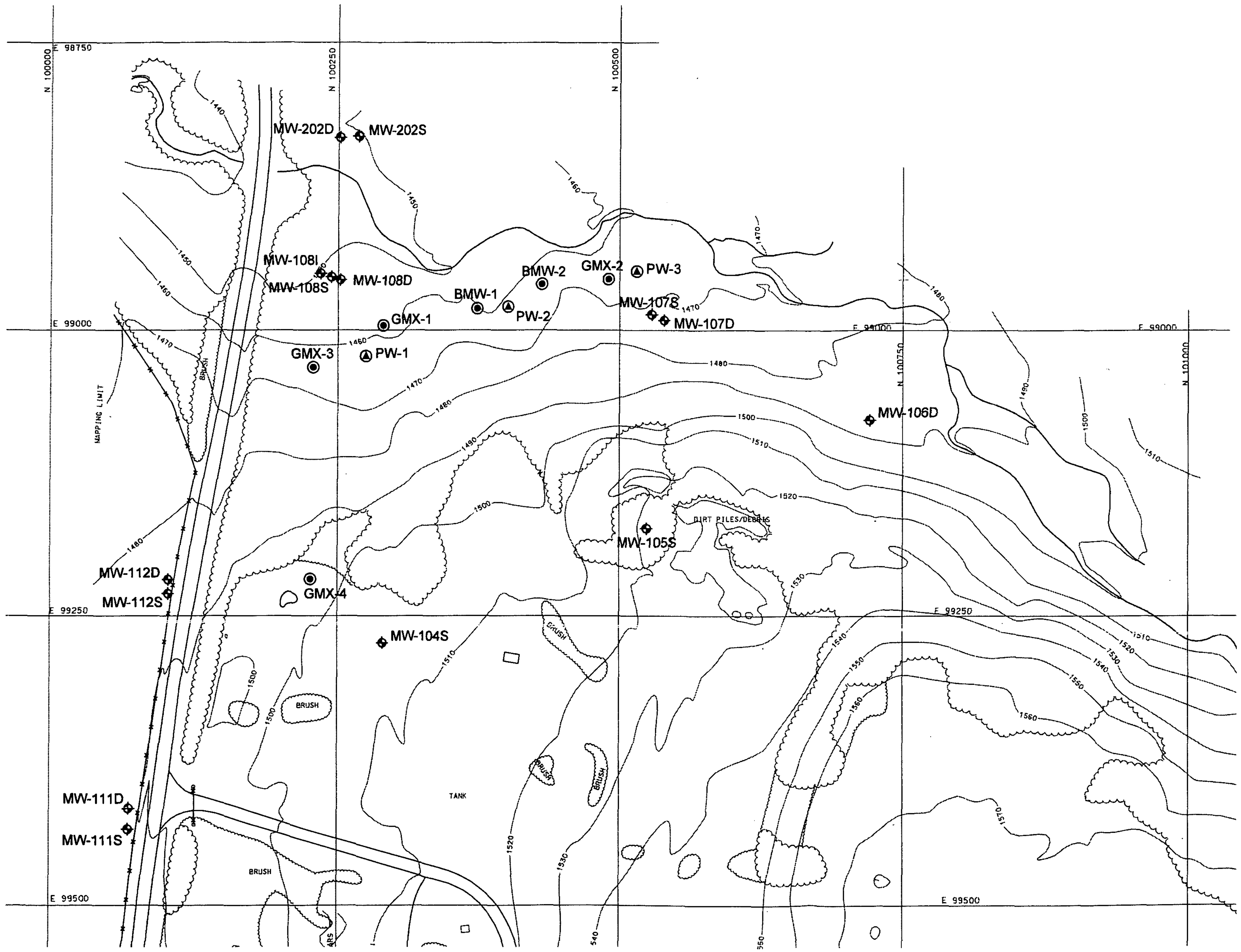
SUMMARY OF OBSERVATION WELLS UTILIZED DURING TESTING

GEOMATRIX

Urbana Landfill
Town of Urbana, New York

Pump Test	Location	Time Designated as Zero Hermit	Time Designated as Zero Manual	Manual Measurements	Hermit/Troll Measurements
PW-1	PW-1	04/21/99 08:57	04/21/99 09:08	x	
	GMX-3				x
	GMX-1			x	
	MW-108S			x	
	MW-108I				x
	MW-108D			x	
	MW-112S			x	
	MW-112D			x	
	BMW-1				x
	BMW-2				x
	PW-2			x	
	GMX-4			x	
	MW-202S			x	
PW-2	PW-2	04/26/99 10:01	04/26/99 10:12	x	
	BMW-1				x
	BMW-2				x
	GMX-1			x	
	PW-1			x	
	MW-108S			x	
	MW-108I				x
	MW-108D			x	
	PW-3			x	
	GMX-3				x
	MW-107S				x
	MW-107D			x	
	GMX-2				x
PW-3	PW-3	04/21/99 08:57	04/21/99 09:08	x	
	PW-2			x	
	MW-107S			x	
	MW-107S				x
	MW-107D			x	
	GMX-2				x
	BMW-1				x
	BMW-2				x

FIGURES



EXPLANATION

MW-108S NYSPEC SHALLOW MONITORING WELL

MW-108I NYSPEC INTERMEDIATE MONITORING WELL

MW-108D NYSPEC DEEP MONITORING WELL

GMX-1 GEOMATRIX OBSERVATION WELL

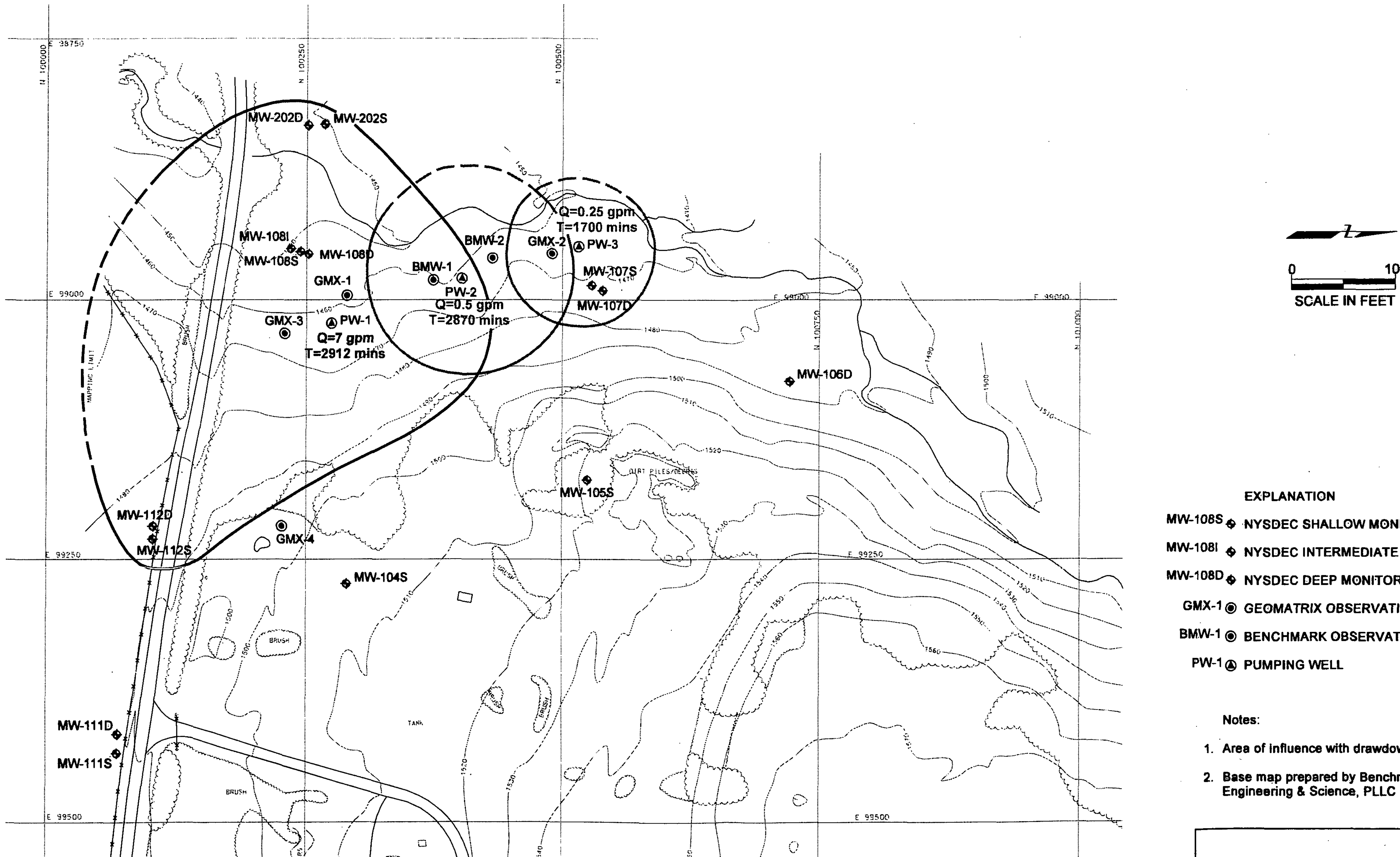
BMW-1 BENCHMARK OBSERVATION WELL

PW-1 PUMPING WELL

SITE PLAN
Urbana Landfill

GEOMATRIX	Project No. B5039	Figure 1

11-MAY-1999 11:26 voltman
q:\buffalo\b5039\client\uff_01.dgn
\\SFPRNT2\Splash Hold Job-Ng@rtx.ctb
MAP_WT3X.pen
CHECKED:________



EXPLANATION

- MW-108S NYSDEC SHALLOW MONITORING WELL
- MW-108I NYSDEC INTERMEDIATE MONITORING WELL
- MW-108D NYSDEC DEEP MONITORING WELL
- GMX-1 GEOMATRIX OBSERVATION WELL
- BMW-1 BENCHMARK OBSERVATION WELL
- PW-1 PUMPING WELL

Notes:

1. Area of influence with drawdown greater than 0.25 feet
2. Base map prepared by Benchmark Environmental Engineering & Science, PLLC

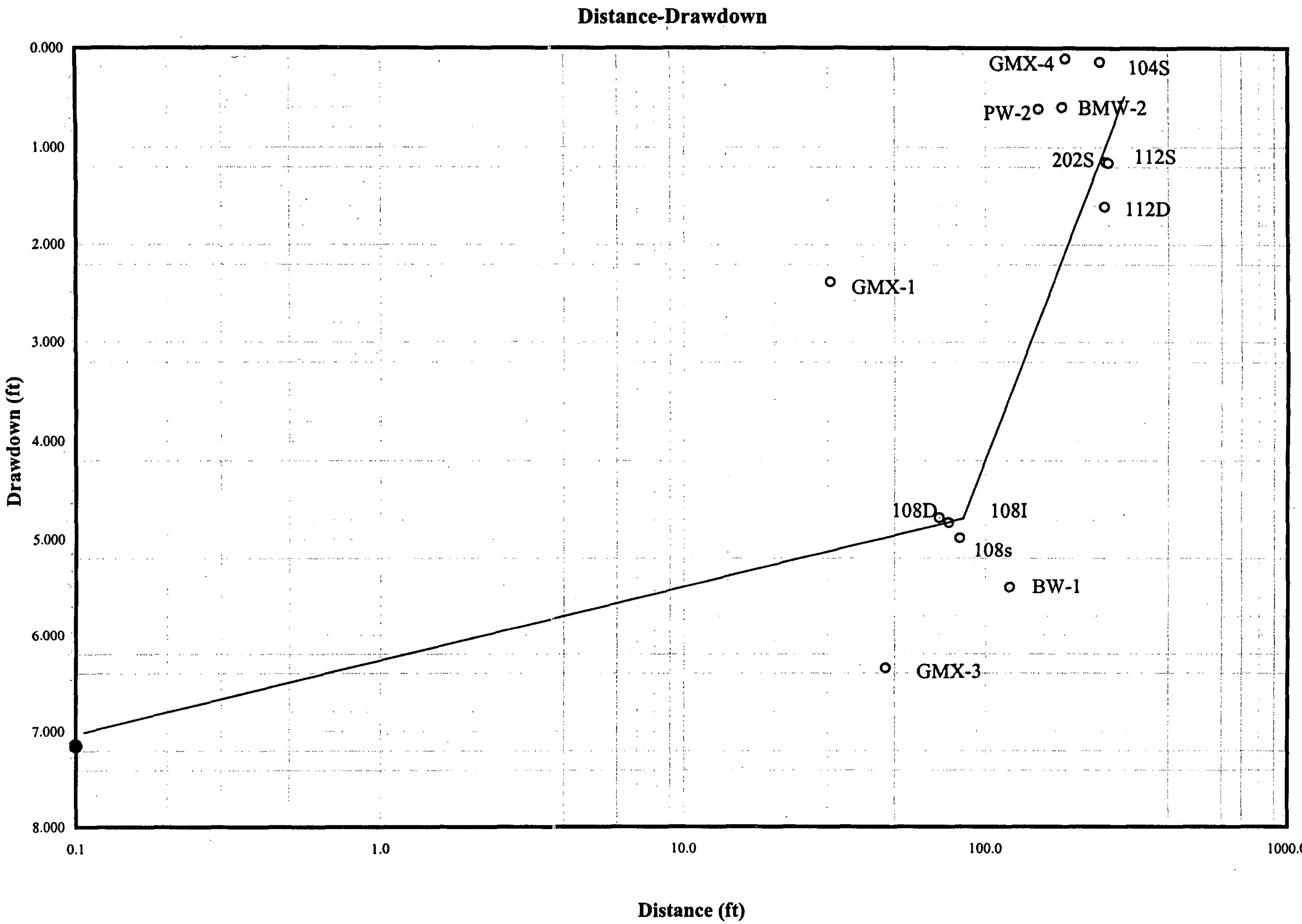
MAXIMUM AREAS OF HYDRAULIC INFLUENCE
Urbana Landfill

GEOMATRIX	Project No. B5039	Figure 2

FIGURE 3

PW-1

GEOMATRIX



GEOMATRIX

FIGURE 4

RESIDUAL DRAWDOWN PLOT

PW-1

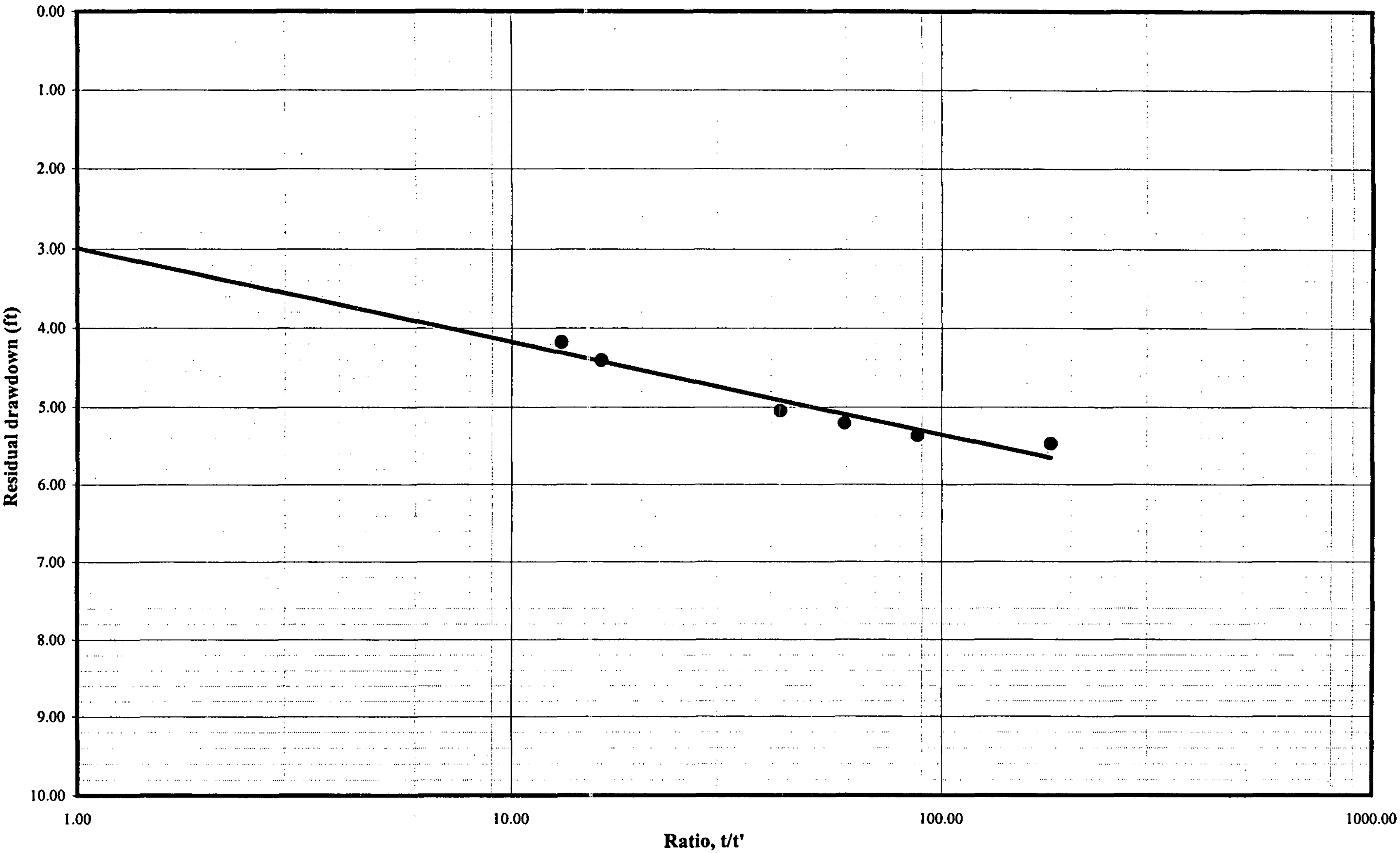
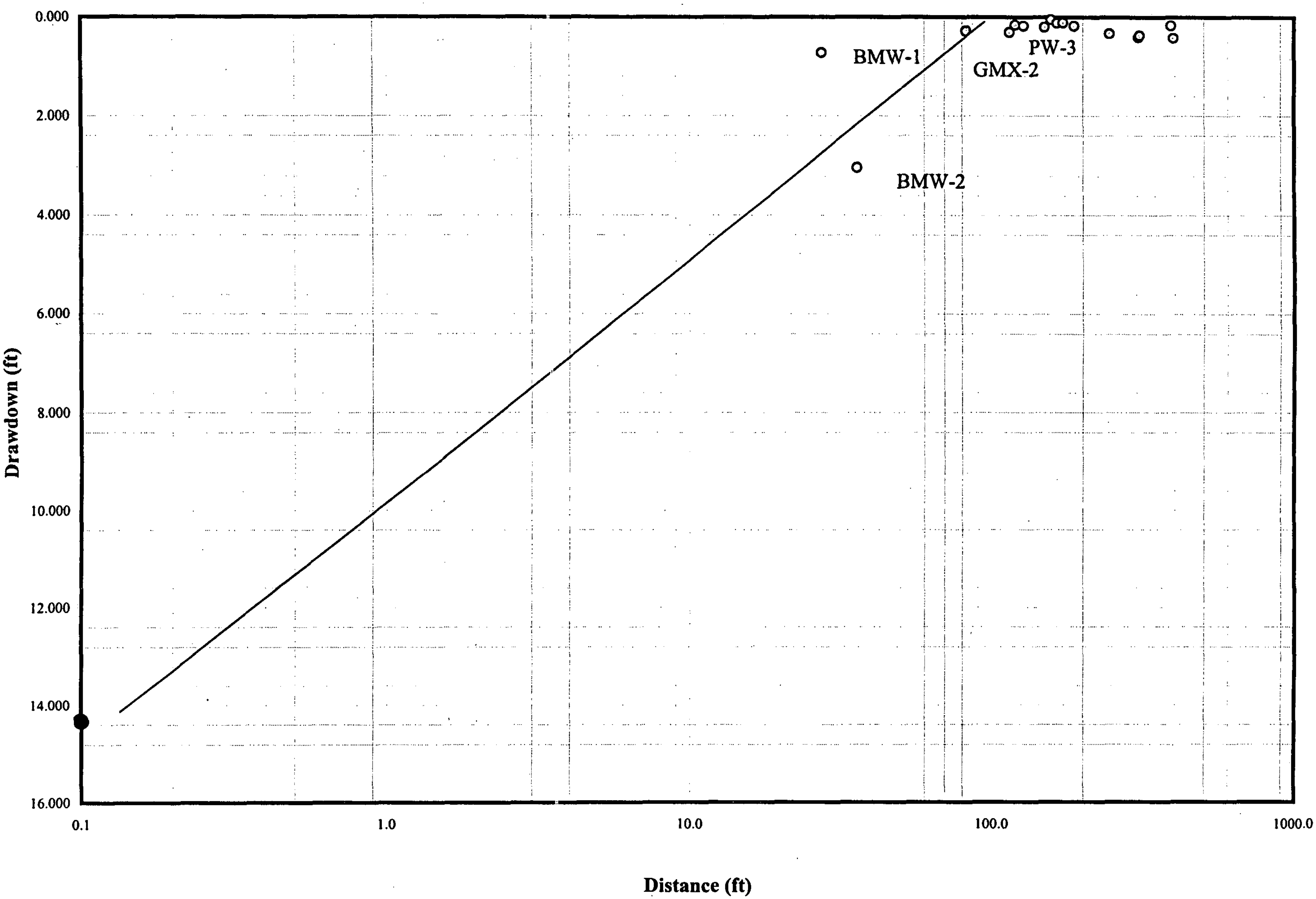


FIGURE 5

PW-2

Distance-Drawdown



GEOMATRIX

FIGURE 6

RESIDUAL DRAWDOWN PLOT

PW-2

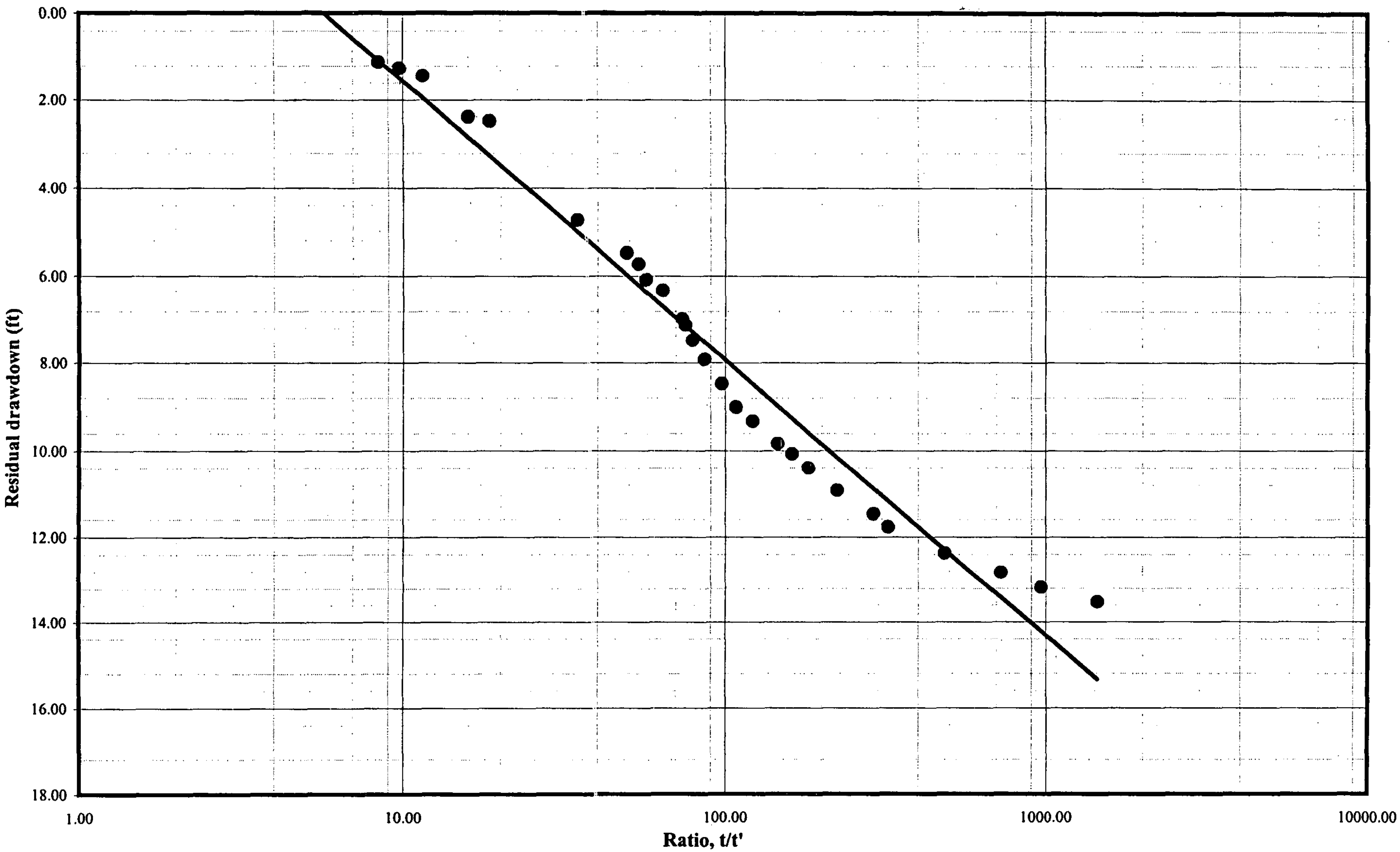


FIGURE 7

PW-3

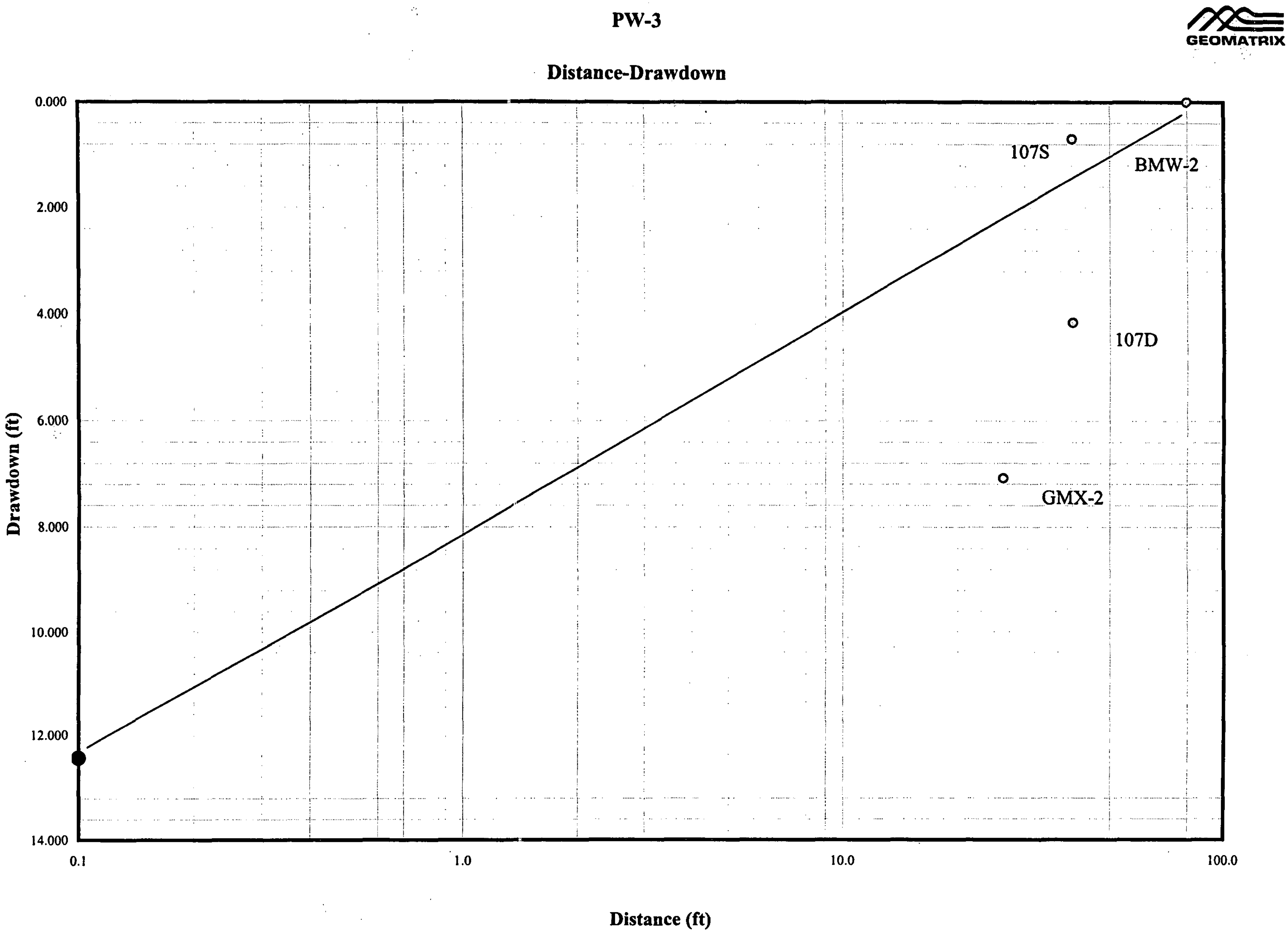
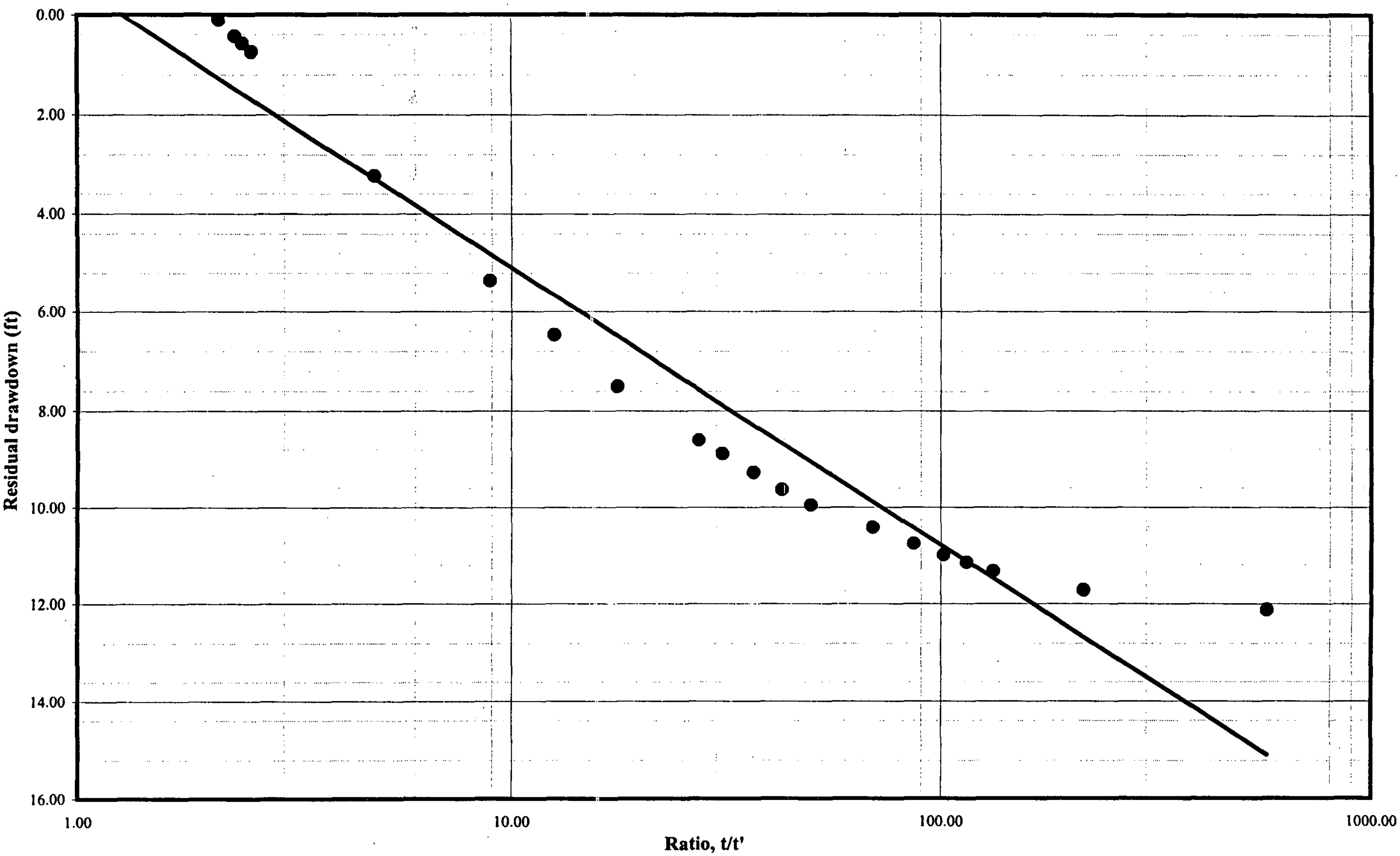

GEOMATRIX
Distance-Drawdown
Drawdown (ft)
0.000
2.000
4.000
6.000
8.000
10.000
12.000
14.000
107S
BMW-2
107D
GMX-2
0.1
1.0
10.0
100.0
Distance (ft)

FIGURE 8

RESIDUAL DRAWDOWN PLOT

PW-3



ATTACHMENT 1

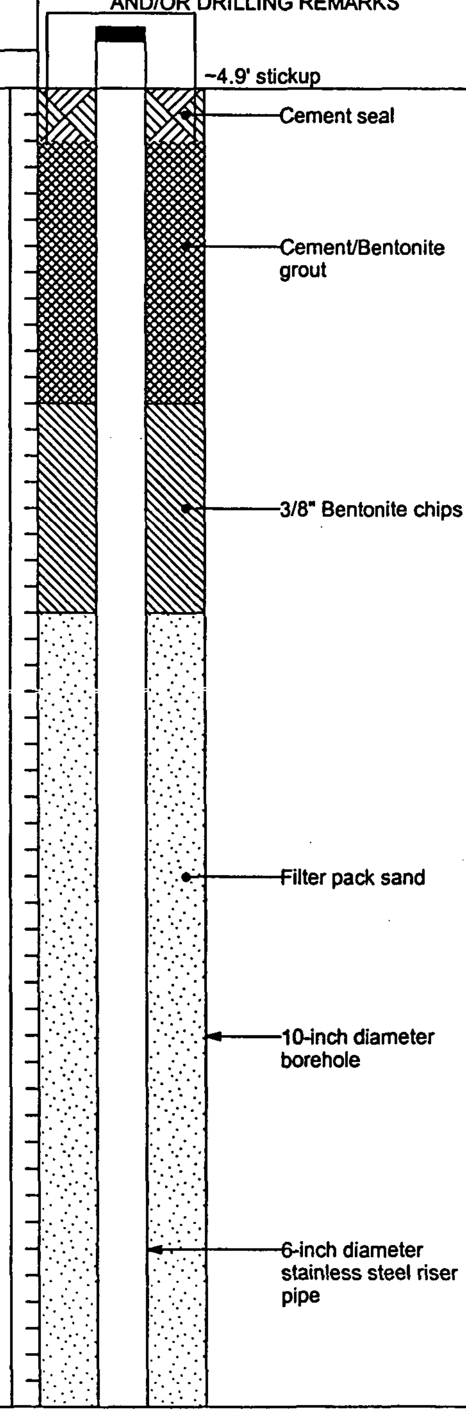
Pumping Well Borehole Logs

Log of Well No. PW-1

PROJECT: Urbana Landfill, Hammondsport, New York	
BORING LOCATION: West of landfill (farthest south)	TOP OF RISER ELEVATION: ~1466.9 fmsl / DATUM:
DRILLING CONTRACTOR: Nothnagle Drilling	DATE STARTED: 4/13/99 / DATE FINISHED: 4/16/99
DRILLING METHOD: HSA (6 1/4" ID) and Air rotary (10" OD roller bit)	TOTAL DEPTH: 45.0 fbgs / SCREEN INTERVAL: 30-40 fbgs
DRILLING EQUIPMENT: Guspech 750 (ATV rig)	DEPTH TO WATER: FIRST 21 fbgs / COMPL. -- / CASING: 6" Stainless steel
SAMPLING METHOD: Drill cuttings	LOGGED BY: BCH
HAMMER WEIGHT: -- / DROP: --	RESPONSIBLE PROFESSIONAL: Richard H. Frappa / REG. NO.

DEPTH (feet)	SAMPLES: Sample No.	Sample	Blows/ foot	OVM (ppm)	DESCRIPTION — NAME (USCS Symbol): color, moist, % by weight, plast., structure, cementation, react. w/HCl, geo. inter. — Surface Elevation: ~1462 fmsl
0–21					**SILT with SAND (ML):** dark brown, moist, 70% fines, 15% fine to medium sand, 15% coarse gravel (subrounded), medium plasticity, [TILL]
21					wet zone (21-23'), increase fraction of fines (21-32 fbgs)
25					

WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS



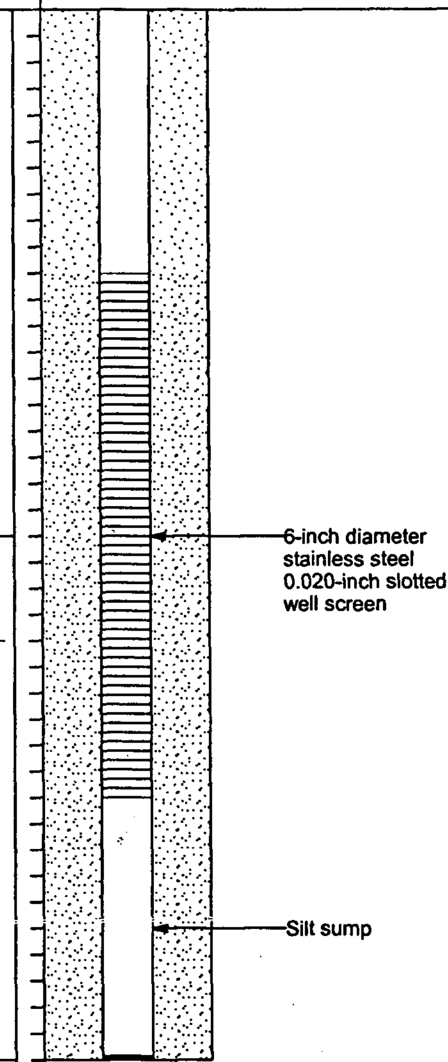
WELL_OVM PW1-3.GPJ (3/00)

PROJECT: Urbana Landfill
Hammondsport, New York

Log of Well No. PW-1 (cont'd)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ foot	OVM (ppm)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight, plast., structure, cementation, react. w/HCl, geo. inter.
26					
27					
28					
29					
30					
31					
32					
33					
34					
35					**WEATHERED BEDROCK:**weathered bedrock
36					
37					**COMPETENT BEDROCK:**competent bedrock
38					
39					
40					
41					
42					
43					
44					
45					Bottom of boring at 45 feet below ground surface
46					
47					
48					
49					
50					
51					
52					
53					
54					
55					

WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS

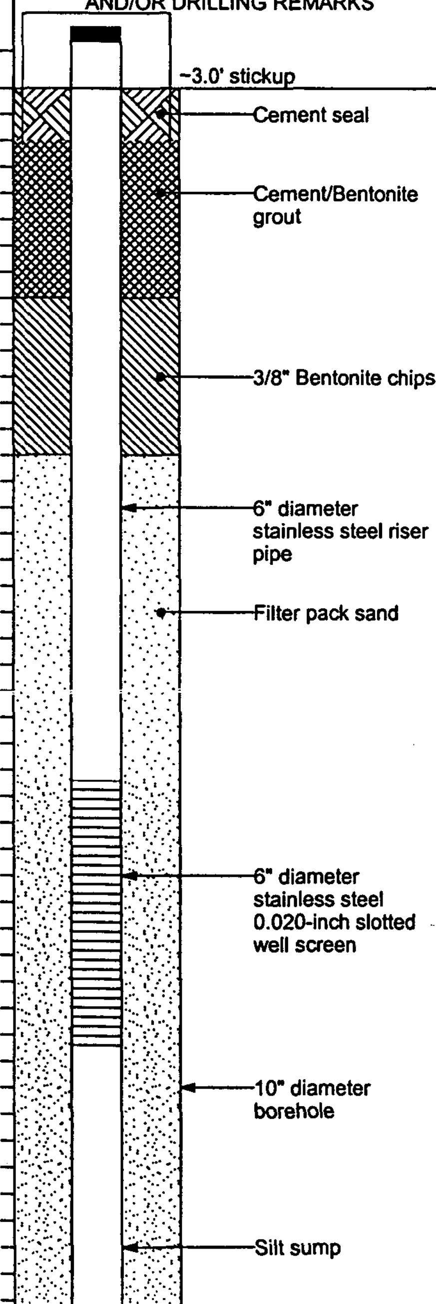


Log of Well No. PW-2

PROJECT: Urbana Landfill, Hammondsport, New York	
BORING LOCATION: West of landfill (central location)	TOP OF RISER ELEVATION: ~1459.0 fmsl / DATUM:
DRILLING CONTRACTOR: Nothnagle Drilling	DATE STARTED: 4/15/99 / DATE FINISHED: 4/16/99
DRILLING METHOD: HSA (6 1/4" ID) and Air rotary (10" OD roller bit)	TOTAL DEPTH: 23.2 fbgs / SCREEN INTERVAL: 13.2-18.2 fbgs
DRILLING EQUIPMENT: Guspech 750 (ATV rig)	DEPTH TO WATER: FIRST 8 fbgs, COMPL. -- / CASING: 6" Stainless steel
SAMPLING METHOD: Drill cuttings	LOGGED BY: BCH
HAMMER WEIGHT: -- / DROP: --	RESPONSIBLE PROFESSIONAL: Richard H. Frappa / REG. NO.

DEPTH (feet)	SAMPLES: Sample No.	Sample	Blows/ foot	OVM (ppm)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight, plast., structure, cementation, react. w/HCl, geo. inter. — Surface Elevation: ~1456 fmsl
0–2					**SILT with SAND (ML):** dark brown, moist, 80% fines, 15% coarse grave, 5% fine sand, medium plasticity, soft, [TILL]
2				0	increase gravel and cobble fraction to 25% (2-7 fbgs)
7				0	decrease gravel and cobble fraction to 10%
16				0	
17					**WEATHERED BEDROCK:** dark blue/gray, weathered shale, dry
18					**COMPETENT BEDROCK:** dark blue/gray, competent shale, dry to moist
23.2					Bottom of boring at 23.2 feet below ground surface

WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS



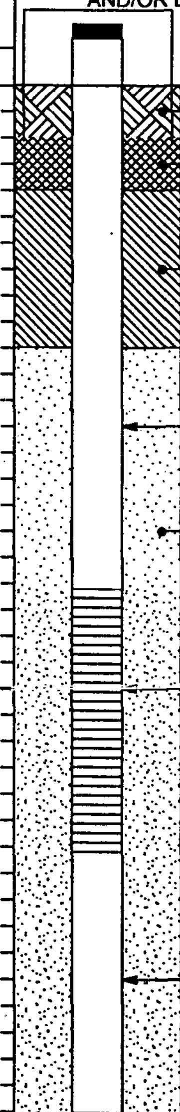
WELL_OVM PW1-3.GPJ (3/00)

Log of Well No. PW-3

PROJECT: Urbana Landfill, Hammondsport, New York	Log of Well No. PW-3
BORING LOCATION: West of landfill (farthest north)	TOP OF RISER ELEVATION: ~1464.4 fmsl; DATUM:
DRILLING CONTRACTOR: Nothnagle Drilling	DATE STARTED: 4/15/99; DATE FINISHED: 4/15/99
DRILLING METHOD: HSA (6 1/4" ID) and Air rotary (10" OD roller bit)	TOTAL DEPTH: 19.6 fbgs; SCREEN INTERVAL: 9.6-14.6 fbgs
DRILLING EQUIPMENT: Guspech 750 (ATV rig)	DEPTH TO WATER: FIRST 5 fbgs; COMPL. --; CASING: 6" Stainless steel
SAMPLING METHOD: Drill cuttings	LOGGED BY: BCH
HAMMER WEIGHT: -- ; DROP: --	RESPONSIBLE PROFESSIONAL: Richard H. Frappa; REG. NO.

DEPTH (feet)	SAMPLES: Sample No.	Sample	Blows/foot	OVM (ppm)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight, plast., structure, cementation, react. w/HCl, geo. inter. — Surface Elevation: ~1462 fmsl
0–8				0 (at 5), 0 (at 8)	**SILT with SAND (ML):** dark brown, moist, 70% fines, 5% fine sand, 15% coarse gravel (subrounded to subangular), trace waste material, medium plasticity, [TILL]
8–14.6				0 (at 13), 0 (at 14.6)	**WEATHERED BEDROCK:** dark blue/gray, weathered shale, dry
14.6–19.6					**COMPETENT BEDROCK:** dark blue/gray, competent shale, dry to moist
19.6					Bottom of boring at 19.6 feet below ground surface

WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS



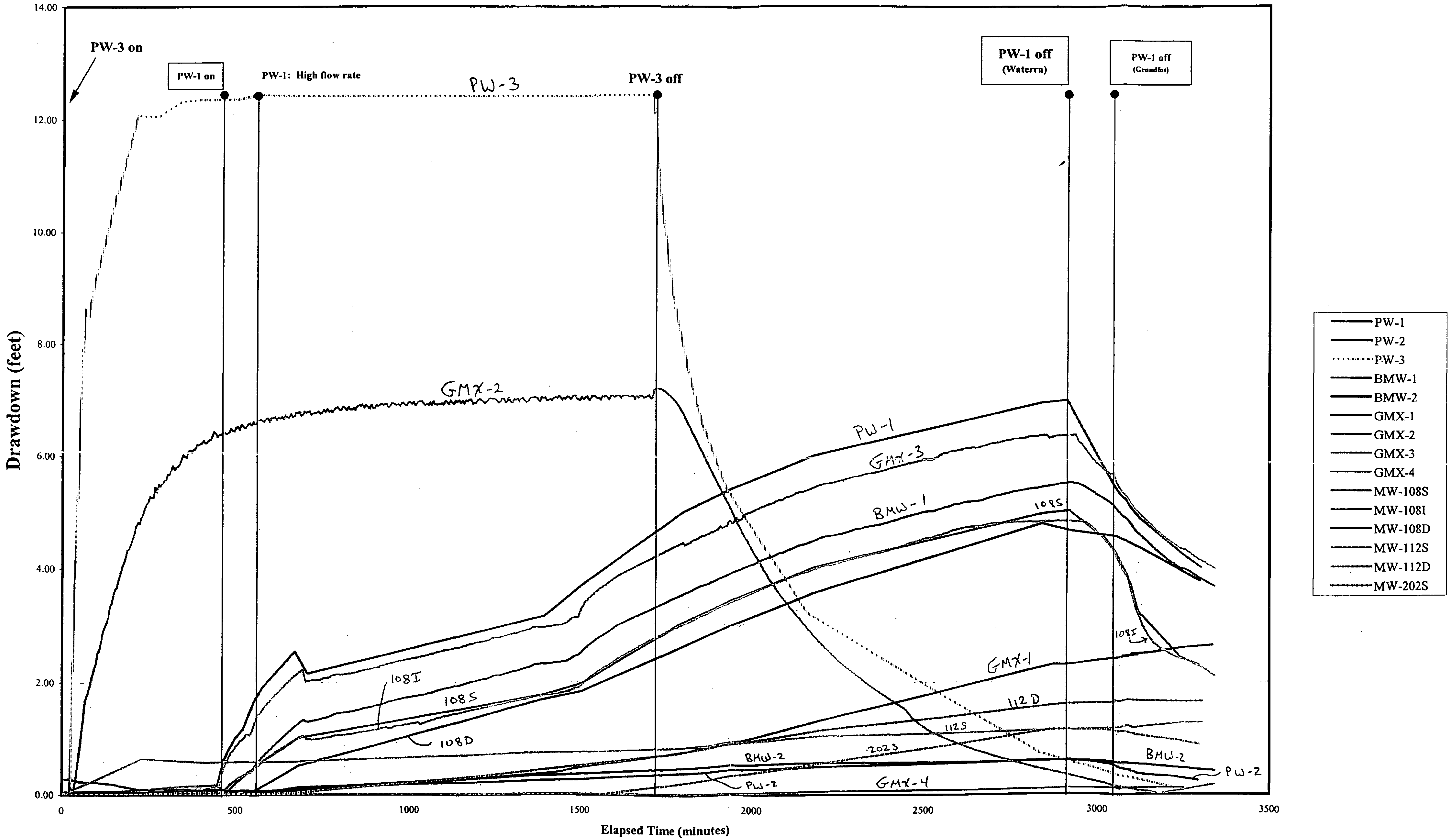
WELL_OVM PW1-3.GPJ (3/00)

ATTACHMENT 2

PW-1 Data

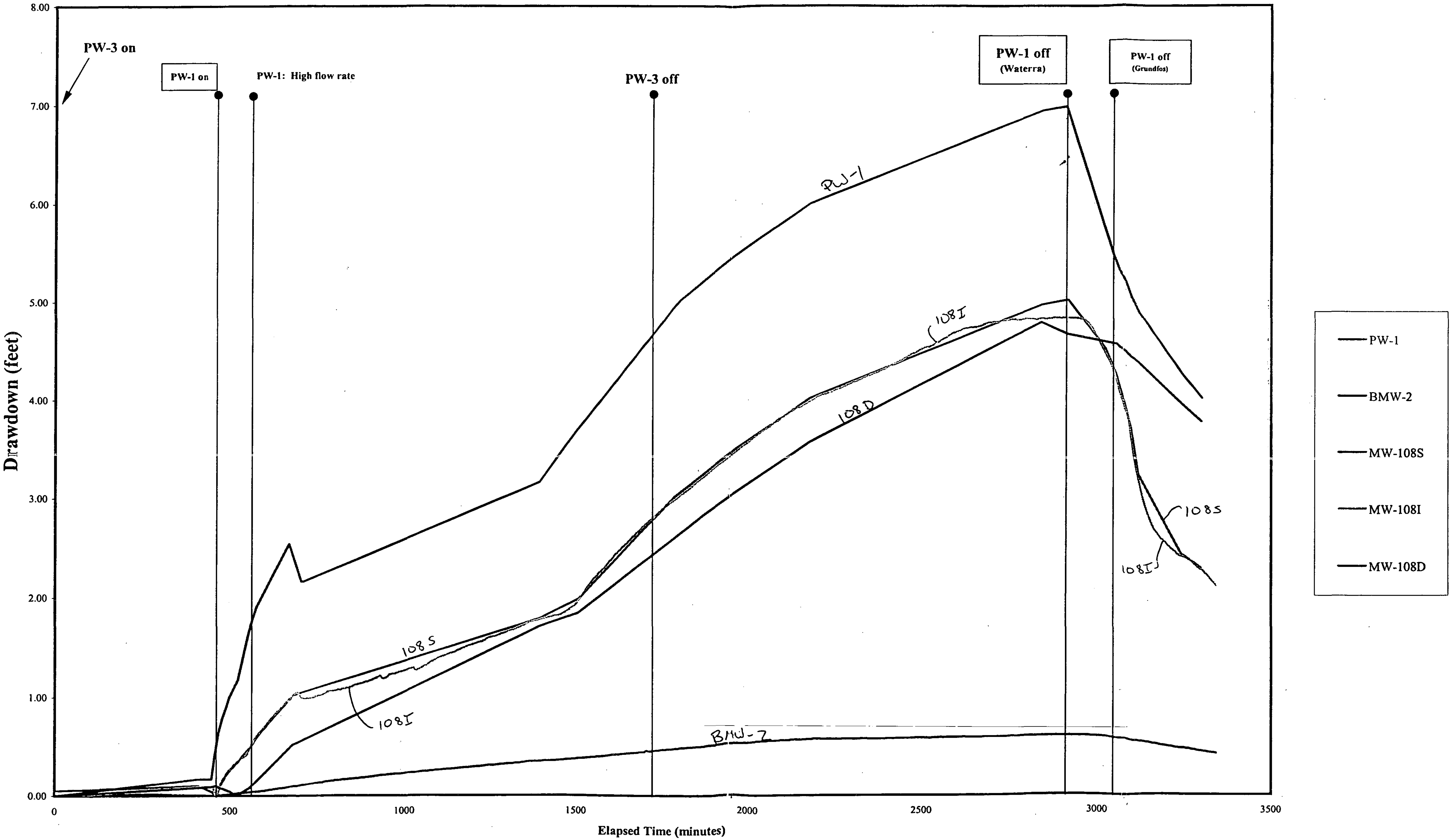
PW-1
HYDRAULIC TESTING
PW-1 AND PW-3

SUMMARY OF DRAWDOWN RESULTS



PW-1
PUMPING TEST

SUMMARY OF PUMPING AND OBSERVATION WELL DRAWDOWN



PW-1 PUMP TEST
PUMPING WELL DRAWDOWN

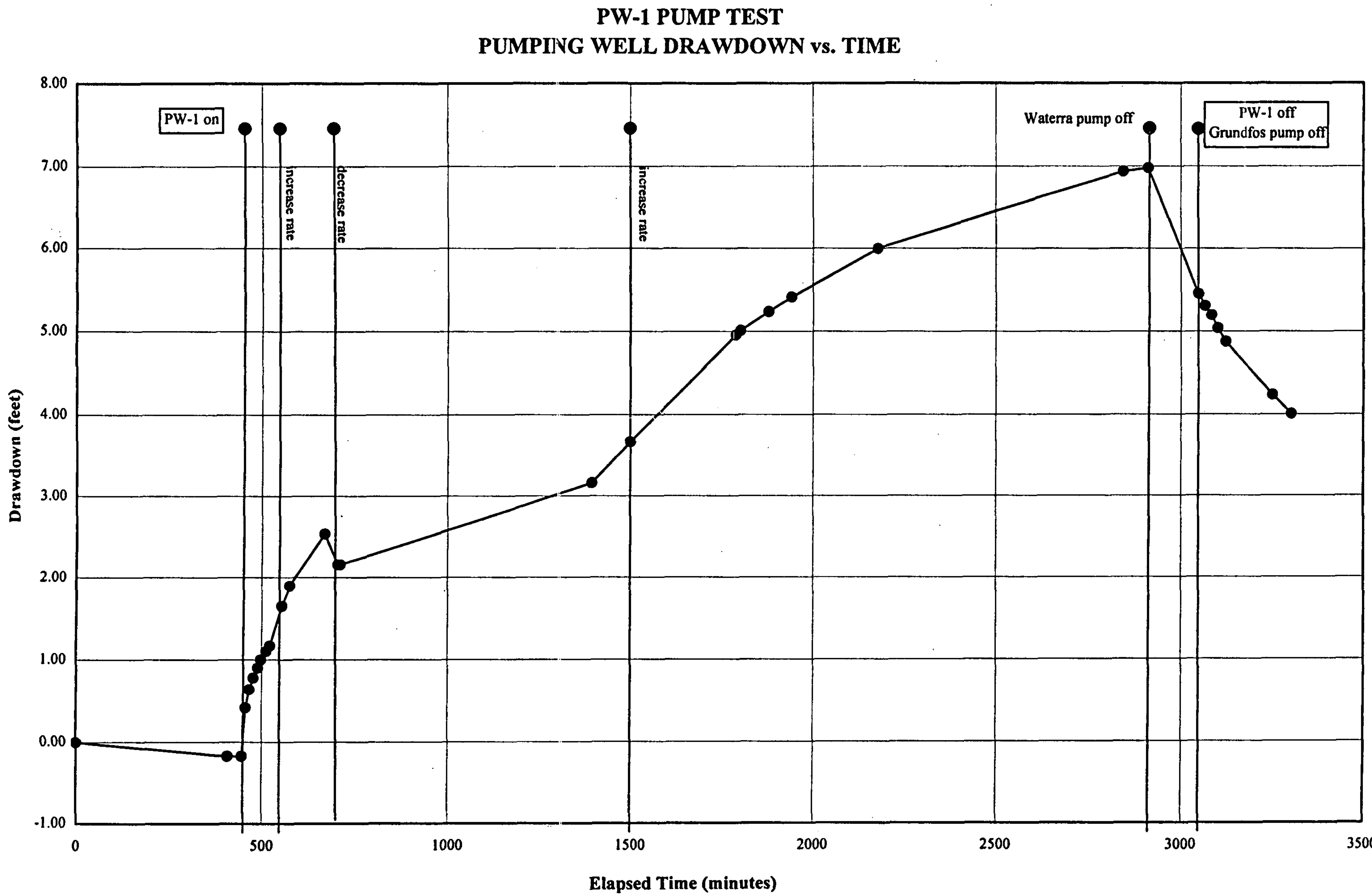
Total Depth = 49.88 TOR
Static Water Level= 17.84 TOR

Time	Depth	Elapsed time		drawdown	Feet H2O
04/21/99 08:34	17.84	0		0.00	32.04
04/21/99 09:08	17.84	0	ZERO TIME	0.00	32.04
04/21/99 15:57	17.67	409		-0.17	32.21
04/21/99 16:35	17.67	447	started pump test at 16:35 p.m.	-0.17	32.21
04/21/99 16:45	18.26	457		0.42	31.62
04/21/99 16:55	18.48	467		0.64	31.40
04/21/99 17:05	18.62	477		0.78	31.26
04/21/99 17:17	18.74	489		0.90	31.14
04/21/99 17:26	18.84	498		1.00	31.04
04/21/99 17:40	18.94	512		1.10	30.94
04/21/99 17:50	19.01	522		1.17	30.87
04/21/99 18:21	19.50	553	turned Grundfos pump on at 18:13 p.m.	1.66	30.38
04/21/99 18:43	19.74	575		1.90	30.14
04/21/99 20:16	20.38	668	turned Grundfos pump off at 20:39 p.m.	2.54	29.50
04/21/99 20:52	20.00	704		2.16	29.88
04/21/99 20:58	20.00	710	*end of day 1*	2.16	29.88
04/22/99 08:22	21.00	1394		3.16	28.88
04/22/99 10:07	21.51	1499	turned Grundfos pump on at 10:00 a.m.	3.67	28.37
04/22/99 14:57	22.80	1789		4.96	27.08
04/22/99 15:09	22.85	1801		5.01	27.03
04/22/99 16:26	23.08	1878		5.24	26.80
04/22/99 17:29	23.26	1941		5.42	26.62
04/22/99 21:26	23.84	2178	*end of day 2*	6.00	26.04
04/23/99 08:33	24.78	2845		6.94	25.10
04/23/99 09:40	24.82	2912		6.98	25.06
04/23/99 11:55	23.30	3047	- turned off PW-1 Waterra pump at ~10:00 a.m. sometime between 10:00 and 11:30 a.m., the poly tubing on Waterra pump snapped in two - turned Grundfos pump off at 11:54 a.m.	5.46	26.58

PW-1 PUMP TEST
PUMPING WELL DRAWDOWN

Time	Depth	Elapsed time		drawdown	Feet H2O
04/23/99 12:12	23.15	3064		5.31	26.73
04/23/99 12:30	23.04	3082		5.20	26.84
04/23/99 12:47	22.88	3099		5.04	27.00
04/23/99 13:09	22.72	3121		4.88	27.16
04/23/99 15:16	22.08	3248		4.24	27.80
04/23/99 16:08	21.85	3300	*end of day 3*	4.01	28.03

PW-1



PW-1 PUMP TEST
PUMPING WELL DRAWDOWN vs. TIME
PW-1 on
increase rate
decrease rate
increase rate
Waterra pump off
PW-1 off
Grundfos pump off
Drawdown (feet)
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
-1.00
0
500
1000
1500
2000
2500
3000
3500
Elapsed Time (minutes)

GMX-1

PW-1 PUMP TEST
OBSERVATION WELL DRAWDOWN

Total Depth =	19.92	TOR
Static Water Level=	13.20	TOR

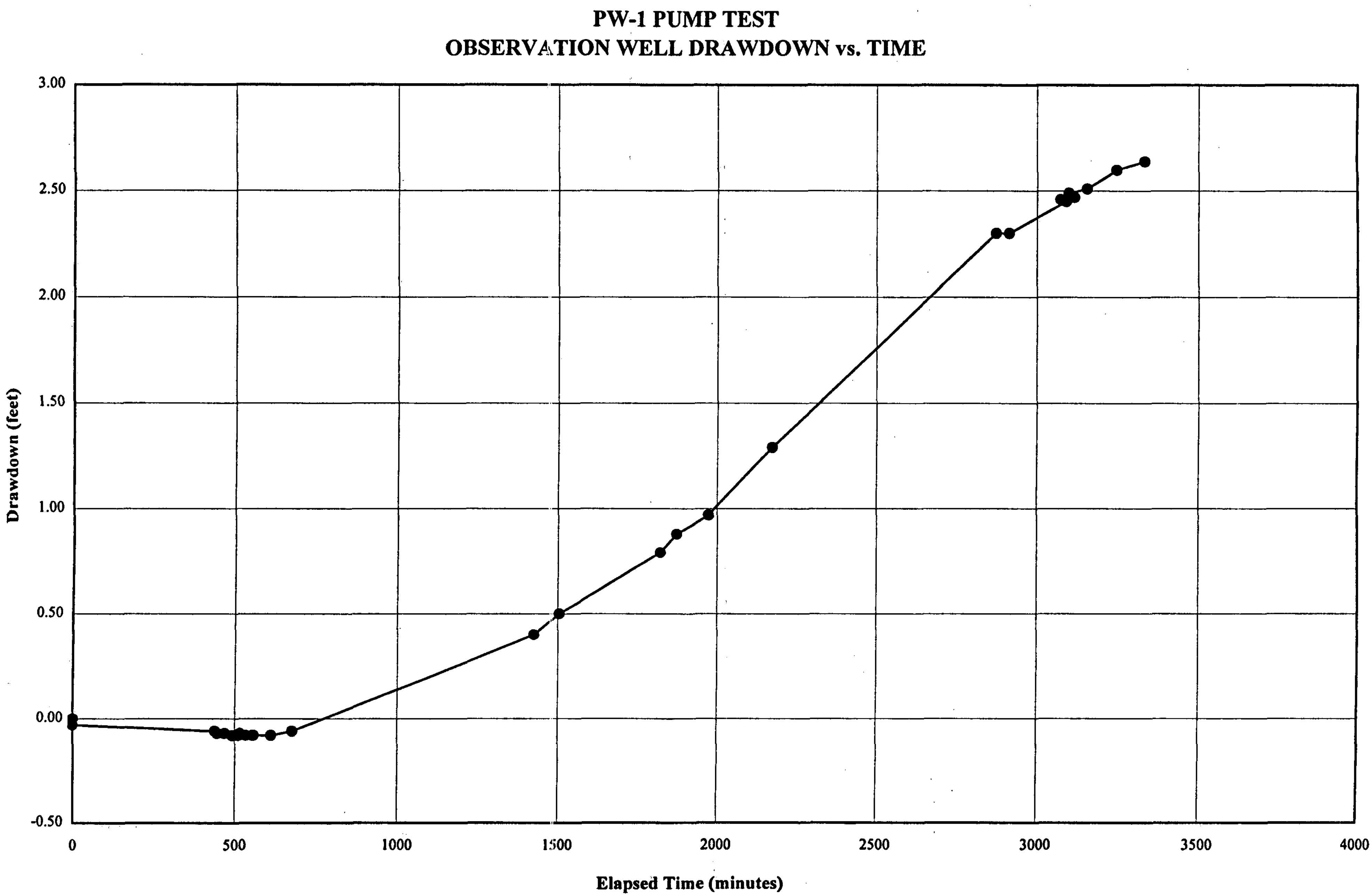
Time	Depth	Elapsed time		drawdown	Feet H2O
04/21/99 08:33	13.20	0		0.00	6.72
04/21/99 09:08	**13.17**	**0**	ZERO TIME	-0.03	6.75
04/21/99 15:52	13.14	439		-0.06	6.78
04/21/99 16:35	**13.13**	**447**	started pump test at 16:35 p.m.	-0.07	6.79
04/21/99 16:48	13.12	495		-0.08	6.8
04/21/99 16:58	13.13	470		-0.07	6.79
04/21/99 17:08	13.13	515		-0.07	6.79
04/21/99 17:20	13.12	492		-0.08	6.8
04/21/99 17:28	13.12	535		-0.08	6.8
04/21/99 17:41	13.12	513		-0.08	6.8
04/21/99 17:51	13.12	558		-0.08	6.8
04/21/99 18:23	13.12	555	turned Grundfos pump on at 18:13 p.m.	-0.08	6.8
04/21/99 18:45	13.12	612	turned Grundfos pump off at 20:39 p.m.	-0.08	6.8
04/21/99 20:25	13.14	677	*end of day 1*	-0.06	6.78
04/22/99 08:18	13.60	1425		0.40	6.32
04/22/99 10:13	13.70	1505	turned Grundfos pump on at 10:00 a.m.	0.50	6.22
04/22/99 14:54	13.99	1821		0.79	5.93
04/22/99 16:20	14.08	1872		0.88	5.84
04/22/99 17:26	14.17	1973		0.97	5.75
04/22/99 21:21	14.49	2173	*end of day 2*	1.29	5.43
04/23/99 08:26	15.50	2873		2.30	4.42
04/23/99 09:42	15.50	2914		2.30	4.42
04/23/99 12:04	15.65	3091	- turned off PW-1 Waterra pump at ~10:00 a.m. sometime between 10:00 and 11:30 a.m., the poly tubing on Waterra pump snapped in two - turned Grundfos pump off at 11:54 a.m.	2.45	4.27
04/23/99 12:21	15.66	3073		2.46	4.26
04/23/99 12:29	15.67	3116		2.47	4.25
04/23/99 12:46	15.69	3098		2.49	4.23
04/23/99 13:08	15.71	3155		2.51	4.21

GMX-1

PW-1 PUMP TEST
OBSERVATION WELL DRAWDOWN

Time	Depth	Elapsed time		drawdown	Feet H2O
04/23/99 15:15	15.80	3247		2.60	4.12
04/23/99 16:07	15.84	3334	*end of day 3*	2.64	4.08

GMX-1



PW-1 PUMP TEST
OBSERVATION WELL DRAWDOWN vs. TIME
3.00
2.50
2.00
1.50
1.00
0.50
0.00
-0.50
Drawdown (feet)
0
500
1000
1500
2000
2500
3000
3500
4000
Elapsed Time (minutes)

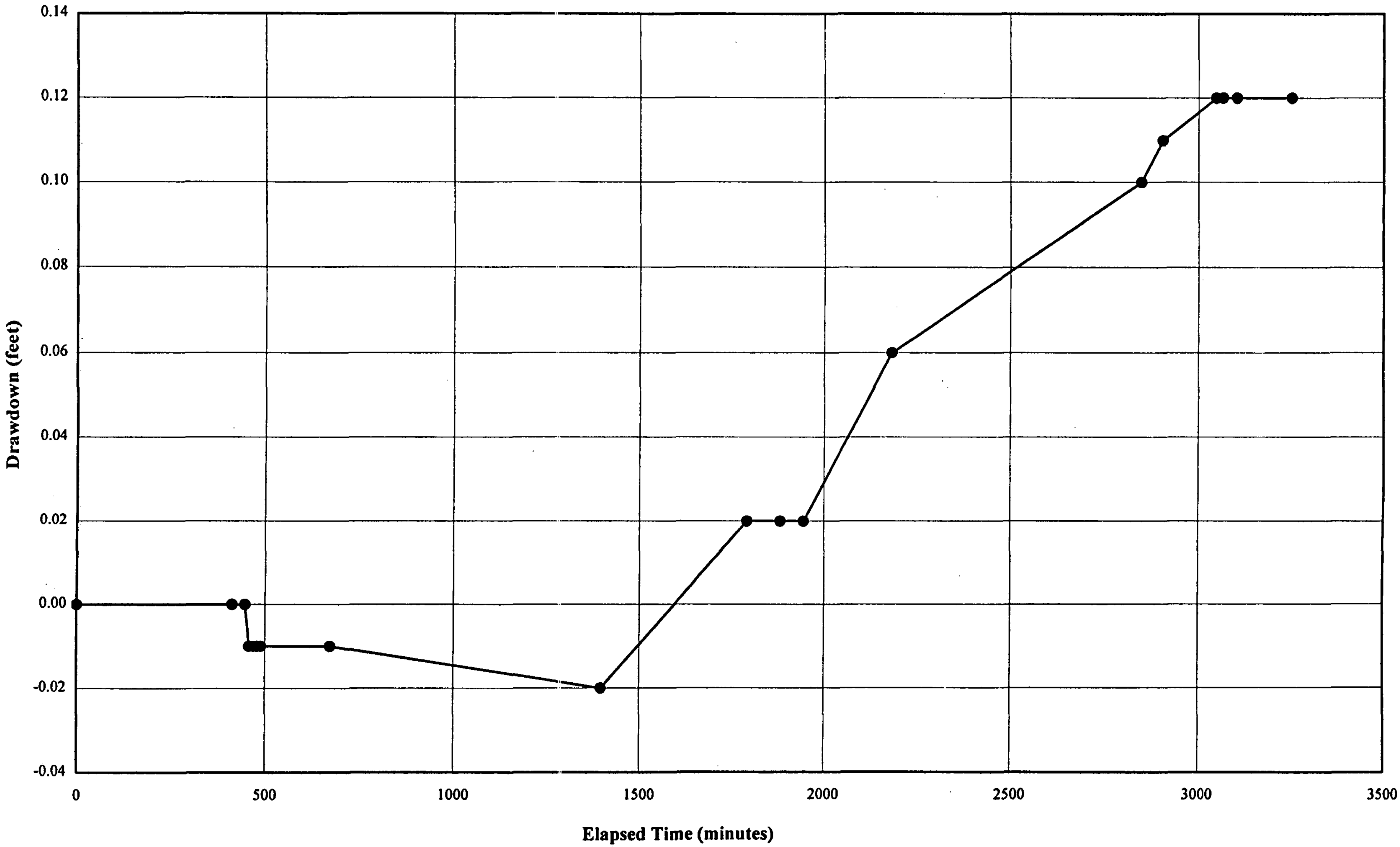
PW-1 PUMP TEST
OBSERVATION WELL DRAWDOWN

Total Depth = 29.50 TOR
Static Water Level= 25.62 TOR

Time	Depth	Elapsed time		change	Feet H2O
04/21/99 08:57	25.62	0		0.00	3.88
04/21/99 09:08	25.62	0	ZERO TIME	0.00	3.88
04/21/99 16:01	25.62	413		0.00	3.88
04/21/99 16:35	25.62	447	started pump test at 16:35 p.m.	0.00	3.88
04/21/99 16:46	25.61	458		-0.01	3.89
04/21/99 16:57	25.61	469		-0.01	3.89
04/21/99 17:07	25.61	479	turned Grundfos pump on at 18:13 p.m.	-0.01	3.89
04/21/99 17:17	25.61	489	turned Grundfos pump off at 20:39 p.m.	-0.01	3.89
04/21/99 20:20	25.61	672	*end of day 1*	-0.01	3.89
04/22/99 08:25	25.60	1397		-0.02	3.9
04/22/99 15:00	25.64	1792	turned Grundfos pump on at 10:00 a.m.	0.02	3.86
04/22/99 16:30	25.64	1882		0.02	3.86
04/22/99 17:33	25.64	1945		0.02	3.86
04/22/99 21:30	25.68	2182	*end of day 2*	0.06	3.82
04/23/99 08:37	25.72	2849		0.10	3.78
04/23/99 09:34	25.73	2906		0.11	3.77
04/23/99 11:57	25.74	3049	- turned off PW-1 Waterra pump at ~10:00 a.m. sometime between 10:00 and 11:30 a.m., the poly tubing on Waterra pump snapped in two - turned Grundfos pump off at 11:54 a.m.	0.12	3.76
04/23/99 12:15	25.74	3067		0.12	3.76
04/23/99 12:52	25.74	3104		0.12	3.76
04/23/99 15:19	25.74	3251	*end of day 3*	0.12	3.76

GMX-4

PW-1 PUMP TEST
OBSERVATION WELL DRAWDOWN vs. TIME



PW-2

PW-1 PUMP TEST
OBSERVATION WELL DRAWDOWN

Total Depth = 26.24 TOR
Static Water Level= 8.39 TOR

Time	Depth	Elapsed time	Comment	drawdown	Feet H2O
04/21/99 08:43	8.39	0		0.00	17.85
04/21/99 09:08	**8.39**	**0**	**ZERO TIME**	0.00	17.85
04/21/99 09:30	**8.38**	**22**	**PW-3: started pump test at 09:30 a.m.**	-0.01	17.86
04/21/99 09:47	8.36	39		-0.03	17.88
04/21/99 09:54	8.34	46		-0.05	17.90
04/21/99 10:04	8.34	56		-0.05	17.90
04/21/99 10:14	8.33	66		-0.06	17.91
04/21/99 10:25	8.33	77		-0.06	17.91
04/21/99 10:35	8.33	87		-0.06	17.91
04/21/99 10:44	8.33	96		-0.06	17.91
04/21/99 11:45	8.28	157		-0.11	17.96
04/21/99 12:44	8.20	216		-0.19	18.04
04/21/99 13:44	8.18	276		-0.21	18.06
04/21/99 14:44	8.15	336		-0.24	18.09
04/21/99 15:44	8.12	396		-0.27	18.12
04/21/99 16:35	**8.10**	**447**	**PW-1: started pump test at 16:35 p.m.**	-0.29	18.14
04/21/99 16:53	8.10	465		-0.29	18.14
04/21/99 17:02	8.10	474		-0.29	18.14
04/21/99 17:12	8.10	484		-0.29	18.14
04/21/99 17:24	8.10	496		-0.29	18.14
04/21/99 17:32	8.10	504		-0.29	18.14
04/21/99 17:45	8.11	517		-0.28	18.13
04/21/99 17:56	8.12	528		-0.27	18.12
04/21/99 18:28	8.14	560	**PW-1: turned Grundfos pump on at 18:13 p.m.**	-0.25	18.10
04/21/99 18:50	8.15	582	**PW-1: turned Grundfos pump off at 20:39 p.m.**	-0.24	18.09
04/21/99 20:32	8.24	684	***end of day 1***	-0.15	18.00
04/22/99 08:15	8.36	1387		-0.03	17.88
04/22/99 10:18	8.38	1510	**PW-1: turned Grundfos pump on at 10:00 a.m.**	-0.01	17.86

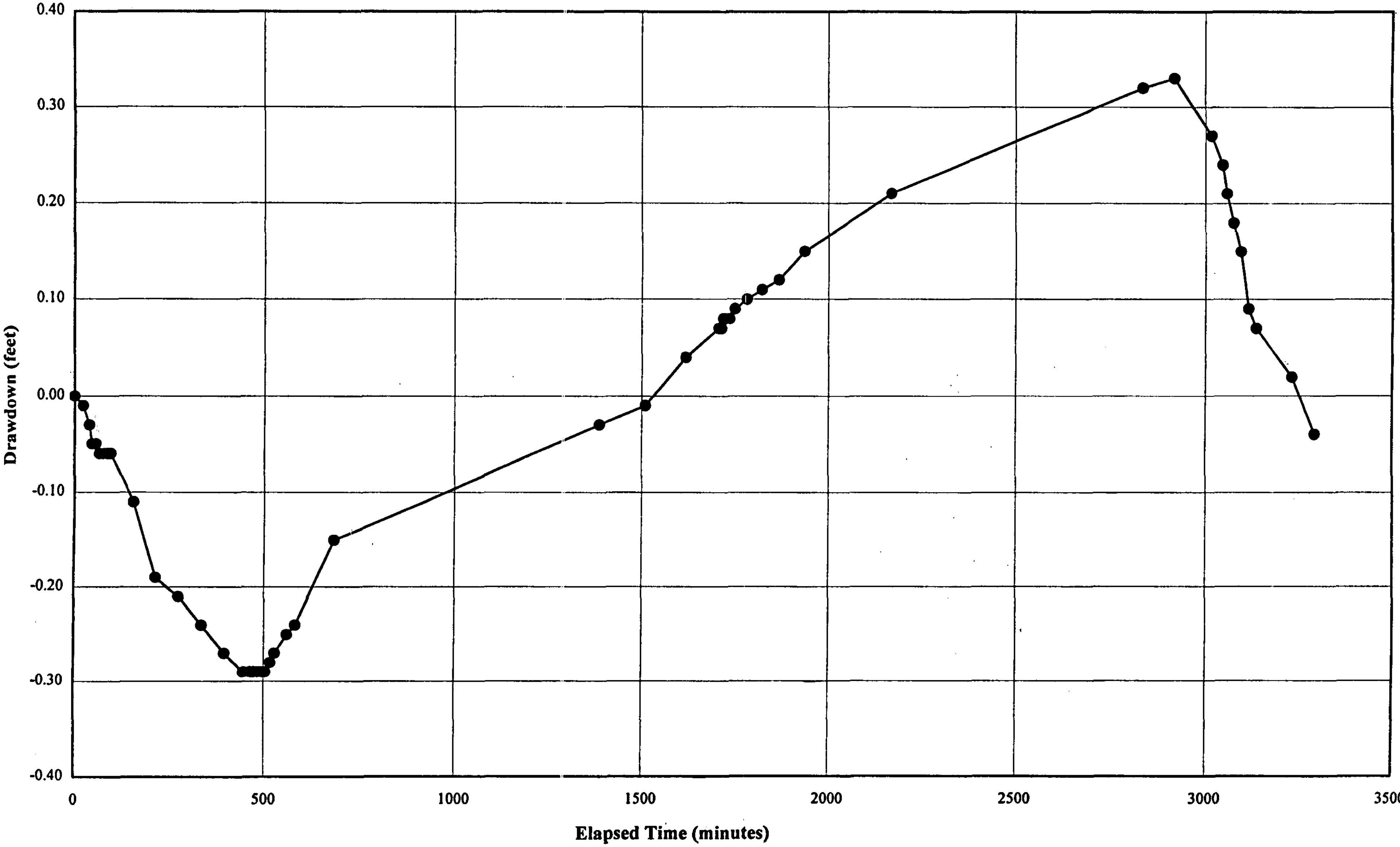
PW-2

PW-1 PUMP TEST
OBSERVATION WELL DRAWDOWN

Time	Depth	Elapsed time	Comment	drawdown	Feet H2O
04/22/99 12:06	8.43	1618		0.04	17.81
04/22/99 13:35	8.46	1707		0.07	17.78
04/22/99 13:40	**8.46**	**1712**	**PW-3: turned off pump at 13:40 p.m.**	0.07	17.78
04/22/99 13:42	8.46	1714		0.07	17.78
04/22/99 13:47	8.47	1719		0.08	17.77
04/22/99 13:51	8.47	1723		0.08	17.77
04/22/99 14:04	8.47	1736		0.08	17.77
04/22/99 14:18	8.48	1750		0.09	17.76
04/22/99 14:50	8.49	1782		0.10	17.75
04/22/99 15:30	8.50	1822		0.11	17.74
04/22/99 16:15	8.51	1867		0.12	17.73
04/22/99 17:24	8.54	1936		0.15	17.70
04/22/99 21:17	8.60	2169	*end of day 2*	0.21	17.64
04/23/99 08:24	8.71	2836		0.32	17.53
04/23/99 09:47	8.72	2919		0.33	17.52
04/23/99 11:24	8.66	3016		0.27	17.58
04/23/99 11:54	**8.63**	**3046**	**- turned off PW-1 Waterra pump at ~10:00 a.m. - turned Grundfos pump off at 11:54 a.m.**	0.24	17.61
04/23/99 12:05	8.60	3057		0.21	17.64
04/23/99 12:23	8.57	3075		0.18	17.67
04/23/99 12:41	8.54	3093		0.15	17.70
04/23/99 13:02	8.48	3114		0.09	17.76
04/23/99 13:22	8.46	3134		0.07	17.78
04/23/99 14:58	8.41	3230		0.02	17.83
04/23/99 15:59	8.35	3291	*end of day 3*	-0.04	17.89

PW-2

PW-1 PUMP TEST
OBSERVATION WELL DRAWDOWN vs. TIME



MW-108S

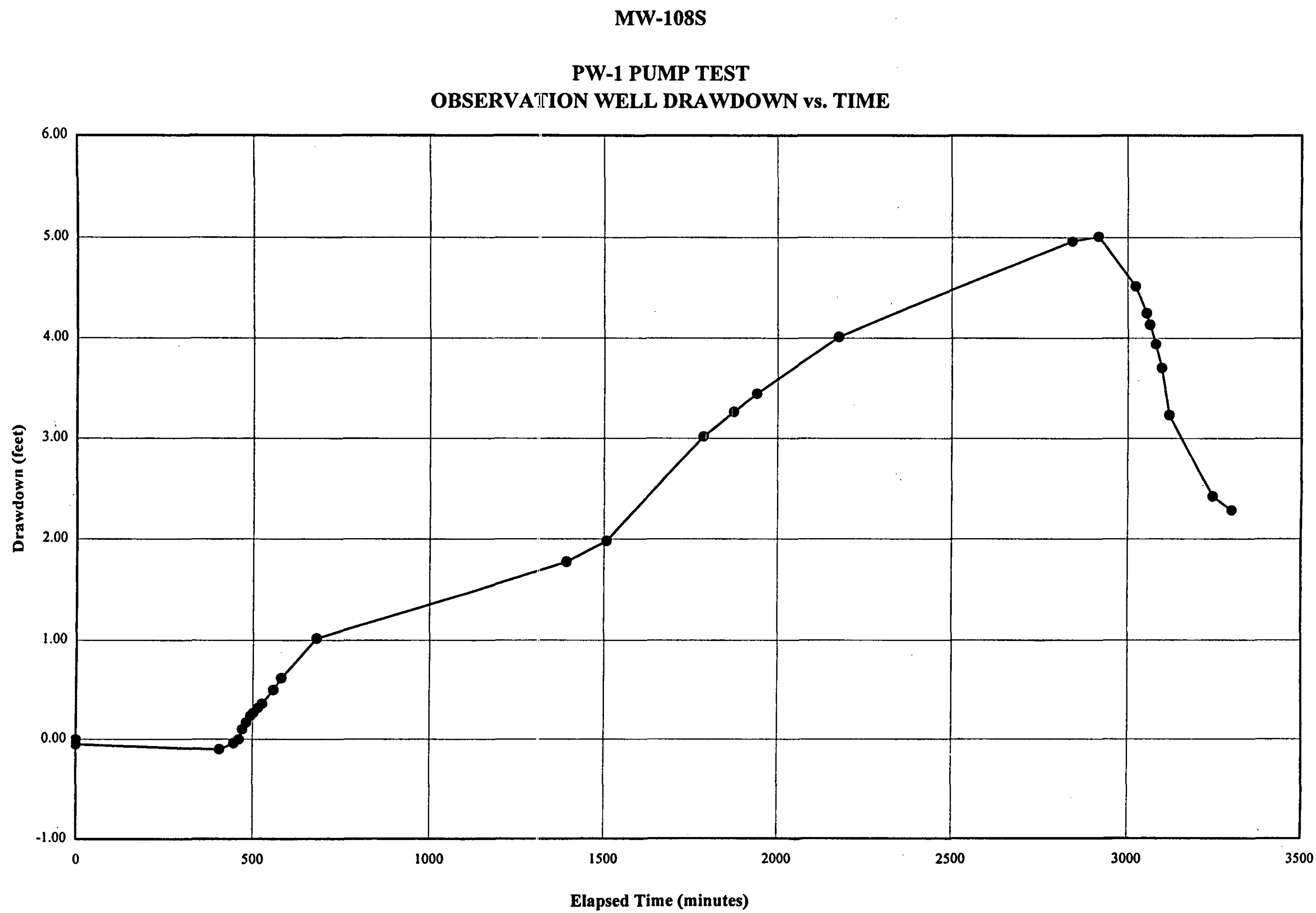
PW-1 PUMP TEST
OBSERVATION WELL DRAWDOWN

Total Depth =	18.58	TOR
Static Water Level=	6.86	TOR

Time	Depth	Elapsed time		drawdown	Feet H2O
04/21/99 08:39	6.86	0		0.00	11.72
04/21/99 09:08	**6.81**	**0**	**ZERO TIME**	-0.05	11.77
04/21/99 15:55	6.76	407		-0.10	11.82
04/21/99 16:35	**6.82**	**447**	**started pump test at 16:35 p.m.**	-0.04	11.76
04/21/99 16:50	6.86	462		0.00	11.72
04/21/99 16:59	6.96	471		0.10	11.62
04/21/99 17:10	7.03	482		0.17	11.55
04/21/99 17:22	7.10	494		0.24	11.48
04/21/99 17:30	7.13	502		0.27	11.45
04/21/99 17:43	7.18	515		0.32	11.4
04/21/99 17:54	7.22	526		0.36	11.36
04/21/99 18:26	7.36	558	**turned Grundfos pump on at 18:13 p.m.**	0.50	11.22
04/21/99 18:48	7.48	580	**turned Grundfos pump off at 20:39 p.m.**	0.62	11.1
04/21/99 20:27	7.88	679	***end of day 1***	1.02	10.7
04/22/99 08:20	8.64	1392		1.78	9.94
04/22/99 10:15	8.84	1507	**turned Grundfos pump on at 10:00 a.m.**	1.98	9.74
04/22/99 14:55	9.88	1787		3.02	8.7
04/22/99 16:22	10.12	1874		3.26	8.46
04/22/99 17:28	10.30	1940		3.44	8.28
04/22/99 21:24	10.87	2176	***end of day 2***	4.01	7.71
04/23/99 08:31	11.82	2843		4.96	6.76
04/23/99 09:45	11.87	2917		5.01	6.71
04/23/99 11:31	11.37	3023	**- turned off PW-1 Waterra pump at ~10:00 a.m. sometime between 10:00 and 11:30 a.m., the poly tubing on Waterra pump snapped in two - turned Grundfos pump off at 11:54 a.m.**	4.51	7.21
04/23/99 12:02	11.10	3054		4.24	7.48
04/23/99 12:11	10.99	3063		4.13	7.59
04/23/99 12:27	10.80	3079		3.94	7.78

PW-1 PUMP TEST
OBSERVATION WELL DRAWDOWN

Time	Depth	Elapsed time		drawdown	Feet H2O
04/23/99 12:44	10.56	3096		3.70	8.02
04/23/99 13:06	10.09	3118		3.23	8.49
04/23/99 15:10	9.28	3242		2.42	9.3
04/23/99 16:05	9.14	3297	*end of day 3*	2.28	9.44



MW-108S
PW-1 PUMP TEST
OBSERVATION WELL DRAWDOWN vs. TIME
Drawdown (feet)
6.00
5.00
4.00
3.00
2.00
1.00
0.00
-1.00
0
500
1000
1500
2000
2500
3000
3500
Elapsed Time (minutes)

MW-108D

PW-1 PUMP TEST
OBSERVATION WELL DRAWDOWN

Total Depth =	42.63	TOR
Static Water Level=	8.34	TOR

Time	Depth	Elapsed time		drawdown	Feet H2O
04/21/99 08:34	8.34	0		0.00	34.29
04/21/99 09:08	**8.34**	**0**	ZERO TIME	0.00	34.29
04/21/99 15:53	8.26	405		-0.08	34.37
04/21/99 16:35	**8.25**	**447**	started pump test at 16:35 p.m.	-0.09	34.38
04/21/99 16:49	8.24	461		-0.10	34.39
04/21/99 16:58	8.26	470		-0.08	34.37
04/21/99 17:08	8.27	480		-0.07	34.36
04/21/99 17:21	8.29	493		-0.05	34.34
04/21/99 17:29	8.30	501		-0.04	34.33
04/21/99 17:42	8.33	514		-0.01	34.3
04/21/99 17:52	8.35	524		0.01	34.28
04/21/99 18:24	8.42	556	turned Grundfos pump on at 18:13 p.m.	0.08	34.21
04/21/99 18:46	8.50	578	turned Grundfos pump off at 20:39 p.m.	0.16	34.13
04/21/99 20:26	8.86	678	*end of day 1*	0.52	33.77
04/22/99 08:19	10.04	1391		1.70	32.59
04/22/99 10:14	10.18	1506	turned Grundfos pump on at 10:00 a.m.	1.84	32.45
04/22/99 14:54	10.94	1786		2.60	31.69
04/22/99 16:21	11.18	1873		2.84	31.45
04/22/99 17:27	11.34	1939		3.00	31.29
04/22/99 21:22	11.90	2174	*end of day 2*	3.56	30.73
04/23/99 08:28	13.12	2840		4.78	29.51
04/23/99 09:43	13.00	2915		4.66	29.63
04/23/99 12:03	12.90	3055	- turned off PW-1 Waterra pump at ~10:00 a.m. sometime between 10:00 and 11:30 a.m., the poly tubing on Waterra pump snapped in two - turned Grundfos pump off at 11:54 a.m.	4.56	29.73
04/23/99 12:12	12.87	3064		4.53	29.76
04/23/99 12:28	12.83	3080		4.49	29.8
04/23/99 12:45	12.77	3097		4.43	29.86
04/23/99 13:07	12.71	3119		4.37	29.92

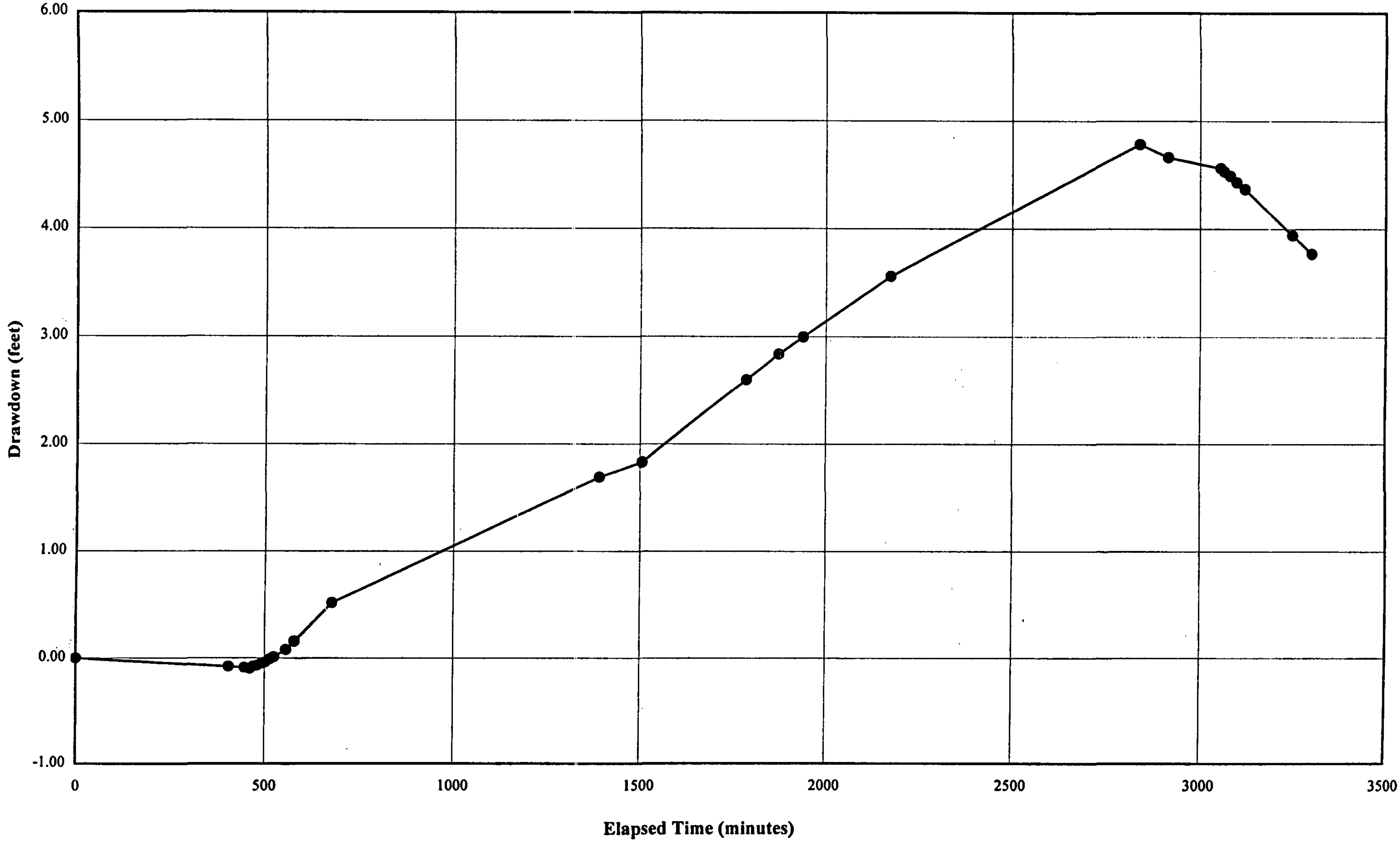
MW-108D

PW-1 PUMP TEST
OBSERVATION WELL DRAWDOWN

Time	Depth	Elapsed time		drawdown	Feet H2O
04/23/99 15:14	12.28	3246		3.94	30.35
04/23/99 16:06	12.11	3298	*end of day 3*	3.77	30.52

MW-108D

PW-1 PUMP TEST
OBSERVATION WELL DRAWDOWN vs. TIME



MW-112S

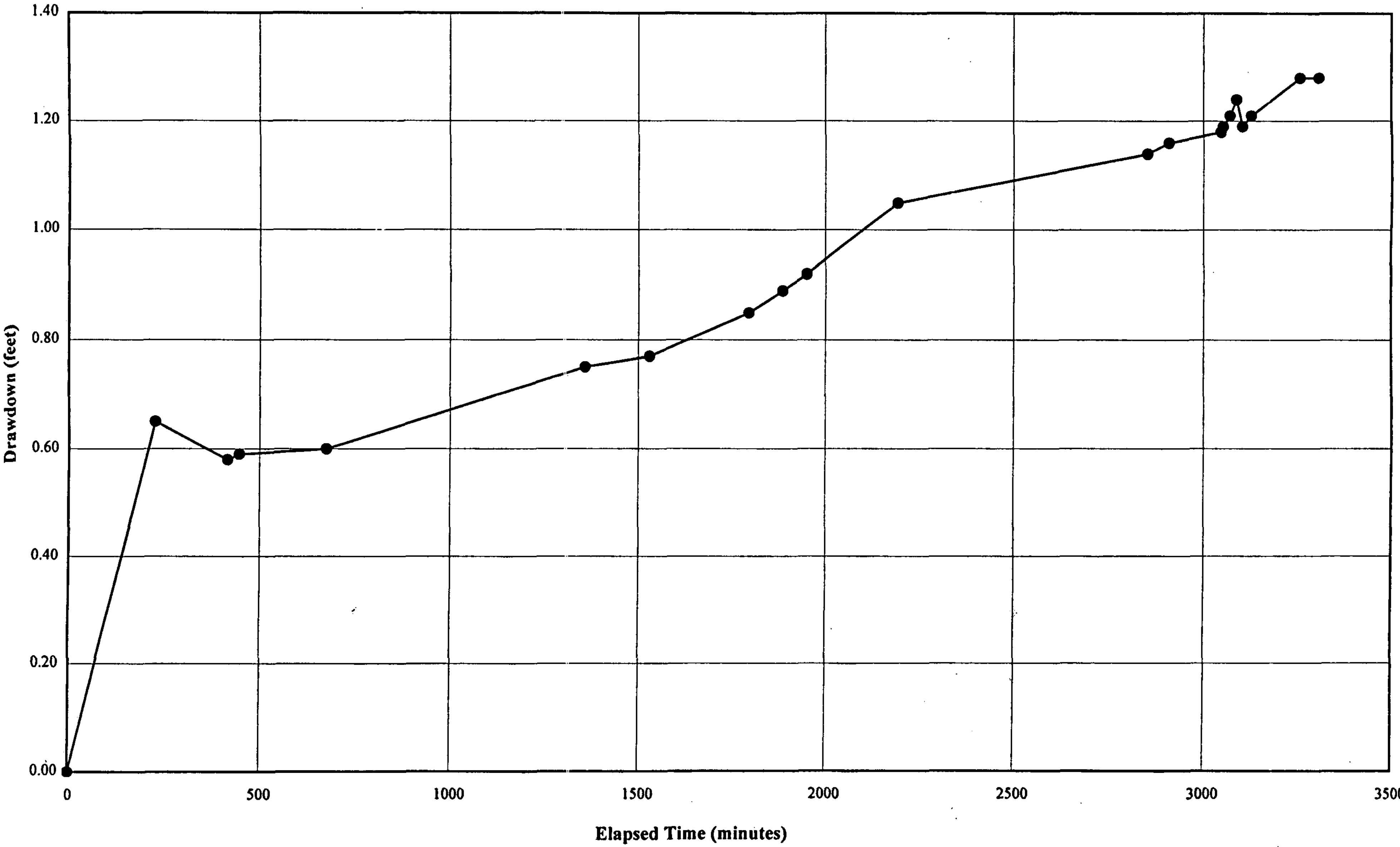
PW-1 PUMP TEST
OBSERVATION WELL DRAWDOWN

Total Depth =	**32.56**	**TOR**
Static Water Level=	**21.27**	**TOR**

Time	Depth	Elapsed time		drawdown	Feet H2O
04/21/99 08:15	21.27	0		0.00	11.29
04/21/99 09:08	**21.27**	**0**	**ZERO TIME**	0.00	11.29
04/21/99 12:55	21.92	227		0.65	10.64
04/21/99 16:05	21.85	417		0.58	10.71
04/21/99 16:35	**21.86**	**447**	**started pump test at 16:35 p.m.**	0.59	10.70
			turned Grundfos pump on at 18:13 p.m.		
04/21/99 20:23	21.87	675	**turned Grundfos pump off at 20:39 p.m.**	0.60	10.69
			end of day 1		
04/22/99 07:46	22.02	1358		0.75	10.54
04/22/99 10:38	22.04	1530	**turned Grundfos pump on at 10:00 a.m.**	0.77	10.52
04/22/99 15:03	22.12	1795		0.85	10.44
04/22/99 16:33	22.16	1885		0.89	10.40
04/22/99 17:38	22.19	1950		0.92	10.37
04/22/99 21:41	22.32	2193	*end of day 2*	1.05	10.24
04/23/99 08:41	22.41	2853		1.14	10.15
04/23/99 09:37	22.43	2909		1.16	10.13
04/23/99 11:54	**22.45**	3046	**- turned off PW-1 Waterra pump at ~10:00 a.m. sometime between 10:00 and 11:30 a.m., the poly tubing on Waterra pump snapped in two - turned Grundfos pump off at 11:54 a.m.**	1.18	10.11
04/23/99 12:00	22.46	3052		1.19	10.10
04/23/99 12:18	22.48	3070		1.21	10.08
04/23/99 12:35	22.51	3087		1.24	10.05
04/23/99 12:51	22.46	3103		1.19	10.10
04/23/99 13:14	22.48	3126		1.21	10.08
04/23/99 15:23	22.55	3255		1.28	10.01
04/23/99 16:13	22.55	3305	*end of day 3*	1.28	10.01

MW-112S

PW-1 PUMP TEST
OBSERVATION WELL DRAWDOWN vs. TIME



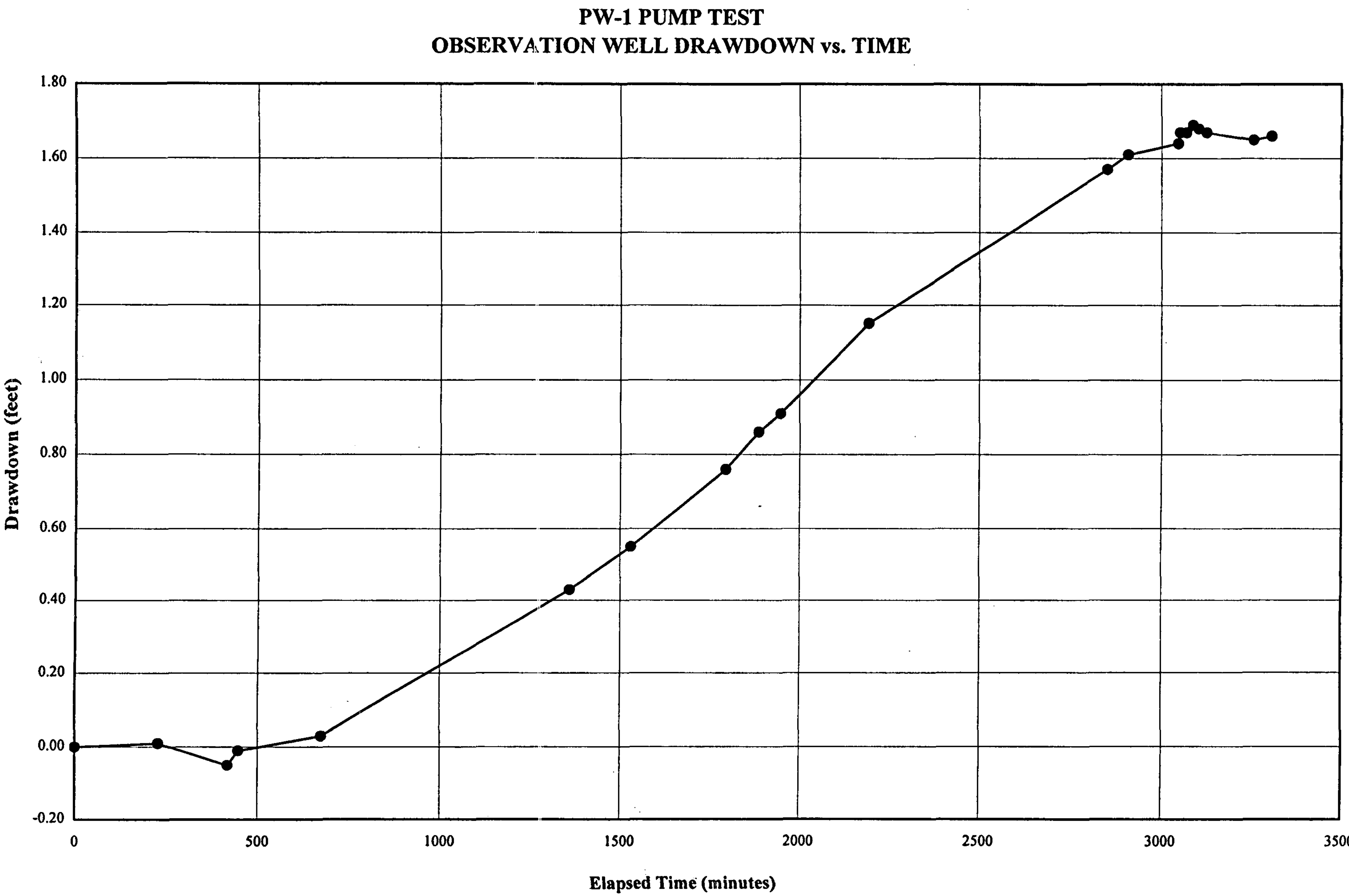
MW-112D

PW-1 PUMP TEST
OBSERVATION WELL DRAWDOWN

Total Depth =	**53.76**	**TOR**
Static Water Level=	**31.25**	**TOR**

Time	Depth	Elapsed time		drawdown	Feet H2O
04/21/99 08:16	31.25	0		0.00	22.51
04/21/99 09:08	**31.25**	**0**	**ZERO TIME**	0.00	22.51
04/21/99 12:56	31.26	228		0.01	22.50
04/21/99 16:06	31.20	418		-0.05	22.56
04/21/99 16:35	**31.24**	**447**	**started pump test at 16:35 p.m.**	-0.01	22.52
			turned Grundfos pump on at 18:13 p.m.		
04/21/99 20:22	31.28	674	**turned Grundfos pump off at 20:39 p.m.**	0.03	22.48
			end of day 1		
04/22/99 07:47	31.68	1359		0.43	22.08
04/22/99 10:38	31.80	1530	**turned Grundfos pump on at 10:00 a.m.**	0.55	21.96
04/22/99 15:02	32.01	1794		0.76	21.75
04/22/99 16:34	32.11	1886		0.86	21.65
04/22/99 17:36	32.16	1948		0.91	21.60
04/22/99 21:40	32.40	2192	***end of day 2***	1.15	21.36
04/23/99 08:40	32.82	2852		1.57	20.94
04/23/99 09:37	32.86	2909		1.61	20.90
04/23/99 11:54	**32.89**	**3046**	**- turned off PW-1 Waterra pump at ~10:00 a.m.** **sometime between 10:00 and 11:30 a.m., the poly tubing on Waterra pump snapped in two** **- turned Grundfos pump off at 11:54 a.m.**	1.64	20.87
04/23/99 11:59	32.92	3051		1.67	20.84
04/23/99 12:17	32.92	3069		1.67	20.84
04/23/99 12:34	32.94	3086		1.69	20.82
04/23/99 12:50	32.93	3102		1.68	20.83
04/23/99 13:12	32.92	3124		1.67	20.84
04/23/99 15:22	32.90	3254		1.65	20.86
04/23/99 16:12	32.91	3304	***end of day 3***	1.66	20.85

MW-112D


PW-1 PUMP TEST
OBSERVATION WELL DRAWDOWN vs. TIME
Drawdown (feet)
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
-0.20
0
500
1000
1500
2000
2500
3000
3500
Elapsed Time (minutes)

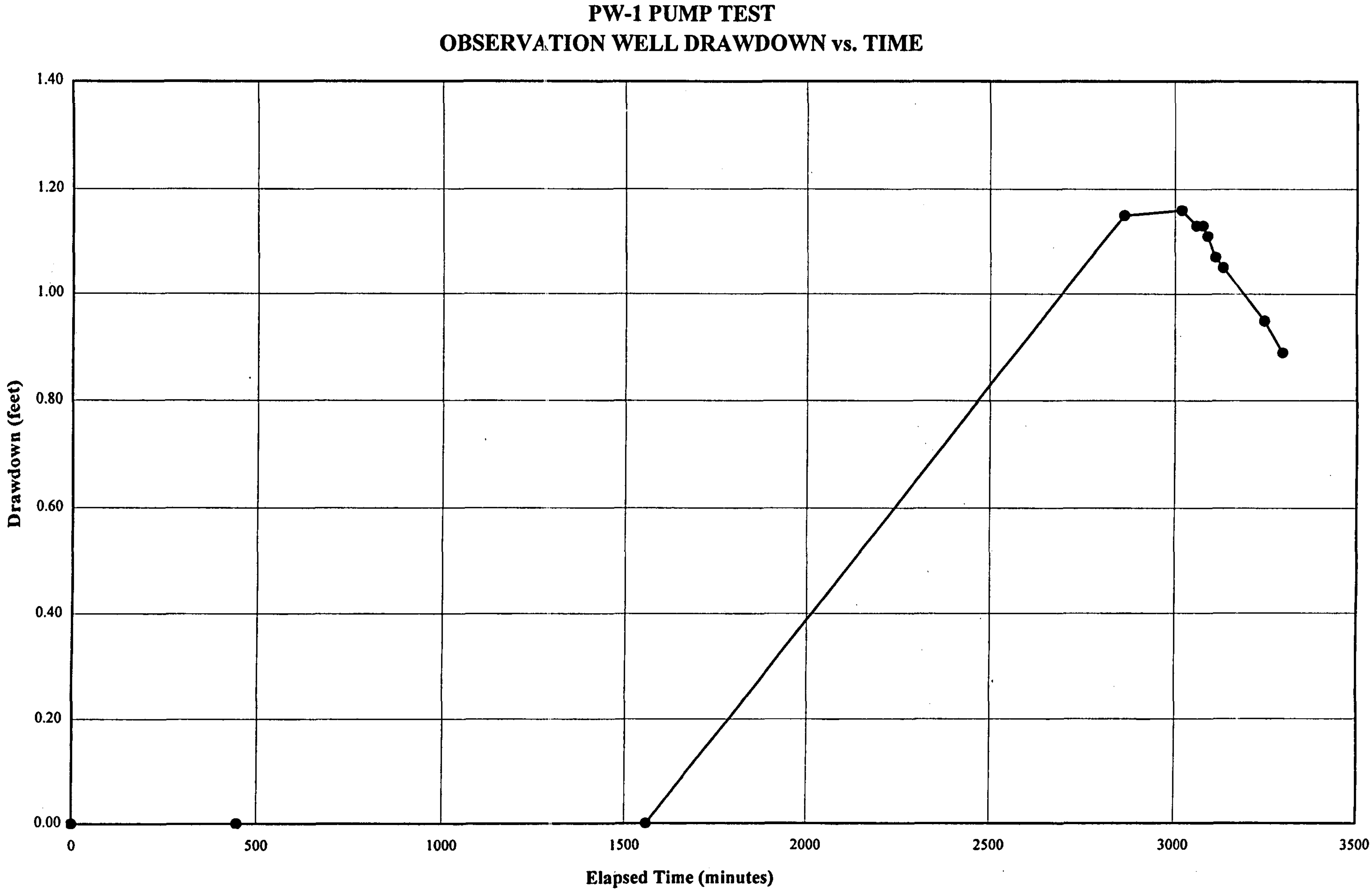
MW-202S

PW-1 PUMP TEST
OBSERVATION WELL DRAWDOWN

Total Depth =	25.03	TOR
Static Water Level=	11.33	TOR

Time	Depth	Elapsed time		drawdown	Feet H2O
04/21/99 09:08	11.33	0	ZERO TIME	0.00	13.70
04/21/99 16:35	11.33	447	started pump test at 16:35 p.m. turned Grundfos pump on at 18:13 p.m. turned Grundfos pump off at 20:39 p.m. *end of day 1*	0.00	13.7
04/22/99 11:08	11.33	1560	turned Grundfos pump on at 10:00 a.m. *end of day 2*	0.00	13.7
04/23/99 08:52	12.48	2864		1.15	12.55
04/23/99 11:28	12.49	3020		1.16	12.54
04/23/99 12:08	12.46	3060	- turned off PW-1 Waterra pump at ~10:00 a.m. sometime between 10:00 and 11:30 a.m., the poly tubing on Waterra pump snapped in two - turned Grundfos pump off at 11:54 a.m.	1.13	12.57
04/23/99 12:25	12.46	3077		1.13	12.57
04/23/99 12:38	12.44	3090		1.11	12.59
04/23/99 12:58	12.40	3110		1.07	12.63
04/23/99 13:19	12.38	3131		1.05	12.65
04/23/99 15:12	12.28	3244		0.95	12.75
04/23/99 16:02	12.22	3294	*end of day 3*	0.89	12.81

MW-202S



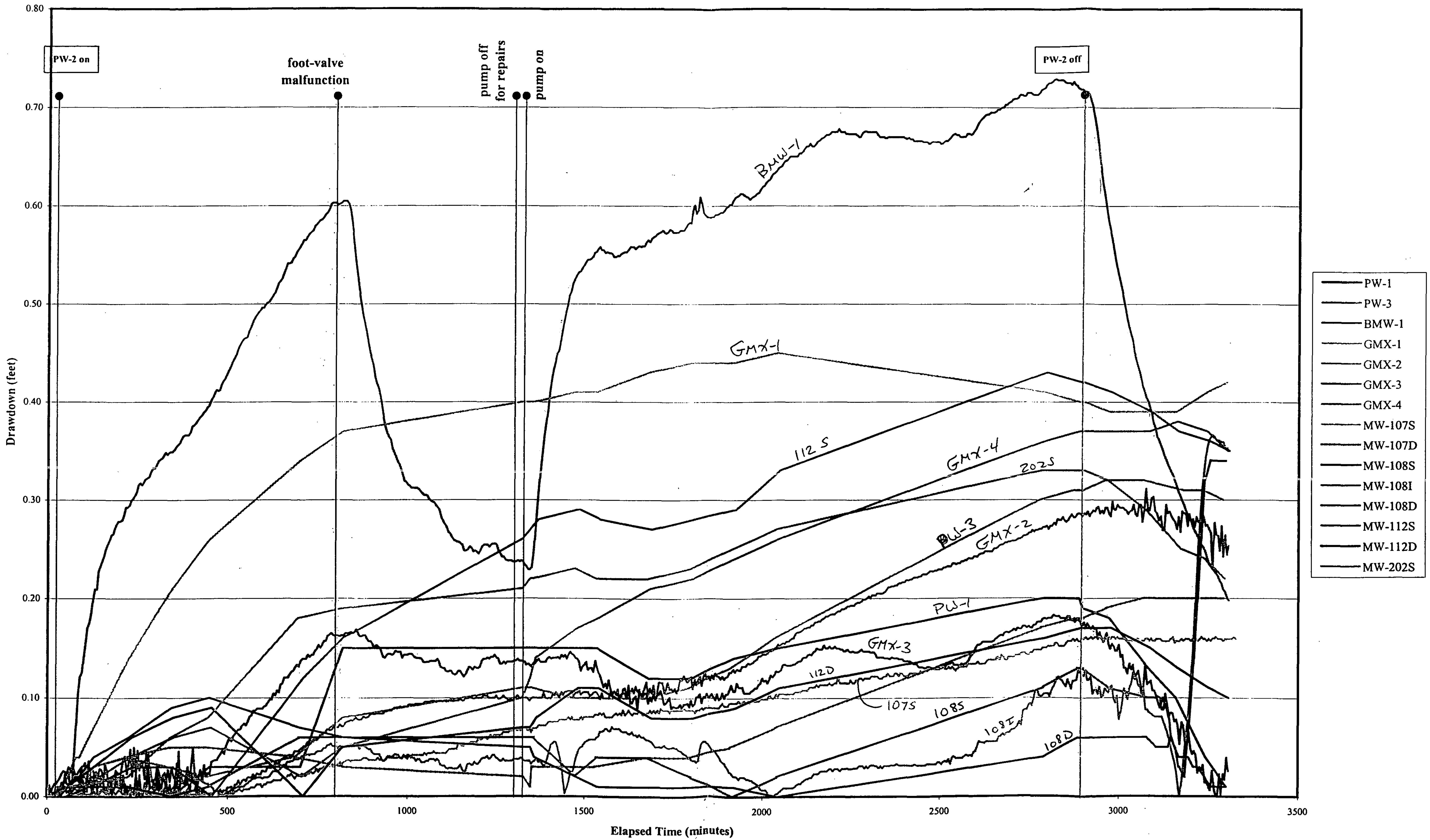
PW-1 PUMP TEST
OBSERVATION WELL DRAWDOWN vs. TIME
Drawdown (feet)
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
0
500
1000
1500
2000
2500
3000
3500
Elapsed Time (minutes)

ATTACHMENT 3

PW-2 Data

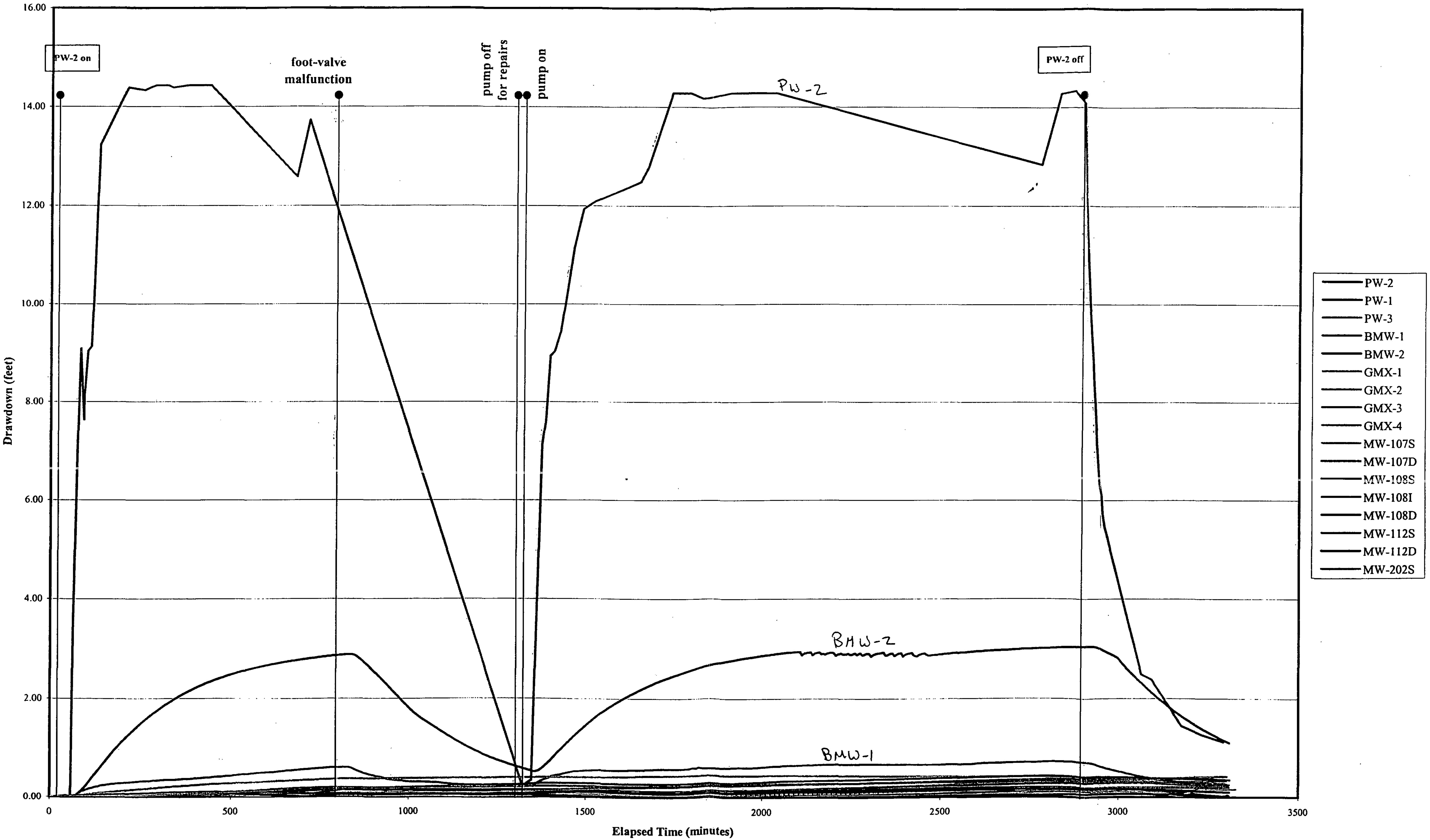
PW-2

SUMMARY OF PUMP TEST RESULTS



PW-2

SUMMARY OF PUMP TEST RESULTS



PUMPING WELL DRAWDOWN

Total Depth (feet) =	26.24	TOR
Static Water Level=	7.22	TOR

Time	Depth	Elapsed time	Comment	change	Feet H20
04/26/99 10:12	7.22	0	ZERO TIME	0.00	19.02
04/26/99 10:22	7.22	10		0.00	19.02
04/26/99 11:09	7.22	57		0.00	19.02
04/26/99 11:10	7.22	58	PW-2: started pump test at 11:10 a.m.	0.00	19.02
04/26/99 11:14	9.60	62		2.38	16.64
04/26/99 11:15	10.25	63		3.03	15.99
04/26/99 11:16	10.85	64		3.63	15.39
04/26/99 11:18	11.50	66		4.28	14.74
04/26/99 11:21	12.50	69		5.28	13.74
04/26/99 11:25	13.68	73		6.46	12.56
04/26/99 11:26	14.15	74		6.93	12.09
04/26/99 11:35	16.30	83		9.08	9.94
04/26/99 11:44	14.85	92		7.63	11.39
04/26/99 11:45	15.30	93		8.08	10.94
04/26/99 11:55	16.25	103		9.03	9.99
04/26/99 12:05	16.35	113		9.13	9.89
04/26/99 12:15	18.10	123		10.88	8.14
04/26/99 12:27	20.45	135		13.23	5.79
04/26/99 13:44	21.60	212		14.38	4.64
04/26/99 14:28	21.55	256		14.33	4.69
04/26/99 14:44	21.60	272		14.38	4.64
04/26/99 15:00	21.65	288		14.43	4.59
04/26/99 15:32	21.65	320		14.43	4.59
04/26/99 15:45	21.60	333		14.38	4.64
04/26/99 16:30	21.65	378		14.43	4.59
04/26/99 17:04	21.65	412		14.43	4.59
04/26/99 17:30	21.65	438		14.43	4.59
04/26/99 21:29	19.80	677		12.58	6.44

PW-2

PUMPING WELL DRAWDOWN

Total Depth (feet) =	26.24	TOR
Static Water Level=	7.22	TOR

Time	Depth	Elapsed time	Comment	change	Feet H20
04/28/99 10:39	19.00	2907		11.78	7.24
04/28/99 10:40	18.70	2908		11.48	7.54
04/28/99 10:43	18.15	2911		10.93	8.09
04/28/99 10:46	17.63	2914		10.41	8.61
04/28/99 10:48	17.30	2916		10.08	8.94
04/28/99 10:50	17.06	2918		9.84	9.18
04/28/99 10:54	16.55	2922		9.33	9.69
04/28/99 10:57	16.23	2925		9.01	10.01
04/28/99 11:00	15.70	2928		8.48	10.54
04/28/99 11:04	15.15	2932		7.93	11.09
04/28/99 11:07	14.70	2935		7.48	11.54
04/28/99 11:09	14.35	2937		7.13	11.89
04/28/99 11:10	14.20	2938		6.98	12.04
04/28/99 11:16	13.55	2944		6.33	12.69
04/28/99 11:22	13.31	2950		6.09	12.93
04/28/99 11:25	12.95	2953		5.73	13.29
04/28/99 11:30	12.70	2958		5.48	13.54
04/28/99 11:56	11.96	2984		4.74	14.28
04/28/99 13:15	9.70	3063		2.48	16.54
04/28/99 13:44	9.60	3092		2.38	16.64
04/28/99 15:05	8.66	3173		1.44	17.58
04/28/99 16:00	8.48	3228		1.26	17.76
04/28/99 17:00	8.34	3288	*end of day 3*	1.12	17.90

PW-2

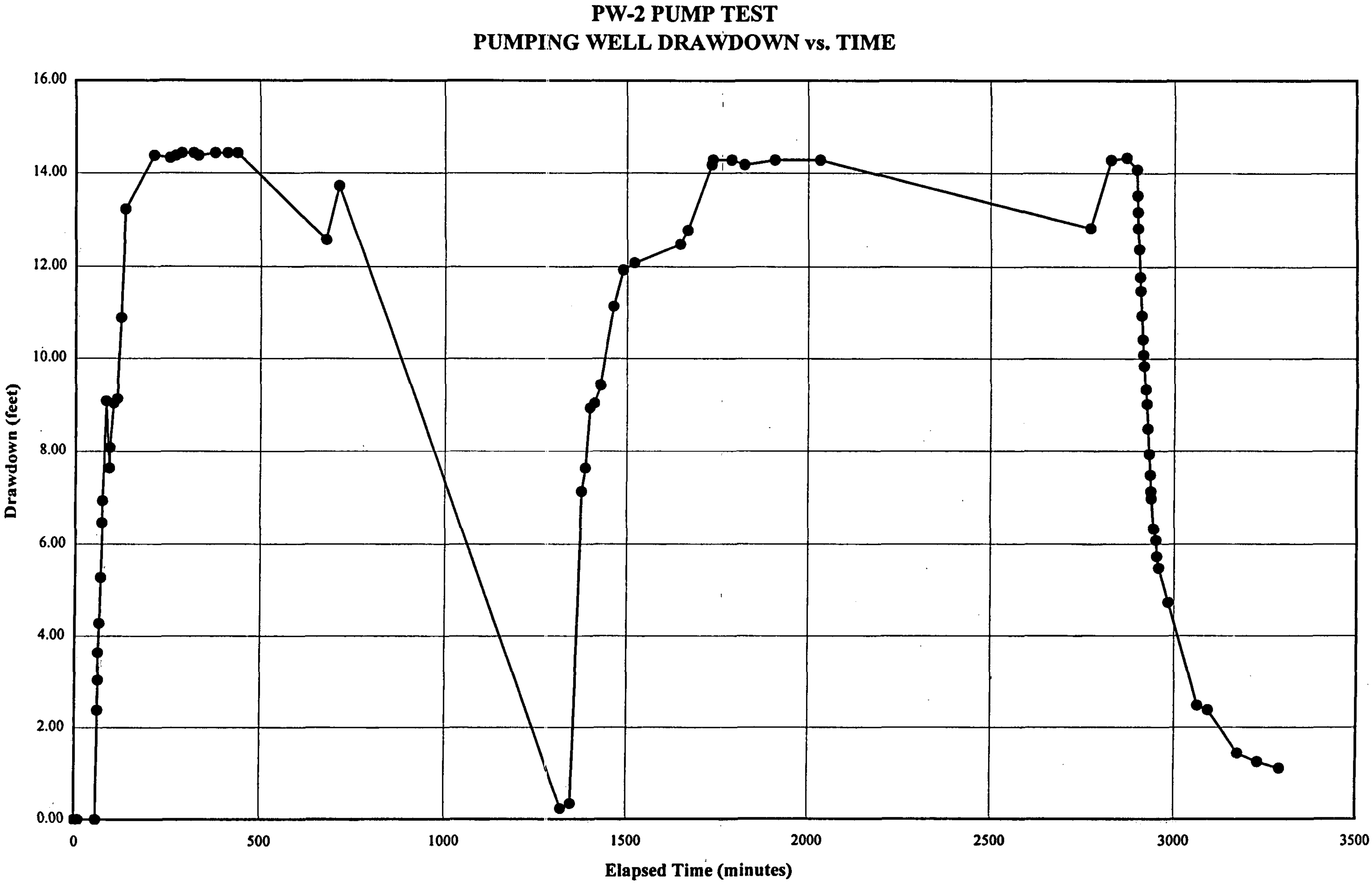
PUMPING WELL DRAWDOWN

Total Depth (feet) =	26.24	TOR
Static Water Level=	7.22	TOR

Time	Depth	Elapsed time	Comment	change	Feet H20
04/26/99 22:05	20.95	713	*end of day 1*	13.73	5.29
04/27/99 08:13	7.45	1321	foot valve worn through, water level at 7.45 at 8:00 a.m. replaced foot valve and continued pump test	0.23	18.79
04/27/99 08:39	7.56	1347		0.34	18.68
04/27/99 09:07	14.35	1375		7.13	11.89
04/27/99 09:17	14.85	1385		7.63	11.39
04/27/99 09:29	16.15	1397		8.93	10.09
04/27/99 09:41	16.25	1409		9.03	9.99
04/27/99 09:58	16.65	1426		9.43	9.59
04/27/99 10:35	18.35	1463		11.13	7.89
04/27/99 11:01	19.15	1489		11.93	7.09
04/27/99 11:32	19.30	1520		12.08	6.94
04/27/99 13:38	19.70	1646		12.48	6.54
04/27/99 14:00	20.00	1668		12.78	6.24
04/27/99 15:06	21.40	1734		14.18	4.84
04/27/99 15:09	21.50	1737		14.28	4.74
04/27/99 16:00	21.50	1788		14.28	4.74
04/27/99 16:36	21.40	1824		14.18	4.84
04/27/99 18:00	21.50	1908		14.28	4.74
04/27/99 20:04	21.50	2032	*end of day 2*	14.28	4.74
04/28/99 08:25	20.05	2773		12.83	6.19
04/28/99 09:20	21.50	2828		14.28	4.74
04/28/99 10:02	21.55	2870		14.33	4.69
04/28/99 10:30	21.30	2898	PW-2: turned pump off at 10:30 a.m.	14.08	4.94
04/28/99 10:32	20.75	2900		13.53	5.49
04/28/99 10:33	20.40	2901		13.18	5.84
04/28/99 10:34	20.05	2902		12.83	6.19
04/28/99 10:36	19.60	2904		12.38	6.64

Greatest Drawdown

PW-2



PW-2 PUMP TEST
PUMPING WELL DRAWDOWN vs. TIME
Drawdown (feet)
Elapsed Time (minutes)
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
0
500
1000
1500
2000
2500
3000
3500

GMX-1

PW-2 PUMP TEST
OBSERVATION WELL DRAWDOWN

Total Depth = 19.92 TOR
Static Water Level= 13.87 TOR

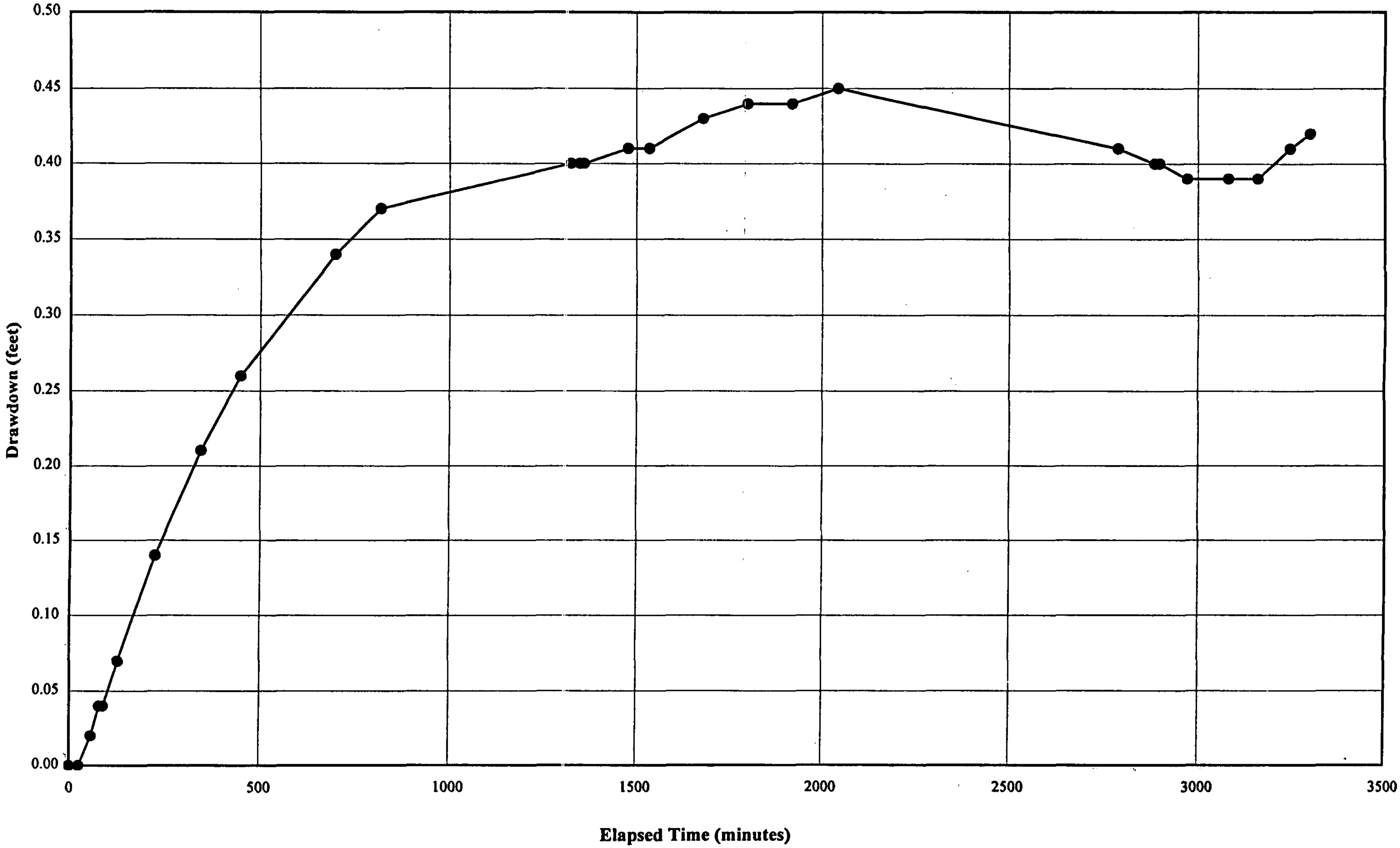
Time	Depth	Elapsed time		drawdown	Feet H2O
04/26/99 10:12	13.87	0	ZERO TIME	0.00	6.05
04/26/99 10:37	13.87	25		0.00	6.05
04/26/99 11:10	13.85	58	started pump test at 11:10 a.m.	0.02	6.07
04/26/99 11:31	13.83	79		0.04	6.09
04/26/99 11:41	13.83	89		0.04	6.09
04/26/99 12:20	13.80	128		0.07	6.12
04/26/99 13:57	13.73	225		0.14	6.19
04/26/99 15:57	13.66	345		0.21	6.26
04/26/99 17:41	13.61	449		0.26	6.31
04/26/99 21:50	13.53	698		0.34	6.39
04/26/99 23:50	13.50	818	*foot valve malfunction in pumping well; water levels recovered* *end of day 1*	0.37	6.42
04/27/99 08:16	13.47	1324	turned Waterra pump off; replaced foot valve	0.40	6.45
04/27/99 08:39	13.47	1347	turned Waterra pump on	0.40	6.45
04/27/99 08:51	13.47	1359		0.40	6.45
04/27/99 10:49	13.46	1477		0.41	6.46
04/27/99 11:46	13.46	1534		0.41	6.46
04/27/99 14:12	13.44	1680		0.43	6.48
04/27/99 16:12	13.43	1800		0.44	6.49
04/27/99 18:12	13.43	1920		0.44	6.49
04/27/99 20:15	13.42	2043	*end of day 2*	0.45	6.5
04/28/99 08:40	13.46	2788		0.41	6.46
04/28/99 10:17	13.47	2885		0.40	6.45
04/28/99 10:30	13.47	2898	turned Waterra pump off	0.40	6.45
04/28/99 11:43	13.48	2971		0.39	6.44
04/28/99 13:32	13.48	3080		0.39	6.44
04/28/99 14:50	13.48	3158		0.39	6.44
04/28/99 16:16	13.46	3244		0.41	6.46
04/28/99 17:11	13.45	3299	*end of day 3*	0.42	6.47

PW-2 PUMP TEST
OBSERVATION WELL DRAWDOWN

Time	Depth	Elapsed time	drawdown Feet H2O

GMX-1

PW-2 PUMP TEST
OBSERVATION WELL DRAWDOWN vs. TIME



MW-107D

PW-2 PUMP TEST
OBSERVATION WELL DRAWDOWN

Total Depth = **26.26** **TOR**
Static Water Level= **9.42** **TOR**

Time	Depth	Elapsed time		drawdown	Feet H2O
04/26/99 10:12	9.42	0	ZERO TIME	0.00	16.84
04/26/99 10:27	9.42	15		0.00	16.84
04/26/99 11:10	9.41	58	started pump test at 11:10 a.m.	0.01	16.85
04/26/99 11:30	9.40	78		0.02	16.86
04/26/99 11:39	9.40	87		0.02	16.86
04/26/99 12:19	9.39	127		0.03	16.87
04/26/99 13:49	9.38	217		0.04	16.88
04/26/99 15:49	9.37	337		0.05	16.89
04/26/99 17:33	9.37	441		0.05	16.89
04/26/99 21:38	9.38	686		0.04	16.88
04/26/99 23:50	9.39	818	*foot valve malfunction in pumping well; water levels recovered* *end of day 1*	0.03	16.87
04/27/99 08:16	9.40	1324	turned Waterra pump off; replaced foot valve	0.02	16.86
04/27/99 08:39	9.43	1347	turned Waterra pump on	0.01	16.83
04/27/99 08:43	9.45	1351		0.03	16.81
04/27/99 10:40	9.45	1468		0.03	16.81
04/27/99 11:38	9.45	1526		0.03	16.81
04/27/99 14:03	9.46	1671		0.04	16.80
04/27/99 16:04	9.46	1792		0.04	16.80
04/27/99 18:02	9.47	1910		0.05	16.79
04/27/99 20:09	9.49	2037	*end of day 2*	0.07	16.77
04/28/99 08:30	9.59	2778		0.17	16.67
04/28/99 10:06	9.60	2874		0.18	16.66
04/28/99 10:30	9.60	2898	turned Waterra pump off	0.18	16.66
04/28/99 11:34	9.61	2962		0.19	16.65
04/28/99 13:19	9.62	3067		0.20	16.64
04/28/99 15:10	9.62	3178		0.20	16.64
04/28/99 16:04	9.62	3232		0.20	16.64
04/28/99 17:02	9.62	3290	*end of day 3*	0.20	16.64

GMX-1

PW-2 PUMP TEST
OBSERVATION WELL DRAWDOWN

Total Depth = 19.92 TOR
Static Water Level= 13.87 TOR

Time	Depth	Elapsed time		drawdown	Feet H2O
04/26/99 10:12	13.87	0	ZERO TIME	0.00	6.05
04/26/99 10:37	13.87	25		0.00	6.05
04/26/99 11:10	13.85	58	started pump test at 11:10 a.m.	0.02	6.07
04/26/99 11:31	13.83	79		0.04	6.09
04/26/99 11:41	13.83	89		0.04	6.09
04/26/99 12:20	13.80	128		0.07	6.12
04/26/99 13:57	13.73	225		0.14	6.19
04/26/99 15:57	13.66	345		0.21	6.26
04/26/99 17:41	13.61	449		0.26	6.31
04/26/99 21:50	13.53	698		0.34	6.39
04/26/99 23:50	13.50	818	*foot valve malfunction in pumping well; water levels recovered* *end of day 1*	0.37	6.42
04/27/99 08:16	13.47	1324	turned Waterra pump off; replaced foot valve	0.40	6.45
04/27/99 08:39	13.47	1347	turned Waterra pump on	0.40	6.45
04/27/99 08:51	13.47	1359		0.40	6.45
04/27/99 10:49	13.46	1477		0.41	6.46
04/27/99 11:46	13.46	1534		0.41	6.46
04/27/99 14:12	13.44	1680		0.43	6.48
04/27/99 16:12	13.43	1800		0.44	6.49
04/27/99 18:12	13.43	1920		0.44	6.49
04/27/99 20:15	13.42	2043	*end of day 2*	0.45	6.5
04/28/99 08:40	13.46	2788		0.41	6.46
04/28/99 10:17	13.47	2885		0.40	6.45
04/28/99 10:30	13.47	2898	turned Waterra pump off	0.40	6.45
04/28/99 11:43	13.48	2971		0.39	6.44
04/28/99 13:32	13.48	3080		0.39	6.44
04/28/99 14:50	13.48	3158		0.39	6.44
04/28/99 16:16	13.46	3244		0.41	6.46
04/28/99 17:11	13.45	3299	*end of day 3*	0.42	6.47

GMX-1

PW-2 PUMP TEST
OBSERVATION WELL DRAWDOWN

Total Depth = 19.92 TOR
Static Water Level= 13.87 TOR

Time	Depth	Elapsed time		drawdown	Feet H2O
04/26/99 10:12	13.87	0	ZERO TIME	0.00	6.05
04/26/99 10:37	13.87	25		0.00	6.05
04/26/99 11:10	13.85	58	started pump test at 11:10 a.m.	0.02	6.07
04/26/99 11:31	13.83	79		0.04	6.09
04/26/99 11:41	13.83	89		0.04	6.09
04/26/99 12:20	13.80	128		0.07	6.12
04/26/99 13:57	13.73	225		0.14	6.19
04/26/99 15:57	13.66	345		0.21	6.26
04/26/99 17:41	13.61	449		0.26	6.31
04/26/99 21:50	13.53	698		0.34	6.39
04/26/99 23:50	13.50	818	*foot valve malfunction in pumping well; water levels recovered* *end of day 1*	0.37	6.42
04/27/99 08:16	13.47	1324	turned Waterra pump off; replaced foot valve	0.40	6.45
04/27/99 08:39	13.47	1347	turned Waterra pump on	0.40	6.45
04/27/99 08:51	13.47	1359		0.40	6.45
04/27/99 10:49	13.46	1477		0.41	6.46
04/27/99 11:46	13.46	1534		0.41	6.46
04/27/99 14:12	13.44	1680		0.43	6.48
04/27/99 16:12	13.43	1800		0.44	6.49
04/27/99 18:12	13.43	1920		0.44	6.49
04/27/99 20:15	13.42	2043	*end of day 2*	0.45	6.5
04/28/99 08:40	13.46	2788		0.41	6.46
04/28/99 10:17	13.47	2885		0.40	6.45
04/28/99 10:30	13.47	2898	turned Waterra pump off	0.40	6.45
04/28/99 11:43	13.48	2971		0.39	6.44
04/28/99 13:32	13.48	3080		0.39	6.44
04/28/99 14:50	13.48	3158		0.39	6.44
04/28/99 16:16	13.46	3244		0.41	6.46
04/28/99 17:11	13.45	3299	*end of day 3*	0.42	6.47

IN_SITU INC. Troll

Report generated:	5/4/99	13:39:31
Report from file:	P:\PROJECT\B5039U~1\DATALO~1\PW2-107S.BIN	
DataMgr Version	2.18.0.0	
Serial number:	274	
Firmware Version	2	
Unit name:	GP-02B	
Test name:	pw2-mw107s	
Test defined on:	4/26/99	10:50:37
Test started on:	4/26/99	10:51:07
Test stopped on:	4/28/99	17:30:50
Test extracted on:	4/28/99	17:30:57

Data gathered using Linear testing

Time between data points:	5.0000	Minutes.
Number of data samples:		656

TOTAL DATA SAMPLES 656

Channel number [1]

Measurement type:	Temperature	
Channel name:	OnBoard Temp	

Channel number [2]

Measurement type:	Pressure/Level	
Channel name:	OnBoard Pressure	
Sensor Range:	15 PSI.	
Specific gravity:	1	
Mode:	Surface	
User-defined reference:	0	Feet H2O
Referenced on:	test start	
Pressure head at reference:	5.01	Feet H2O

				Chan[1]	Chan[2]		
			Adjusted		MW-107S		
Date	Time	ET (min)	ET (min)	Celsius	Feet H2O	drawdown	
4/26/99	10:01:13	0	0		0	0	ZERO TIME
4/26/99	10:51:07	0	50	6.7	0	0	
4/26/99	10:56:07	5	55	6.62	0	0	
4/26/99	11:01:07	10	60	6.58	0.002	0.002	
4/26/99	11:06:07	15	65	6.57	0	0	
4/26/99	11:11:07	20	70	6.57	0.002	0.002	
4/26/99	11:16:07	25	75	6.57	0.005	0.005	
4/26/99	11:21:07	30	80	6.57	0.005	0.005	

Date	Time	ET (min)	Adjusted ET (min)	Celsius	MW-107S Feet H2O	drawdown
4/26/99	11:26:07	35	85	6.57	0.002	0.002
4/26/99	11:31:07	40	90	6.56	-0.002	0.002
4/26/99	11:36:07	45	95	6.57	0.005	0.005
4/26/99	11:41:07	50	100	6.57	0.002	0.002
4/26/99	11:46:07	55	105	6.57	-0.002	0.002
4/26/99	11:51:07	60	110	6.56	0.002	0.002
4/26/99	11:56:07	65	115	6.57	0.002	0.002
4/26/99	12:01:07	70	120	6.56	-0.002	0.002
4/26/99	12:06:07	75	125	6.57	0.005	0.005
4/26/99	12:11:07	80	130	6.57	0.005	0.005
4/26/99	12:16:07	85	135	6.57	-0.002	0.002
4/26/99	12:21:07	90	140	6.57	0.002	0.002
4/26/99	12:26:07	95	145	6.57	0.005	0.005
4/26/99	12:31:07	100	150	6.57	0.007	0.007
4/26/99	12:36:07	105	155	6.57	0.005	0.005
4/26/99	12:41:07	110	160	6.57	0.005	0.005
4/26/99	12:46:07	115	165	6.57	0.005	0.005
4/26/99	12:51:07	120	170	6.56	0.002	0.002
4/26/99	12:56:07	125	175	6.57	0.005	0.005
4/26/99	13:01:07	130	180	6.56	-0.005	0.005
4/26/99	13:06:07	135	185	6.57	0.005	0.005
4/26/99	13:11:07	140	190	6.57	0.002	0.002
4/26/99	13:16:07	145	195	6.56	0.005	0.005
4/26/99	13:21:07	150	200	6.57	0.007	0.007
4/26/99	13:26:07	155	205	6.57	0.005	0.005
4/26/99	13:31:07	160	210	6.57	0.002	0.002
4/26/99	13:36:07	165	215	6.57	0.002	0.002
4/26/99	13:41:07	170	220	6.56	0.002	0.002
4/26/99	13:46:07	175	225	6.56	0.002	0.002
4/26/99	13:51:07	180	230	6.57	0.005	0.005
4/26/99	13:56:07	185	235	6.57	0.005	0.005
4/26/99	14:01:07	190	240	6.57	0	0
4/26/99	14:06:07	195	245	6.57	0.005	0.005
4/26/99	14:11:07	200	250	6.57	0.005	0.005
4/26/99	14:16:07	205	255	6.57	0.007	0.007
4/26/99	14:21:07	210	260	6.58	0.005	0.005
4/26/99	14:26:07	215	265	6.57	0.005	0.005
4/26/99	14:31:07	220	270	6.57	-0.014	0.014
4/26/99	14:36:07	225	275	6.56	0.002	0.002
4/26/99	14:41:07	230	280	6.57	0.005	0.005
4/26/99	14:46:07	235	285	6.57	0.005	0.005
4/26/99	14:51:07	240	290	6.57	0.007	0.007
4/26/99	14:56:07	245	295	6.57	0.002	0.002
4/26/99	15:01:07	250	300	6.57	0.002	0.002
4/26/99	15:06:07	255	305	6.57	0.005	0.005
4/26/99	15:11:07	260	310	6.57	0.002	0.002
4/26/99	15:16:07	265	315	6.58	0.005	0.005
4/26/99	15:21:07	270	320	6.57	0.007	0.007
4/26/99	15:26:07	275	325	6.57	0.005	0.005
4/26/99	15:31:07	280	330	6.57	0.007	0.007
4/26/99	15:36:07	285	335	6.57	0.002	0.002
4/26/99	15:41:07	290	340	6.57	0.005	0.005
4/26/99	15:46:07	295	345	6.57	0	0
4/26/99	15:51:07	300	350	6.57	0.007	0.007
4/26/99	15:56:07	305	355	6.57	-0.002	0.002

Date	Time	ET (min)	Adjusted ET (min)	Celsius	MW-107S Feet H2O	drawdown
4/26/99	16:01:07	310	360	6.57	0.007	0.007
4/26/99	16:06:07	315	365	6.57	0.002	0.002
4/26/99	16:11:07	320	370	6.57	0.005	0.005
4/26/99	16:16:07	325	375	6.57	0.002	0.002
4/26/99	16:21:07	330	380	6.57	0.005	0.005
4/26/99	16:26:07	335	385	6.57	0.005	0.005
4/26/99	16:31:07	340	390	6.58	0.007	0.007
4/26/99	16:36:07	345	395	6.58	0.005	0.005
4/26/99	16:41:07	350	400	6.57	0	0
4/26/99	16:46:07	355	405	6.57	0.002	0.002
4/26/99	16:51:07	360	410	6.57	0.002	0.002
4/26/99	16:56:07	365	415	6.57	0	0
4/26/99	17:01:07	370	420	6.57	0.002	0.002
4/26/99	17:06:07	375	425	6.57	0.002	0.002
4/26/99	17:11:07	380	430	6.57	0.002	0.002
4/26/99	17:16:07	385	435	6.57	0.002	0.002
4/26/99	17:21:07	390	440	6.57	0.002	0.002
4/26/99	17:26:07	395	445	6.58	0.002	0.002
4/26/99	17:31:07	400	450	6.58	0.002	0.002
4/26/99	17:36:07	405	455	6.57	-0.002	0.002
4/26/99	17:41:07	410	460	6.57	0	0
4/26/99	17:46:07	415	465	6.58	0	0
4/26/99	17:51:07	420	470	6.57	0	0
4/26/99	17:56:07	425	475	6.57	0.002	0.002
4/26/99	18:01:07	430	480	6.57	-0.002	0.002
4/26/99	18:06:07	435	485	6.57	-0.002	0.002
4/26/99	18:11:07	440	490	6.57	-0.002	0.002
4/26/99	18:16:07	445	495	6.58	-0.005	0.005
4/26/99	18:21:07	450	500	6.58	-0.005	0.005
4/26/99	18:26:07	455	505	6.57	-0.002	0.002
4/26/99	18:31:07	460	510	6.57	-0.005	0.005
4/26/99	18:36:07	465	515	6.57	-0.002	0.002
4/26/99	18:41:07	470	520	6.57	-0.005	0.005
4/26/99	18:46:07	475	525	6.57	-0.005	0.005
4/26/99	18:51:07	480	530	6.57	-0.007	0.007
4/26/99	18:56:07	485	535	6.57	-0.007	0.007
4/26/99	19:01:07	490	540	6.57	-0.005	0.005
4/26/99	19:06:07	495	545	6.57	-0.007	0.007
4/26/99	19:11:07	500	550	6.57	-0.007	0.007
4/26/99	19:16:07	505	555	6.57	-0.007	0.007
4/26/99	19:21:07	510	560	6.57	-0.007	0.007
4/26/99	19:26:07	515	565	6.58	-0.009	0.009
4/26/99	19:31:07	520	570	6.57	-0.009	0.009
4/26/99	19:36:07	525	575	6.57	-0.009	0.009
4/26/99	19:41:07	530	580	6.57	-0.012	0.012
4/26/99	19:46:07	535	585	6.58	-0.012	0.012
4/26/99	19:51:07	540	590	6.57	-0.012	0.012
4/26/99	19:56:07	545	595	6.57	-0.009	0.009
4/26/99	20:01:07	550	600	6.58	-0.012	0.012
4/26/99	20:06:07	555	605	6.57	-0.012	0.012
4/26/99	20:11:07	560	610	6.57	-0.014	0.014
4/26/99	20:16:07	565	615	6.57	-0.014	0.014
4/26/99	20:21:07	570	620	6.58	-0.014	0.014
4/26/99	20:26:07	575	625	6.58	-0.016	0.016
4/26/99	20:31:07	580	630	6.58	-0.016	0.016

Date	Time	ET (min)	Adjusted ET (min)	Celsius	MW-107S Feet H2O	MW-107S drawdown
4/26/99	20:36:07	585	635	6.58	-0.016	0.016
4/26/99	20:41:07	590	640	6.58	-0.016	0.016
4/26/99	20:46:07	595	645	6.58	-0.016	0.016
4/26/99	20:51:07	600	650	6.58	-0.018	0.018
4/26/99	20:56:07	605	655	6.58	-0.018	0.018
4/26/99	21:01:07	610	660	6.58	-0.018	0.018
4/26/99	21:06:07	615	665	6.58	-0.021	0.021
4/26/99	21:11:07	620	670	6.58	-0.021	0.021
4/26/99	21:16:07	625	675	6.57	-0.023	0.023
4/26/99	21:21:07	630	680	6.58	-0.021	0.021
4/26/99	21:26:07	635	685	6.58	-0.018	0.018
4/26/99	21:31:07	640	690	6.58	-0.021	0.021
4/26/99	21:36:07	645	695	6.58	-0.021	0.021
4/26/99	21:41:07	650	700	6.58	-0.021	0.021
4/26/99	21:46:07	655	705	6.58	-0.023	0.023
4/26/99	21:51:07	660	710	6.58	-0.021	0.021
4/26/99	21:56:07	665	715	6.58	-0.021	0.021
4/26/99	22:01:07	670	720	6.58	-0.023	0.023
4/26/99	22:06:07	675	725	6.58	-0.023	0.023
4/26/99	22:11:07	680	730	6.59	-0.025	0.025
4/26/99	22:16:07	685	735	6.58	-0.023	0.023
4/26/99	22:21:07	690	740	6.58	-0.025	0.025
4/26/99	22:26:07	695	745	6.58	-0.028	0.028
4/26/99	22:31:07	700	750	6.58	-0.025	0.025
4/26/99	22:36:07	705	755	6.58	-0.028	0.028
4/26/99	22:41:07	710	760	6.58	-0.028	0.028
4/26/99	22:46:07	715	765	6.58	-0.03	0.03
4/26/99	22:51:07	720	770	6.58	-0.03	0.03
4/26/99	22:56:07	725	775	6.58	-0.03	0.03
4/26/99	23:01:07	730	780	6.58	-0.03	0.03
4/26/99	23:06:07	735	785	6.58	-0.032	0.032
4/26/99	23:11:07	740	790	6.58	-0.03	0.03
4/26/99	23:16:07	745	795	6.57	-0.032	0.032
4/26/99	23:21:07	750	800	6.58	-0.032	0.032
4/26/99	23:26:07	755	805	6.58	-0.032	0.032
4/26/99	23:31:07	760	810	6.58	-0.035	0.035
4/26/99	23:36:07	765	815	6.58	-0.032	0.032
4/26/99	23:41:07	770	820	6.58	-0.035	0.035
4/26/99	23:46:07	775	825	6.58	-0.035	0.035
4/26/99	23:51:07	780	830	6.58	-0.037	0.037
4/26/99	23:56:07	785	835	6.58	-0.037	0.037
4/27/99	0:01:07	790	840	6.58	-0.035	0.035
4/27/99	0:06:07	795	845	6.58	-0.037	0.037
4/27/99	0:11:07	800	850	6.58	-0.037	0.037
4/27/99	0:16:07	805	855	6.58	-0.037	0.037
4/27/99	0:21:07	810	860	6.58	-0.037	0.037
4/27/99	0:26:07	815	865	6.58	-0.037	0.037
4/27/99	0:31:07	820	870	6.58	-0.037	0.037
4/27/99	0:36:07	825	875	6.58	-0.039	0.039
4/27/99	0:41:07	830	880	6.58	-0.039	0.039
4/27/99	0:46:07	835	885	6.58	-0.039	0.039
4/27/99	0:51:07	840	890	6.58	-0.037	0.037
4/27/99	0:56:07	845	895	6.58	-0.037	0.037
4/27/99	1:01:07	850	900	6.58	-0.037	0.037
4/27/99	1:06:07	855	905	6.58	-0.037	0.037

Date	Time	ET (min)	Adjusted ET (min)	Celsius	MW-107S Feet H2O	MW-107S drawdown
4/27/99	1:11:07	860	910	6.58	-0.037	0.037
4/27/99	1:16:07	865	915	6.58	-0.039	0.039
4/27/99	1:21:07	870	920	6.59	-0.037	0.037
4/27/99	1:26:07	875	925	6.58	-0.037	0.037
4/27/99	1:31:07	880	930	6.58	-0.037	0.037
4/27/99	1:36:07	885	935	6.58	-0.037	0.037
4/27/99	1:41:07	890	940	6.58	-0.039	0.039
4/27/99	1:46:07	895	945	6.58	-0.039	0.039
4/27/99	1:51:07	900	950	6.58	-0.039	0.039
4/27/99	1:56:07	905	955	6.58	-0.039	0.039
4/27/99	2:01:07	910	960	6.58	-0.039	0.039
4/27/99	2:06:07	915	965	6.58	-0.039	0.039
4/27/99	2:11:07	920	970	6.58	-0.039	0.039
4/27/99	2:16:07	925	975	6.58	-0.039	0.039
4/27/99	2:21:07	930	980	6.58	-0.039	0.039
4/27/99	2:26:07	935	985	6.58	-0.039	0.039
4/27/99	2:31:07	940	990	6.58	-0.042	0.042
4/27/99	2:36:07	945	995	6.58	-0.039	0.039
4/27/99	2:41:07	950	1000	6.59	-0.042	0.042
4/27/99	2:46:07	955	1005	6.59	-0.042	0.042
4/27/99	2:51:07	960	1010	6.58	-0.039	0.039
4/27/99	2:56:07	965	1015	6.58	-0.042	0.042
4/27/99	3:01:07	970	1020	6.58	-0.042	0.042
4/27/99	3:06:07	975	1025	6.58	-0.042	0.042
4/27/99	3:11:07	980	1030	6.58	-0.042	0.042
4/27/99	3:16:07	985	1035	6.58	-0.042	0.042
4/27/99	3:21:07	990	1040	6.58	-0.042	0.042
4/27/99	3:26:07	995	1045	6.58	-0.042	0.042
4/27/99	3:31:07	1000	1050	6.58	-0.044	0.044
4/27/99	3:36:07	1005	1055	6.59	-0.042	0.042
4/27/99	3:41:07	1010	1060	6.58	-0.044	0.044
4/27/99	3:46:07	1015	1065	6.58	-0.044	0.044
4/27/99	3:51:07	1020	1070	6.58	-0.044	0.044
4/27/99	3:56:07	1025	1075	6.58	-0.046	0.046
4/27/99	4:01:07	1030	1080	6.58	-0.044	0.044
4/27/99	4:06:07	1035	1085	6.58	-0.044	0.044
4/27/99	4:11:07	1040	1090	6.58	-0.044	0.044
4/27/99	4:16:07	1045	1095	6.58	-0.044	0.044
4/27/99	4:21:07	1050	1100	6.58	-0.044	0.044
4/27/99	4:26:07	1055	1105	6.58	-0.044	0.044
4/27/99	4:31:07	1060	1110	6.58	-0.044	0.044
4/27/99	4:36:07	1065	1115	6.59	-0.046	0.046
4/27/99	4:41:07	1070	1120	6.59	-0.048	0.048
4/27/99	4:46:07	1075	1125	6.59	-0.048	0.048
4/27/99	4:51:07	1080	1130	6.58	-0.048	0.048
4/27/99	4:56:07	1085	1135	6.58	-0.048	0.048
4/27/99	5:01:07	1090	1140	6.58	-0.048	0.048
4/27/99	5:06:07	1095	1145	6.58	-0.053	0.053
4/27/99	5:11:07	1100	1150	6.58	-0.053	0.053
4/27/99	5:16:07	1105	1155	6.58	-0.051	0.051
4/27/99	5:21:07	1110	1160	6.58	-0.051	0.051
4/27/99	5:26:07	1115	1165	6.59	-0.053	0.053
4/27/99	5:31:07	1120	1170	6.58	-0.053	0.053
4/27/99	5:36:07	1125	1175	6.59	-0.053	0.053
4/27/99	5:41:07	1130	1180	6.58	-0.055	0.055

Date	Time	ET (min)	Adjusted ET (min)	Celsius	MW-107S Feet H2O	drawdown
4/27/99	5:46:07	1135	1185	6.58	-0.055	0.055
4/27/99	5:51:07	1140	1190	6.58	-0.055	0.055
4/27/99	5:56:07	1145	1195	6.58	-0.055	0.055
4/27/99	6:01:07	1150	1200	6.58	-0.058	0.058
4/27/99	6:06:07	1155	1205	6.58	-0.058	0.058
4/27/99	6:11:07	1160	1210	6.58	-0.058	0.058
4/27/99	6:16:07	1165	1215	6.58	-0.06	0.06
4/27/99	6:21:07	1170	1220	6.59	-0.06	0.06
4/27/99	6:26:07	1175	1225	6.59	-0.058	0.058
4/27/99	6:31:07	1180	1230	6.59	-0.06	0.06
4/27/99	6:36:07	1185	1235	6.59	-0.062	0.062
4/27/99	6:41:07	1190	1240	6.59	-0.06	0.06
4/27/99	6:46:07	1195	1245	6.58	-0.062	0.062
4/27/99	6:51:07	1200	1250	6.59	-0.062	0.062
4/27/99	6:56:07	1205	1255	6.58	-0.062	0.062
4/27/99	7:01:07	1210	1260	6.58	-0.062	0.062
4/27/99	7:06:07	1215	1265	6.59	-0.062	0.062
4/27/99	7:11:07	1220	1270	6.59	-0.065	0.065
4/27/99	7:16:07	1225	1275	6.59	-0.065	0.065
4/27/99	7:21:07	1230	1280	6.59	-0.065	0.065
4/27/99	7:26:07	1235	1285	6.59	-0.065	0.065
4/27/99	7:31:07	1240	1290	6.59	-0.067	0.067
4/27/99	7:36:07	1245	1295	6.59	-0.067	0.067
4/27/99	7:41:07	1250	1300	6.58	-0.067	0.067
4/27/99	7:46:07	1255	1305	6.58	-0.069	0.069
4/27/99	7:51:07	1260	1310	6.58	-0.067	0.067
4/27/99	7:56:07	1265	1315	6.58	-0.069	0.069
4/27/99	8:01:07	1270	1320	6.58	-0.067	0.067
4/27/99	8:06:07	1275	1325	6.59	-0.069	0.069
4/27/99	8:11:07	1280	1330	6.59	-0.069	0.069
4/27/99	8:16:07	1285	1335	6.59	-0.069	0.069
4/27/99	8:21:07	1290	1340	6.59	-0.067	0.067
4/27/99	8:26:07	1295	1345	6.59	-0.069	0.069
4/27/99	8:31:07	1300	1350	6.58	-0.065	0.065
4/27/99	8:36:07	1305	1355	6.58	-0.069	0.069
4/27/99	8:41:07	1310	1360	6.59	-0.069	0.069
4/27/99	8:46:07	1315	1365	6.59	-0.069	0.069
4/27/99	8:51:07	1320	1370	6.58	-0.072	0.072
4/27/99	8:56:07	1325	1375	6.58	-0.072	0.072
4/27/99	9:01:07	1330	1380	6.58	-0.072	0.072
4/27/99	9:06:07	1335	1385	6.58	-0.072	0.072
4/27/99	9:11:07	1340	1390	6.58	-0.072	0.072
4/27/99	9:16:07	1345	1395	6.58	-0.074	0.074
4/27/99	9:21:07	1350	1400	6.58	-0.076	0.076
4/27/99	9:26:07	1355	1405	6.58	-0.076	0.076
4/27/99	9:31:07	1360	1410	6.58	-0.076	0.076
4/27/99	9:36:07	1365	1415	6.58	-0.076	0.076
4/27/99	9:41:07	1370	1420	6.58	-0.076	0.076
4/27/99	9:46:07	1375	1425	6.58	-0.076	0.076
4/27/99	9:51:07	1380	1430	6.59	-0.078	0.078
4/27/99	9:56:07	1385	1435	6.59	-0.078	0.078
4/27/99	10:01:07	1390	1440	6.59	-0.078	0.078
4/27/99	10:06:07	1395	1445	6.59	-0.078	0.078
4/27/99	10:11:07	1400	1450	6.59	-0.078	0.078
4/27/99	10:16:07	1405	1455	6.59	-0.081	0.081

Date	Time	ET (min)	Adjusted ET (min)	Celsius	MW-107S Feet H2O	MW-107S drawdown
4/27/99	10:21:07	1410	1460	6.59	-0.078	0.078
4/27/99	10:26:07	1415	1465	6.59	-0.081	0.081
4/27/99	10:31:07	1420	1470	6.59	-0.078	0.078
4/27/99	10:36:07	1425	1475	6.59	-0.078	0.078
4/27/99	10:41:07	1430	1480	6.59	-0.078	0.078
4/27/99	10:46:07	1435	1485	6.58	-0.078	0.078
4/27/99	10:51:07	1440	1490	6.58	-0.081	0.081
4/27/99	10:56:07	1445	1495	6.59	-0.078	0.078
4/27/99	11:01:07	1450	1500	6.59	-0.081	0.081
4/27/99	11:06:07	1455	1505	6.58	-0.081	0.081
4/27/99	11:11:07	1460	1510	6.58	-0.081	0.081
4/27/99	11:16:07	1465	1515	6.59	-0.081	0.081
4/27/99	11:21:07	1470	1520	6.58	-0.081	0.081
4/27/99	11:26:07	1475	1525	6.58	-0.081	0.081
4/27/99	11:31:07	1480	1530	6.58	-0.083	0.083
4/27/99	11:36:07	1485	1535	6.58	-0.083	0.083
4/27/99	11:41:07	1490	1540	6.58	-0.083	0.083
4/27/99	11:46:07	1495	1545	6.58	-0.085	0.085
4/27/99	11:51:07	1500	1550	6.59	-0.083	0.083
4/27/99	11:56:07	1505	1555	6.59	-0.085	0.085
4/27/99	12:01:07	1510	1560	6.59	-0.081	0.081
4/27/99	12:06:07	1515	1565	6.59	-0.081	0.081
4/27/99	12:11:07	1520	1570	6.59	-0.081	0.081
4/27/99	12:16:07	1525	1575	6.59	-0.081	0.081
4/27/99	12:21:07	1530	1580	6.58	-0.081	0.081
4/27/99	12:26:07	1535	1585	6.59	-0.083	0.083
4/27/99	12:31:07	1540	1590	6.58	-0.085	0.085
4/27/99	12:36:07	1545	1595	6.58	-0.083	0.083
4/27/99	12:41:07	1550	1600	6.58	-0.085	0.085
4/27/99	12:46:07	1555	1605	6.59	-0.083	0.083
4/27/99	12:51:07	1560	1610	6.59	-0.088	0.088
4/27/99	12:56:07	1565	1615	6.59	-0.083	0.083
4/27/99	13:01:07	1570	1620	6.59	-0.085	0.085
4/27/99	13:06:07	1575	1625	6.59	-0.088	0.088
4/27/99	13:11:07	1580	1630	6.59	-0.085	0.085
4/27/99	13:16:07	1585	1635	6.59	-0.083	0.083
4/27/99	13:21:07	1590	1640	6.59	-0.085	0.085
4/27/99	13:26:07	1595	1645	6.59	-0.085	0.085
4/27/99	13:31:07	1600	1650	6.59	-0.085	0.085
4/27/99	13:36:07	1605	1655	6.59	-0.088	0.088
4/27/99	13:41:07	1610	1660	6.59	-0.085	0.085
4/27/99	13:46:07	1615	1665	6.59	-0.083	0.083
4/27/99	13:51:07	1620	1670	6.59	-0.085	0.085
4/27/99	13:56:07	1625	1675	6.59	-0.085	0.085
4/27/99	14:01:07	1630	1680	6.59	-0.085	0.085
4/27/99	14:06:07	1635	1685	6.59	-0.088	0.088
4/27/99	14:11:07	1640	1690	6.59	-0.085	0.085
4/27/99	14:16:07	1645	1695	6.59	-0.088	0.088
4/27/99	14:21:07	1650	1700	6.59	-0.085	0.085
4/27/99	14:26:07	1655	1705	6.59	-0.088	0.088
4/27/99	14:31:07	1660	1710	6.59	-0.085	0.085
4/27/99	14:36:07	1665	1715	6.59	-0.09	0.09
4/27/99	14:41:07	1670	1720	6.59	-0.088	0.088
4/27/99	14:46:07	1675	1725	6.59	-0.088	0.088
4/27/99	14:51:07	1680	1730	6.59	-0.088	0.088

Date	Time	ET (min)	Adjusted ET (min)	Celsius	MW-107S Feet H2O	MW-107S drawdown
4/27/99	14:56:07	1685	1735	6.59	-0.088	0.088
4/27/99	15:01:07	1690	1740	6.59	-0.085	0.085
4/27/99	15:06:07	1695	1745	6.58	-0.088	0.088
4/27/99	15:11:07	1700	1750	6.59	-0.088	0.088
4/27/99	15:16:07	1705	1755	6.58	-0.088	0.088
4/27/99	15:21:07	1710	1760	6.59	-0.088	0.088
4/27/99	15:26:07	1715	1765	6.59	-0.088	0.088
4/27/99	15:31:07	1720	1770	6.59	-0.088	0.088
4/27/99	15:36:07	1725	1775	6.59	-0.088	0.088
4/27/99	15:41:07	1730	1780	6.58	-0.09	0.09
4/27/99	15:46:07	1735	1785	6.59	-0.088	0.088
4/27/99	15:51:07	1740	1790	6.59	-0.088	0.088
4/27/99	15:56:07	1745	1795	6.59	-0.088	0.088
4/27/99	16:01:07	1750	1800	6.59	-0.088	0.088
4/27/99	16:06:07	1755	1805	6.59	-0.088	0.088
4/27/99	16:11:07	1760	1810	6.59	-0.085	0.085
4/27/99	16:16:07	1765	1815	6.59	-0.088	0.088
4/27/99	16:21:07	1770	1820	6.59	-0.088	0.088
4/27/99	16:26:07	1775	1825	6.59	-0.088	0.088
4/27/99	16:31:07	1780	1830	6.59	-0.09	0.09
4/27/99	16:36:07	1785	1835	6.59	-0.088	0.088
4/27/99	16:41:07	1790	1840	6.59	-0.09	0.09
4/27/99	16:46:07	1795	1845	6.59	-0.09	0.09
4/27/99	16:51:07	1800	1850	6.59	-0.09	0.09
4/27/99	16:56:07	1805	1855	6.59	-0.09	0.09
4/27/99	17:01:07	1810	1860	6.59	-0.09	0.09
4/27/99	17:06:07	1815	1865	6.59	-0.09	0.09
4/27/99	17:11:07	1820	1870	6.59	-0.09	0.09
4/27/99	17:16:07	1825	1875	6.59	-0.09	0.09
4/27/99	17:21:07	1830	1880	6.59	-0.09	0.09
4/27/99	17:26:07	1835	1885	6.59	-0.092	0.092
4/27/99	17:31:07	1840	1890	6.59	-0.095	0.095
4/27/99	17:36:07	1845	1895	6.59	-0.092	0.092
4/27/99	17:41:07	1850	1900	6.59	-0.092	0.092
4/27/99	17:46:07	1855	1905	6.59	-0.092	0.092
4/27/99	17:51:07	1860	1910	6.59	-0.095	0.095
4/27/99	17:56:07	1865	1915	6.59	-0.095	0.095
4/27/99	18:01:07	1870	1920	6.59	-0.095	0.095
4/27/99	18:06:07	1875	1925	6.59	-0.095	0.095
4/27/99	18:11:07	1880	1930	6.59	-0.095	0.095
4/27/99	18:16:07	1885	1935	6.59	-0.097	0.097
4/27/99	18:21:07	1890	1940	6.59	-0.095	0.095
4/27/99	18:26:07	1895	1945	6.59	-0.095	0.095
4/27/99	18:31:07	1900	1950	6.59	-0.097	0.097
4/27/99	18:36:07	1905	1955	6.59	-0.095	0.095
4/27/99	18:41:07	1910	1960	6.59	-0.097	0.097
4/27/99	18:46:07	1915	1965	6.59	-0.095	0.095
4/27/99	18:51:07	1920	1970	6.59	-0.097	0.097
4/27/99	18:56:07	1925	1975	6.59	-0.097	0.097
4/27/99	19:01:07	1930	1980	6.59	-0.097	0.097
4/27/99	19:06:07	1935	1985	6.59	-0.097	0.097
4/27/99	19:11:07	1940	1990	6.59	-0.097	0.097
4/27/99	19:16:07	1945	1995	6.59	-0.099	0.099
4/27/99	19:21:07	1950	2000	6.59	-0.099	0.099
4/27/99	19:26:07	1955	2005	6.59	-0.099	0.099

Date	Time	ET (min)	Adjusted ET (min)	Celsius	MW-107S Feet H2O	MW-107S drawdown
4/27/99	19:31:07	1960	2010	6.59	-0.099	0.099
4/27/99	19:36:07	1965	2015	6.59	-0.099	0.099
4/27/99	19:41:07	1970	2020	6.6	-0.104	0.104
4/27/99	19:46:07	1975	2025	6.6	-0.101	0.101
4/27/99	19:51:07	1980	2030	6.59	-0.099	0.099
4/27/99	19:56:07	1985	2035	6.6	-0.101	0.101
4/27/99	20:01:07	1990	2040	6.6	-0.104	0.104
4/27/99	20:06:07	1995	2045	6.59	-0.101	0.101
4/27/99	20:11:07	2000	2050	6.6	-0.104	0.104
4/27/99	20:16:07	2005	2055	6.6	-0.104	0.104
4/27/99	20:21:07	2010	2060	6.59	-0.104	0.104
4/27/99	20:26:07	2015	2065	6.59	-0.104	0.104
4/27/99	20:31:07	2020	2070	6.59	-0.104	0.104
4/27/99	20:36:07	2025	2075	6.59	-0.104	0.104
4/27/99	20:41:07	2030	2080	6.59	-0.104	0.104
4/27/99	20:46:07	2035	2085	6.59	-0.104	0.104
4/27/99	20:51:07	2040	2090	6.59	-0.104	0.104
4/27/99	20:56:07	2045	2095	6.59	-0.106	0.106
4/27/99	21:01:07	2050	2100	6.59	-0.106	0.106
4/27/99	21:06:07	2055	2105	6.59	-0.106	0.106
4/27/99	21:11:07	2060	2110	6.59	-0.106	0.106
4/27/99	21:16:07	2065	2115	6.59	-0.108	0.108
4/27/99	21:21:07	2070	2120	6.59	-0.108	0.108
4/27/99	21:26:07	2075	2125	6.59	-0.108	0.108
4/27/99	21:31:07	2080	2130	6.59	-0.108	0.108
4/27/99	21:36:07	2085	2135	6.59	-0.111	0.111
4/27/99	21:41:07	2090	2140	6.59	-0.111	0.111
4/27/99	21:46:07	2095	2145	6.6	-0.111	0.111
4/27/99	21:51:07	2100	2150	6.6	-0.111	0.111
4/27/99	21:56:07	2105	2155	6.6	-0.113	0.113
4/27/99	22:01:07	2110	2160	6.6	-0.111	0.111
4/27/99	22:06:07	2115	2165	6.6	-0.113	0.113
4/27/99	22:11:07	2120	2170	6.6	-0.113	0.113
4/27/99	22:16:07	2125	2175	6.6	-0.113	0.113
4/27/99	22:21:07	2130	2180	6.6	-0.113	0.113
4/27/99	22:26:07	2135	2185	6.6	-0.113	0.113
4/27/99	22:31:07	2140	2190	6.59	-0.115	0.115
4/27/99	22:36:07	2145	2195	6.6	-0.113	0.113
4/27/99	22:41:07	2150	2200	6.6	-0.113	0.113
4/27/99	22:46:07	2155	2205	6.6	-0.115	0.115
4/27/99	22:51:07	2160	2210	6.6	-0.115	0.115
4/27/99	22:56:07	2165	2215	6.61	-0.12	0.12
4/27/99	23:01:07	2170	2220	6.6	-0.115	0.115
4/27/99	23:06:07	2175	2225	6.6	-0.115	0.115
4/27/99	23:11:07	2180	2230	6.6	-0.115	0.115
4/27/99	23:16:07	2185	2235	6.59	-0.115	0.115
4/27/99	23:21:07	2190	2240	6.6	-0.115	0.115
4/27/99	23:26:07	2195	2245	6.6	-0.115	0.115
4/27/99	23:31:07	2200	2250	6.6	-0.118	0.118
4/27/99	23:36:07	2205	2255	6.6	-0.115	0.115
4/27/99	23:41:07	2210	2260	6.6	-0.115	0.115
4/27/99	23:46:07	2215	2265	6.6	-0.118	0.118
4/27/99	23:51:07	2220	2270	6.59	-0.118	0.118
4/27/99	23:56:07	2225	2275	6.6	-0.12	0.12
4/28/99	0:01:07	2230	2280	6.59	-0.12	0.12

Date	Time	ET (min)	Adjusted ET (min)	Celsius	MW-107S Feet H2O	drawdown
4/28/99	0:06:07	2235	2285	6.59	-0.118	0.118
4/28/99	0:11:07	2240	2290	6.6	-0.12	0.12
4/28/99	0:16:07	2245	2295	6.6	-0.12	0.12
4/28/99	0:21:07	2250	2300	6.6	-0.12	0.12
4/28/99	0:26:07	2255	2305	6.59	-0.12	0.12
4/28/99	0:31:07	2260	2310	6.6	-0.122	0.122
4/28/99	0:36:07	2265	2315	6.6	-0.122	0.122
4/28/99	0:41:07	2270	2320	6.6	-0.122	0.122
4/28/99	0:46:07	2275	2325	6.59	-0.122	0.122
4/28/99	0:51:07	2280	2330	6.59	-0.12	0.12
4/28/99	0:56:07	2285	2335	6.59	-0.12	0.12
4/28/99	1:01:07	2290	2340	6.6	-0.12	0.12
4/28/99	1:06:07	2295	2345	6.6	-0.122	0.122
4/28/99	1:11:07	2300	2350	6.6	-0.122	0.122
4/28/99	1:16:07	2305	2355	6.59	-0.125	0.125
4/28/99	1:21:07	2310	2360	6.59	-0.122	0.122
4/28/99	1:26:07	2315	2365	6.59	-0.122	0.122
4/28/99	1:31:07	2320	2370	6.6	-0.122	0.122
4/28/99	1:36:07	2325	2375	6.59	-0.125	0.125
4/28/99	1:41:07	2330	2380	6.59	-0.125	0.125
4/28/99	1:46:07	2335	2385	6.59	-0.122	0.122
4/28/99	1:51:07	2340	2390	6.59	-0.125	0.125
4/28/99	1:56:07	2345	2395	6.6	-0.125	0.125
4/28/99	2:01:07	2350	2400	6.6	-0.122	0.122
4/28/99	2:06:07	2355	2405	6.59	-0.122	0.122
4/28/99	2:11:07	2360	2410	6.6	-0.122	0.122
4/28/99	2:16:07	2365	2415	6.59	-0.125	0.125
4/28/99	2:21:07	2370	2420	6.6	-0.125	0.125
4/28/99	2:26:07	2375	2425	6.59	-0.125	0.125
4/28/99	2:31:07	2380	2430	6.6	-0.125	0.125
4/28/99	2:36:07	2385	2435	6.6	-0.125	0.125
4/28/99	2:41:07	2390	2440	6.6	-0.125	0.125
4/28/99	2:46:07	2395	2445	6.6	-0.127	0.127
4/28/99	2:51:07	2400	2450	6.59	-0.125	0.125
4/28/99	2:56:07	2405	2455	6.59	-0.127	0.127
4/28/99	3:01:07	2410	2460	6.6	-0.127	0.127
4/28/99	3:06:07	2415	2465	6.6	-0.127	0.127
4/28/99	3:11:07	2420	2470	6.6	-0.129	0.129
4/28/99	3:16:07	2425	2475	6.6	-0.129	0.129
4/28/99	3:21:07	2430	2480	6.6	-0.129	0.129
4/28/99	3:26:07	2435	2485	6.6	-0.129	0.129
4/28/99	3:31:07	2440	2490	6.6	-0.129	0.129
4/28/99	3:36:07	2445	2495	6.59	-0.129	0.129
4/28/99	3:41:07	2450	2500	6.6	-0.129	0.129
4/28/99	3:46:07	2455	2505	6.59	-0.131	0.131
4/28/99	3:51:07	2460	2510	6.59	-0.131	0.131
4/28/99	3:56:07	2465	2515	6.6	-0.129	0.129
4/28/99	4:01:07	2470	2520	6.6	-0.129	0.129
4/28/99	4:06:07	2475	2525	6.61	-0.131	0.131
4/28/99	4:11:07	2480	2530	6.6	-0.129	0.129
4/28/99	4:16:07	2485	2535	6.6	-0.131	0.131
4/28/99	4:21:07	2490	2540	6.6	-0.129	0.129
4/28/99	4:26:07	2495	2545	6.6	-0.127	0.127
4/28/99	4:31:07	2500	2550	6.6	-0.129	0.129
4/28/99	4:36:07	2505	2555	6.59	-0.131	0.131

Date	Time	ET (min)	Adjusted ET (min)	Celsius	MW-107S Feet H2O	drawdown
4/28/99	4:41:07	2510	2560	6.59	-0.131	0.131
4/28/99	4:46:07	2515	2565	6.6	-0.131	0.131
4/28/99	4:51:07	2520	2570	6.6	-0.131	0.131
4/28/99	4:56:07	2525	2575	6.6	-0.131	0.131
4/28/99	5:01:07	2530	2580	6.6	-0.134	0.134
4/28/99	5:06:07	2535	2585	6.6	-0.134	0.134
4/28/99	5:11:07	2540	2590	6.6	-0.134	0.134
4/28/99	5:16:07	2545	2595	6.59	-0.134	0.134
4/28/99	5:21:07	2550	2600	6.59	-0.134	0.134
4/28/99	5:26:07	2555	2605	6.59	-0.136	0.136
4/28/99	5:31:07	2560	2610	6.59	-0.134	0.134
4/28/99	5:36:07	2565	2615	6.6	-0.134	0.134
4/28/99	5:41:07	2570	2620	6.6	-0.134	0.134
4/28/99	5:46:07	2575	2625	6.6	-0.134	0.134
4/28/99	5:51:07	2580	2630	6.6	-0.136	0.136
4/28/99	5:56:07	2585	2635	6.61	-0.138	0.138
4/28/99	6:01:07	2590	2640	6.6	-0.138	0.138
4/28/99	6:06:07	2595	2645	6.6	-0.138	0.138
4/28/99	6:11:07	2600	2650	6.6	-0.138	0.138
4/28/99	6:16:07	2605	2655	6.6	-0.138	0.138
4/28/99	6:21:07	2610	2660	6.6	-0.141	0.141
4/28/99	6:26:07	2615	2665	6.6	-0.138	0.138
4/28/99	6:31:07	2620	2670	6.61	-0.143	0.143
4/28/99	6:36:07	2625	2675	6.6	-0.141	0.141
4/28/99	6:41:07	2630	2680	6.6	-0.138	0.138
4/28/99	6:46:07	2635	2685	6.59	-0.138	0.138
4/28/99	6:51:07	2640	2690	6.6	-0.141	0.141
4/28/99	6:56:07	2645	2695	6.6	-0.141	0.141
4/28/99	7:01:07	2650	2700	6.6	-0.141	0.141
4/28/99	7:06:07	2655	2705	6.6	-0.141	0.141
4/28/99	7:11:07	2660	2710	6.61	-0.143	0.143
4/28/99	7:16:07	2665	2715	6.61	-0.143	0.143
4/28/99	7:21:07	2670	2720	6.61	-0.143	0.143
4/28/99	7:26:07	2675	2725	6.61	-0.145	0.145
4/28/99	7:31:07	2680	2730	6.61	-0.145	0.145
4/28/99	7:36:07	2685	2735	6.61	-0.145	0.145
4/28/99	7:41:07	2690	2740	6.6	-0.143	0.143
4/28/99	7:46:07	2695	2745	6.6	-0.143	0.143
4/28/99	7:51:07	2700	2750	6.61	-0.145	0.145
4/28/99	7:56:07	2705	2755	6.61	-0.145	0.145
4/28/99	8:01:07	2710	2760	6.61	-0.148	0.148
4/28/99	8:06:07	2715	2765	6.61	-0.148	0.148
4/28/99	8:11:07	2720	2770	6.61	-0.148	0.148
4/28/99	8:16:07	2725	2775	6.61	-0.148	0.148
4/28/99	8:21:07	2730	2780	6.6	-0.148	0.148
4/28/99	8:26:07	2735	2785	6.61	-0.15	0.15
4/28/99	8:31:07	2740	2790	6.61	-0.15	0.15
4/28/99	8:36:07	2745	2795	6.61	-0.15	0.15
4/28/99	8:41:07	2750	2800	6.61	-0.152	0.152
4/28/99	8:46:07	2755	2805	6.61	-0.152	0.152
4/28/99	8:51:07	2760	2810	6.61	-0.152	0.152
4/28/99	8:56:07	2765	2815	6.61	-0.152	0.152
4/28/99	9:01:07	2770	2820	6.61	-0.155	0.155
4/28/99	9:06:07	2775	2825	6.61	-0.155	0.155
4/28/99	9:11:07	2780	2830	6.61	-0.152	0.152

Date	Time	ET (min)	Adjusted ET (min)	Celsius	MW-107S Feet H2O	drawdown
4/28/99	9:16:07	2785	2835	6.6	-0.152	0.152
4/28/99	9:21:07	2790	2840	6.6	-0.152	0.152
4/28/99	9:26:07	2795	2845	6.6	-0.152	0.152
4/28/99	9:31:07	2800	2850	6.61	-0.155	0.155
4/28/99	9:36:07	2805	2855	6.61	-0.157	0.157
4/28/99	9:41:07	2810	2860	6.61	-0.157	0.157
4/28/99	9:46:07	2815	2865	6.61	-0.157	0.157
4/28/99	9:51:07	2820	2870	6.61	-0.159	0.159
4/28/99	9:56:07	2825	2875	6.61	-0.157	0.157
4/28/99	10:01:07	2830	2880	6.61	-0.159	0.159
4/28/99	10:06:07	2835	2885	6.6	-0.157	0.157
4/28/99	10:11:07	2840	2890	6.6	-0.157	0.157
4/28/99	10:16:07	2845	2895	6.61	-0.159	0.159
4/28/99	10:21:07	2850	2900	6.61	-0.159	0.159
4/28/99	10:26:07	2855	2905	6.61	-0.161	0.161
4/28/99	10:31:07	2860	2910	6.61	-0.159	0.159
4/28/99	10:36:07	2865	2915	6.61	-0.159	0.159
4/28/99	10:41:07	2870	2920	6.61	-0.161	0.161
4/28/99	10:46:07	2875	2925	6.61	-0.159	0.159
4/28/99	10:51:07	2880	2930	6.61	-0.161	0.161
4/28/99	10:56:07	2885	2935	6.61	-0.161	0.161
4/28/99	11:01:07	2890	2940	6.61	-0.161	0.161
4/28/99	11:06:07	2895	2945	6.61	-0.161	0.161
4/28/99	11:11:07	2900	2950	6.6	-0.159	0.159
4/28/99	11:16:07	2905	2955	6.6	-0.157	0.157
4/28/99	11:21:07	2910	2960	6.61	-0.161	0.161
4/28/99	11:26:07	2915	2965	6.6	-0.159	0.159
4/28/99	11:31:07	2920	2970	6.61	-0.161	0.161
4/28/99	11:36:07	2925	2975	6.6	-0.159	0.159
4/28/99	11:41:07	2930	2980	6.61	-0.161	0.161
4/28/99	11:46:07	2935	2985	6.61	-0.161	0.161
4/28/99	11:51:07	2940	2990	6.61	-0.159	0.159
4/28/99	11:56:07	2945	2995	6.61	-0.161	0.161
4/28/99	12:01:07	2950	3000	6.61	-0.159	0.159
4/28/99	12:06:07	2955	3005	6.61	-0.159	0.159
4/28/99	12:11:07	2960	3010	6.61	-0.159	0.159
4/28/99	12:16:07	2965	3015	6.61	-0.159	0.159
4/28/99	12:21:07	2970	3020	6.61	-0.157	0.157
4/28/99	12:26:07	2975	3025	6.61	-0.157	0.157
4/28/99	12:31:07	2980	3030	6.61	-0.157	0.157
4/28/99	12:36:07	2985	3035	6.61	-0.157	0.157
4/28/99	12:41:07	2990	3040	6.61	-0.157	0.157
4/28/99	12:46:07	2995	3045	6.61	-0.157	0.157
4/28/99	12:51:07	3000	3050	6.61	-0.159	0.159
4/28/99	12:56:07	3005	3055	6.61	-0.159	0.159
4/28/99	13:01:07	3010	3060	6.61	-0.155	0.155
4/28/99	13:06:07	3015	3065	6.6	-0.157	0.157
4/28/99	13:11:07	3020	3070	6.61	-0.157	0.157
4/28/99	13:16:07	3025	3075	6.61	-0.159	0.159
4/28/99	13:21:07	3030	3080	6.61	-0.159	0.159
4/28/99	13:26:07	3035	3085	6.61	-0.157	0.157
4/28/99	13:31:07	3040	3090	6.61	-0.159	0.159
4/28/99	13:36:07	3045	3095	6.61	-0.157	0.157
4/28/99	13:41:07	3050	3100	6.61	-0.157	0.157
4/28/99	13:46:07	3055	3105	6.61	-0.159	0.159

			Adjusted		MW-107S	
Date	Time	ET (min)	ET (min)	Celsius	Feet H2O	drawdown
4/28/99	13:51:07	3060	3110	6.61	-0.159	0.159
4/28/99	13:56:07	3065	3115	6.61	-0.159	0.159
4/28/99	14:01:07	3070	3120	6.61	-0.157	0.157
4/28/99	14:06:07	3075	3125	6.61	-0.157	0.157
4/28/99	14:11:07	3080	3130	6.61	-0.157	0.157
4/28/99	14:16:07	3085	3135	6.61	-0.157	0.157
4/28/99	14:21:07	3090	3140	6.61	-0.157	0.157
4/28/99	14:26:07	3095	3145	6.61	-0.159	0.159
4/28/99	14:31:07	3100	3150	6.61	-0.161	0.161
4/28/99	14:36:07	3105	3155	6.6	-0.155	0.155
4/28/99	14:41:07	3110	3160	6.61	-0.157	0.157
4/28/99	14:46:07	3115	3165	6.61	-0.157	0.157
4/28/99	14:51:07	3120	3170	6.61	-0.157	0.157
4/28/99	14:56:07	3125	3175	6.61	-0.159	0.159
4/28/99	15:01:07	3130	3180	6.6	-0.157	0.157
4/28/99	15:06:07	3135	3185	6.61	-0.159	0.159
4/28/99	15:11:07	3140	3190	6.61	-0.159	0.159
4/28/99	15:16:07	3145	3195	6.61	-0.159	0.159
4/28/99	15:21:07	3150	3200	6.61	-0.157	0.157
4/28/99	15:26:07	3155	3205	6.61	-0.159	0.159
4/28/99	15:31:07	3160	3210	6.61	-0.159	0.159
4/28/99	15:36:07	3165	3215	6.61	-0.159	0.159
4/28/99	15:41:07	3170	3220	6.61	-0.157	0.157
4/28/99	15:46:07	3175	3225	6.61	-0.159	0.159
4/28/99	15:51:07	3180	3230	6.61	-0.161	0.161
4/28/99	15:56:07	3185	3235	6.61	-0.159	0.159
4/28/99	16:01:07	3190	3240	6.61	-0.159	0.159
4/28/99	16:06:07	3195	3245	6.61	-0.157	0.157
4/28/99	16:11:07	3200	3250	6.61	-0.159	0.159
4/28/99	16:16:07	3205	3255	6.61	-0.157	0.157
4/28/99	16:21:07	3210	3260	6.61	-0.159	0.159
4/28/99	16:26:07	3215	3265	6.61	-0.159	0.159
4/28/99	16:31:07	3220	3270	6.61	-0.161	0.161
4/28/99	16:36:07	3225	3275	6.61	-0.159	0.159
4/28/99	16:41:07	3230	3280	6.61	-0.159	0.159
4/28/99	16:46:07	3235	3285	6.61	-0.159	0.159
4/28/99	16:51:07	3240	3290	6.61	-0.157	0.157
4/28/99	16:56:07	3245	3295	6.61	-0.159	0.159
4/28/99	17:01:07	3250	3300	6.61	-0.159	0.159
4/28/99	17:06:07	3255	3305	6.61	-0.159	0.159
4/28/99	17:11:07	3260	3310	6.62	-0.159	0.159
4/28/99	17:16:07	3265	3315	6.61	-0.159	0.159
4/28/99	17:21:07	3270	3320	6.61	-0.161	0.161
4/28/99	17:26:07	3275	3325	6.61	-0.159	0.159

PW-1

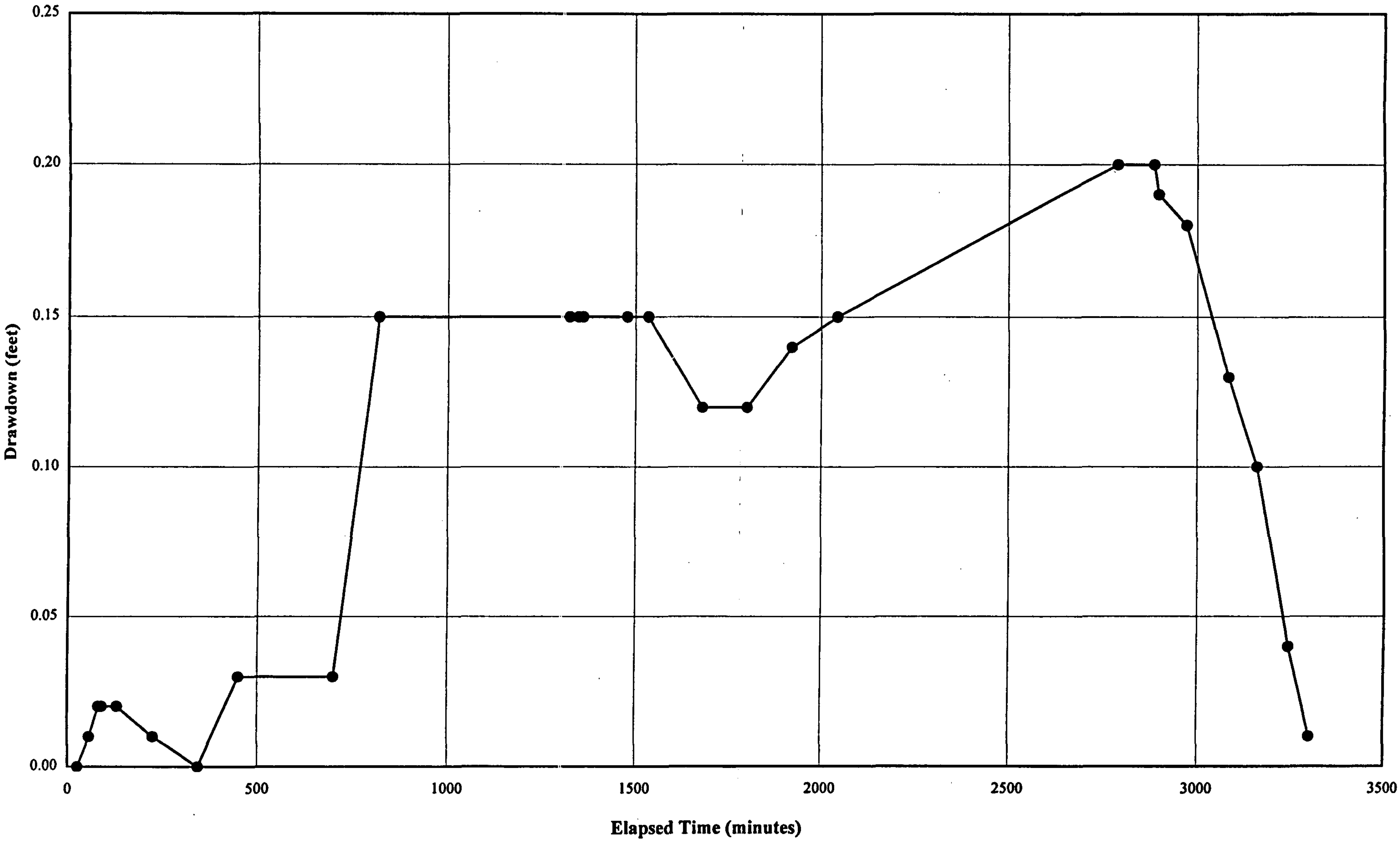
PW-2 PUMP TEST
OBSERVATION WELL DRAWDOWN

Total Depth = 49.88 TOR
Static Water Level= 17.67 TOR

Time	Depth	Elapsed time		drawdown	Feet H2O
04/26/99 10:12	**17.67**	**0**	ZERO TIME	0.00	32.21
04/26/99 10:38	17.67	26		0.00	32.21
04/26/99 11:10	**17.66**	**58**	**started pump test at 11:10 a.m.**	0.01	32.22
04/26/99 11:34	17.65	82		0.02	32.23
04/26/99 11:43	17.65	91		0.02	32.23
04/26/99 12:23	17.65	131		0.02	32.23
04/26/99 13:58	17.66	226		0.01	32.22
04/26/99 15:57	17.67	345		0.00	32.21
04/26/99 17:42	17.70	450		0.03	32.18
04/26/99 21:52	17.70	700		0.03	32.18
04/26/99 23:50	**17.82**	**818**	***foot valve malfunction in pumping well; water levels recovered*** ***end of day 1***	0.15	32.06
04/27/99 08:16	**17.82**	**1324**	**turned Waterra pump off; replaced foot valve**	0.15	32.06
04/27/99 08:39	**17.82**	**1347**	**turned Waterra pump on**	0.15	32.06
04/27/99 08:52	17.82	1360		0.15	32.06
04/27/99 10:50	17.82	1478		0.15	32.06
04/27/99 11:47	17.82	1535		0.15	32.06
04/27/99 14:13	17.79	1681		0.12	32.09
04/27/99 16:13	17.79	1801		0.12	32.09
04/27/99 18:13	17.81	1921		0.14	32.07
04/27/99 20:16	17.82	2044	***end of day 2***	0.15	32.06
04/28/99 08:41	17.87	2789		0.20	32.01
04/28/99 10:18	17.87	2886		0.20	32.01
04/28/99 10:30	**17.86**	**2898**	**turned Waterra pump off**	0.19	32.02
04/28/99 11:44	17.85	2972		0.18	32.03
04/28/99 13:34	17.80	3082		0.13	32.08
04/28/99 14:51	17.77	3159		0.10	32.11
04/28/99 16:14	17.71	3242		0.04	32.17
04/28/99 17:11	17.68	3299	***end of day 3***	0.01	32.20

PW-1

PW-2 PUMP TEST
OBSERVATION WELL DRAWDOWN vs. TIME



PW-2 PUMP TEST
OBSERVATION WELL DRAWDOWN

Total Depth = 18.58 TOR
Static Water Level= 6.55 TOR

Time	Depth	Elapsed time		drawdown	Feet H2O
04/26/99 10:12	6.55	0	ZERO TIME	0.00	12.03
04/26/99 10:35	6.55	23		0.00	12.03
04/26/99 11:10	6.55	58	started pump test at 11:10 a.m.	0.00	12.03
04/26/99 11:33	6.54	81		0.01	12.04
04/26/99 11:42	6.54	90		0.01	12.04
04/26/99 12:22	6.54	130		0.01	12.04
04/26/99 13:55	6.54	223		0.01	12.04
04/26/99 15:55	6.55	343		0.00	12.03
04/26/99 17:39	6.56	447		0.01	12.02
04/26/99 21:47	6.61	695		0.06	11.97
04/26/99 23:50	6.61	818	*foot valve malfunction in pumping well; water levels recovered* *end of day 1*	0.06	11.97
04/27/99 08:16	6.61	1324	turned Waterra pump off; replaced foot valve	0.06	11.97
04/27/99 08:39	6.61	1347	turned Waterra pump on	0.06	11.97
04/27/99 08:49	6.61	1357		0.06	11.97
04/27/99 10:46	6.53	1474		0.02	12.05
04/27/99 11:44	6.51	1532		0.04	12.07
04/27/99 14:11	6.51	1679		0.04	12.07
04/27/99 16:11	6.53	1799		0.02	12.05
04/27/99 18:10	6.55	1918		0.00	12.03
04/27/99 20:13	6.57	2041	*end of day 2*	0.02	12.01
04/28/99 08:38	6.66	2786		0.11	11.92
04/28/99 10:14	6.68	2882		0.13	11.90
04/28/99 10:30	6.68	2898	turned Waterra pump off	0.13	11.90
04/28/99 11:41	6.66	2969		0.11	11.92
04/28/99 13:29	6.65	3077		0.10	11.93
04/28/99 13:57	6.65	3105		0.10	11.93
04/28/99 14:07	6.64	3115	started infiltration test near MW-108 well cluster	0.09	11.94
04/28/99 14:15	6.65	3123		0.10	11.93
04/28/99 14:24	6.64	3132		0.09	11.94

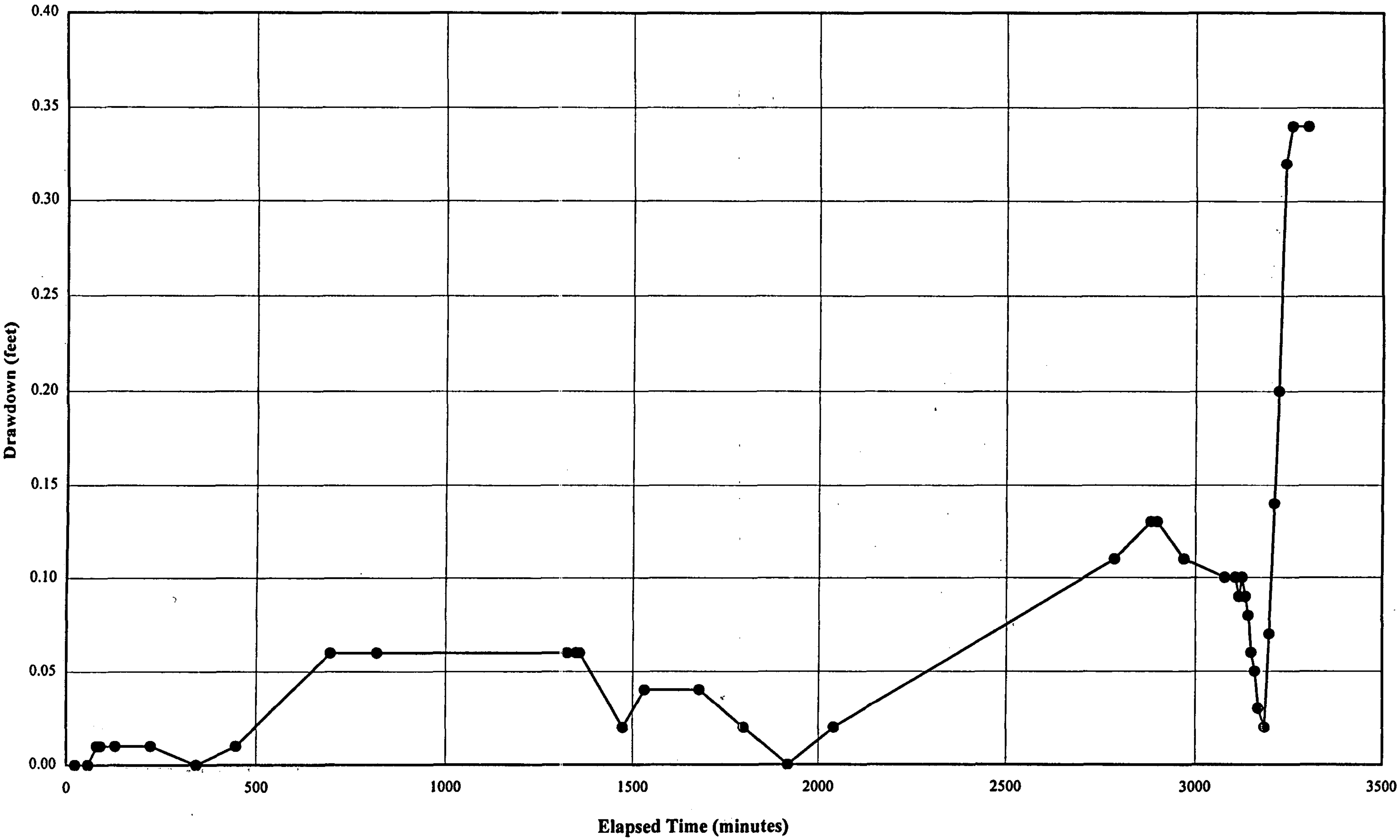
MW-108S

PW-2 PUMP TEST
OBSERVATION WELL DRAWDOWN

Time	Depth	Elapsed time		drawdown	Feet H2O
04/28/99 14:32	6.63	3140		0.08	11.95
04/28/99 14:39	6.61	3147		0.06	11.97
04/28/99 14:49	6.60	3157		0.05	11.98
04/28/99 14:59	6.58	3167		0.03	12.00
04/28/99 15:15	6.53	3183		0.02	12.05
04/28/99 15:27	6.48	3195		0.07	12.10
04/28/99 15:41	6.41	3209		0.14	12.17
04/28/99 15:51	6.35	3219		0.20	12.23
04/28/99 16:10	6.23	3238		0.32	12.35
04/28/99 16:26	6.21	3254		0.34	12.37
04/28/99 17:08	6.21	3296	*end of day 3*	0.34	12.37

MW-108S

PW-2 PUMP TEST
OBSERVATION WELL DRAWDOWN vs. TIME



PW-2 PUMP TEST
OBSERVATION WELL DRAWDOWN

Total Depth =	42.63	TOR
Static Water Level=	8.25	TOR

Time	Depth	Elapsed time		drawdown	Feet H2O
04/26/99 10:12	8.25	0	ZERO TIME	0.00	34.38
04/26/99 10:36	8.25	24		0.00	34.38
04/26/99 11:10	8.24	58	started pump test at 11:10 a.m.	0.01	34.39
04/26/99 11:32	8.23	80		0.02	34.40
04/26/99 11:41	8.23	89		0.02	34.40
04/26/99 12:20	8.21	128		0.04	34.42
04/26/99 13:56	8.19	224		0.06	34.44
04/26/99 15:56	8.16	344		0.09	34.47
04/26/99 17:40	8.15	448		0.10	34.48
04/26/99 21:49	8.18	697		0.07	34.45
04/26/99 23:50	8.19	818	*foot valve malfunction in pumping well; water levels recovered end of day 1*	0.06	34.44
04/27/99 08:16	8.20	1324	turned Waterra pump off; replaced foot valve	0.05	34.43
04/27/99 08:39	8.20	1347	turned Waterra pump on	0.05	34.43
04/27/99 08:50	8.21	1358		0.04	34.42
04/27/99 10:48	8.23	1476		0.02	34.40
04/27/99 11:46	8.24	1534		0.01	34.39
04/27/99 14:12	8.24	1680		0.01	34.39
04/27/99 16:12	8.24	1800		0.01	34.39
04/27/99 18:11	8.24	1919		0.01	34.39
04/27/99 20:14	8.25	2042	*end of day 2*	0.00	34.38
04/28/99 08:39	8.29	2787		0.04	34.34
04/28/99 10:16	8.31	2884		0.06	34.32
04/28/99 10:30	8.31	2898	turned Waterra pump off	0.06	34.32
04/28/99 11:42	8.31	2970		0.06	34.32
04/28/99 13:30	8.31	3078		0.06	34.32
04/28/99 13:57	8.30	3105		0.05	34.33
04/28/99 14:07	8.30	3115	started infiltration test near MW-108 well cluster	0.05	34.33
04/28/99 14:16	8.30	3124		0.05	34.33
04/28/99 14:22	8.30	3130		0.05	34.33

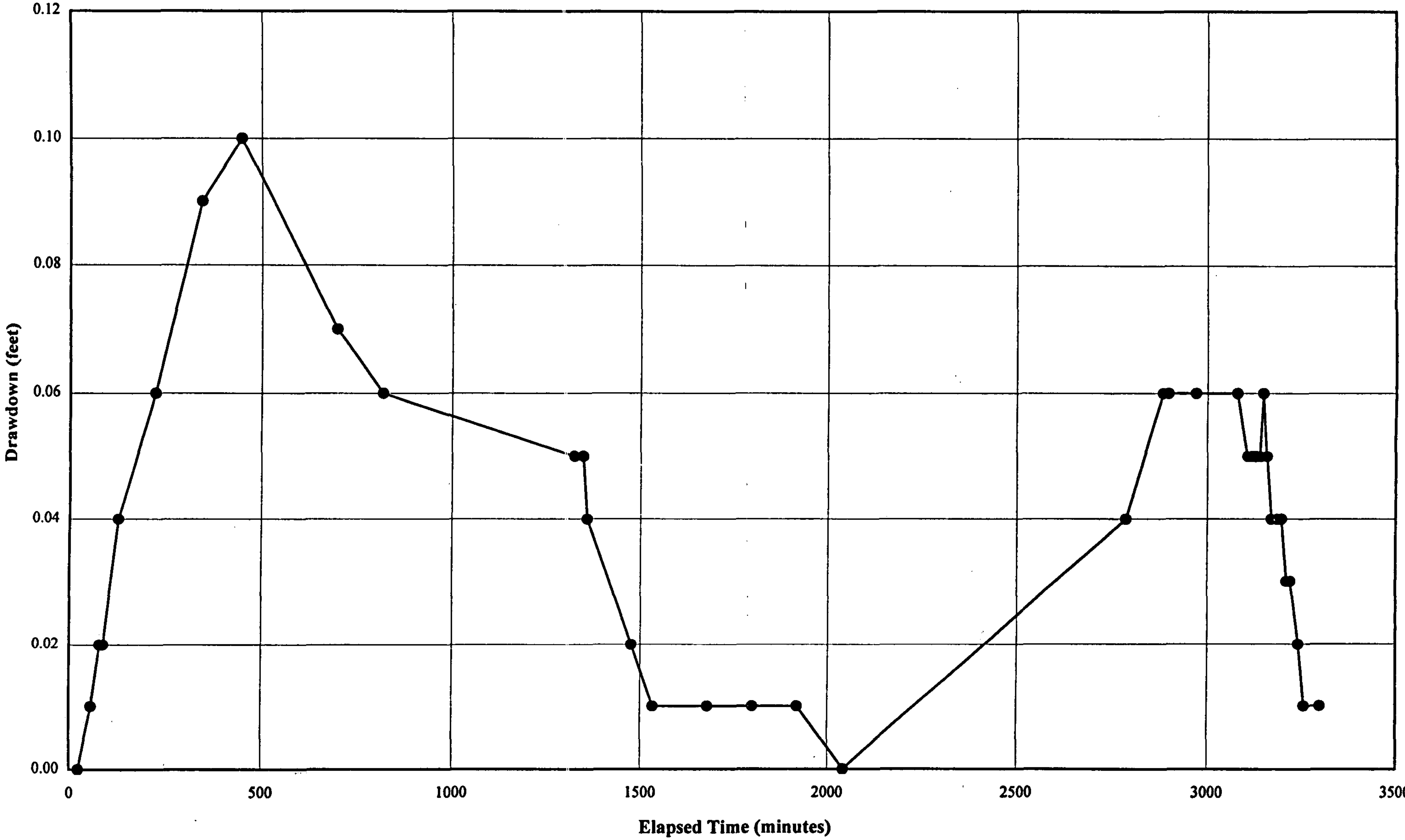
MW-108D

PW-2 PUMP TEST
OBSERVATION WELL DRAWDOWN

Time	Depth	Elapsed time		drawdown	Feet H2O
04/28/99 14:30	8.30	3138		0.05	34.33
04/28/99 14:38	8.31	3146		0.06	34.32
04/28/99 14:48	8.30	3156		0.05	34.33
04/28/99 15:00	8.29	3168		0.04	34.34
04/28/99 15:14	8.29	3182		0.04	34.34
04/28/99 15:26	8.29	3194		0.04	34.34
04/28/99 15:40	8.28	3208		0.03	34.35
04/28/99 15:50	8.28	3218		0.03	34.35
04/28/99 16:11	8.27	3239		0.02	34.36
04/28/99 16:27	8.26	3255		0.01	34.37
04/28/99 17:09	8.26	3297	*end of day 3*	0.01	34.37

MW-108D

PW-2 PUMP TEST
OBSERVATION WELL DRAWDOWN vs. TIME



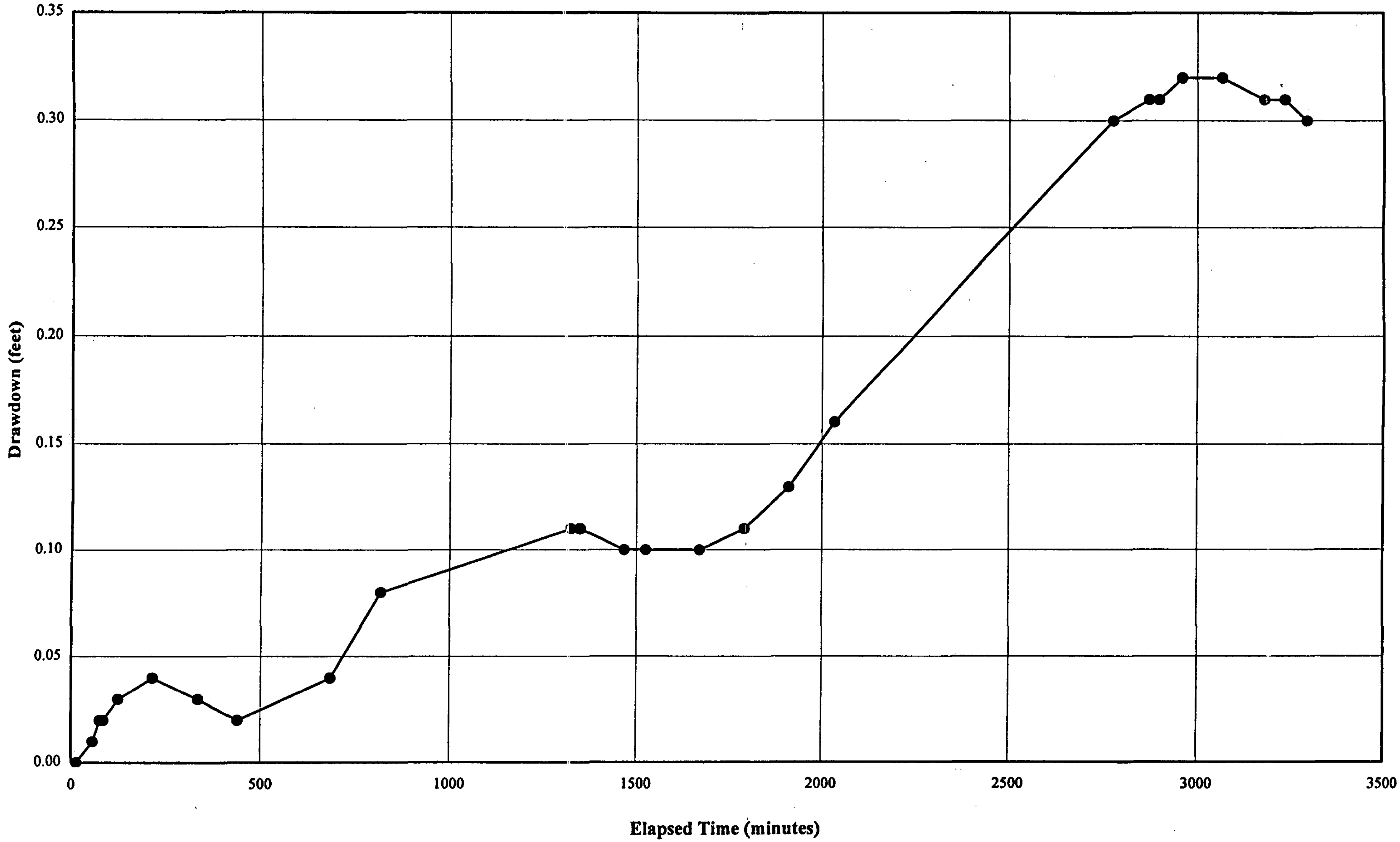
PW-2 PUMP TEST
OBSERVATION WELL DRAWDOWN

Total Depth = 22.03 TOR
Static Water Level= 5.35 TOR

Time	Depth	Elapsed time		drawdown	Feet H2O
04/26/99 10:12	5.35	0	ZERO TIME	0.00	16.68
04/26/99 10:26	5.35	14		0.00	16.68
04/26/99 11:10	5.34	58	started pump test at 11:10 a.m.	0.01	16.69
04/26/99 11:29	5.33	77		0.02	16.70
04/26/99 11:38	5.33	86		0.02	16.70
04/26/99 12:17	5.32	125		0.03	16.71
04/26/99 13:48	5.31	216		0.04	16.72
04/26/99 15:48	5.32	336		0.03	16.71
04/26/99 17:32	5.33	440		0.02	16.70
04/26/99 21:36	5.39	684		0.04	16.64
04/26/99 23:50	5.43	818	*foot valve malfunction in pumping well; water levels recovered* *end of day 1*	0.08	16.60
04/27/99 08:16	5.46	1324	turned Waterra pump off; replaced foot valve	0.11	16.57
04/27/99 08:39	5.46	1347	turned Waterra pump on	0.11	16.57
04/27/99 08:41	5.46	1349		0.11	16.57
04/27/99 10:39	5.45	1467		0.10	16.58
04/27/99 11:37	5.45	1525		0.10	16.58
04/27/99 14:02	5.45	1670		0.10	16.58
04/27/99 16:03	5.46	1791		0.11	16.57
04/27/99 18:02	5.48	1910		0.13	16.55
04/27/99 20:06	5.51	2034	*end of day 2*	0.16	16.52
04/28/99 08:28	5.65	2776		0.30	16.38
04/28/99 10:04	5.66	2872		0.31	16.37
04/28/99 10:30	5.66	2898	turned Waterra pump off	0.31	16.37
04/28/99 11:32	5.67	2960		0.32	16.36
04/28/99 13:18	5.67	3066		0.32	16.36
04/28/99 15:09	5.66	3177		0.31	16.37
04/28/99 16:03	5.66	3231		0.31	16.37
04/28/99 17:02	5.65	3290	*end of day 3*	0.30	16.38

PW-3

PW-2 PUMP TEST
OBSERVATION WELL DRAWDOWN vs. TIME



MW-107D

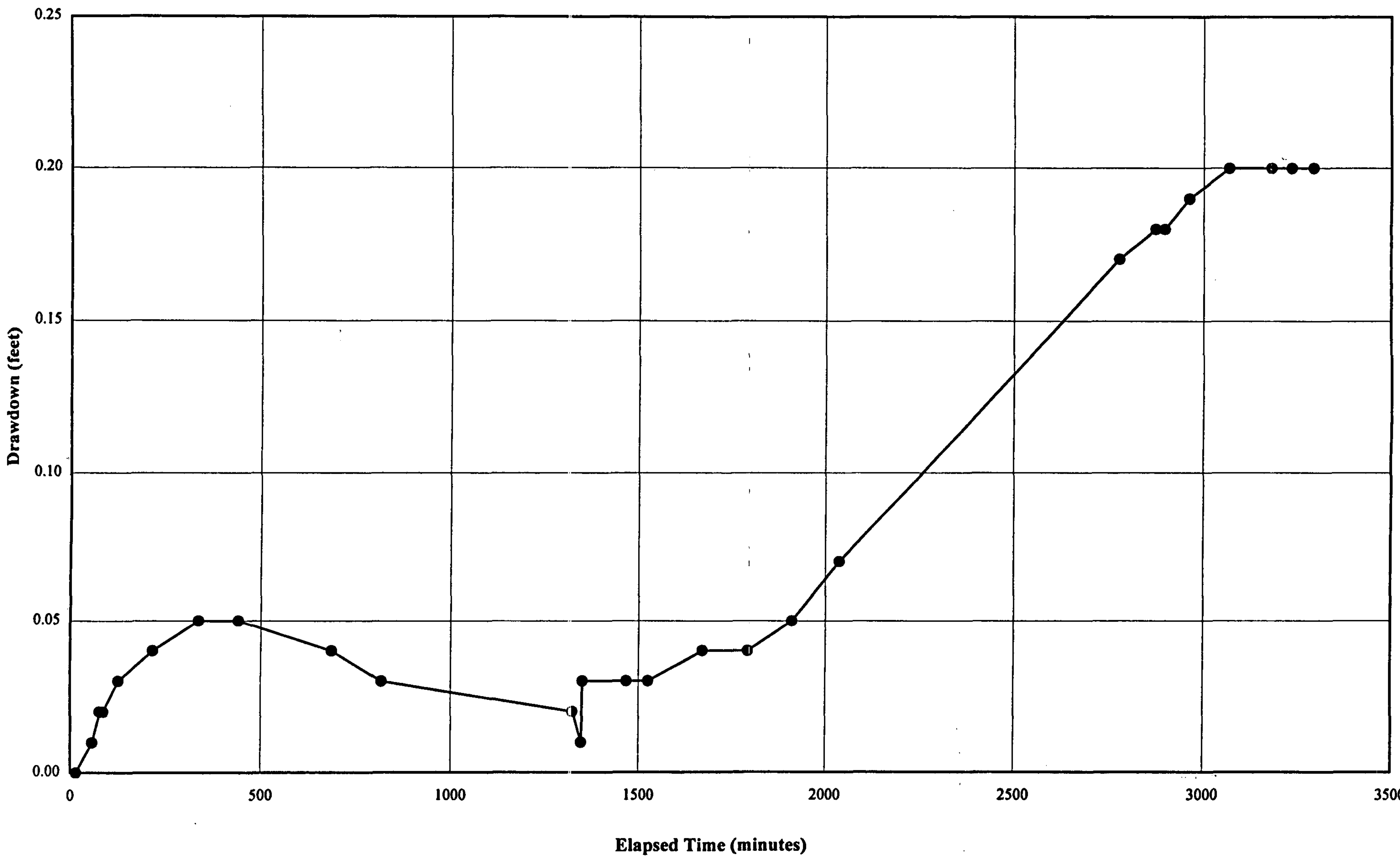
PW-2 PUMP TEST
OBSERVATION WELL DRAWDOWN

Total Depth = 26.26 TOR
Static Water Level= 9.42 TOR

Time	Depth	Elapsed time		drawdown	Feet H2O
04/26/99 10:12	9.42	0	ZERO TIME	0.00	16.84
04/26/99 10:27	9.42	15		0.00	16.84
04/26/99 11:10	9.41	58	started pump test at 11:10 a.m.	0.01	16.85
04/26/99 11:30	9.40	78		0.02	16.86
04/26/99 11:39	9.40	87		0.02	16.86
04/26/99 12:19	9.39	127		0.03	16.87
04/26/99 13:49	9.38	217		0.04	16.88
04/26/99 15:49	9.37	337		0.05	16.89
04/26/99 17:33	9.37	441		0.05	16.89
04/26/99 21:38	9.38	686		0.04	16.88
04/26/99 23:50	9.39	818	*foot valve malfunction in pumping well; water levels recovered* *end of day 1*	0.03	16.87
04/27/99 08:16	9.40	1324	turned Waterra pump off; replaced foot valve	0.02	16.86
04/27/99 08:39	9.43	1347	turned Waterra pump on	0.01	16.83
04/27/99 08:43	9.45	1351		0.03	16.81
04/27/99 10:40	9.45	1468		0.03	16.81
04/27/99 11:38	9.45	1526		0.03	16.81
04/27/99 14:03	9.46	1671		0.04	16.80
04/27/99 16:04	9.46	1792		0.04	16.80
04/27/99 18:02	9.47	1910		0.05	16.79
04/27/99 20:09	9.49	2037	*end of day 2*	0.07	16.77
04/28/99 08:30	9.59	2778		0.17	16.67
04/28/99 10:06	9.60	2874		0.18	16.66
04/28/99 10:30	9.60	2898	turned Waterra pump off	0.18	16.66
04/28/99 11:34	9.61	2962		0.19	16.65
04/28/99 13:19	9.62	3067		0.20	16.64
04/28/99 15:10	9.62	3178		0.20	16.64
04/28/99 16:04	9.62	3232		0.20	16.64
04/28/99 17:02	9.62	3290	*end of day 3*	0.20	16.64

MW-107D

PW-2 PUMP TEST
OBSERVATION WELL DRAWDOWN vs. TIME

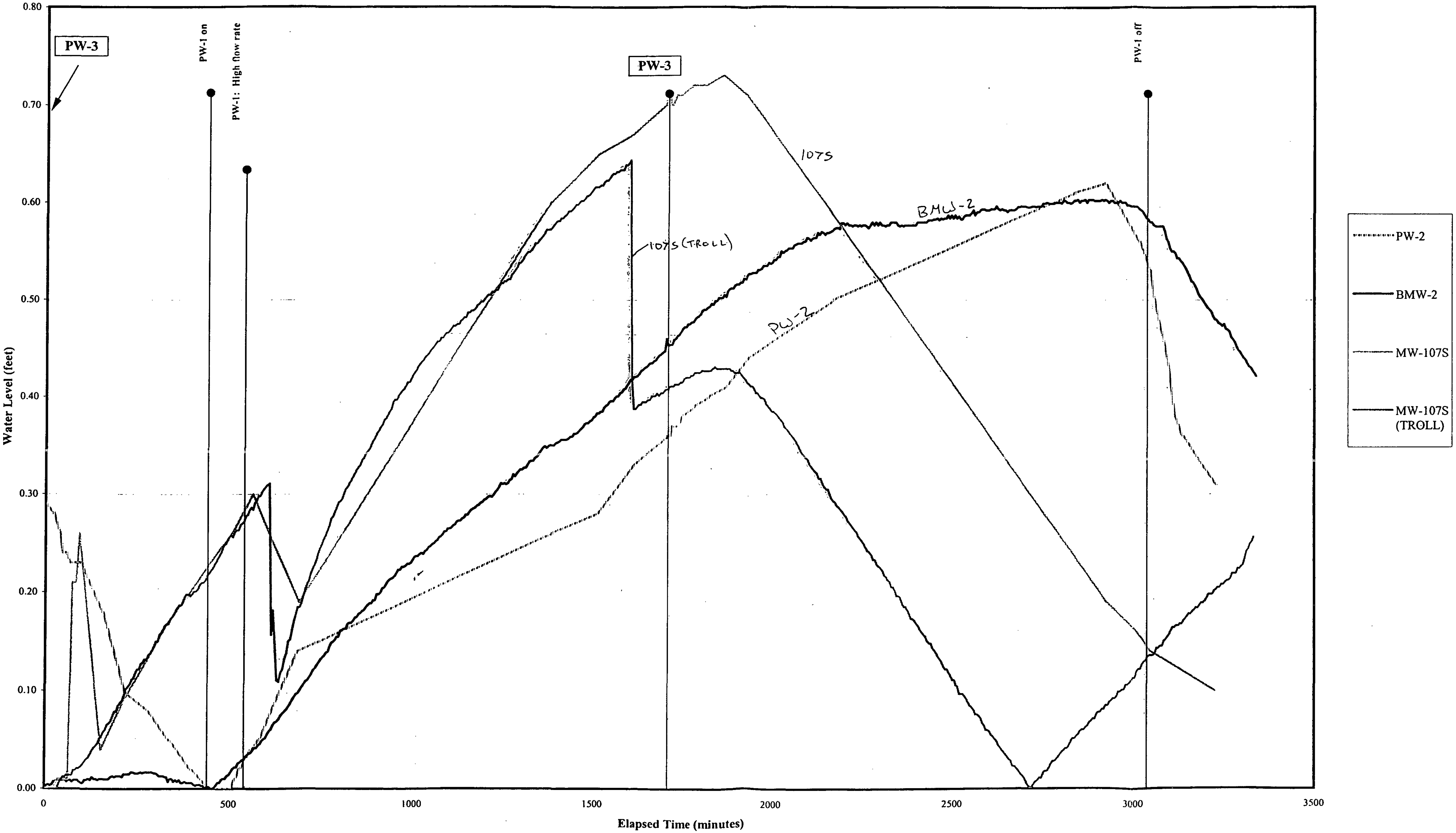


ATTACHMENT 4

PW-3 Data

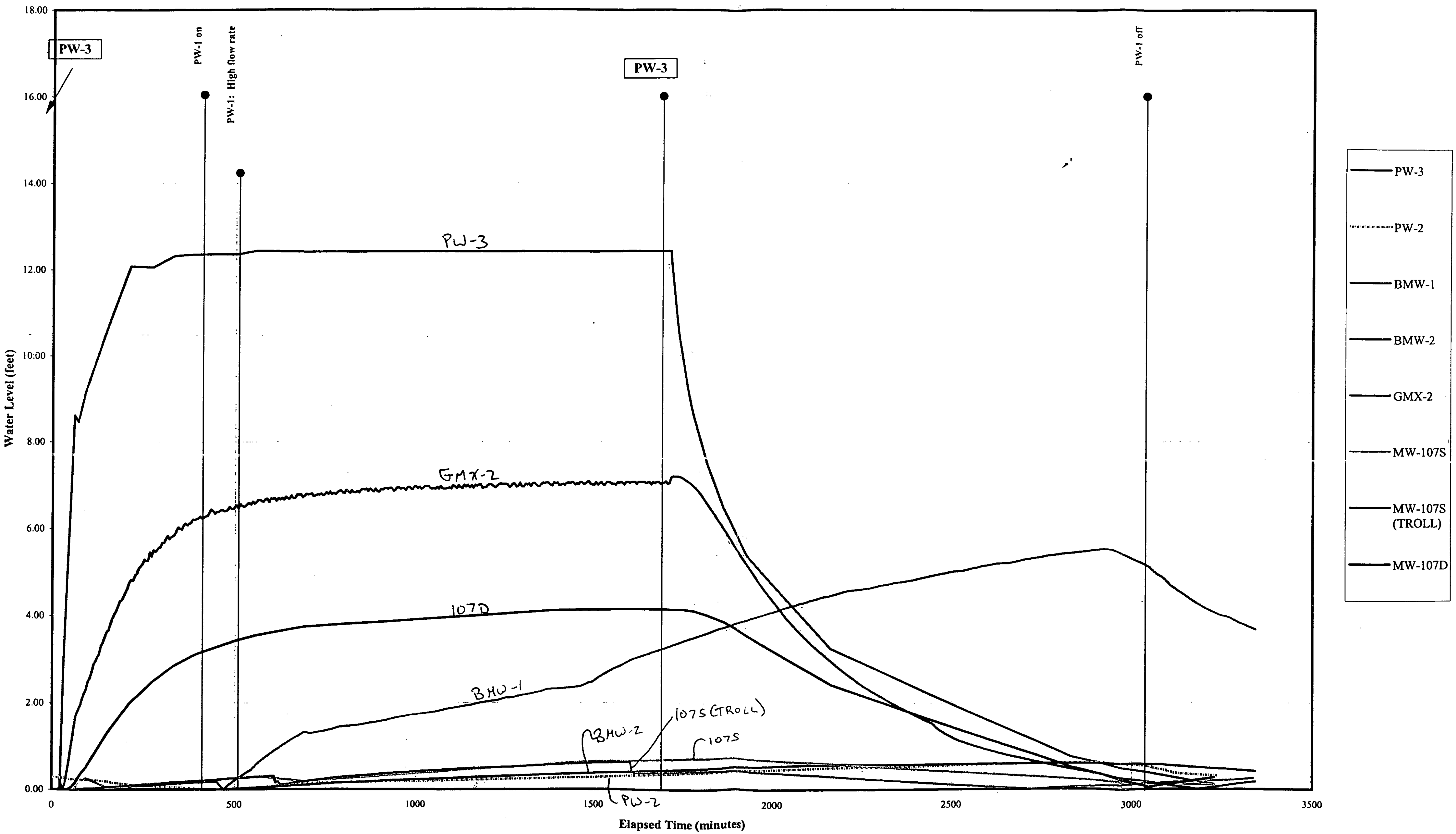
PW-3
PUMPING TEST

SUMMARY OF DATA LOGGER RESULTS



PW-3
PUMPING TEST

SUMMARY OF DRAWDOWN RESULTS



MW-107S

PW-3 PUMP TEST
OBSERVATION WELL DRAWDOWN

Total Depth (feet) =	**17.43**	**TOR**
Static Water Level=	**6.69**	**TOR**

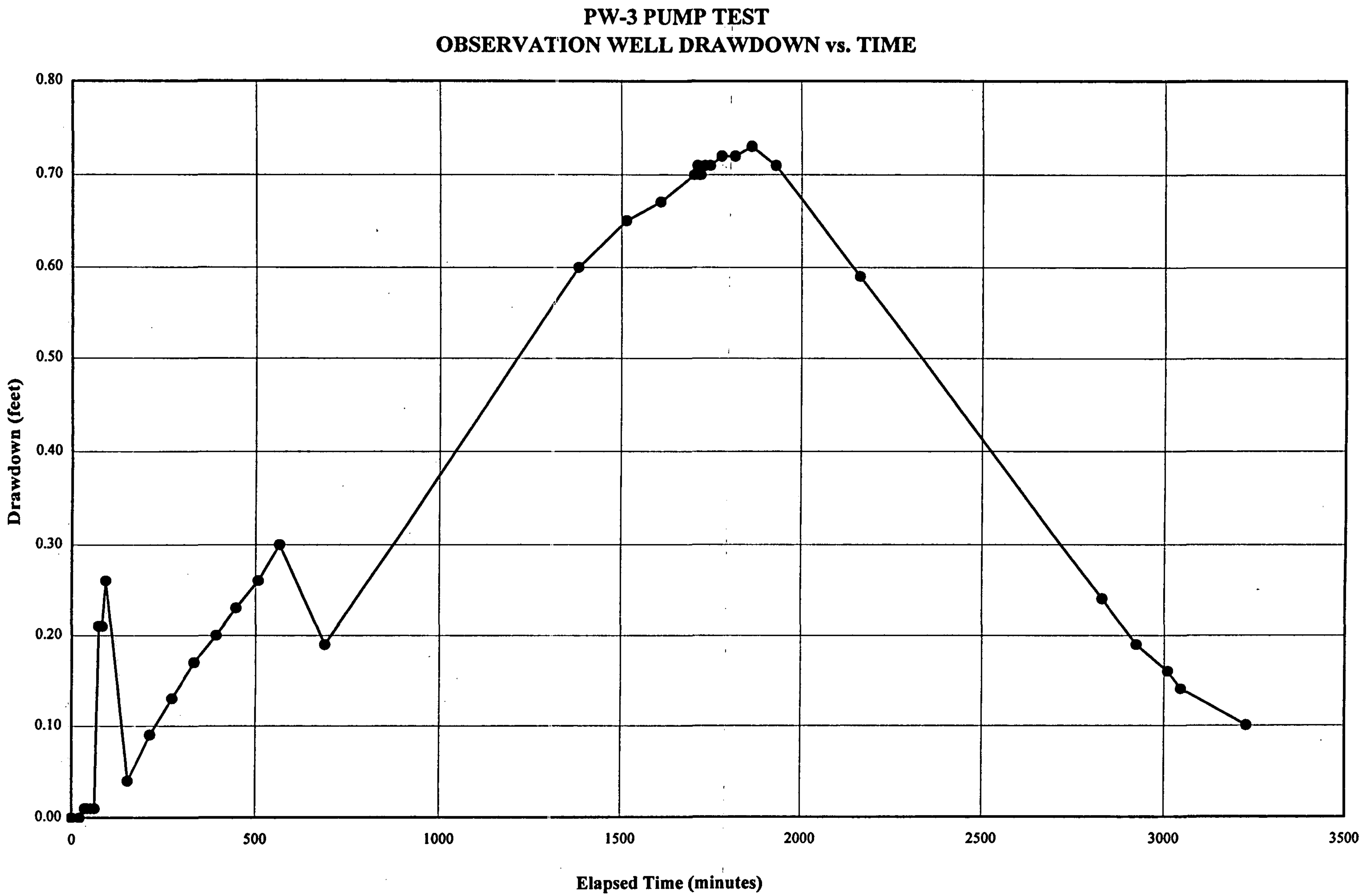
Time	Depth	Elapsed time	Comment	change	Feet H20
04/21/99 08:50	6.69	0		0.00	10.74
04/21/99 09:08	**6.69**	**0**	**ZERO TIME**	0.00	10.74
04/21/99 09:30	**6.69**	**22**	**PW-3: started pump test at 09:30 a.m.**	0.00	10.74
04/21/99 09:44	6.68	36		0.01	10.75
04/21/99 09:51	6.68	43		0.01	10.75
04/21/99 10:01	6.68	53		0.01	10.75
04/21/99 10:11	6.68	63		0.01	10.75
04/21/99 10:21	6.90	73		0.21	10.53
04/21/99 10:31	6.90	83		0.21	10.53
04/21/99 10:41	6.95	93		0.26	10.48
04/21/99 11:41	6.73	153		0.04	10.7
04/21/99 12:41	6.78	213		0.09	10.65
04/21/99 13:41	6.82	273		0.13	10.61
04/21/99 14:41	6.86	333		0.17	10.57
04/21/99 15:41	6.89	393		0.20	10.54
04/21/99 16:35	**6.92**	**447**	**PW-1: started pump test at 16:35 p.m.**	0.23	10.51
04/21/99 17:35	6.95	507	**PW-1: turned Grundfos pump on at 18:13 p.m.**	0.26	10.48
04/21/99 18:32	6.99	564	**PW-1: turned Grundfos pump off at 20:39 p.m.**	0.30	10.44
04/21/99 20:36	6.88	688	***end of day 1***	0.19	10.55
04/22/99 08:09	7.29	1381		0.60	10.14
04/22/99 10:22	7.34	1514	**PW-1: turned Grundfos pump on at 10:00 a.m.**	0.65	10.09
04/22/99 11:58	7.36	1610		0.67	10.07
04/22/99 13:30	7.39	1702		0.70	10.04
04/22/99 13:40	**7.40**	**1712**	**PW-3: turned off pump at 13:40 p.m.**	0.71	10.03
04/22/99 13:44	7.39	1716		0.70	10.04
04/22/99 13:49	7.39	1721		0.70	10.04
04/22/99 14:01	7.40	1733		0.71	10.03
04/22/99 14:15	7.40	1747		0.71	10.03

MW-107S

PW-3 PUMP TEST
OBSERVATION WELL DRAWDOWN

Time	Depth	Elapsed time	Comment	change	Feet H20
04/22/99 14:47	7.41	1779		0.72	10.02
04/22/99 15:24	7.41	1816		0.72	10.02
04/22/99 16:10	7.42	1862		0.73	10.01
04/22/99 17:17	7.40	1929		0.71	10.03
04/22/99 21:10	7.28	2162	*end of day 2*	0.59	10.15
04/23/99 08:18	6.93	2830		0.24	10.5
04/23/99 09:52	6.88	2924		0.19	10.55
04/23/99 11:18	6.85	3010		0.16	10.58
04/23/99 11:54	**6.83**	**3046**	**- turned off PW-1 Waterra pump at ~10:00 a.m.** **- turned Grundfos pump off at 11:54 a.m.**	0.14	10.6
04/23/99 14:54	6.79	3226	*end of day 3*	0.10	10.64

MW-107S


PW-3 PUMP TEST
OBSERVATION WELL DRAWDOWN vs. TIME
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
Drawdown (feet)
0
500
1000
1500
2000
2500
3000
3500
Elapsed Time (minutes)

PW-2

PW-3 PUMP TEST
OBSERVATION WELL DRAWDOWN

Total Depth (feet) = 26.24 TOR
Static Water Level= 8.10 TOR

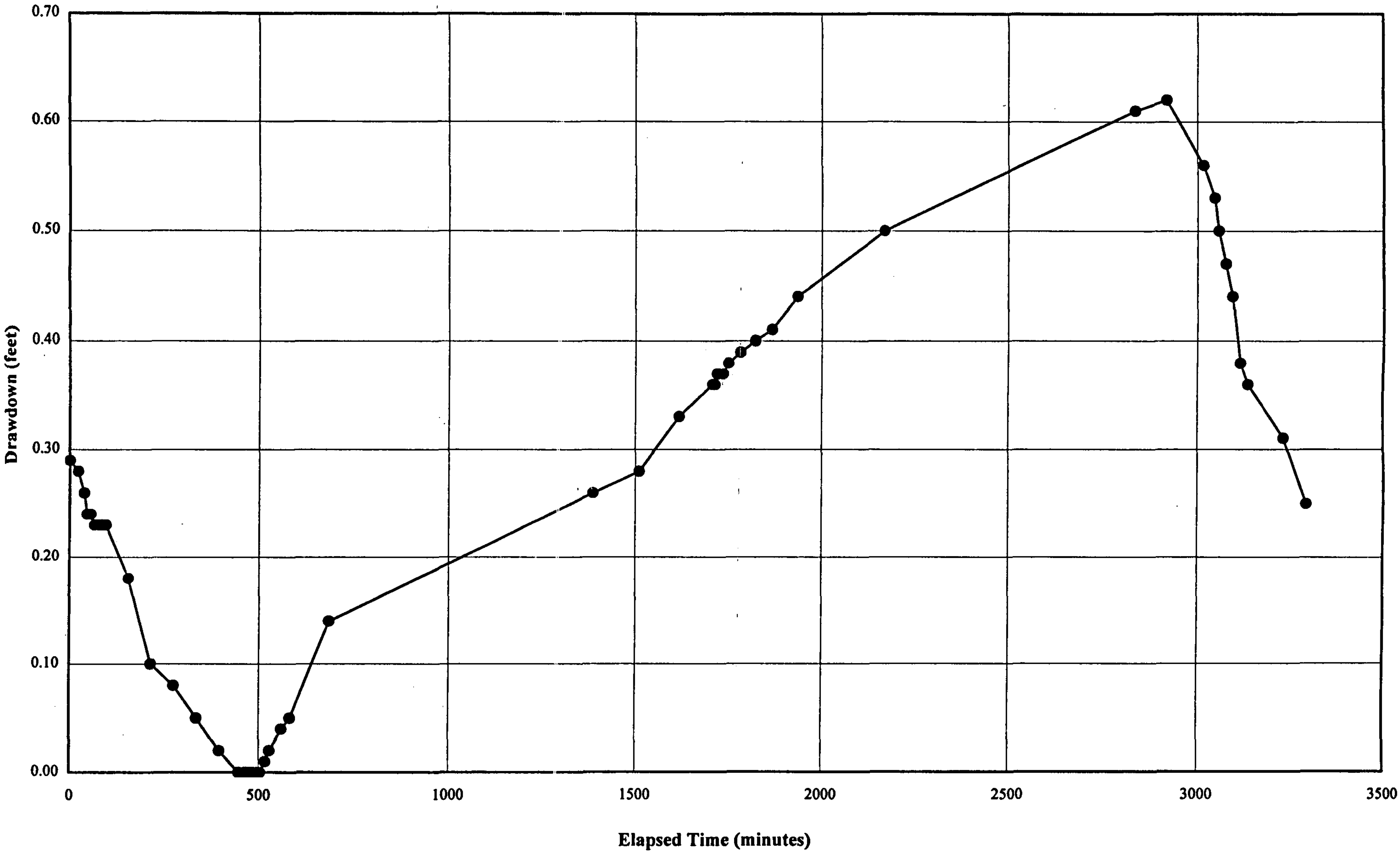
Time	Depth	Elapsed time	Comment	drawdown	Feet H20
04/21/99 08:43	8.39	0		0.29	17.85
04/21/99 09:08	8.39	0	ZERO TIME	0.29	17.85
04/21/99 09:30	8.38	22	PW-3: started pump test at 09:30 a.m.	0.28	17.86
04/21/99 09:47	8.36	39		0.26	17.88
04/21/99 09:54	8.34	46		0.24	17.9
04/21/99 10:04	8.34	56		0.24	17.9
04/21/99 10:14	8.33	66		0.23	17.91
04/21/99 10:25	8.33	77		0.23	17.91
04/21/99 10:35	8.33	87		0.23	17.91
04/21/99 10:44	8.33	96		0.23	17.91
04/21/99 11:45	8.28	157		0.18	17.96
04/21/99 12:44	8.20	216		0.10	18.04
04/21/99 13:44	8.18	276		0.08	18.06
04/21/99 14:44	8.15	336		0.05	18.09
04/21/99 15:44	8.12	396		0.02	18.12
04/21/99 16:35	8.10	447	PW-1: started pump test at 16:35 p.m.	0.00	18.14
04/21/99 16:53	8.10	465		0.00	18.14
04/21/99 17:02	8.10	474		0.00	18.14
04/21/99 17:12	8.10	484		0.00	18.14
04/21/99 17:24	8.10	496		0.00	18.14
04/21/99 17:32	8.10	504		0.00	18.14
04/21/99 17:45	8.11	517		0.01	18.13
04/21/99 17:56	8.12	528		0.02	18.12
04/21/99 18:28	8.14	560	PW-1: turned Grundfos pump on at 18:13 p.m.	0.04	18.1
04/21/99 18:50	8.15	582	PW-1: turned Grundfos pump off at 20:39 p.m.	0.05	18.09
04/21/99 20:32	8.24	684	*end of day 1*	0.14	18
04/22/99 08:15	8.36	1387		0.26	17.88
04/22/99 10:18	8.38	1510	PW-1: turned Grundfos pump on at 10:00 a.m.	0.28	17.86

PW-3 PUMP TEST
OBSERVATION WELL DRAWDOWN

Time	Depth	Elapsed time	Comment	drawdown	Feet H20
04/22/99 12:06	8.43	1618		0.33	17.81
04/22/99 13:35	8.46	1707		0.36	17.78
04/22/99 13:40	8.46	1712	PW-3: turned off pump at 13:40 p.m.	0.36	17.78
04/22/99 13:42	8.46	1714		0.36	17.78
04/22/99 13:47	8.47	1719		0.37	17.77
04/22/99 13:51	8.47	1723		0.37	17.77
04/22/99 14:04	8.47	1736		0.37	17.77
04/22/99 14:18	8.48	1750		0.38	17.76
04/22/99 14:50	8.49	1782		0.39	17.75
04/22/99 15:30	8.50	1822		0.40	17.74
04/22/99 16:15	8.51	1867		0.41	17.73
04/22/99 17:24	8.54	1936		0.44	17.7
04/22/99 21:17	8.60	2169	*end of day 2*	0.50	17.64
04/23/99 08:24	8.71	2836		0.61	17.53
04/23/99 09:47	8.72	2919		0.62	17.52
04/23/99 11:24	8.66	3016		0.56	17.58
04/23/99 11:54	8.63	3046	- turned off PW-1 Waterra pump at ~10:00 a.m. - turned Grundfos pump off at 11:54 a.m.	0.53	17.61
04/23/99 12:05	8.60	3057		0.50	17.64
04/23/99 12:23	8.57	3075		0.47	17.67
04/23/99 12:41	8.54	3093		0.44	17.7
04/23/99 13:02	8.48	3114		0.38	17.76
04/23/99 13:22	8.46	3134		0.36	17.78
04/23/99 14:58	8.41	3230		0.31	17.83
04/23/99 15:59	8.35	3291	*end of day 3*	0.25	17.89

PW-2

PW-3 PUMP TEST
OBSERVATION WELL DRAWDOWN vs. TIME



MW-107D

PW-3 PUMP TEST
OBSERVATION WELL DRAWDOWN

Total Depth (feet) =	26.26	TOR
Static Water Level=	11.28	TOR

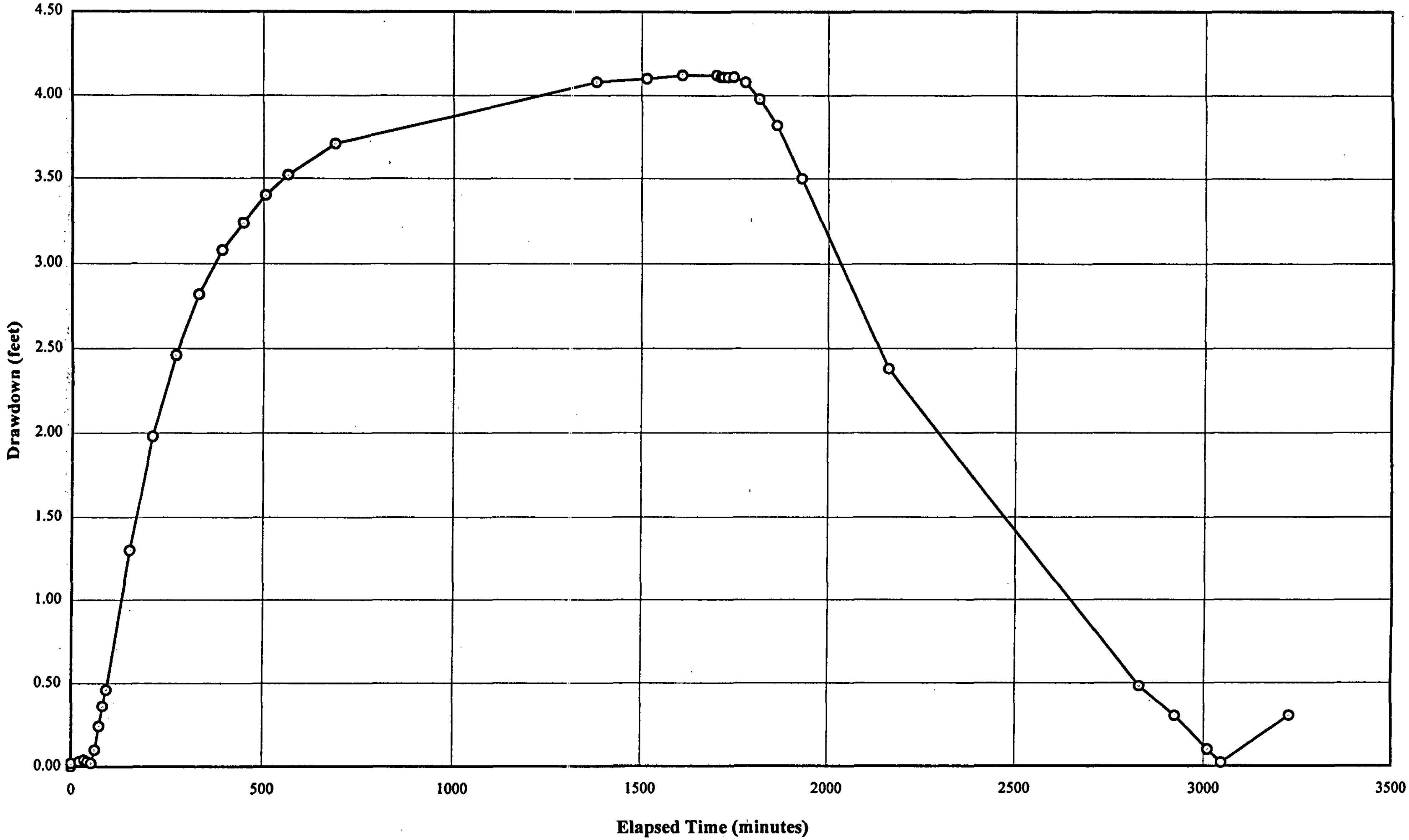
Time	Depth	Elapsed time		change	Feet H20
04/21/99 08:49	11.28	0		0.00	14.98
04/21/99 09:08	**11.26**	**0**	ZERO TIME	0.02	15.00
04/21/99 09:30	**11.25**	**22**	PW-3: started pump test at 09:30 a.m.	0.03	15.01
04/21/99 09:43	11.24	35		0.04	15.02
04/21/99 09:51	11.25	43		0.03	15.01
04/21/99 10:01	11.30	53		0.02	14.96
04/21/99 10:11	11.38	63		0.10	14.88
04/21/99 10:21	11.52	73		0.24	14.74
04/21/99 10:31	11.64	83		0.36	14.62
04/21/99 10:41	11.74	93		0.46	14.52
04/21/99 11:41	12.58	153		1.30	13.68
04/21/99 12:40	13.26	212		1.98	13.00
04/21/99 13:40	13.74	272		2.46	12.52
04/21/99 14:40	14.10	332		2.82	12.16
04/21/99 15:40	14.36	392		3.08	11.90
04/21/99 16:35	**14.52**	**447**	PW-1: started pump test at 16:35 p.m.	3.24	11.74
04/21/99 17:34	14.68	506	PW-1: turned Grundfos pump on at 18:13 p.m.	3.40	11.58
04/21/99 18:32	14.80	564	PW-1: turned Grundfos pump off at 20:39 p.m.	3.52	11.46
04/21/99 20:36	14.99	688	*end of day 1*	3.71	11.27
04/22/99 08:08	15.36	1380		4.08	10.90
04/22/99 10:22	15.38	1514	PW-1: turned Grundfos pump on at 10:00 a.m.	4.10	10.88
04/22/99 11:57	15.40	1609		4.12	10.86
04/22/99 13:29	15.40	1701		4.12	10.86
04/22/99 13:40	**15.39**	**1712**	PW-3: turned off pump at 13:40 p.m.	4.11	10.87
04/22/99 13:44	15.39	1716		4.11	10.87
04/22/99 13:49	15.39	1721		4.11	10.87
04/22/99 14:00	15.39	1732		4.11	10.87
04/22/99 14:15	15.39	1747		4.11	10.87

PW-3 PUMP TEST
OBSERVATION WELL DRAWDOWN

Time	Depth	Elapsed time		change	Feet H20
04/22/99 14:46	15.36	1778		4.08	10.90
04/22/99 15:24	15.26	1816		3.98	11.00
04/22/99 16:10	15.10	1862		3.82	11.16
04/22/99 17:17	14.78	1929		3.50	11.48
04/22/99 21:09	13.66	2161	*end of day 2*	2.38	12.60
04/23/99 08:18	11.76	2830		0.48	14.50
04/23/99 09:51	11.58	2923		0.30	14.68
04/23/99 11:18	11.38	3010		0.10	14.88
04/23/99 11:54	**11.30**	**3046**	**- turned off PW-1 Waterra pump at ~10:00 a.m. - turned Grundfos pump off at 11:54 a.m.**	0.02	14.96
04/23/99 14:53	10.98	3225	*end of day 3*	0.30	15.28

MW-107D

PW-3 PUMP TEST
OBSERVATION WELL DRAWDOWN vs. TIME



Appendix B4 - AOT Treatability Test Results

11 Maxal Street
Green Brook, NJ 08812-2609

Telephone (732) 424-2089
Facsimile (732) 926-0597

CALGON
CALGON CARBON CORPORATION

June 29, 1999

By Courier

Mr. Tom Forbes
Benchmark Engineering & Science
Key Tower, Suite 1350
50 Fountain Plaza
Buffalo, NY
14202

Dear Tom:

Calgon Carbon Oxidation Technologies is pleased to submit this UV/Oxidation Design Test Report for the treatment of VOC's in leachate water from the Urbana Landfill. I have attached two (2) copies of the report for your convenience.

I trust that the enclosed is complete and satisfactory. If you have any questions or concerns, please do not hesitate to contact me.

Yours sincerely,

CALGON CARBON CORPORATION
per:

fte: Mike Donaway
Sales Manager, Advanced Oxidation Technologies

P.1032

130 Royal Crest Court
Markham, Ontario
Canada L3R 0A1

Telephone (905) 477-9242
Facsimile (905) 477-4511

Confidential

Design Report on the

UV/Oxidation Design Test to Treat

VOC's in Urbana Landfill Leachate Water

Prepared for

Benchmark Engineering
Buffalo, NY

by

Calgon Carbon Corporation

NO. P-1032 *JUNE 29, 1999*

TABLE OF CONTENTS

1.0 Summary

This report outlines the design testing results for the UV/oxidation treatment of leachate water containing VOC's received from the Urbana Landfill Site on May 12, 1999. A design test was performed to demonstrate the effectiveness of Calgon Carbon Corporation's (CCC) UV/oxidation process for the destruction of VOC's in the leachate water. Specifically, the objectives of the design test were:

- to confirm the effectiveness of the UV/oxidation process for destruction of vinyl chloride (VC), 1,2-dichloroethylene (1,2-DCE), and trichloroethylene (TCE) in leachate water down to effluent limits of 2 ppb, 5 ppb, and 5 ppb, respectively.
- to determine the optimal system along with respective capital and operating costs for a 20 USgpm full scale system.

The test work completed on the water has confirmed that:

- destruction of the target VOC's down to below the effluent requirements can be met using the **Rayox®** UV/peroxide process.
- to meet the treatment objectives for a 20 USgpm flow rate, a 30 kW **Rayox®** UV/Oxidation system is required, with an estimated peroxide dosage of 50 mg/L.

2.0 UV/OXIDATION THEORY

2.1 Advanced Oxidation Processes (AOP)

In advanced oxidation processes, the primary treatment mechanism involves the reaction of UV light with hydrogen peroxide or ozone to generate highly reactive hydroxyl radicals (•OH) as shown below:

$$H_2O_2 + \text{UV light} \longrightarrow 2\,{\bullet}OH \qquad [1]$$

The OH radical initiates a rapid cascade of oxidation reactions which, if allowed to proceed to completion, result in carbon dioxide and water as end products. This oxidation can be greatly enhanced by the addition of homogenous catalysts which increase the efficiency of the UV light reactions.

In some cases, other mechanistic pathways can also be identified such as direct photolysis of the contaminants by UV light or direct reaction of ozone or oxygen radicals with the target contaminants or their intermediate byproducts.

UV Light

The formation of hydroxyl radicals relies on the absorbance of UV light in the range of 200 to 240 nm. In CCC's UV/oxidation system, this light is provided by high intensity medium pressure mercury vapor lamps. The lamps are housed in quartz tubes and a patented device is used to prevent fouling of the quartz tubes. Calgon Carbon Corporation's medium pressure UV lamps have been designed to give out significantly more UV light in the 200 to 240 nm range than any other UV light source. While UV light is needed for the formation of hydroxyl radicals from hydrogen peroxide, it may also serve to break or weaken the chemical bonds of many organic compounds by direct photolysis. This is important for compounds that react slowly with hydroxyl radicals.

Hydrogen Peroxide

Hydrogen peroxide is a commonly used chemical oxidant in advanced oxidation processes. It is normally supplied in concentrations of 35 or 50% in water and is metered into the flow line upstream of the UV lamps. The combination of high intensity UV light and hydrogen peroxide produces an oxidative environment that is effective for the treatment of a broad range of organic compounds.

Other Processes

There are other types of UV/oxidation processes that can be employed in the treatment of contaminated water. For example, **Rayox®-F** is a patented photo-oxidation process that utilizes an iron based catalyst called **ENOX 510** to increase the rate of destruction of aromatic and olefinic pollutants. In some cases, low levels of dissolved iron already present in the water can be used as a catalyst by lowering the pH. **Rayox®-A** is another patented photo-oxidation process that is particularly effective for the treatment of heavily contaminated water with a high background absorption in the UV region.

2.2 *UV Dose*

In the UV oxidation process, a high powered lamp emits UV radiation through a quartz sleeve into the contaminated water. The photons of light activate hydrogen peroxide, ozone or a catalyst and generate highly reactive radicals which destroy the organic contaminants. The destruction of organic contaminants is therefore dependent upon the amount of UV light which is applied to the contaminated water.

Calgon Carbon Corporation's design parameter for the scale-up of UV oxidation systems is the "UV dose" which is defined as the amount of UV lamp energy (in kWh) applied to 1000 gallons of water. This design parameter can be calculated from either flow through or batch situations as follows;

$$\text{UV Dose (Batch)} = \frac{\text{Lamp Size(kW)} \times \text{Time(min)} \times 3785\ \text{(L/1000gal)}}{\text{Volume (L)} \times 60\ \text{(min/hr)}}$$

And [2]

$$\text{UV Dose (Flow)} = \frac{\text{Lamp Size (kW)} \times 1000\ \text{(gal/ 1000gal)}}{\text{Flow Rate (gpm)} \times 60\ \text{(min/h)}}$$

The UV Dose is used to scale-up from a batch design test to a full scale system.

2.3 *Electrical Energy per Order (EE/O)*

The destruction of a contaminant by a UV/Oxidation process involves a complex series of chemical reactions. Experience has shown that this destruction generally follows a first order relationship with the amount of energy input into a unit volume of water (UV Dose). A simple design parameter, which incorporates the UV Dose input to the system and the number of orders of contaminant destruction, can be used to compare and scale-up processes. This design parameter is defined as the Electrical Energy per Order or the EE/O and its units are in kWh/1000gal/order.

For example, if it takes 10 kWh of electrical energy to reduce the concentration of a target compound from 10 ppm to 1 ppm (1 order of magnitude or 90% destruction) in 1000 gallons of water, then the EE/O is 10 kWh/1000gal/order for this compound. It will take another 10 kWh/1000gal of UV Dose to reduce the compound from 1 ppm to 0.1 ppm (another 90% reduction).

The EE/O values obtained in a batch system can be applied directly to a full scale flowthrough system. The equation for the EE/O which applies to both batch and flow through situations is:

$$EE/O = \frac{\text{UV Dose}}{\log (C_i/C_f),} \qquad [3]$$

where C_i is the initial concentration and C_f is the final concentration.

In scaling up from bench scale results to a full scale system the EE/O value is calculated. In systems with more than one compound of interest the EE/O for each compound must be determined in the batch testing. The effluent concentration for each compound can then be calculated for the full scale design.

3.0 DESIGN TEST RESULTS

3.1 Pilot Unit

Design testing at Calgon Carbon Corporation is performed using a 1 kW pilot unit. The pilot unit consists of a 10 gallon cylindrical stainless steel reactor equipped with a 1 kW lamp. The lamp used has an identical UV output to the 30 kW lamps which are used in a full scale system so that scale-up using the design parameter, UV Dose, is extremely accurate. The 1 kW lamp is mounted vertically in the reactor and separated from the water by a quartz sleeve. An air-actuated transmittance controller automatically wipes the quartz sleeve at regular intervals to ensure that the quartz remains clean throughout the entire run. A mixer in the reactor ensures complete mixing of the sample during the tests. The pilot unit also has a steel shutter which, when closed, serves to block the transmittance of UV light into the sample.

3.2 Sample Preparation and Handling

Calgon Carbon Corporation received 2 x 15 gallon containers of the leachate water for design testing. The contents of the two drums were mixed together and a sample was drawn for preliminary analysis. Since the water was found to contain no visible solids, filtration (or other pretreatment) was not required prior to conducting the test runs. Known standards of t-1,2-DCE and TCE solution were used to spike an additional 750 ppb and 200 ppb, respectively, into the water to ensure that the initial concentrations were at or near the design levels. Note, t-1,2-DCE was used as a surrogate for c-1,2-DCE due to limited availability of stock solutions in the CCC laboratory. Since the reaction rates of both the *cis* and *trans* isomers of 1,2-DCE with hydroxyl radicals are virtually identical, either form is suitable for spiking purposes.

3.3 Experimental Procedure

For each test run, approximately seven (7) gallons of leachate water was added to the pilot unit. The initial pH was measured at 7.0 and was not adjusted prior to treatment. After a brief period of mixing, an initial sample was taken. The UV Lamp was then ignited with the steel shutter closed. Hydrogen peroxide was added as a treatment reagent and after allowing adequate time for mixing and lamp warm-up, the shutter was opened and the run timer was started. Samples were taken at periodic intervals corresponding to increasing UV doses and were sent by overnight courier (on ice) to Philip Analytical Services for analysis.

Results of the test runs were compared by plotting the concentration of selected VOC's as a function of UV dose (expressed as total lamp energy per thousand gallons of water).

3.4 Water Characterization

Thirty (30) gallons of sample water was received on May 12, 1999. Analysis of the combined mixed water (as received) gave the following results shown in Table 1.

Table 1: Results of Preliminary Analysis

Parameter	Mixed Water
Appearance	Colorless, slightly turbid
TSS, mg/L	< 5
pH	7.0
COD, mg/L	8
Alkalinity, mg/L	530
Total Fe, mg/L	< 1
Chloride, mg/L	13
Nitrate, mg/L	< 1
Bromide, mg/L	< 1

The UV absorbance of the mixed water was measured with values at different wavelengths shown in Table 2.

Table 2: Measured UV Absorbance Values

Wavelength (nm)	Absorbance/cm
200	0.684
210	0.324
220	0.221
230	0.162
240	0.135
250	0.127
260	0.122
270	0.118
280	0.111
290	0.105
300	0.100

With the UV/peroxide process, peroxide absorbs UV light predominantly in the 200 to 240 nm region. In general, a high UV absorbance indicates that non-target water constituents are competing for UV light energy against the target contaminants and hydrogen peroxide, thus decreasing treatment efficiency. The absorbance levels of the water were moderate, thus indicating some competition for UV light.

3.5 *Sample Analysis*

Samples were analyzed for VOC's at a certified external laboratory, Philip Analytical Services, with VC, 1,2-DCE, and TCE being the primary VOC's of interest. These samples were analyzed for VOC's using US EPA Method 8260B (modified), employing purge & trap GC/MS.

Additionally, an initial sample was collected from Run 1 and analyzed by Philip Analytical for metals listed on the Target Analyte List (TAL). With the exception of mercury (Hg), all metals were analyzed by ICP/MS following standard laboratory protocols. Hg was analyzed by Method SW 7470 (Cold vapour Atomic Adsorption).

3.6 *Test Results*

Calgon Carbon Corporation carried out two treatment runs on the leachate water. The runs were carried out using the UV/peroxide process at neutral pH. The test matrix is summarized in Table 3 and the design test results are presented in Table 4.

Table 3: Design Test Matrix

Run #	Treatment Process	pH	H2O2, ppm
1	UV/Peroxide	7	50
2	UV/Peroxide	7	100

Table 4: Analytical Data from Runs

Run #1: UV/50 ppm H_2O_2/pH 7

Sampie	UV Dose, kWh/1000gal	VC, ppb	1,2-DCE (total), ppb	TCE, ppb	1,2-DCA, ppb	$CHCl_3$, ppb
1-0	0	39.0	1,208	216	*9.4*	*6.8*
1-1	6	*0.4*	9.3	2.0	5.4	5.0
1-2	12	*0.4*	4.3	1.3	3.5	4.7
1-3	24	*0.3*	1.2	0.4	2.0	4.0

Run #2: UV/100 ppm H_2O_2/pH 7

Sample	UV Dose, kWh/1000gal	VC, ppb	1,2-DCE (total), ppb	TCE, ppb	1,2-DCA, ppb	$CHCl_3$, ppb
2-0	0	42.4	1,204	228	*9.6*	*8.2*
2-1	6	*0.2*	6.0	1.8	3.7	4.1
2-2	12	*0.2*	3.1	1.0	2.2	3.9
2-3	24	*0.2*	*< 0.8*	0.3	0.9	3.4

NOTES:
NA = Not Analyzed; Data in italics represents a result below the method quantitation limit.

3.7 *Discussion of Results*

Based on data received from Benchmark Engineering, the flow-weighted average concentrations in the influent at full scale for VC, cis-1,2-DCE, and TCE were calculated to be 109 ppb, 655 ppb, and 187 ppb, respectively. According to the Benchmark data, peak concentrations for each of these compounds were measured at 130 ppb, 760 ppb, and 210 ppb, respectively. Therefore, CCC decided to base the design testing on treatment at peak concentrations. Since cis-1,2-DCE was expected to be the controlling compound, and some VOC's were likely lost during sample shipping and handling, CCC spiked each run sample with 750 ppb of trans-1,2-DCE and 200 ppb of TCE. Note, since the reaction rates for the *cis* and *trans* isomers are virtually identical, trans-1,2-DCE was used for spiking as it was readily available. As indicated in the sample results presented in Section 3.6, initial concentrations of the target VOC's were reasonably close to design levels. The 1,2-DCE concentration was presented in terms of 'total 1,2-DCE' in order to simplify the data interpretation. At around 40 ppb, the initial VC concentration was somewhat lower than the 130 ppb design concentration, however this was not a concern since VC reacts readily with hydroxyl radicals and will not be controlling in this matrix.

As shown in Figure 1, almost all of the target VOC's were destroyed to < 5 ppb after the first intermediate sample (UV dose of 6 kWh/1000gal). Below 5 ppb, the treatment rates for DCE and TCE slowed somewhat, as reflected in the change in slope of the destruction curves at low concentration. This is most likely the result of relatively high background competition when treating very low level VOC's. The high alkalinity of this water (530 mg/L) could explain this effect. Bicarbonate alkalinity is a source of hydroxyl radical scavenging. Iron also absorbs UV light strongly and is a potential source of interference. Although the initial iron concentration of 0.44 mg/L is considered low, oxidation of the iron inside the reactor may be responsible for the interference at low VOC levels. However, the effect was not significant and only observed in the latter stages of treatment (i.e., higher UV doses). Effluent limits were easily met for all of the targeted VOC's.

As indicated in Figure 1, Run 2 (100 ppm peroxide dose) gave slightly better results than Run 1 (50 ppm peroxide dose) for each of the target VOC's. However, this improvement was marginal and would not justify operation at the higher peroxide dose at full scale to treat the target contaminants. Therefore, Run 1 was considered the optimum run. As expected, vinyl chloride was the fastest reacting compound, followed by DCE and TCE. Due to the higher treatment requirements for DCE, it is the controlling compound for UV/Oxidation system sizing.

From Run 1, a UV dose of 12 kWh/1000gal resulted in the destruction of 1,2-DCE (total) from 1,208 ppb down to 4.3 ppb. The EE/O was subsequently calculated to be 4.9 kWh/1000gal/order. TCE was treated from 216 ppb down to 1.3 ppb after the same UV dose, resulting in an EE/O of 5.4. An EE/O for VC could not be calculated, since it was treated to non-detect levels after the lowest applied UV dose. Although not targeted for treatment, the VOC results indicated the presence of both 1,2-DCA and chloroform. These compounds were present at initial concentrations of 9.4 and 6.8 ppb, respectively (Run 1). Since these compounds react more slowly with hydroxyl radicals than the target VOC's, their destruction rates were slower. Treatment of these compounds was not considered as part of the scale-up calculations since no treatment objectives were identified. As the Table 4 data indicates, DCA and chloroform treated faster at the higher peroxide dose, as expected.

Per a request from Benchmark Engineering, CCC had the initial spiked sample from Run 1 analyzed for metals, consistent with those associated with the Target Analyte List (TAL). In general, metal concentrations were found to be low (see attached Raw Data). The most notable concentrations were those of Ca, Mg, and Fe, which were measured at 134 mg/L, 36.8 mg/L, and 0.44 mg/L, respectively. These concentrations are not expected to interfere significantly with the UV/Oxidation process at full scale.

The full scale design flow rate for this application is 20 USgpm. Note, the maximum temperature rise of the water through a 30 kW system at a flow rate of 20 USgpm is 10 °F. Based on an influent water temperature of 45 to 55 °F, the final effluent will be well below the limit of 90 °F.

Residual peroxide will also be present in the effluent at an estimated concentration of 20 ppm (based on an initial dose of 50 ppm).

3.8 *Extrapolation of Results*

In scaling up from bench scale results to a full-scale system the EE/O value is calculated. The larger the EE/O the more energy required and hence treatment is less efficient. By comparing EE/O values from each run one can easily see the reduction in electrical power required for treatment as the conditions are varied. By multiplying the EE/O by the number of orders of magnitude of destruction required, the UV dose is obtained.

From Run 1, a UV dose of 12 kWh/1000 gallons reduced the total 1,2-DCE concentration from 1,208 ppb to 4.3 ppb. The EE/O, using equation [3] is thus calculated as:

$$EE/O = \frac{12}{\log(1{,}208/4.3)} = 4.9$$

Using this EE/O value, the full size system is easily scaled to any flow rate or concentration required using equation [2]. Treating at the full scale flow rate of 20 USgpm can be expected to decrease treatment efficiency due to reduced mixing efficiency. Based on CCC's experience and previous lab data, we estimate the reduction in efficiency at 20 USgpm to be 30%. Therefore, a 30% safety factor has been applied to the experimental EE/O of 4.9, resulting in a final design EE/O of 6.4 kWh/1000gal/order for 1,2-DCE.

For example, at 20 gpm and 760 ppb influent 1,2-DCE concentration, the system size to go down to 5 ppb is:

$$\text{UV Dose} = 6.4 \times \log(760/5) = 14.0 \ \text{kWh/1000 gal}$$

$$\text{kW} = \frac{14.0\ (\text{kWh/1000 gal}) \times 20\ (\text{gpm}) \times 60\ (\text{min/h})}{1000\ (\text{gal/1000 gal})} = 16.8\ \text{kW}$$

Thus a total lamp power of 16.8 kW is required which can be met with a 30 kW **Rayox**® system. The 30 kW system can be designed to allow operation both at reduced power (fixed at approximately 20 kW from factory) or at full power (nominal 27 kW). This would enable some flexibility in the selection of lamp power, thus reducing operating costs.

Alternatively, the system can be provided with an adjustable power supply, allowing infinite adjustment of lamp power between 20 and 30 kW. This option would provide maximum flexibility and optimization of operating costs since operation can be customized to the influent flow rate and actual VOC concentrations.

4.0 FULL SCALE DESIGN

For the treatment of VOC's at the Urbana Landfill site, a 30 kW **Rayox®** system is recommended based on a full scale flow rate of 20 USgpm and the treatment objectives specified in Table 5.

Table 5: Treatment Objectives

Contaminant	**Influent, ppb**	**Effluent, ppb**
VC	130	< 2
1,2-DCE (total)	760	< 5
TCE	210	< 5
1,2-DCA*	10	< 5
Chloroform*	6.8	< 5

**Treatment objectives for 1,2-DCA and Chloroform were not identified, as these compounds were not targeted for treatment. They have been included in Table 5 for information purposes only.*

The estimated capital cost of the 30 kW **Rayox®** system is US$. The capital cost of the system includes:

- **Rayox®** system skid, including 1 x 30 kW reactor module with Quartz Cleaner and Fixed Power Supply (Adjustable Power Supply also available as an option for additional US$.)
- 220VAC, 1 phase electrical hook-up (200A service required)
- Programmable Logic Controller (PLC) System Controller
- In-line Static Mixer and Magnetic Flow Meter
- Hydrogen Peroxide Dosing System
- Set of Engineering Drawings and Operating and Maintenance Manuals

From Run 1, a peroxide dose of 50 ppm provided suitable treatment of the target VOC's. Hence, the full-scale peroxide dose is estimated at 50 ppm. Based on this dose, the estimated operating costs of the system can be broken out as follows for a 20 USgpm continuous full scale flow rate:

	\$/1000 USgal	*\$/year*
Electrical Power (@ \$0.10/kWh)		
Lamp Replacement		
Hydrogen Peroxide (est. 50 ppm @ \$0.34/lb. 50%)		
Total		

Once the system is installed, further optimization of the peroxide dose may be possible, further reducing operating costs.

SUPPLEMENTAL INFORMATION

- Fig. 1 - Destruction of VOC's in Urbana Landfill Leachate Water
- Equipment Layout Drawing for 30 kW **Rayox**® UV/Oxidation System
- Cut-sheet for Hydrogen Peroxide Dosing System
- Raw Data

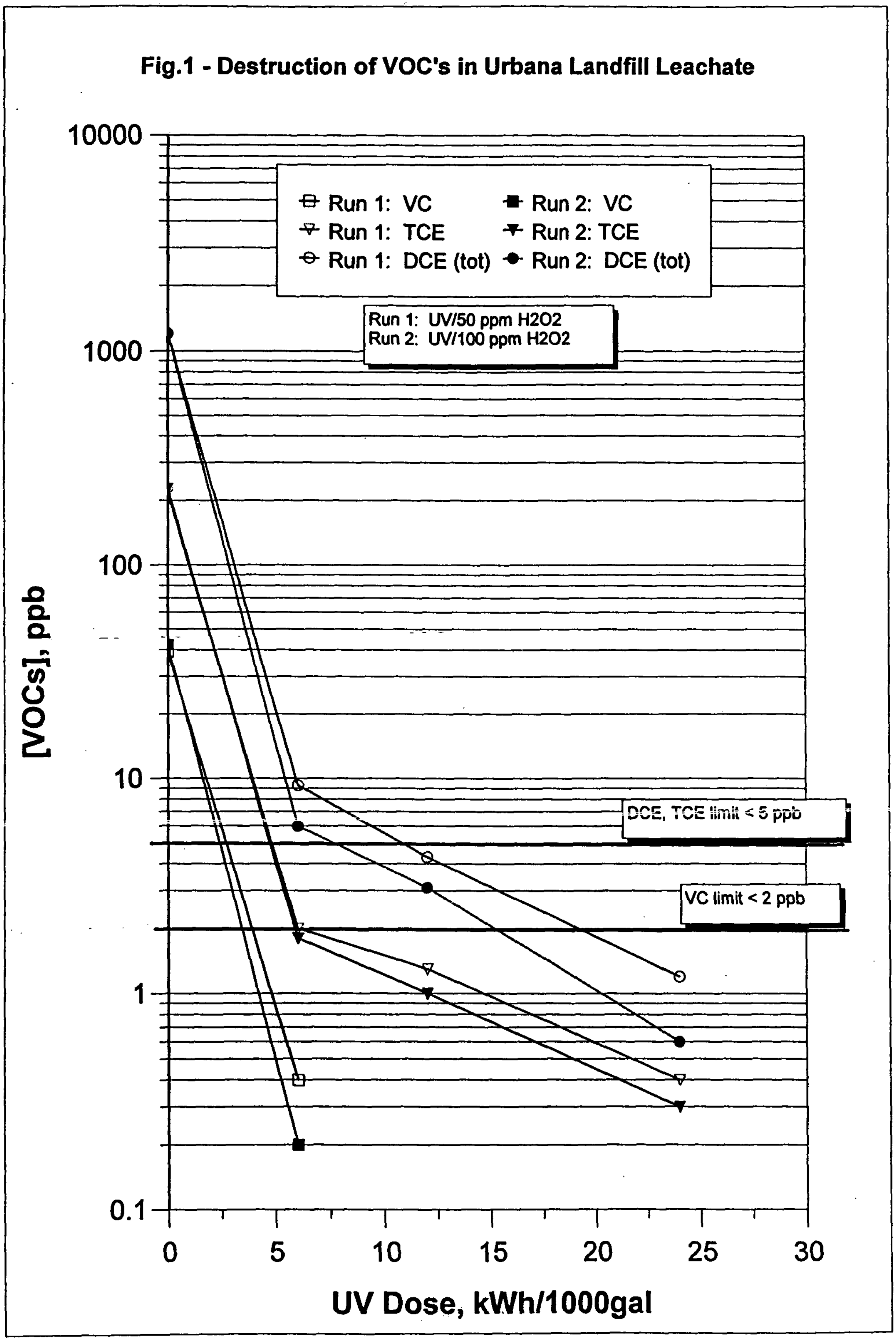
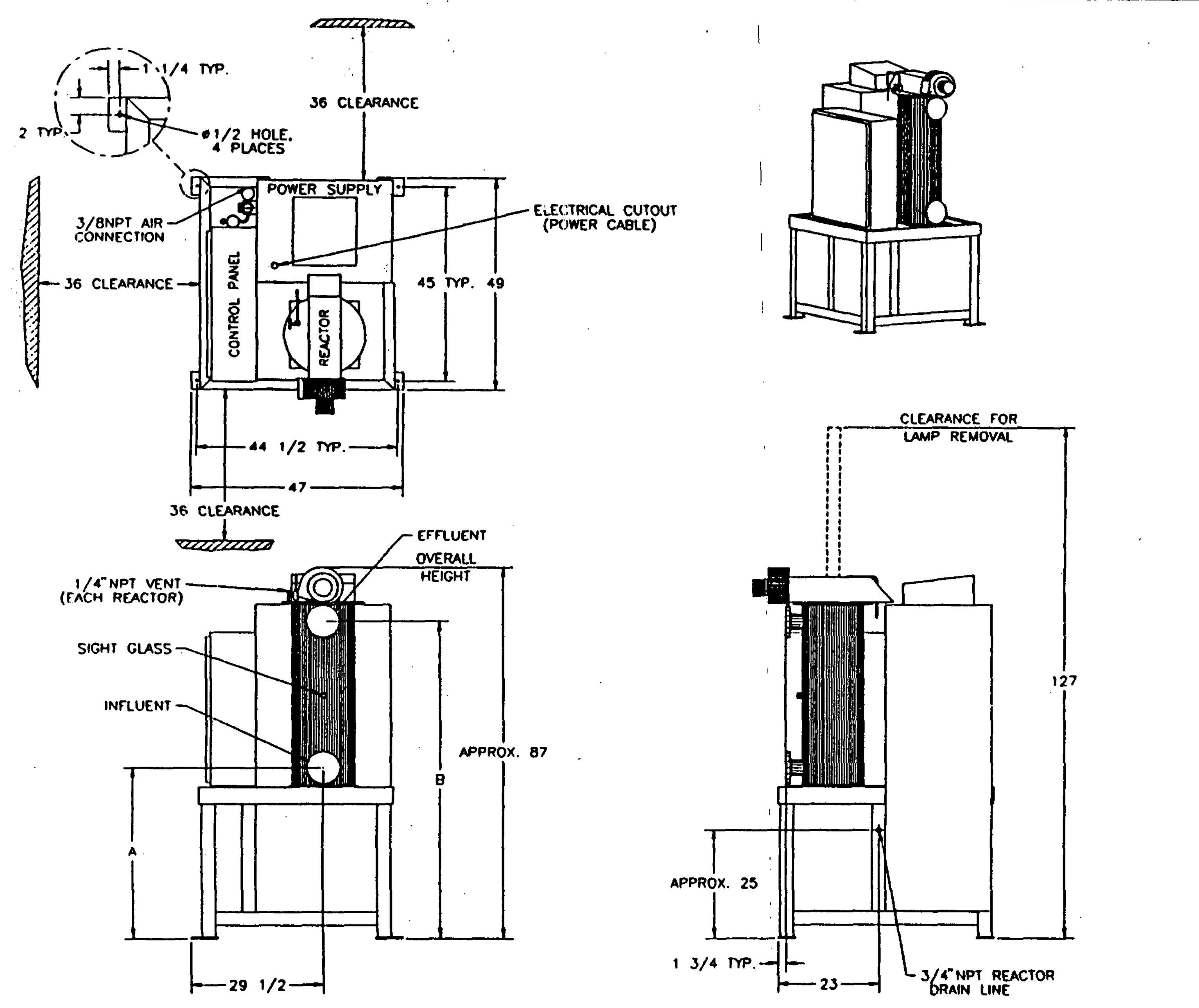


Fig.1 - Destruction of VOC's in Urbana Landfill Leachate
Run 1: VC
Run 2: VC
Run 1: TCE
Run 2: TCE
Run 1: DCE (tot)
Run 2: DCE (tot)
Run 1: UV/50 ppm H2O2
Run 2: UV/100 ppm H2O2
DCE, TCE limit < 5 ppb
VC limit < 2 ppb
[VOCs], ppb
10000
1000
100
10
1
0.1
0
5
10
15
20
25
30
UV Dose, kWh/1000gal



REVISIONS

REV	DESCRIPTION	DATE	APP'D
F	E.C.O.[illegible] - T. D. R.	30 Jun/95	
G	E.C.O.1027 - T. D. R.	19 Sep/96	
C	E.C.O.[illegible] - T. D. R.	21 Feb/94	
D	E.C.O.013 - S. P.	1 Jun/94	
E	E.C.O.[illegible] - J. H.	2[illegible] Jun/94	

NOTES

1. APPROX. WEIGHT: 2500 lbs.
2. REFER TO PIPING DRAWING FOR REACTOR NOZZLE ORIENTATION
3. MINIMUM 36" CLEARANCE ACCESS AS SHOWN.
4. UNIT TO BE MOUNTED ON 3" RAISED CONCRETE PAD.
5. REFER TO P. & I.D. DRAWING FOR ACTUAL PIPE SIZE.

PORT SIZE	APPROX. DIM'S	
	A	B
1	39	*74-3/4
1-1/2	39-3/4	*74
2	39-3/4	74
3	39-3/4	74
4	40-1/4	73-1/2

* WHERE THERE ARE LOW FLOWS INVOLVED, THE REACTOR EFFLUENT MAY BE OUT OF THE TOP PLATE RATHER THAN OUT THE SIDE

FINISH

MATERIAL

DIMENSIONS IN INCHES (unless otherwise specified)

TOLERANCES (unless otherwise specified)

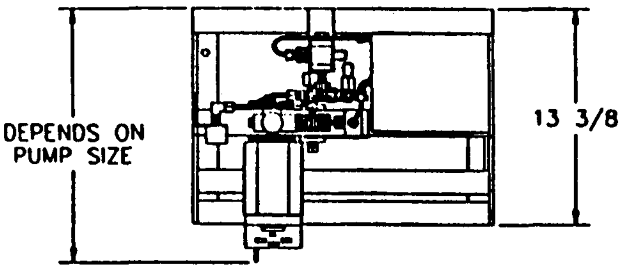
ANGULAR	± 0°30'	DECIMAL 2 PLACES	± .010
FRACTIONAL	± 1/32	DECIMAL 3 PLACES	± .005
DECIMAL 1 PLACE	± .015	DECIMAL 4 PLACES	± .0005

CALGON CARBON OXIDATION TECHNOLOGIES
130 ROYAL CREST CT.
MARKHAM, ONTARIO
CANADA L3R 0A1

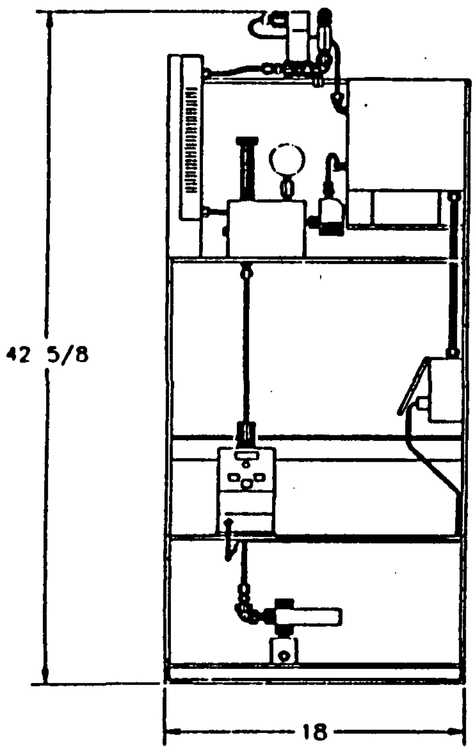
	NAME	SIGN.	DATE
DRAFT.	T. D. R.		19 Sep/91
DESIGN.			
CHECK	J. H.		
APPR.	R. C. H.		

TITLE: RAYOX 1 X 30kW REACTOR OUTLINE DETAIL

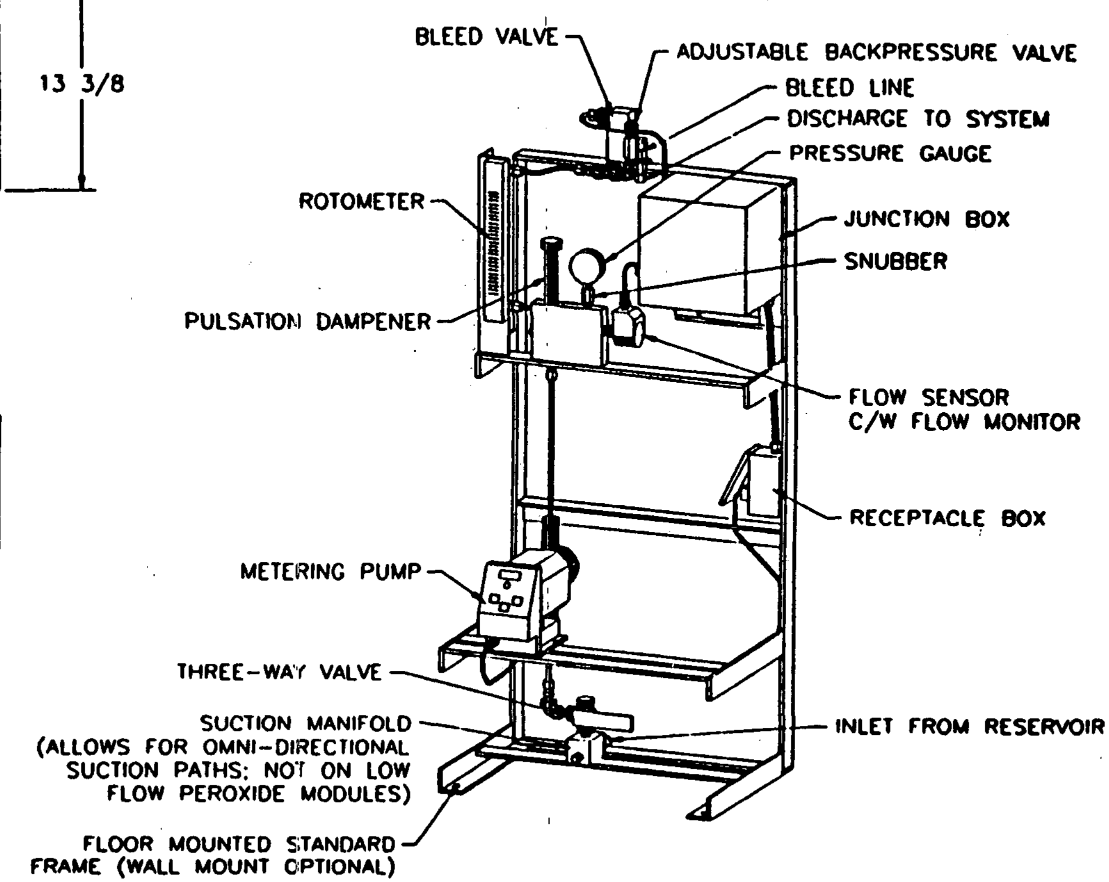
SHEET No.	SHEET 1 OF 1	SCALE	NONE
DWG. No.	000-0-000111	REV.	G



PLAN



FRONT ELEVATION



ISOMETRIC

PEROXIDE

REVISIONS

NOTES

1. REFER TO P&ID FOR LINE SIZES AND CONNECTION TYPE.

3D FILE: R180

FINISH

MATERIAL

CALGON CARBON OXIDATION TECHNOLOGIES

METERING PUMP FRAME DETAIL

SHEET 1 OF 3

000-X-400001

PHILIP SERVICES

CALGON CARBON CANADA INC.
130 Royal Crest Court
Markham, ON
L3R 0A1

3-Jun-99

Page: 1
Copy: 1 of 2
Set : 2

Attn: Dan Dolan/CCOT
Project: URBANA/P1032

Received: 27-May-99 15:21
PO #: P1032-05-27

Job: 9953669

Status: Final

Water Samples

Sample Id	Hg SW 7470 mg/L	Ag ICP/MS mg/L	Al ICP/MS mg/L	As ICP/MS mg/L	Ba ICP/MS mg/L	Be ICP/MS mg/L	Ca ICP/MS mg/L	Cd ICP/MS mg/L
P1032-1-0	0.00005	<0.0001	0.071	<0.002	0.178	<0.001	134.	0.0002
Blank	<0.00005	<0.0001	<0.005	<0.002	<0.005	<0.001	<0.5	<0.0001
QC Standard (found)	0.00108	0.0033	0.854	0.053	0.051	0.048	5.1	0.0480
QC Standard (expected)	0.00100	0.0030	1.00	0.050	0.050	0.050	5.0	0.0500
Repeat P1032-1-0	<0.00005	<0.0001	0.068	<0.002	0.175	<0.001	131.	0.0001

Sample Id	Co ICP/MS mg/L	Cr ICP/MS mg/L	Cu ICP/MS mg/L	Fe ICP/MS mg/L	K ICP/MS mg/L	Mg ICP/MS mg/L	Mn ICP/MS mg/L	Na ICP/MS mg/L
P1032-1-0	0.0024	<0.005	0.0065	0.44	3.3	36.8	3.65	29.3
Blank	<0.0001	<0.005	<0.0005	<0.03	<0.1	<0.05	<0.005	<0.1
QC Standard (found)	0.0490	0.048	0.0479	0.06	0.9	0.98	0.050	4.3
QC Standard (expected)	0.0500	0.050	0.0500	0.05	1.0	1.00	0.050	5.0
Repeat P1032-1-0	0.0023	<0.005	0.0066	0.40	3.1	36.0	3.57	28.0

PHILIP SERVICES

3-Jun-99

CALGON CARBON CANADA INC.
130 Royal Crest Court
Markham, ON
L3R 0A1

Attn: Dan Dolan/CCOT
Project: URBANA/P1032

Received: 27-May-99 15:21
PO #: P1032-05-27

Job: 9953669 Status: Final

Water Samples

Sample Id	Ni ICP/MS mg/L	Pb ICP/MS mg/L	Sb ICP/MS mg/L	Se ICP/MS mg/L	Tl ICP/MS mg/L	V ICP/MS mg/L	Zn ICP/MS mg/L
P1032-1-0	0.004	0.0008	<0.0005	<0.002	<0.00005	0.0016	0.002
Blank	<0.001	<0.0005	<0.0005	<0.002	<0.00005	<0.0005	<0.002
QC Standard (found)	0.048	0.0470	0.0496	0.048	0.0957	0.0487	0.049
QC Standard (expected)	0.050	0.0500	0.0500	0.050	0.100	0.0500	0.050
Repeat P1032-1-0	0.004	0.0007	<0.0005	<0.002	<0.00005	0.0015	0.002

PSC
PHILIP SERVICES

3-Jun-99

CALGON CARBON CANADA INC.
130 Royal Crest Court
Markham, ON
L3R 0A1

Page: 3
Copy: 1 of 2

Attn: Dan Dolan/CCOT
Project: URBANA/P1032

Received: 27-May-99 15:21
PO #: P1032-05-27

Job: 9953669 Status: Final

All work recorded herein has been done in accordance with normal professional standards using accepted testing methodologies and QA/QC procedures. Philip Analytical is limited in liability to the actual cost of the pertinent analyses done unless otherwise agreed upon by contractual arrangement. Your samples will be retained by PASC for a period of 30 days following reporting or as per specific contractual arrangements.

Job approved by:

Signed: ....

Ralph Siebert, B.Sc.
Project Manager

PHILIP SERVICES

Client: Calgon Carbon Canada Inc.
Project Reference: P1032
Work Order: 9953669
Matrix: Water

VOLATILE ORGANIC COMPOUNDS

Units: micrograms/liter (µg/L)

Date: 03-Jun-99

Compound	EQL µg/L	P1032-1-0 DF=50	P1032-1-0 DF=50 Dup.	EQL µg/L	P1032-1-1	P1032-1-2	P1032-1-3
Chloromethane	50.0	nd	nd	1.0	nd	nd	nd
Vinyl chloride	25.0	33.7	44.2	0.5	*0.4	*0.4	*0.3
Bromomethane	25.0	nd	nd	0.5	nd	nd	nd
Chloroethane	25.0	nd	nd	0.5	1.1	0.5	*0.2
Trichlorofluoromethane	25.0	nd	nd	0.5	nd	nd	nd
Acetone	500	nd	nd	10.0	16.1	20.4	19.3
1,1-Dichloroethene	10.0	nd	nd	0.2	nd	nd	nd
Dichloromethane (Methylene Chloride)	50.0	nd	nd	1.0	6.8	6.0	4.8
trans-1,2-Dichloroethene	10.0	757	906	0.2	6.7	3.6	1.0
Methyl-t-Butyl Ether	10.0	nd	nd	0.2	nd	nd	nd
1,1-Dichloroethane	10.0	nd	nd	0.2	1.0	0.8	0.5
Methyl Ethyl Ketone (MEK)	250	nd	nd	5.0	nd	nd	nd
cis-1,2-Dichloroethene	10.0	359	395	0.2	2.6	0.7	0.2
Chloroform	10.0	*7.6	*5.9	0.2	5.0	4.7	4.0
1,2-Dichloroethane	10.0	*9.5	*9.2	0.2	5.4	3.5	2.0
1,1,1-Trichloroethane	10.0	nd	nd	0.2	nd	nd	nd
Carbon Tetrachloride	10.0	nd	nd	0.2	0.7	0.6	0.4
Benzene	5.0	nd	nd	0.1	nd	nd	nd
1,2-Dichloropropane	10.0	nd	nd	0.2	1.1	0.5	0.2
Trichloroethene	10.0	196	236	0.2	2.0	1.3	0.4
Bromodichloromethane	10.0	nd	nd	0.2	nd	nd	nd
cis-1,3-Dichloropropene	10.0	nd	nd	0.2	nd	nd	nd
Methyl Isobutyl Ketone (MIBK)	250	nd	nd	5.0	nd	nd	nd
trans-1,3-Dichloropropene	10.0	nd	nd	0.2	nd	nd	nd
1,1,2-Trichloroethane	10.0	nd	nd	0.2	*0.1	nd	nd
Toluene	10.0	nd	nd	0.2	nd	nd	nd
2-Hexanone	250	nd	nd	5.0	nd	nd	nd
Dibromochloromethane	10.0	nd	nd	0.2	nd	nd	nd
1,2-Dibromoethane (Ethylene dibromide)	10.0	nd	nd	0.2	nd	nd	nd
Tetrachloroethene (Perchloroethylene)	10.0	nd	nd	0.2	nd	nd	nd
1,1,1,2-Tetrachloroethane	10.0	nd	nd	0.2	nd	nd	nd
Chlorobenzene	10.0	nd	nd	0.2	nd	nd	nd
Ethylbenzene	10.0	nd	nd	0.2	nd	nd	nd
m-Xylene & p-Xylene	10.0	nd	nd	0.2	nd	nd	nd
Bromoform	10.0	nd	nd	0.2	nd	nd	nd
Styrene	10.0	nd	nd	0.2	nd	nd	nd
1,1,2,2-Tetrachloroethane	10.0	nd	nd	0.2	0.3	0.3	0.3
o-Xylene	10.0	nd	nd	0.2	nd	nd	nd
1,3-Dichlorobenzene	10.0	nd	nd	0.2	nd	nd	nd
1,4-Dichlorobenzene	10.0	nd	nd	0.2	nd	nd	nd
1,2-Dichlorobenzene	10.0	nd	nd	0.2	nd	nd	nd

Surrogate Standard Recoveries: Control Limits: 70-130%

Dibromofluoromethane	109%	109%		108%	110%	104%
Toluene-d8	101%	102%		103%	101%	105%
4-Bromofluorobenzene	108%	109%		107%	108%	108%

PSC
PHILIP SERVICES

Client: Calgon Carbon Canada Inc.
Project Reference: P1032
Work Order: 9953669
Matrix: Water

VOLATILE ORGANIC COMPOUNDS

Units: micrograms/liter (µg/L)

Date: 03-Jun-99

Compound	**EQL µg/L**	P1032-2-0 DF=50	**EQL µg/L**	P1032-2-1	P1032-2-2	P1032-2-3
Chloromethane	50.0	nd	1.0	nd	nd	nd
Vinyl chloride	25.0	42.4	0.5	*0.2	*0.2	*0.2
Bromomethane	25.0	nd	0.5	nd	nd	nd
Chloroethane	25.0	nd	0.5	0.8	*0.3	nd
Trichlorofluoromethane	25.0	nd	0.5	nd	nd	nd
Acetone	500	nd	10.0	13.6	14.7	11.1
1,1-Dichloroethene	10.0	nd	0.2	nd	nd	nd
Dichloromethane (Methylene Chloride)	50.0	nd	1.0	5.2	4.3	3.4
trans-1,2-Dichloroethene	10.0	829	0.2	4.8	2.7	0.6
Methyl-t-Butyl Ether	10.0	nd	0.2	nd	nd	nd
1,1-Dichloroethane	10.0	nd	0.2	0.8	0.6	0.3
Methyl Ethyl Ketone (MEK)	250	nd	5.0	nd	nd	nd
cis-1,2-Dichloroethene	10.0	375	0.2	1.2	0.4	nd
Chloroform	10.0	*8.2	0.2	4.1	3.9	3.4
1,2-Dichloroethane	10.0	*9.6	0.2	3.7	2.2	0.9
1,1,1-Trichloroethane	10.0	nd	0.2	nd	nd	nd
Carbon Tetrachloride	10.0	nd	0.2	0.6	0.5	0.4
Benzene	5.0	nd	0.1	nd	nd	nd
1,2-Dichloropropane	10.0	nd	0.2	0.7	0.3	nd
Trichloroethene	10.0	228	0.2	1.8	1.0	0.3
Bromodichloromethane	10.0	nd	0.2	nd	nd	nd
cis-1,3-Dichloropropene	10.0	nd	0.2	nd	nd	nd
Methyl Isobutyl Ketone (MIBK)	250	nd	5.0	nd	nd	nd
trans-1,3-Dichloropropene	10.0	nd	0.2	nd	nd	nd
1,1,2-Trichloroethane	10.0	nd	0.2	nd	nd	nd
Toluene	10.0	nd	0.2	nd	nd	nd
2-Hexanone	250	nd	5.0	nd	nd	nd
Dibromochloromethane	10.0	nd	0.2	nd	nd	nd
1,2-Dibromoethane (Ethylene dibromide)	10.0	nd	0.2	nd	nd	nd
Tetrachloroethene (Perchloroethylene)	10.0	nd	0.2	nd	nd	nd
1,1,1,2-Tetrachloroethane	10.0	nd	0.2	nd	nd	nd
Chlorobenzene	10.0	nd	0.2	nd	nd	nd
Ethylbenzene	10.0	nd	0.2	nd	nd	nd
m-Xylene & p-Xylene	10.0	nd	0.2	nd	nd	nd
Bromoform	10.0	nd	0.2	nd	nd	nd
Styrene	10.0	nd	0.2	nd	nd	nd
1,1,2,2-Tetrachloroethane	10.0	nd	0.2	0.4	0.3	0.2
o-Xylene	10.0	nd	0.2	nd	nd	nd
1,3-Dichlorobenzene	10.0	nd	0.2	nd	nd	nd
1,4-Dichlorobenzene	10.0	nd	0.2	nd	nd	nd
1,2-Dichlorobenzene	10.0	nd	0.2	nd	nd	nd

Surrogate Standard Recoveries: Control Limits: 70-130%

	P1032-2-0	P1032-2-1	P1032-2-2	P1032-2-3
Dibromofluoromethane	100%	95%	95%	106%
Toluene-d8	109%	109%	106%	102%
4-Bromofluorobenzene	101%	103%	102%	107%

PHILIP SERVICES

Client: Calgon Carbon Canada Inc.
Project Reference: P1032
Work Order: 9953669
Matrix: Water

VOLATILE ORGANIC COMPOUNDS

Date: 03-Jun-99

Units: micrograms/liter (µg/L)

		Method Blank			Spiked Method Blank			
Compound	EQL µg/L	Result	Upper Limit	Accept	% Recovery	Lower Limit	Upper Limit	Accept
Chloromethane	1.0	nd	1.0	yes	109	60	140	yes
Vinyl chloride	0.5	nd	0.5	yes	100	60	140	yes
Bromomethane	0.5	nd	0.5	yes	112	60	140	yes
Chloroethane	0.5	nd	0.5	yes	96	60	140	yes
Trichlorofluoromethane	0.5	nd	0.5	yes	96	70	130	yes
Acetone	10.0	nd	10.0	yes	97	60	140	yes
1,1-Dichloroethene	0.2	nd	0.2	yes	96	70	130	yes
Dichloromethane (Methylene Chloride)	1.0	nd	1.0	yes	95	70	130	yes
trans-1,2-Dichloroethene	0.2	nd	0.2	yes	96	70	130	yes
Methyl-t-Butyl Ether	0.2	nd	0.2	yes	96	70	130	yes
1,1-Dichloroethane	0.2	nd	0.2	yes	93	70	130	yes
Methyl Ethyl Ketone (MEK)	5.0	nd	5.0	yes	98	60	140	yes
cis-1,2-Dichloroethene	0.2	nd	0.2	yes	94	70	130	yes
Chloroform	0.2	nd	0.2	yes	96	70	130	yes
1,2-Dichloroethane	0.2	nd	0.2	yes	95	70	130	yes
1,1,1-Trichloroethane	0.2	nd	0.2	yes	94	70	130	yes
Carbon Tetrachloride	0.2	nd	0.2	yes	95	70	130	yes
Benzene	0.1	nd	0.1	yes	96	70	130	yes
1,2-Dichloropropane	0.2	nd	0.2	yes	95	70	130	yes
Trichloroethene	0.2	nd	0.2	yes	95	70	130	yes
Bromodichloromethane	0.2	nd	0.2	yes	98	70	130	yes
cis-1,3-Dichloropropene	0.2	nd	0.2	yes	99	70	130	yes
Methyl Isobutyl Ketone (MIBK)	5.0	nd	5.0	yes	105	60	140	yes
trans-1,3-Dichloropropene	0.2	nd	0.2	yes	100	70	130	yes
1,1,2-Trichloroethane	0.2	nd	0.2	yes	101	70	130	yes
Toluene	0.2	nd	0.2	yes	96	70	130	yes
2-Hexanone	5.0	nd	5.0	yes	108	60	140	yes
Dibromochloromethane	0.2	nd	0.2	yes	101	70	130	yes
1,2-Dibromoethane (Ethylene dibromide)	0.2	nd	0.2	yes	100	70	130	yes
Tetrachloroethene (Perchloroethylene)	0.2	nd	0.2	yes	94	70	130	yes
1,1,1,2-Tetrachloroethane	0.2	nd	0.2	yes	101	70	130	yes
Chlorobenzene	0.2	nd	0.2	yes	99	70	130	yes
Ethylbenzene	0.2	nd	0.2	yes	101	70	130	yes
m-Xylene & p-Xylene	0.2	nd	0.2	yes	101	70	130	yes
Bromoform	0.2	nd	0.2	yes	104	70	130	yes
Styrene	0.2	nd	0.2	yes	103	70	130	yes
1,1,2,2-Tetrachloroethane	0.2	nd	0.2	yes	111	70	130	yes
o-Xylene	0.2	nd	0.2	yes	101	70	130	yes
1,3-Dichlorobenzene	0.2	nd	0.2	yes	110	70	130	yes
1,4-Dichlorobenzene	0.2	nd	0.2	yes	105	70	130	yes
1,2-Dichlorobenzene	0.2	nd	0.2	yes	110	70	130	yes
Surrogate Standard Recoveries:								
Dibromofluoromethane		112%			97	70	130	yes
Toluene-d8		101%			100	70	130	yes
4-Bromofluorobenzene		107%			104	70	130	yes

PHILIP SERVICES

Client: Calgon Carbon Canada Inc.
Project Reference: P1032
Work Order: 9953669
Matrix: Water

VOLATILE ORGANIC COMPOUNDS

Units: micrograms/liter (µg/L)

Date: 03-Jun-99

Spiked Sample

Compound	EQL µg/L	Sample ID	Amount Spiked	% Recovery	Lower Limit	Upper Limit	Accept
Chloromethane	1.0	P1032-2-3	10.0	74	60	140	yes
Vinyl chloride	0.5	P1032-2-3	10.0	82	60	140	yes
Bromomethane	0.5	P1032-2-3	10.0	81	60	140	yes
Chloroethane	0.5	P1032-2-3	10.0	92	60	140	yes
Trichlorofluoromethane	0.5	P1032-2-3	10.0	91	70	130	yes
Acetone	10.0	P1032-2-3	50.0	85	60	140	yes
1,1-Dichloroethene	0.2	P1032-2-3	5.0	96	70	130	yes
Dichloromethane (Methylene Chloride)	1.0	P1032-2-3	10.0	83	70	130	yes
trans-1,2-Dichloroethene	0.2	P1032-2-3	5.0	104	70	130	yes
Methyl-t-Butyl Ether	0.2	P1032-2-3	5.0	92	70	130	yes
1,1-Dichloroethane	0.2	P1032-2-3	5.0	96	70	130	yes
Methyl Ethyl Ketone (MEK)	5.0	P1032-2-3	50.0	96	60	140	yes
cis-1,2-Dichloroethene	0.2	P1032-2-3	5.0	97	70	130	yes
Chloroform	0.2	P1032-2-3	5.0	86	70	130	yes
1,2-Dichloroethane	0.2	P1032-2-3	5.0	91	70	130	yes
1,1,1-Trichloroethane	0.2	P1032-2-3	5.0	97	70	130	yes
Carbon Tetrachloride	0.2	P1032-2-3	5.0	96	70	130	yes
Benzene	0.1	P1032-2-3	2.0	98	70	130	yes
1,2-Dichloropropane	0.2	P1032-2-3	5.0	101	70	130	yes
Trichloroethene	0.2	P1032-2-3	5.0	96	70	130	yes
Bromodichloromethane	0.2	P1032-2-3	5.0	95	70	130	yes
cis-1,3-Dichloropropene	0.2	P1032-2-3	5.0	101	70	130	yes
Methyl Isobutyl Ketone (MIBK)	5.0	P1032-2-3	50.0	103	60	140	yes
trans-1,3-Dichloropropene	0.2	P1032-2-3	5.0	98	70	130	yes
1,1,2-Trichloroethane	0.2	P1032-2-3	5.0	102	70	130	yes
Toluene	0.2	P1032-2-3	2.0	107	70	130	yes
2-Hexanone	5.0	P1032-2-3	50.0	113	60	140	yes
Dibromochloromethane	0.2	P1032-2-3	5.0	99	70	130	yes
1,2-Dibromoethane (Ethylene dibromide)	0.2	P1032-2-3	5.0	102	70	130	yes
Tetrachloroethene (Perchloroethylene)	0.2	P1032-2-3	5.0	102	70	130	yes
1,1,1,2-Tetrachloroethane	0.2	P1032-2-3	5.0	102	70	130	yes
Chlorobenzene	0.2	P1032-2-3	2.0	104	70	130	yes
Ethylbenzene	0.2	P1032-2-3	2.0	111	70	130	yes
m-Xylene & p-Xylene	0.2	P1032-2-3	4.0	112	70	130	yes
Bromoform	0.2	P1032-2-3	5.0	98	70	130	yes
Styrene	0.2	P1032-2-3	2.0	110	70	130	yes
1,1,2,2-Tetrachloroethane	0.2	P1032-2-3	5.0	102	70	130	yes
o-Xylene	0.2	P1032-2-3	2.0	110	70	130	yes
1,3-Dichlorobenzene	0.2	P1032-2-3	5.0	103	70	130	yes
1,4-Dichlorobenzene	0.2	P1032-2-3	5.0	98	70	130	yes
1,2-Dichlorobenzene	0.2	P1032-2-3	5.0	101	70	130	yes
Surrogate Standard Recoveries:							
Dibromofluoromethane			8.0	94	70	130	yes
Toluene-d8			4.0	106	70	130	yes
4-Bromofluorobenzene			8.0	101	70	130	yes

PHILIP SERVICES

Client: Calgon Carbon Canada Inc.
Project Reference: P1032
Work Order: 9953669V
Matrix: Water

VOLATILE ORGANIC COMPOUNDS

Date: 03-Jun-99

Legend: EQL = Estimated Quantitation Limit
nd = Not Detected Above EQL
Dup. = Duplicate
DF = Dilution Factor
* = Detected below EQL but passed compound identification criteria

Date of sample receipt: May 27, 1999
Date of sample analysis: May 28, 1999

Analytical Method:

The water samples were analysed by purge & trap gas chromatography/mass spectrometry using US EPA Method 8260B (modified).

Report Discussion:

Since some target compounds present were at a level above the calibration range of the instrument, some of the samples were run at a dilution factor to avoid exceeding the calibration range and causing excessive contamination of the purge & trap equipment. The quantitation limits for these samples are higher than the EQL's for undiluted samples as indicated above. The amounts reported have been corrected for the dilution factors that were used.

Note: Estimated quantitation limit is the lowest concentration that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions.

NOTE: All work recorded herein has been done in accordance with normal professional standards using accepted testing methodologies and QA/QC procedures. Philip Analytical is limited in liability to the actual cost of the pertinent analysis done. Your samples will be retained by PASC for a period of 30 days following reporting or as per specific contractual arrangement.

Job Approved By:

For Tom Pickering, M.Sc.
Chemist, Mass Spectrometry Services

APPENDIX C

Appendix C1 - SVE Pilot Test Work Plan
Appendix C2 - SVE Pilot Test Results

Appendix C1 - SVE Pilot Test Work Plan

Benchmark Environmental Engineering & Science, PLLC

January 22, 1999

Mr. Joseph M. Moloughney
Environmental Engineer
Bureau of Western Remedial Action
Division of Environmental Remediation
New York State Department of Environmental Conservation
50 Wolf Road
Albany, New York 12233-7010

Re: SVE Pilot Test Work Plan Response to Comments
Urbana Landfill, NYSDEC Site No. 8-51-007

Dear Mr. Moloughney:

We have reviewed the Department's January 8, 1999 comment letter concerning the December 1998 SVE Pilot Test Work Plan proposed for the Urbana Landfill site. Our responses to each of the issues are presented below.

Comment 1: *The work plan proposes the installation of three piezometers to monitor the induced vacuum in the subsurface. It has been our experience that six monitoring points are more appropriate for a pilot test. This would allow for more monitoring points in more directions and multiple points in the same direction. The points should be biased north of the proposed vapor extraction point because this is the area of highest VOC contamination.*

Response: The SVE pilot test subconsultant, SAIC, will install a total of four piezometers to monitor the induced vacuum in the subsurface. The first and second piezometers will be located at distances of five and fifteen feet north of the SVE test well, the third piezometer will be located ten feet west of the test well and the fourth piezometer will be located five feet south of the test well. This configuration will allow for adequate monitoring of the subsurface vacuum in three different compass directions with an emphasis to the north where the greatest concentrations of volatile organic compounds (VOCs) in the soil are reported to be present.

Comment 2: *The work plan specifies the use of rotary air drilling. Air rotary drilling can produce excessive dust and vapors generation around the drill rig. The health and safety plan should include the monitoring of particulates and vinyl chloride (VC). Because of the threshold values VC regarding worker protection it is suggested that VC*

50 FOUNTAIN PLAZA, SUITE 1350 • BUFFALO, NEW YORK 14202
TEL (716) 856-0599 • FAX (716) 856-0583

detector tubes be used. VC detector tubes should also be used on the GAC intake and discharge.

Response: During the installation of the test well and piezometers and during the completion of the pilot test, health and safety monitoring will include monitoring for airborne particulates and vinyl chloride as specified in the site health and safety plan. Appropriate action levels will be presented in the health and safety plan and vinyl chloride detector tubes will be utilized during monitoring. If action levels are exceeded during drilling activities, the work area will be ventilated with the blower unit. If action levels are exceeded during the pilot test, Level C personnel protection equipment will be used during the pilot test. In addition, the air intake and discharge of the granular activated carbon unit will be screened for vinyl chloride using the detector tubes during the pilot test.

Comment 3: *You should consider including a bentonite-cement cap above the hydrated bentonite seal to prevent ambient air infiltration.*

Response: At the test well and the four monitoring piezometers the bentonite seal will be located at 1 to 2.5 feet below ground surface and a bentonite cement seal will be placed from grade to 1 foot below grade.

Comment 4: *The time frame of the vapor extraction test is a little short. It is our experience that two to three hour vacuum steps (or a total of eight to twelve hours) are more appropriate to allow the subsurface system to reach equilibrium conditions.*

Response: Each vacuum step during the pilot test will be conducted for a minimum of 1 hour. At the end of one hour, if the recorded subsurface vacuum values at the four monitoring piezometers are stable, the step will be considered complete. Stabilization is defined as two consecutive readings that do not differ by more than 10 percent within a 15-minute interval. If stabilization is not reached at the end of 1 hour, the step will be continued until stabilization is reached. The selected time intervals and stabilization criteria are based on SAIC's extensive experience in conducting SVE pilot tests and the collection of accurate design data.

Comment 5: *Data Management. The final report should describe the weather conditions during the test period. Weather conditions to monitor include, but should not be limited to, overnight low temperatures, temperature during the test, and precipitation during the last 48 hours can assist in the evaluation of the data. It should be noted that some of the equipment is not rated for winter operation, in particular, the PID is recommended not to be used below 32° F and the vacuum gages are not recommended to be used under 20° F. Further, the depth of snow and distance below grade of the freeze line in the soil should be estimated.*

Response: The final report will include information about the weather conditions during the field activities. Weather information will include daily low and high temperatures; ambient temperatures during the pilot test; precipitation during the field activities and at least two days prior to the field activities; and additional information on weather conditions that may assist with evaluating the test performance.

If ambient air temperatures are below 32° F, the Photovac Microtip meter that will be used to screen ambient air and soil gas for VOCs will be kept in the heated cab of the truck. The truck will be located in the immediate vicinity of the field activities. This activity will ensure that the internal components of the Microtip remain above 32° F. Furthermore, if ambient air temperatures are below 20 ° F, in order to insure the effective operation of the magnehelic gauges used to record vacuum values, portable gauges will be utilized and will also be kept in the cab of the truck when not in use.

The depth to the frost line below ground surface will be estimated by Benchmark based on test pit activities, which are currently being conducted on properties near the site for determination of borrow material suitability. In addition, each borehole, prior to well construction, will be evaluated to estimate the depth of the frost line in the pilot test area.

We trust these responses adequately address the Department's concerns. We would appreciate your earliest possible reply, as we are eager to complete the pilot test as soon as possible to maintain the project schedule. Weather permitting, we would like to schedule the test for the 2nd week of February.

Sincerely,

Thomas H. Forbes, P.E.
Project Manager

C: S. D'Angelo (Mercury Aircraft)
B. Meade (Mercury Aircraft)
W. Helferich (Harter, Secrest)
G. Bailey (NYSDEC Reg. 9)
M. Peachey (NYSDEC Reg. 8)
M. Kadlec (NYSDOH)

File: 0001-001-100
CG

WORK PLAN FOR
SOIL VAPOR EXTRACTION (SVE) PILOT TEST

URBANA LANDFILL
URBANA, NEW YORK

Prepared For:

MERCURY AIRCRAFT, INC.
DECEMBER, 1988

Prepared By:

Science Applications International, Inc.
Benchmark Environmental Engineering & Science, PLLC

INTRODUCTION

The SVE pilot test is to be performed at an inactive landfill in Urbana, New York. The area where the test is to be performed is near the top of the landfill within the subarea designated as "Hot Spot 5" (see Figure 1). The depth to groundwater in the test area is reported to range from six to ten feet below grade. The vadose zone soil and debris in the test area contain chlorinated and nonchlorinated volatile organic compounds (VOCs). Table 1 presents a summary of soil gas VOC concentrations in the proposed SVE pilot test area.

The specific work task elements presented in this work plan include the installation of a pilot test well, the installation of three monitoring piezometers, and performing an SVE pilot test on the test well. The primary objective of the project is to perform an SVE pilot test and collect the data necessary to design a full scale SVE treatment system.

INSTALLATION OF TEST WELL AND MONITORING PIEZOMETERS

The test well (VEW-1) and three monitoring piezometers (P-1, P-2 and P-3) will be constructed specifically for the purpose of completing the pilot test. The construction methods and piezometer configuration are based on SAIC's extensive experience in conducting SVE pilot tests and site-specific subsurface conditions. The test well and piezometers will be constructed in 6-inch diameter boreholes drilled using an air rotary drilling method. The air rotary method minimizes the extent of borehole surface smearing that occurs when using a hollow stem auger method, thus allowing for a more accurate evaluation of the subsurface air flow characteristics. The boreholes will be completed to a maximum depth of ten feet below grade as the depth to groundwater is approximately 6 to 10 feet below grade. The actual depth of each borehole will be based on the actual depth to the groundwater in the test area. The extent of screen below the groundwater table will be limited to one to two feet.

The SVE pilot extraction well will be targeted in the immediate vicinity of soil gas sample location B-14. Based on the results of soil gas sampling performed during the remedial investigation (RI) at the site, sample B-14 was the only soil gas monitoring location where vinyl chloride was detected. As vinyl chloride emissions will have a significant impact on the need for and size of emission control equipment, installation and sampling of gas from an SVE well located within the vicinity of B-14 will provide more representative emission control design data for this parameter.

The piezometers will be located at distances of 5, 10 and 15 feet from the test well and will be positioned in three different compass directions from the test well. This type of well

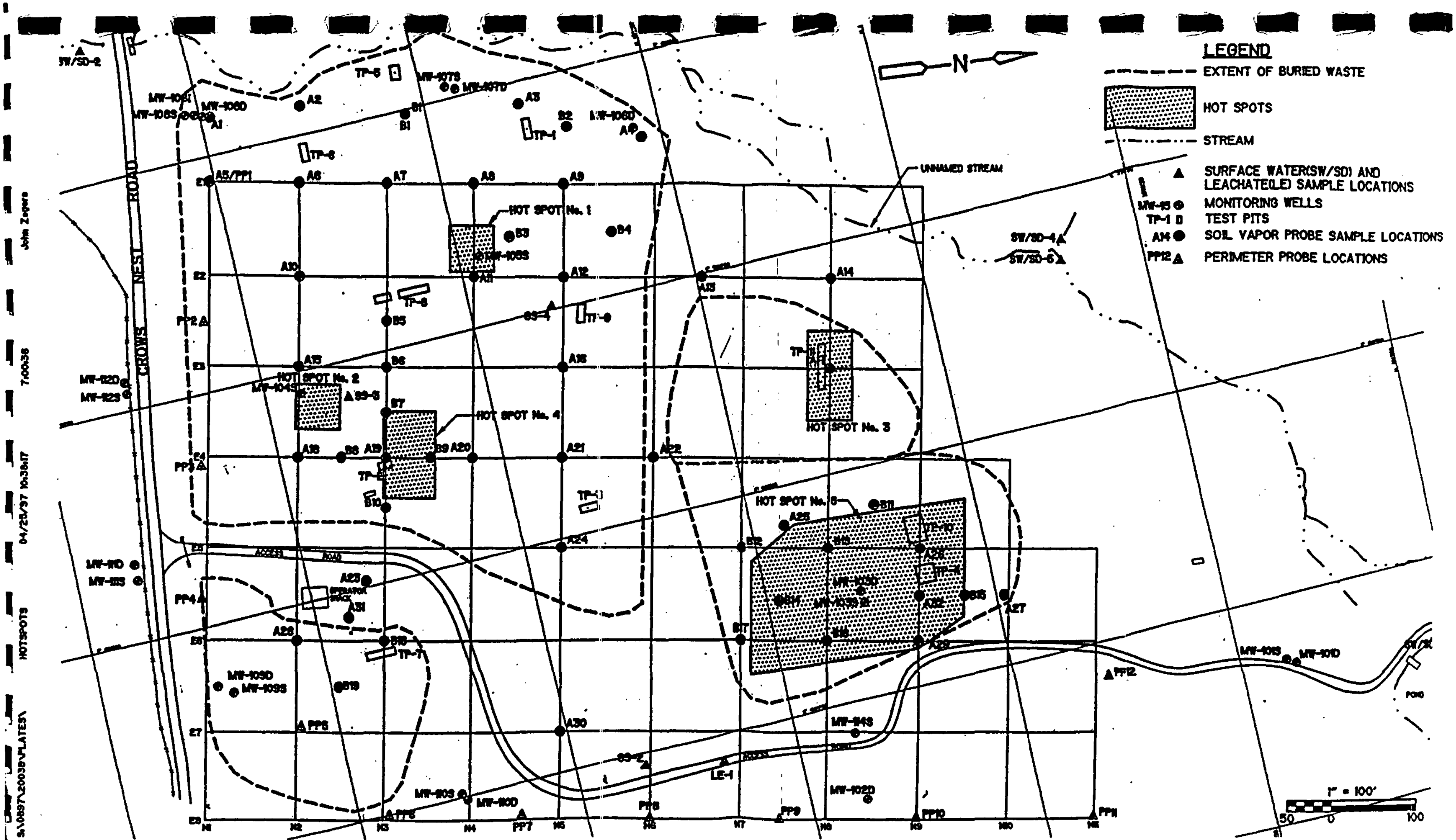


Figure 1
Sample Locations
Urbana Landfill Feasibility Study

CDM Camp Dresser & McKee

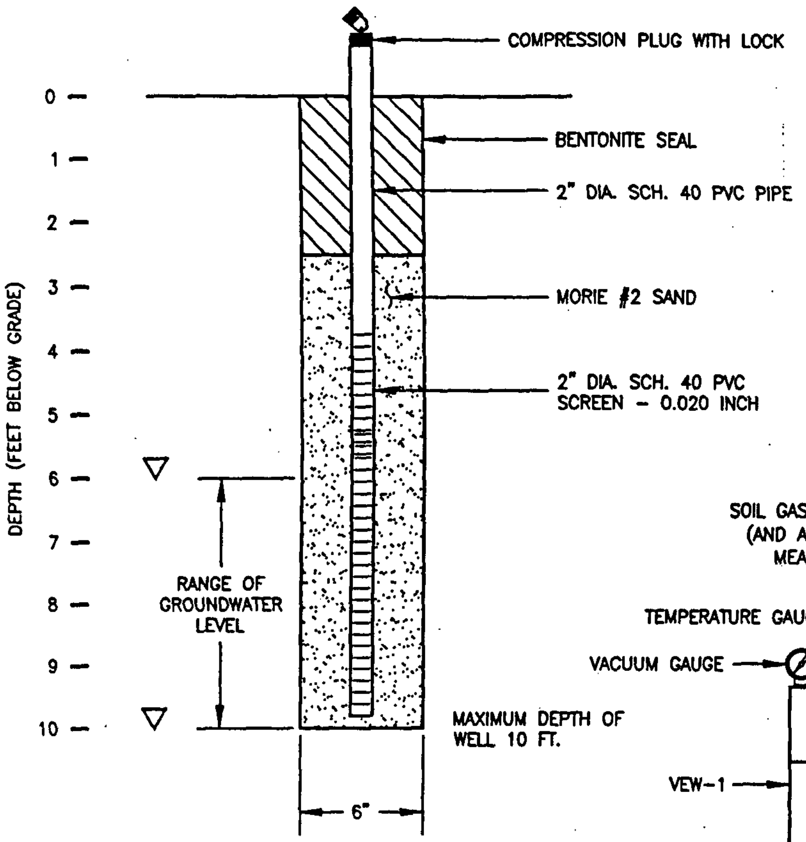
and piezometer configuration will allow for evaluating the variability in the subsurface air flow characteristics within the test area. The test well and three piezometers will have the same construction, thus allowing for one or more of the points, if necessary, to be used as an extraction well(s) during the full scale remediation of the site. The well and piezometers will be constructed of 2-inch diameter schedule 40 PVC pipe and screen. Figure 2 presents the well and piezometer construction details. Slotted screen (0.020-inch) will be located from three to ten feet below grade. A sand pack will be located from 2.5 to 10 feet below grade. Solid 2-inch diameter schedule 40 PVC pipe will be located from the ground surface to three feet below grade. A hydrated bentonite seal will be placed from grade to 2.5 feet below grade. In addition, two feet of unprotected PVC pipe will extend above the ground surface at all four locations. The unprotected surface completion will allow for easier incorporation of the well or piezometers into the full scale remediation system, as necessary. The well and piezometers will contain a 2-inch diameter compression fitting plug with a lock at the surface.

During the installation of the boreholes, an SAIC professional soil scientist will document the physical and morphorological properties of the soil cuttings that are important with respect to subsurface air flow characteristics. These properties include soil texture, relative moisture content, soil color, and any other notable characteristics. Formal soil samples will not be collected from the borings. Actual construction details with respect to the length of screen and pipe and the placement of the sand and bentonite seal will be based on actual site conditions; however, the actual construction is not expected to differ significantly from the details presented in this work plan. The soil properties and the well and piezometer construction details will be documented in the field on well construction logs.

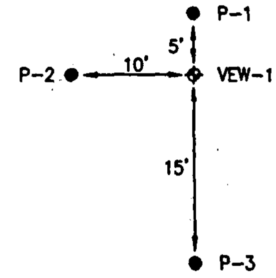
An organic vapor analyzer equipped with a photoionization detector (OVA-PID) will be used to measure the relative concentration of total VOCs in the borehole upon completion of the borehole. In addition, the SAIC soil scientist will perform health and safety monitoring during the installation of the wells and completion of the SVE pilot test.

SVE PILOT TEST PROTOCOLS

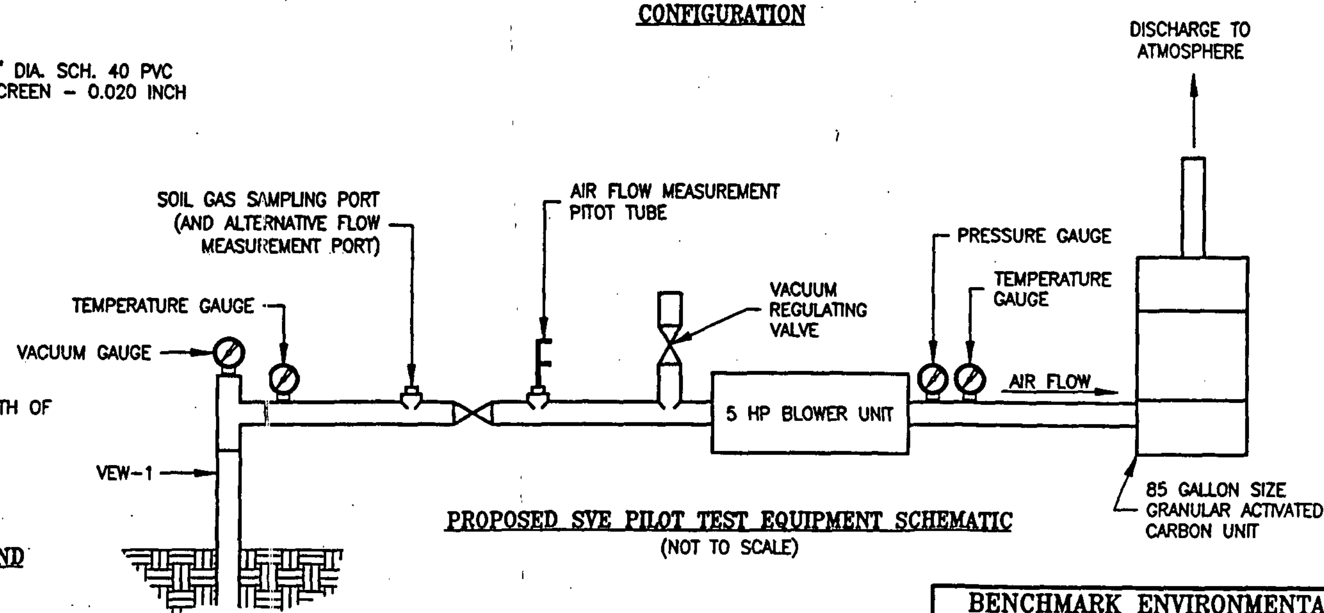
A short term SVE pilot test will be completed on the test well VEW-1. The test will primarily involve extracting soil gas from well VEW-1 at four different rates of vacuum and monitoring the induced subsurface vacuum at the monitoring piezometers, the



PROPOSED VACUUM EXTRACTION WELL AND PIEZOMETER CONSTRUCTION DETAILS



PROPOSED TEST WELL AND PIEZOMETER CONFIGURATION



PROPOSED SVE PILOT TEST EQUIPMENT SCHEMATIC
(NOT TO SCALE)

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE
BUFFALO, NY

SOIL VAPOR EXTRACTION PILOT TEST DETAILS - URBANA, NY LANDFILL SITE

drawn KRC	checked PJC	approved PJC	figure no.
date 12/18/98	date 12/18/98	date 12/18/98	2
job no. 01-1406-00-3692-007		file no. 03692-01-B	

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extraction flow rate from well VEW-1, and the concentration of VOCs in the extracted soil gas. Each of the four vacuum steps will be conducted for a minimum of one hour. Table 2 summarizes the monitoring parameters and monitoring frequency for the SVE pilot test.

A 5-HP regenerative blower with a explosion proof motor will be used to apply four different rates of vacuum on the test well during the SVE pilot test. The four applied vacuum rates will be determined in the field as a percentage of the maximum vacuum obtainable on the wellhead. An atmospheric intake valve located prior to the blower intake will be used to adjust the applied vacuum on the wellhead. An EG&G Rotron model DR707 regenerative blower capable of extracting 280 standard cubic feet per minute (scfm) of soil gas at a vacuum of 0-inches of WC or 60 scfm at 90-inches of WC will be used. The specifications and performance curve for the blower unit are attached. The operational range of this blower is sufficient to perform the SVE test based on the reported silty sand soil type at the site.

A pitot tube will be located on a section of extraction piping located between the wellhead and the blower atmospheric intake valve. The pitot tube in conjunction with a magnehelic gauge and temperature gauge will be used to determine the extraction flow rate. The pilot test equipment schematic is presented in Figure 2. The pitot tube specifications are attached. The flow rate will be determined at 15-minute intervals during each vacuum step of the pilot test.

The test wellhead and the piezometer wellheads will each be equipped with magnehelic gauges in order to monitor the applied or induced vacuum values. Magnehelic gauge specifications are attached. Several magnehelic gauges with vacuum value ranges of 0 to 0.2 inches of WC, 0 to 1.0 inches of WC, 0 to 5 inches of WC, 0 to 20 inches of WC, and 0 to 80 inches of WC will be used during the test. The applied and induced vacuum values will be recorded at 15-minute intervals during each vacuum step.

An organic vapor analyzer equipped with a photoionization detector (OVA-PID) will be used to determine the relative concentration of VOCs in the soil gas. The ionization potential of the bulb in the OVA-PID is 10.6 millivolts. This ionization potential is sufficient to detect the target compounds present at the site. The VOC concentrations will be recorded at the beginning and at the end of each vacuum step. Specifications for the OVA-PID to be used during the pilot test are attached. A landfill gas monitor will be used to determine the concentration of methane in the extracted soil gas at the beginning and end of each vacuum step.

In addition, at the conclusion of the first and fourth vacuum steps, an extraction gas sample will be collected in a one liter sample bag. The two samples will be laboratory analyzed by EPA Method TO14 for total VOCs which will include the parameters of interest [TCE, 1,1,1-TCA, 1-1-dichlorothene (1,1-DCE), 1,1-dichloroethane (1,1-DCA), cis-1,2-dichloroethene (cis-1,2,-DCE), vinyl chloride, toluene, ethylbenzene and xylenes]. The samples will be kept cool at 4 degrees Celsius during shipment to the laboratory and will be submitted using proper chain of custody protocols.

Prior to the start of the pilot test, the depth to groundwater will be recorded at well VEW-1 and the three piezometers using a standard water level indicator. At the conclusion of each vacuum step the depth to groundwater will be recorded at well VEW-1 in order to evaluate the extent of any upwelling of groundwater near the extraction well.

The discharge gas from the blower unit will be piped directly to one 85-gallon size granular activated carbon unit (GAC). The purpose for using the GAC is to treat the extracted soil gas prior to discharge to the atmosphere. The one GAC unit contains approximately 300 pounds of carbon which should be sufficient to filter the extracted VOCs from the offgas during the 4-hour step test. The discharge from the GAC unit will be screened with the OVA-PID at the beginning and end of each vacuum step to determine the relative efficiency of the GAC to adsorb the VOCs.

DATA MANAGEMENT

Proper documentation of all field data will allow for the optimal interpretation of data and the generation of remedial design parameters. All field measurements and observations will be recorded on well construction detail logs, and a field notebook. All data will be recorded directly and legibly on the field forms with all entries signed and dated.

All field measurements will be made by a professional soil scientist and the following standard reporting units will be used during the field activities:

1. Water levels measured will be reported to the nearest 0.01 foot.

2. Vacuum values up to 0.25-inches of WC will be recorded to the nearest 0.01 inch, vacuum values between 0.25-inches of WC and 10.0 inches of WC will be recorded to the nearest 0.1 inch, vacuum values between 10 and 40-inches of WC will be recorded to the nearest 0.5 inch and vacuum values between 40 and 80-inches of WC will be recorded to the nearest 1.0 inch.

3. OVA-PID values will be recorded to the nearest 0.1 part per million (ppm) for values less than 100 ppm and to the nearest 1.0 for values greater than 100 ppm.

4. The landfill gas monitor value for methane will be recorded to the nearest 0.1%.

5. The pressure differential from the pitot tube will be recorded to the nearest 0.01 inch.

6. Temperature will be recorded to the nearest 1.0 degrees Celsius.

Data collected during the SVE pilot test will be presented in a remediation design parameters report. The data will be presented in both tabular and graphical form. The data will be interpreted to determine the optimal extraction flow rate and vacuum on the extraction well, the effective radius of influent, the required well spacing, the number of wells required, the full scale remediation blower size, and the initial VOC removal rate.

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TABLE 1
Summary of Detected VOCs in Soil Gas at Hot Spot No. 5
Urbana, New York Landfill Site
SAIC Project No. 01-1408-00-3692-007

	Soil Gas Sample Location							
Contaminants	B-12	B-13	B-13 Duplicate	B-14	A-25	A-32	A-32 Duplicate	A-32(B)
	ppb v/v							
Vinyl Chloride	ND	ND	ND	11,539	ND	ND	ND	ND
1,1-Dichloroethane	ND	56	75	ND	ND	ND	ND	ND
cis-1,2-Dichloroethene	ND	5,456	6,200	620	ND	ND	ND	ND
Tetrachloroethene	6	ND	ND	ND	19	ND	ND	ND
1,1-Dichloroethene	ND	2,976	3,224	ND	ND	1,662	6,448	6,928
1,1,1-Trichloroethane	ND	5,586	6,307	ND	ND	11,352	17,839	21,624
Trichloroethene	ND	3,113	3479	ND	ND	25,635	34,790	38,452
Toluene	ND	ND	ND	965	ND	ND	ND	ND
Ethylbenzene	ND	ND	ND	294	ND	ND	ND	ND
Total Xylenes	ND	ND	ND	759	ND	ND	ND	ND

ppb v/v = parts per billion, volume/volume
ND = not detected

Note: All data is from the second round of sampling in January 1997 as presented in the Urbana Landfill Remedial Investigation/Feasibility Study with the exception of A-32(B) which is from the first round of sampling in January 1997.

L:\WP\1408\00\3692\PARAMETERS.TBL

TABLE 2 Soil Vapor Extraction Pilot Test Monitoring Parameters Urbana, New York Landfill Site SAIC Project No. 01-1408-00-3692-007		
Parameter	**Location**	**Frequency**
Applied vacuum	VEW-1	15-minute intervals during each 1-hour step
Induced vacuum	P-1, P-2, & P-3	15-minute intervals during each 1-hour step
Extraction flow rate	VEW-1	15-minute intervals during each 1-hour step
VOCs-extracted soil gas (field)	VEW-1	Beginning and end of each 1-hour step
VOCs-extracted soil gas (lab)	VEW-1	Conclusion of the 1st and 4th vacuum step
VOCs-extracted soil gas (field)	GAC Intake	Beginning and end of each 1-hour step
VOCs-extracted soil gas (field)	GAC Discharge	Beginning and end of each 1-hour step
Methane-extracted soil gas (field)	VEW-1	Beginning and end of each 1-hour step
Depth to groundwater	VEW-1	Prior to test and at conclusion of each 1-hour step
Depth to groundwater	P-1, P-2, & P-3	Prior to test and at conclusion of SVE step test
Temperature	VEW-1	15-minute intervals during each 1-hour step
Temperature	Blower Discharge	Beginning and end of each 1-hour step
Pressure	Blower Discharge	Beginning and end of each 1-hour step

ATTACHMENT

Equipment Specifications

EG&G ROTRON

DR 707
Regenerative Blower

FEATURES

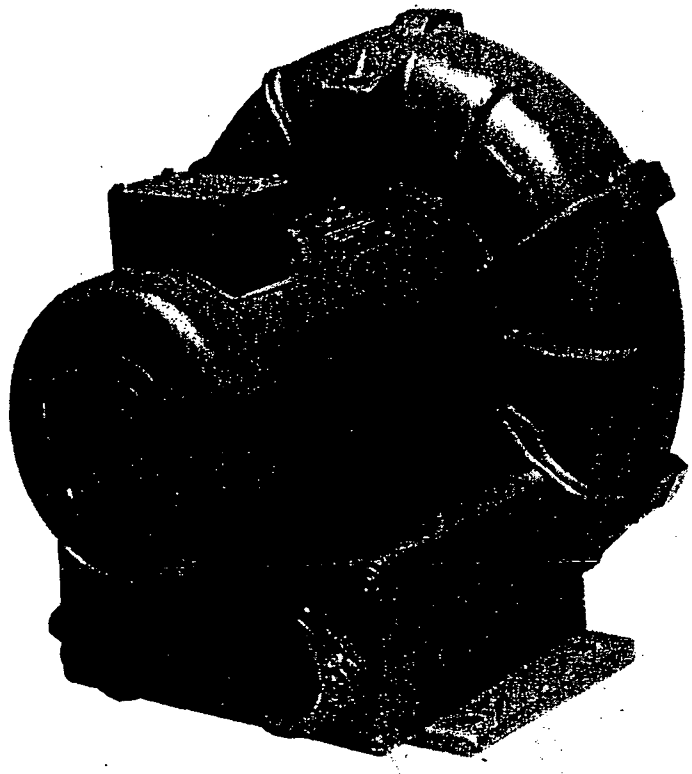
- Manufactured in the USA
- Maximum flow 280 SCFM
- Maximum pressure 114" WG
- Maximum vacuum 6.8" Hg
- 5 HP standard
- Blower construction—cast aluminum housing, impeller and cover
- Inlet and outlet internal muffling
- Noise level within OSHA standards
- Weight: 156 lbs. (71 Kg)

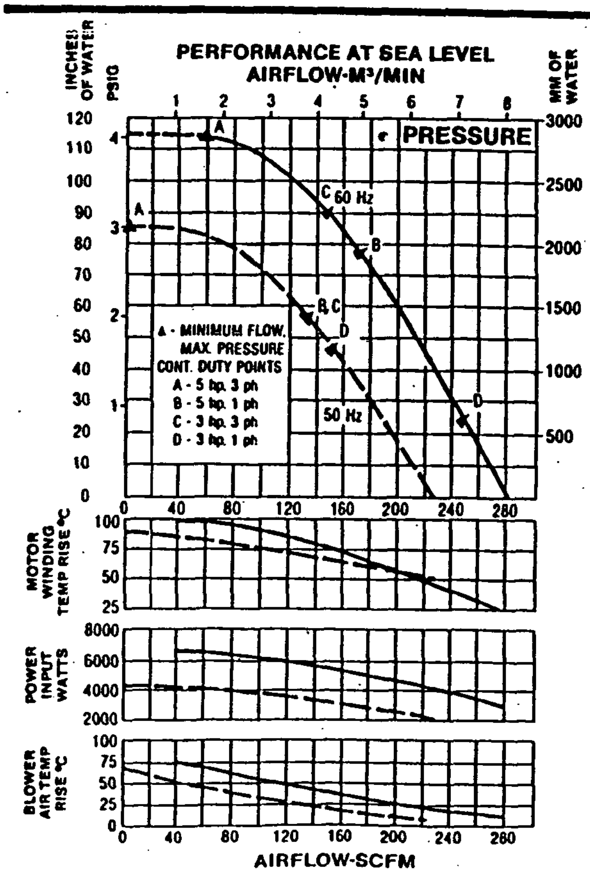
ACCESSORIES

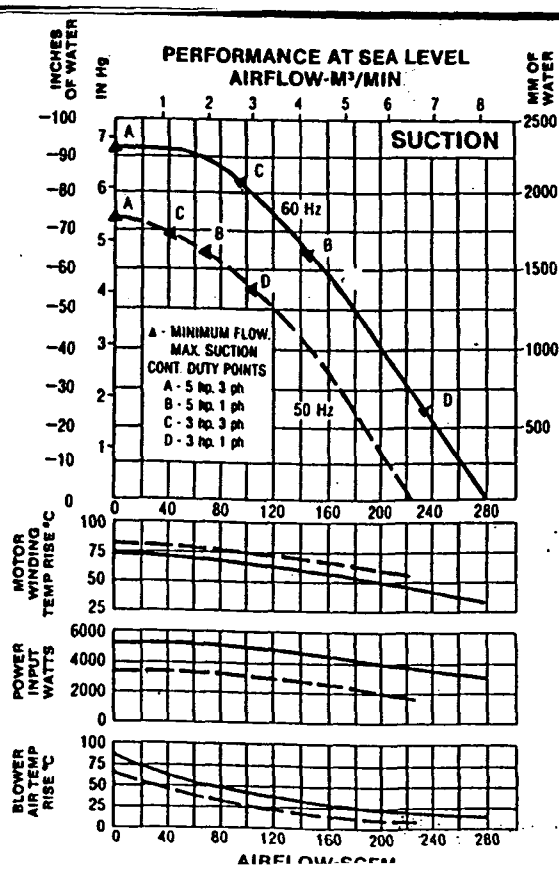
- External mufflers
- Slip-on flanges
- Inlet and/or inline filters
- For details see Accessories Section

OPTIONS

- Smaller HP motors
- 575-volt and XP motors
- Surface treatment or plating
- Single or three phase motors
- Remote drive (motorless) model
- Gas tight sealing
- Belt drive (motorless) model; for details see Remote Drive Section

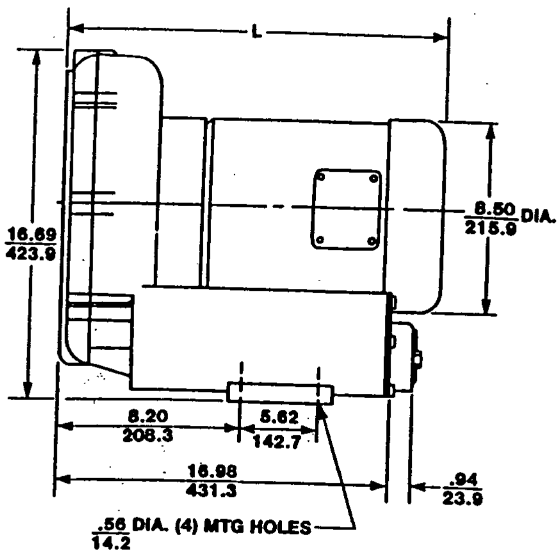


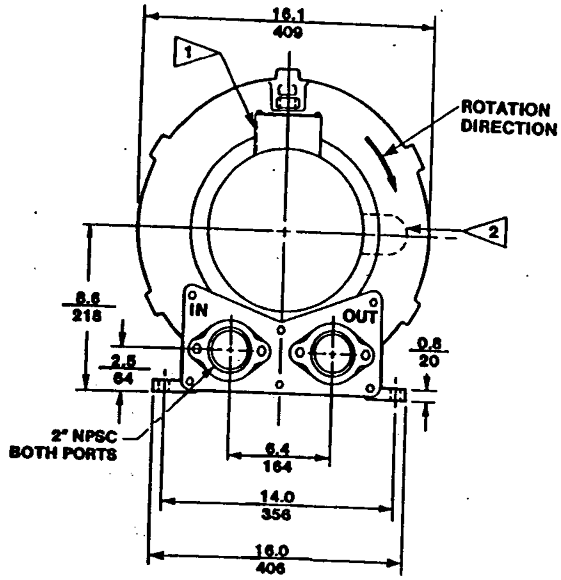




EG&G ROTRON

DR 707 Regenerative Blower





Model	L (IN)	L (MM)
DR707D89X	18.17	461.5
DR707K72K	18.17	461.5
DR707F72X	20.49	520.4
DR70786X	18.17	461.5
DR707D5X	19.67	499.6
DR707K9X	17.5	444.5

1. T'BOX CONNECTION 1.06" DIA. ON TEFC MOTORS, .75 NPT ON XP MOTORS
2. LOCATION OF CAPACITOR ON SINGLE PHASE MOTORS

DIMENSIONS: IN / MM
TOLERANCE: .XX ± .1 / 2.5

Specifications subject to change without notice.

SPECIFICATIONS

MODEL	DR707D89X	DR707K72X	DR707F72X	DR707D86X	DR707D5X	DR707K9X
Part No.	036789	036791	036790	036914	036875	036794
Motor Enclosure Type	TEFC	TEFC	XP	TEFC	TEFC	TEFC
Motor Horsepower	5	3	5	5	5	3
Voltage[1]	208-230/460	230/460	230/460	575	230	115/230
Phase	3	3	3	3	1	1
Frequency[1] (Hz)	60	60	60	60	60	60
Insulation Class[2]	F	F	B	F	F	F
NEMA Rated Motor Amps	14.2-14.0/7.0	8.0/4.0	14.0/7.0	5.6	21	26.2/13.1
Service Factor	1.15	1.15	1.0	1.15	1.0	1.0
Locked Rotor Amps	98-96/48	52/26	96/48	37	124	158/79
Max. Blower Amps	18.5-18.2/9.1	13/6.5	14.0/7.0	6.9	25	18.5/9.25
Recommended NEMA Starter Size	1-1/0	0/0	1/0	0	1.5	1.5/1
Weight (lbs/Kg)	169/76.8	157/71.4	184/83.6	169/76.8	194/88.2	186/84.5
Blower Limitations for Continuous Duty (60 Hz/50 Hz)						
Max. Pressure-In. of water	113/83	90/65	100/75	113 (60 Hz)	77/65	25/55
Max. Suction-In. of water	93/73	83/70	82/70	93 (60 Hz)	65/65	25/55
Min. Flow-Pressure-SCFM	60/0	145/120	120/88	60 (60Hz)	175/120	245/130
Min. Flow-Suction-SCFM	0/0	97/40	100/44	0 (60 Hz)	145/70	230/105

[1]All 3 phase motors are factory tested and certified to operate on 200-230/460 VAC-3 ph-60 Hz and 220-240/380-415 VAC-3 ph-50 Hz.

[2]Maximum operating temperatures: Motor winding temperature (winding rise plus ambient) should not exceed 140°C for Class F insulation or 110°C for Class B insulation. Blower outlet air temperature should not exceed 140°C (air temperature rise plus ambient).

Dwyer

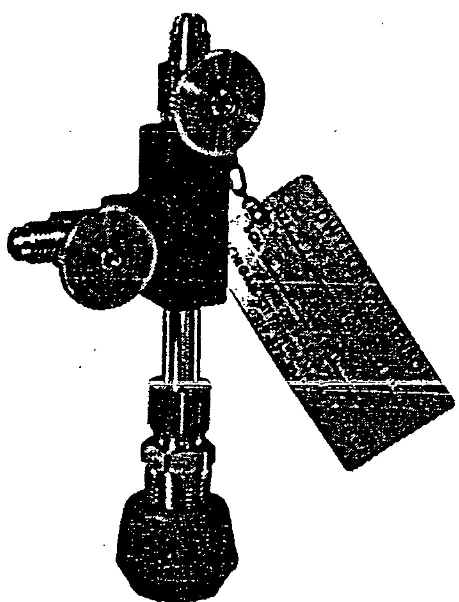
Series DS-200 Flow Sensor

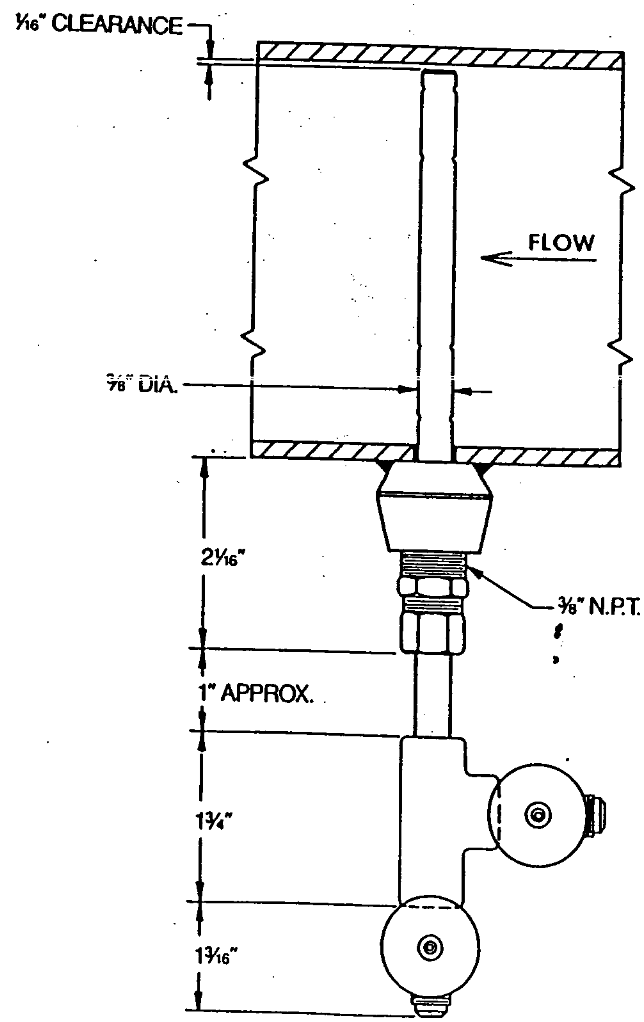
Flow Calculation and Data Bulletin

This bulletin contains equations, charts, and data for determining the differential pressure developed by the Dwyer Series DS 200 Flow Sensor for various flow rates of water, air, steam, or gases in various pipe sizes.

The contents of this bulletin can be utilized to prepare conversion charts to translate the differential pressure readings in a given flow sensor installation to the equivalent flow rate. Where direct readout of flow is required, use the bulletin to calculate the full flow differential pressure in order to specify the exact Dwyer Capsuhelic gage range needed. Special ranges and scale calibrations for the Capsuhelic gage are available at minimal extra cost. Consult Bulletin A-30 in the Dwyer catalog or contact the factory for additional information. Bulletin F-50 covers installation.

For additional useful information in working up flow calculations, the following reference is recommended: Crane Co. Technical Paper No. 400 "Flow of Fluids Through Valves, fittings and pipe" available from Crane Company, 300 Park Avenue, New York, New York 10022, Attn: Advertising Dept. Price $8.00.





FLOW EQUATIONS

1. Any Liquid

$$Q\ (GPM) = 5.668 \times K \times D^2 \times \sqrt{\Delta P / S_f}$$

2. Steam or Any Gas

$$Q\ (lb/Hr) = 359.1 \times K \times D^2 \times \sqrt{p \times \Delta P}$$

3. Any Gas

$$Q\ (SCFM) = 128.8 \times K \times D^2 \times \sqrt{\frac{P \times \Delta P}{(T+460) \times S_s}}$$

DIFFERENTIAL PRESSURE EQUATIONS

1. Any Liquid

$$\Delta P\ (in.\ WC) = \frac{Q^2 \times S_f}{K^2 \times D^4 \times 32.14}$$

2. Steam or Any Gas

$$\Delta P\ (in.\ WC) = \frac{Q^2}{K^2 \times D^4 \times p \times 128{,}900}$$

3. Any Gas

$$\Delta P\ (in.\ WC) = \frac{Q^2 \times S_s \times (T+460)}{K^2 \times D^4 \times P \times 16{,}590}$$

TECHNICAL NOTATIONS

The following notations apply:

ΔP = Differential pressure expressed in inches of water column.
Q = Flow expressed in GPM, SCFM or PPH as shown in equation.
K = Flow coefficient — See Values Tabulated on page 3.
D = Inside diameter of line size expressed in inches. For square & rectangular ducts use $D = \sqrt{\frac{4 \times \text{Height} \times \text{Width}}{\pi}}$

P = Static Line pressure (psia)
T = Temperature in degrees Fahrenheit (plus 460=°Rankin)
p = Density of medium in pounds per cubic foot
S_f = Sp Gr at flowing conditions
S_s = Sp Gr at 60°F

SCFM TO ACFM EQUATION

$$SCFM = ACFM \times \left(\frac{14.7 + PSIG}{14.7}\right)\left(\frac{520^*}{460 + °F}\right)$$

$$ACFM = SCFM \times \left(\frac{14.7}{14.7 + PSIG}\right)\left(\frac{460 + °F}{520}\right)$$

$$\text{POUNDS PER CUBIC FOOT STD.} = \text{POUNDS PER CUBIC FOOT ACT.} \times \left(\frac{14.7}{14.7 + PSIG}\right)\left(\frac{460 + °F}{520}\right)$$

$$\text{POUNDS PER CUBIC FOOT ACT.} = \text{POUNDS PER CUBIC FOOT STD.} \times \left(\frac{14.7 + PSIG}{14.7}\right)\left(\frac{520}{460 + °F}\right)$$

1 CUBIC FOOT OF AIR = 0.076 POUNDS PER CUBIC FOOT AT 60°F AND 14.7 PSIA

*(520 = 460 + 60°) Std. Temp. Rankine

TABLE 1
FLOW COEFFICIENTS (K)

FPS = Average Velocity Ft./Sec. (Water)

PIPE SIZE (SCH. 40)	VELOCITY* FPS	K	
1	13.0	.521	(use .558 above 7 FPS)
1-1/4	13.3	.536	(use .572 above 7 FPS)
1-1/2	13.0	.556	
2	15.0	.586	
2-1/2	15.1	.625	
3	15.2	.645	
4	15.6	.670	
5	16.0	.681	
6	16.6	.652	
8	16.0	.669	
10	17.1	.677	(use .726 above 6 FPS)

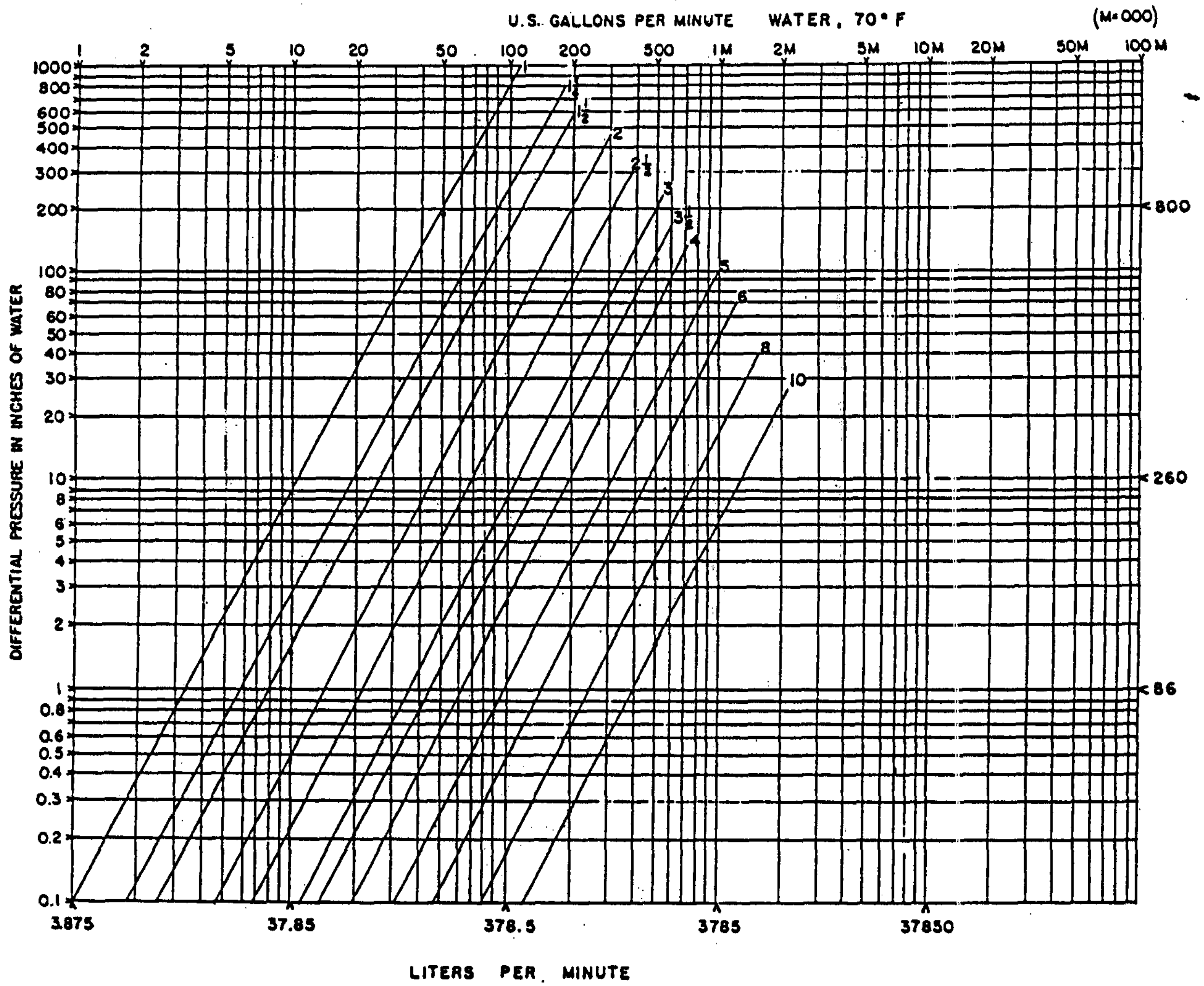
NOTE: If only one K factor is listed, it applies to all flow rates for the size of pipe and velocity limits listed.

*Represents velocity at 100" H_2O differential pressure. Consult factory for velocities above those listed.

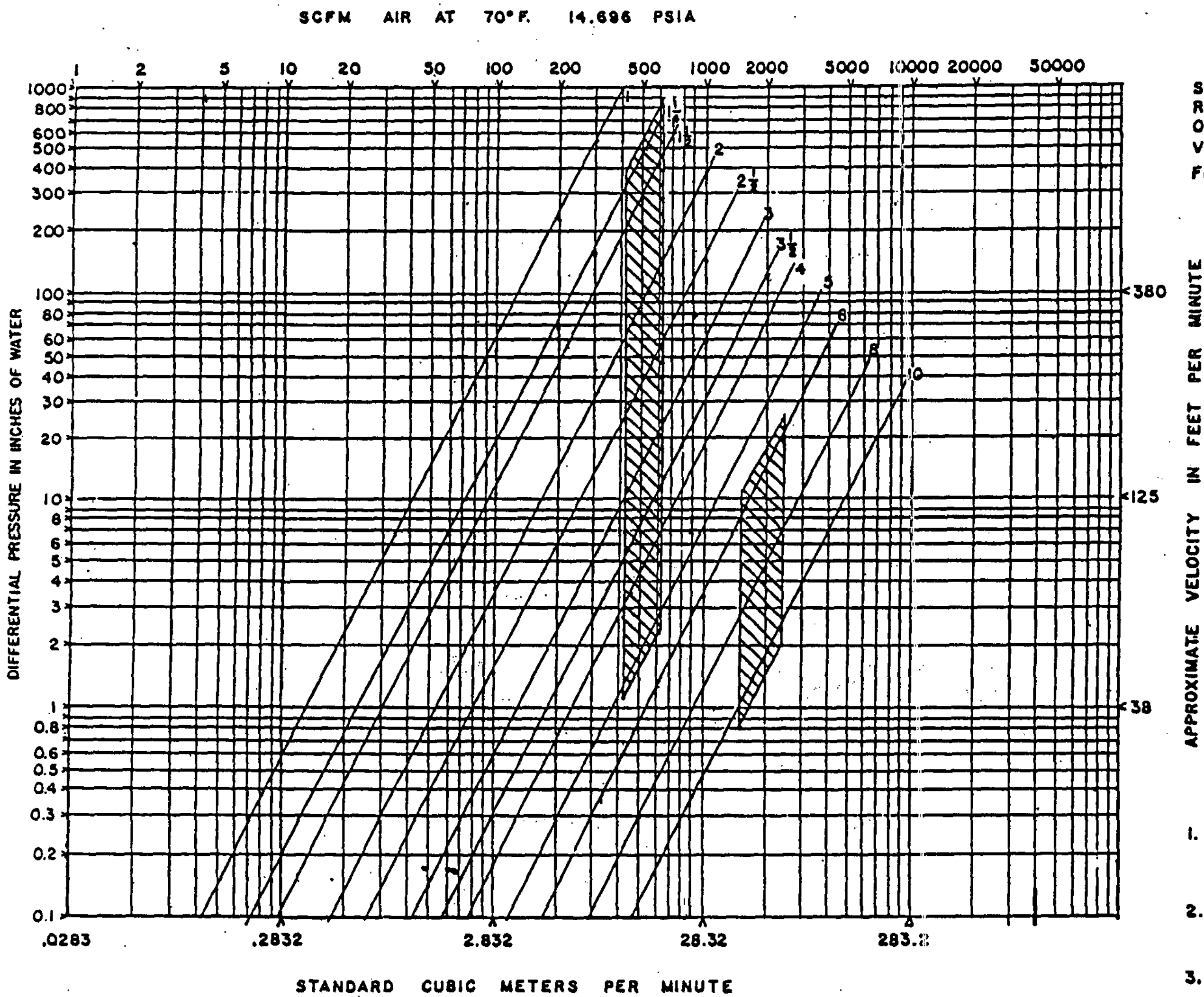
TABLE 2
ALTITUDE/PRESSURE TABLE

The following table gives the U.S. standard atmosphere (1962) for various altitudes above sea level.

Altitude Feet	Atmospheric Pressure PSIA
0	14.696
500	14.433
1,000	14.173
1,500	13.917
2,000	13.664
2,500	13.416
3,000	13.171
3,500	12.930
4,000	12.692
4,500	12.458
5,000	12.227
6,000	11.777
7,000	11.340
8,000	10.916
9,000	10.505
10,000	10.106
15,000	8.293



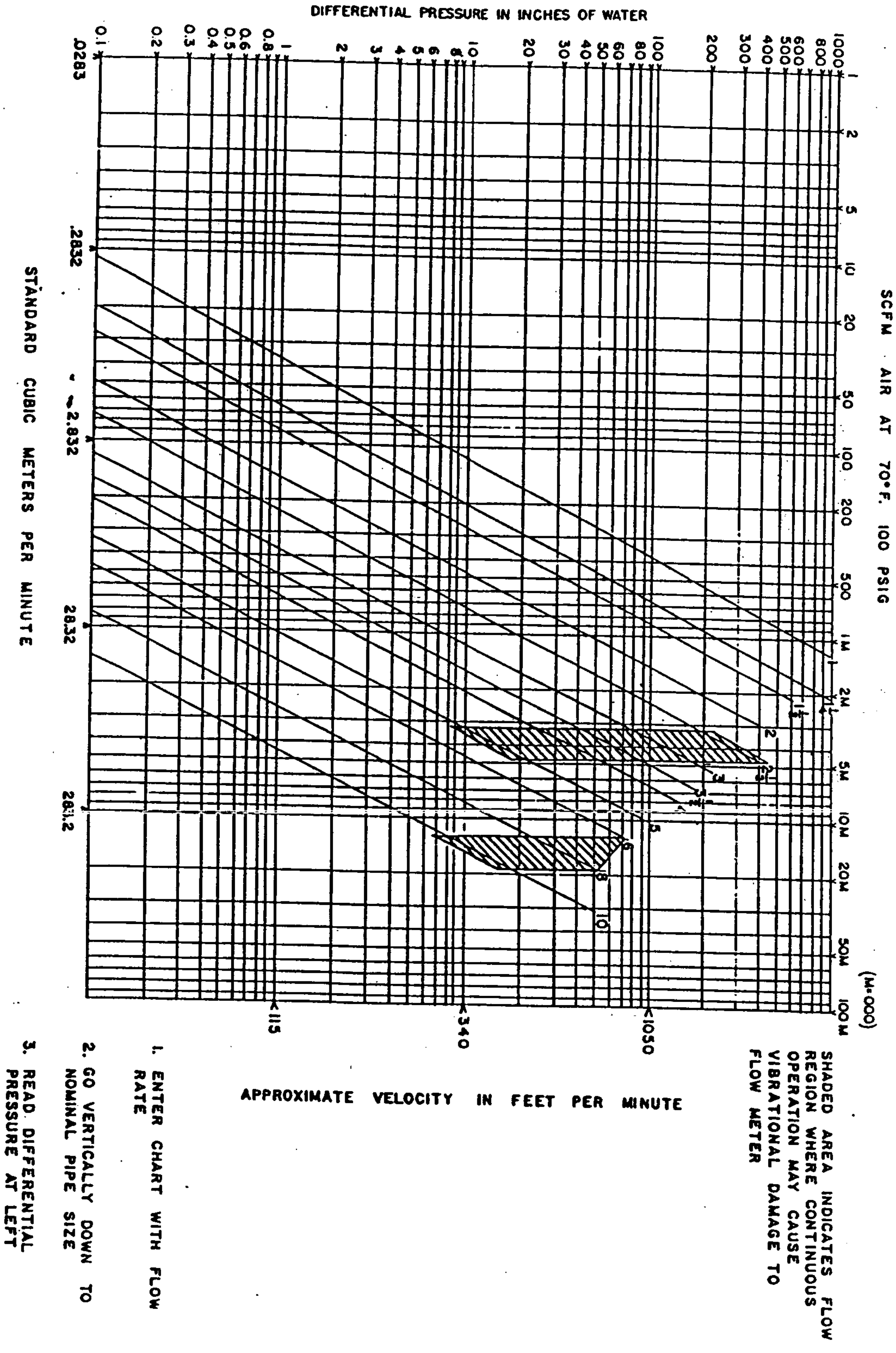
1. ENTER CHART WITH FLOW RATE
2. GO VERTICALLY DOWN TO NOMINAL PIPE SIZE
3. READ DIFFERENTIAL PRESSURE AT LEFT

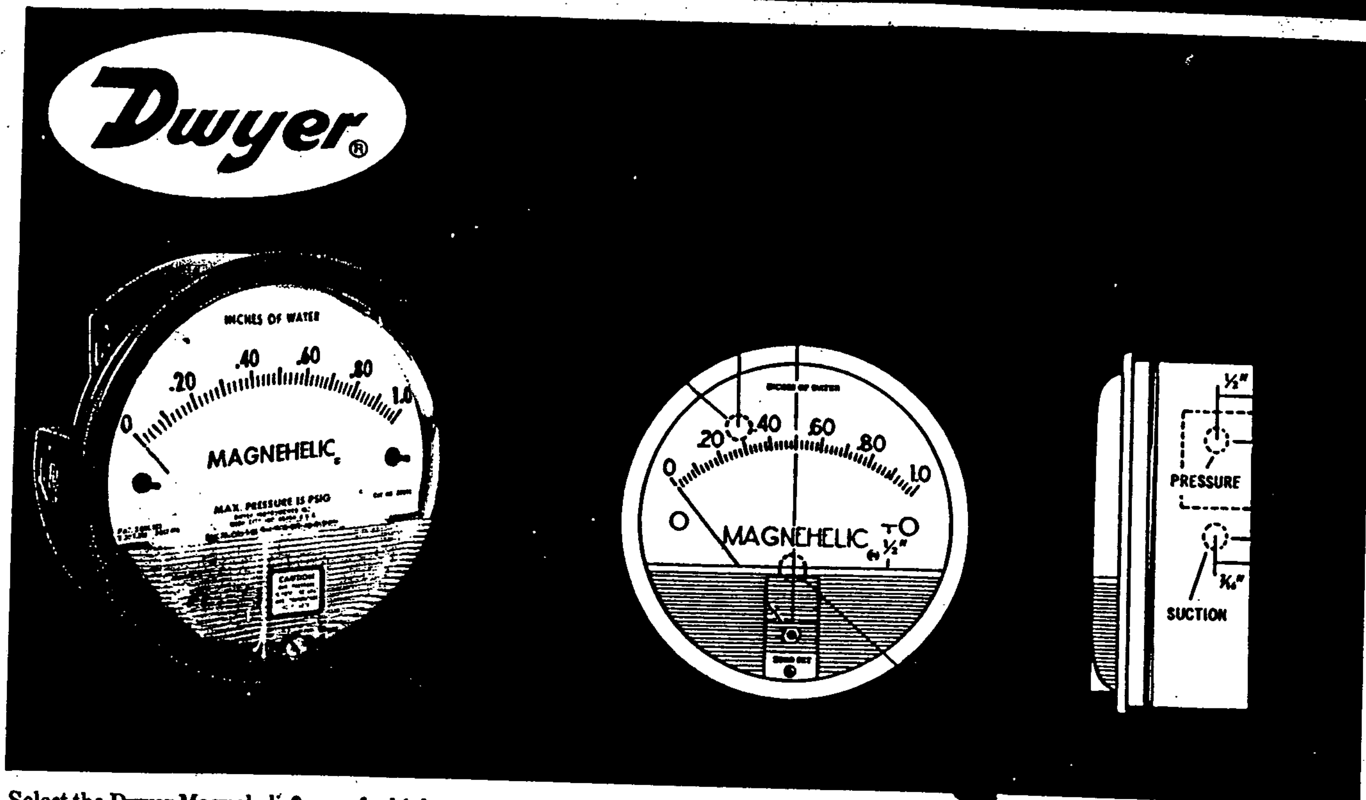


SHADED AREA INDICATES FLOW REGION WHERE CONTINUOUS OPERATION MAY CAUSE VIBRATIONAL DAMAGE TO FLOW METER

1. ENTER CHART WITH FLOW RATE
2. GO VERTICALLY DOWN TO NOMINAL PIPE SIZE
3. READ DIFFERENTIAL PRESSURE AT LEFT

DWYER INSTRUMENTS, INC.


DIFFERENTIAL PRESSURE IN INCHES OF WATER
0.1 0.2 0.3 0.4 0.5 0.6 0.8 1 2 3 4 5 6 8 10 20 30 40 50 60 80 100 200 300 400 500 600 800 1000
SCFM AIR AT 70°F. 100 PSIG
1 2 5 10 20 50 100 200 500 1M 2M 5M 10M 20M 50M 100M
(M=000)
STANDARD CUBIC METERS PER MINUTE
.0283 .2832 2.832 28.32 281.2
APPROXIMATE VELOCITY IN FEET PER MINUTE
115 340 1050
1 1¼ 1½ 2 2½ 3 3½ 4 5 6 8 10
SHADED AREA INDICATES FLOW REGION WHERE CONTINUOUS OPERATION MAY CAUSE VIBRATIONAL DAMAGE TO FLOW METER
1. ENTER CHART WITH FLOW RATE
2. GO VERTICALLY DOWN TO NOMINAL PIPE SIZE
3. READ DIFFERENTIAL PRESSURE AT LEFT

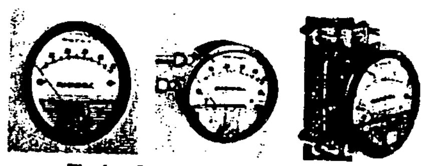


Select the Dwyer Magnehelic® gage for high accuracy – guaranteed within 2% of full scale – and for the wide choice of 81 ranges available to suit your needs precisely. Using Dwyer's simple, frictionless Magnehelic® movement, it quickly indicates low air or non-corrosive gas pressures – either positive, negative (vacuum) or differential. The design resists shock, vibration and over-pressures. No manometer fluid to evaporate, freeze or cause toxic or leveling problems. It's inexpensive, too.

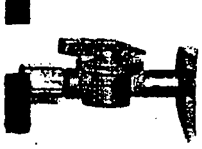
Widely used to measure fan and blower pressures, filter resistance, air velocity, furnace draft, pressure drop across orifice plates, liquid levels with bubbler systems and pressures in fluid amplifier or fluidic systems. It also checks gas-air ratio controls and automatic valves, and monitors blood and respiratory pressures in medical care equipment.

MOUNTING.

A single case size is used for most ranges of Magnehelic® gages. They can be flush or surface mounted with standard hardware supplied. With the optional A-610 Pipe Mounting Kit they may be conveniently installed on horizontal or vertical 1¼" - 2" pipe. Although calibrated for vertical position, many ranges above 1" may be used at any angle by simply re-zeroing. However, for maximum accuracy, they must be calibrated in the same position in which they are used. These characteristics make Magnehelic® gages ideal for both stationary and portable applications. A 4 13/16" hole is required for flush panel mounting. Complete mounting and connection fittings plus instructions are furnished with each instrument.


Flush ...Surface...or Pipe Mounted

VENT VALVES



In applications where pressure is continuous and the Magnehelic® gage is connected by metal or plastic tubing which cannot be easily removed, we suggest using Dwyer A-310A vent valves to connect gage. Pressure can then be removed to check or re-zero the gage.

HIGH AND MEDIUM PRESSURE MODELS

Installation is similar to standard gages except that a 4 11/16" hole is needed for flush mounting. The medium pressure construction is rated for internal pressures up to 35 psig and the high pressure up to 80 psig. Available in all ranges. Because of larger case, will not fit in portable case. Weight 1 lb., 10 oz (Installation of the A-321 safety relief valve on standard Magnehelic® gages often provides adequate protection against infrequent overpressure; see Bulletin S-101).

PHYSICAL DATA

Ambient temperature range: 20° to 140° F. *

Rated total pressure: –20" Hg. to 15 psig. †

Overpressure: Relief plug opens at approximately 25 psig.

Connections: 1/8" NPT female high and low pressure taps, duplicated — one pair side and one pair back.

Housing: Die cast aluminum. Case and aluminum parts iridite-dipped to withstand 168 hour salt spray test. Exterior finish is baked dark gray hammerloid.

Accuracy: Plus or minus 2% of full scale (3% on -0 and 4% on -00 ranges), throughout range at 70°F.

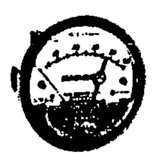
Standard accessories: Two 1/8" NPT plugs for duplicate pressure taps, two 1/8" pipe thread to rubber tubing adapters and three flush mounting adapters with screws. (Mounting ring and snap ring retainer substituted for 3 adapters in MP & HP gage accessories.)

Weight: 1 lb. 2 oz.

*Low temperature models available as special option.

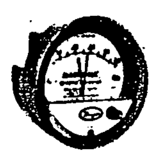
†For applications with high cycle rate within gage total pressure rating, next higher rating is recommended. See Medium and High pressure options at lower left.

OPTIONS AND ACCESSORIES



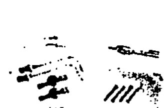
Transparent overlays
Furnished in red and green to highlight and emphasize critical pressures.

Adjustable signal flag
Integral with plastic gage cover; has external reset screw. Available for most ranges except those with medium or high pressure construction. Can be ordered with gage or separate.



LED Setpoint Indicator
Bright red LED on right of scale shows when setpoint is reached. Field adjustable from gage face, unit operates on 12-24 VDC. Requires MP or HP style cover and bezel.

Portable units
Combine carrying case with any Magnehelic® gage of standard range (not high pressure). Includes 9 ft of 3/16" I.D. rubber tubing, standhang bracket and terminal tube with holder.



Air filter gage accessory package
Adapts any standard Magnehelic® for use as an air filter gage. Includes aluminum surface mounting bracket with screws, two 5 ft. lengths of 1/4" aluminum tubing two static pressure tips and two molded plastic vent valves, integral compression fittings on both tips and valves.

Dwyer Instruments, Inc. P.O. Box 373/Michigan City, Indiana 46361/Phone 219 879-8000/Fax 219 872-9057 • U.K. Phone

Quality design and construction features

Bezel provides flange for flush mounting in panel.

Clear plastic face is highly resistant to breakage. Provides undistorted viewing of pointer and scale.

Precision litho-printed scale is accurate and easy to read.

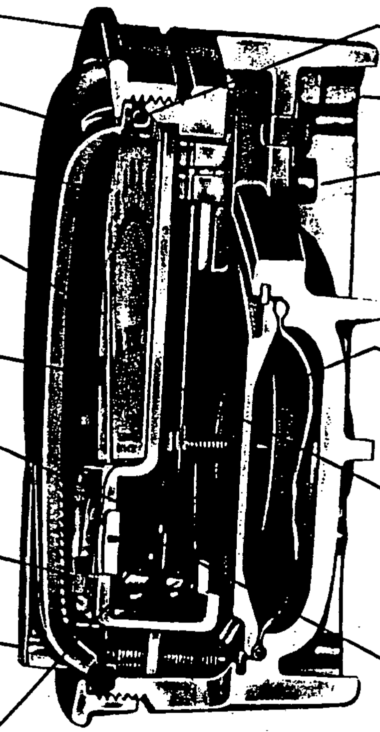
Red tipped pointer of heat treated aluminum tubing is easy to see. It is rigidly mounted on helix shaft.

Pointer stops of molded rubber prevent pointer over-travel without damage.

"Wishbone" assembly provides mounting for helix, helix bearings and pointer shaft.

Sapphire bearings are shock-resistant mounted; provide virtually friction-free motion for helix. Motion damped with high viscosity silicone fluid.

Zero adjustment screw is conveniently located in plastic cover, accessible without removing cover. "O" ring seal provides pressure tightness.



"O" ring seal for cover assures pressure integrity of case.

Blowout plug of silicone rubber protects against overpressure on 15 PSIG rated models. Opens at approximately 25 PSIG.

Die cast aluminum case is precision made. Iridite-dipped to withstand 168 hour salt spray test. Exterior finished in baked dark gray hammerloid. One case size used for all standard pressure ranges, and for both surface and flush mounting.

Silicone rubber diaphragm with integrally molded "O" ring is supported by front and rear plates. It is locked and sealed in position with a sealing plate and retaining ring. Diaphragm motion is restricted to prevent damage due to overpressures.

Calibrated range spring is a flat leaf of Swedish spring steel in temperature compensated design. Small amplitude of motion assures consistency and long life. It reacts to pressure on diaphragm. Live length adjustable for calibration.

Alnico magnet mounted at one end of range spring rotates helix without mechanical linkages.

Helix is precision milled from an alloy of high magnetic permeability, deburred and annealed in a hydrogen atmosphere for best magnetic qualities. Mounted in jeweled bearings, it turns freely to align with magnetic field of magnet to transmit pressure indication to pointer.

SERIES 2000 MAGNEHELIC® — MODELS AND RANGES

The models below will fulfill most requirements. Page 5 also shows examples of special models built for OEM customers. For special scales furnished in ounces per square inch, inches of mercury, metric units, etc., contact the factory.

Dual Scale English/Metric Models

Model Number	Range, In. W.C.	Range, Pa or kPa	Price
2000-0D	0-0.5	0-125 Pa	$50.00
2001D	0-1.0	0-250 Pa	50.00
2002D	0-2.0	0-500 Pa	50.00
2003D	0-3.0	0-700 Pa	50.00
2004D	0-0.4	0-1.0 kPa	50.00
2006D	0-6.0	0-1.5 kPa	50.00
2008D	0-8.0	0-2.0 kPa	50.00
20010D	0-10	0-2.5 kPa	50.00

Model Number	Range Inches of Water	Price
2000-00†	0-.25	$55.00
2000-0†	0-.50	50.00
2001	0-1.0	50.00
2002	0-2.0	50.00
2003	0-3.0	50.00
2004	0-4.0	50.00
2005	0-5.0	50.00
2006	0-6.0	50.00
2008	0-8.0	50.00
2010	0-10	50.00
2015	0-15	50.00
2020	0-20	50.00
2025	0-25	50.00
2030	0-30	50.00
2040	0-40	50.00
2050	0-50	50.00
2060	0-60	50.00
2080	0-80	50.00
2100	0-100	50.00
2150	0-150	50.00

Model Number	Range Zero Center Inches of Water	Price
2300-0†	.25-0-.25	$55.00
2301	.5-0-.5	55.00
2302	1-0-1	55.00
2304	2-0-2	55.00
2310	5-0-5	55.00
2320	10-0-10	55.00
2330	15-0-15	55.00

Model Number	Range PSI	Price
2201	0-1	$50.00
2202	0-2	50.00
2203	0-3	50.00
2204	0-4	50.00
2205	0-5	50.00
2210*	0-10	81.00
2215*	0-15	81.00
2220*	0-20	81.00
2230**	0-30	100.00

*MP option standard
**HP option standard

Dual Scale Air Velocity Units

Model Number	Range in W.C.I Velocity, F.P.M.	Price
2000-00AV	0-.25/300-2000	$55.00
2000-0AV	0-.50/500-2800	50.00
2001AV	0-1.0/500-4000	50.00
2002AV	0-2.0/1000-5600	50.00
2010AV	0-10/2000-12500	50.00

For use with pitot tube.

Model Number	Range MM of Water	Price
2000-6MM†	0-6	$55.00
2000-10MM	0-10	50.00
2000-25MM	0-25	50.00
2000-50MM	0-50	50.00
2000-80MM	0-80	50.00
2000-100MM	0-100	

Zero Center Ranges

2300-20MM†	10-0-10	$55.00

Model Number	Range, CM of Water	Price
2000-15CM	0-15	$50.00
2000-20CM	0-20	50.00
2000-25CM	0-25	50.00
2000-50CM	0-50	50.00
2000-80CM	0-80	50.00
2000-100CM	0-100	50.00
2000-150CM	0-150	50.00
2000-200CM	0-200	50.00
2000-250CM	0-250	50.00
2000-300CM	0-300	50.00

Zero Center Ranges

2300-4CM	2-0-2	$55.00
2300-10CM	5-0-5	55.00
2300-30CM	15-0-15	55.00

†These ranges calibrated for vertical scale position.

Model Number	Range, Pascals	Price
2000-60 Pa†	0-60	$55.00
2000-125 Pa†	0-125	50.00
2000-250 Pa	0-250	50.00
2000-500 Pa	0-500	50.00
2000-750 Pa	0-700	50.00

Zero Center Ranges

2300-250 Pa	125-0-125	$55.00
2300-500 Pa	250-0-250	55.00

Model Number	Range, Kilopascals	Price
2000-1 kPa	0-1	$50.00
2000-1.5 kPa	0-1.5	50.00
2000-2 kPa	0-2	50.00
2000-3 kPa	0-3	50.00
2000-4 kPa	0-4	50.00
2000-5 kPa	0-5	50.00
2000-8 kPa	0-8	50.00
2000-10 kPa	0-10	50.00
2000-15 kPa	0-15	50.00
2000-20 kPa	0-20	50.00
2000-25 kPa	0-25	50.00
2000-30 kPa	0-30	50.00

Zero Center Ranges

2300-1 kPa	.5-0-.5	$55.00
2300-3 kPa	1.5-0-1.5	55.00

Accessories

A-310A, 3-Way Vent Valve....................$6.90
A-321, Safety Relief Valve....................$8.60
A-432, Portable Kit....................$19.40
A-605, Air Filter Kit....................$19.40
A-610, Pipe Mount Kit....................$9.90

Options — To order, add suffix: I.E. 2001-ASF

ASF (Adjustable Signal Flag)....................add $10.90
HP (High Pressure Option)....................add $50.00
LT (Low Temperatures to -20°F)....................$3.00
MP (Med. Pressure Option)....................add $31.00
SP (Setpoint Indicator)....................add $50.00

Scale Overlays — Red, Green, Mirrored or Combination, Specify Locations Add $5.00 Net

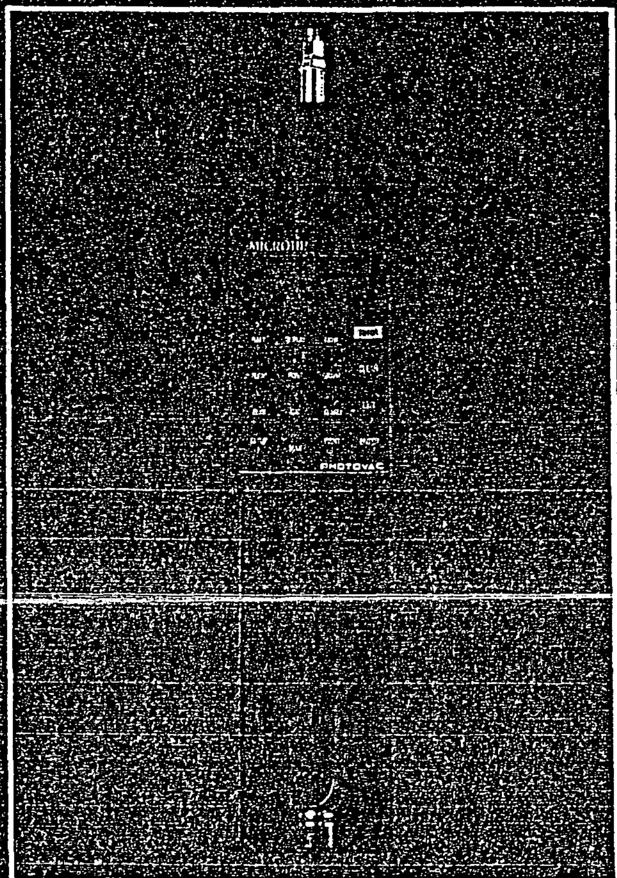
Special Purpose Ranges

Scale No. 2401 Square Root Specify Range

Scale No. 2402 Blank Scale Specify Range

Model 2000-00N, range -.05 to +.20" W.C. For room pressure monitoring....................$55.00

MicroTIP™ The First Choice For Accurate VOC Monitoring



PHOTOVAC

Registered to the ISO 9002 International Quality Standard

The MicroTIP From Photovac Out

The First Choice Of Professionals

The MicroTIP portable datalogging PID with improved detector and software is the instrument of choice for environmental, industrial hygiene, and safety professionals needing to monitor volatile organic compounds (VOC) in a variety of applications. Using our exclusive **Photovac photoionization detector (PID)**, the MicroTIP provides immediate determination of contaminant levels over a range of 0.1 to 2000 PPM. The bypass-type detector with UHF-excited electrodeless discharge tube allows an inherently cleaner and simpler detector design which contributes to both an enhanced sensitivity and a longer lamp life.

MicroTIP combines maximum performance, sensitivity and ease of operation in a lightweight, single component, intelligent VOC analyzer.

MicroTIP Applications

- Leaking Underground Storage Tanks (UST)
- Hazardous Waste Site Screening
- Contaminant Plume Delineation
- Groundwater Headspace Screening
- Soil Vapor Borehole Analysis
- Soil Headspace Screening
- Vapor Extraction Systems
- Emergency Response to Leaks and Spills

- Fugitive Emissions Monitoring
- Health and Safety Monitoring
- Degreasing Solvents
- Chemical Processing
- Leak Checking for VOCs
- Pulp and Paper (Reduced Sulfur Compounds)
- Refineries
- Residual Agricultural Fumigants
- Petroleum Exploration
- Paint Spray Operations

- Indoor Air Quality
- Ink and Adhesive Vapors
- Investigation of "Sick Building Syndrome"

Available In 4 Models

MP-1000
HL-2000
IS-3000
EX-4000

Photovac has a MicroTIP model for every monitoring application.

The IS-3000 is the <u>only</u> portable PID available that is classified as intrinsically safe under North American standards. The MicroTIP IS-3000 is UL classified for Class I, Division 1, Groups A, B, C, D, T4 hazardous locations, or areas in which explosive or ignitable mixtures of gases or vapors are normally present.

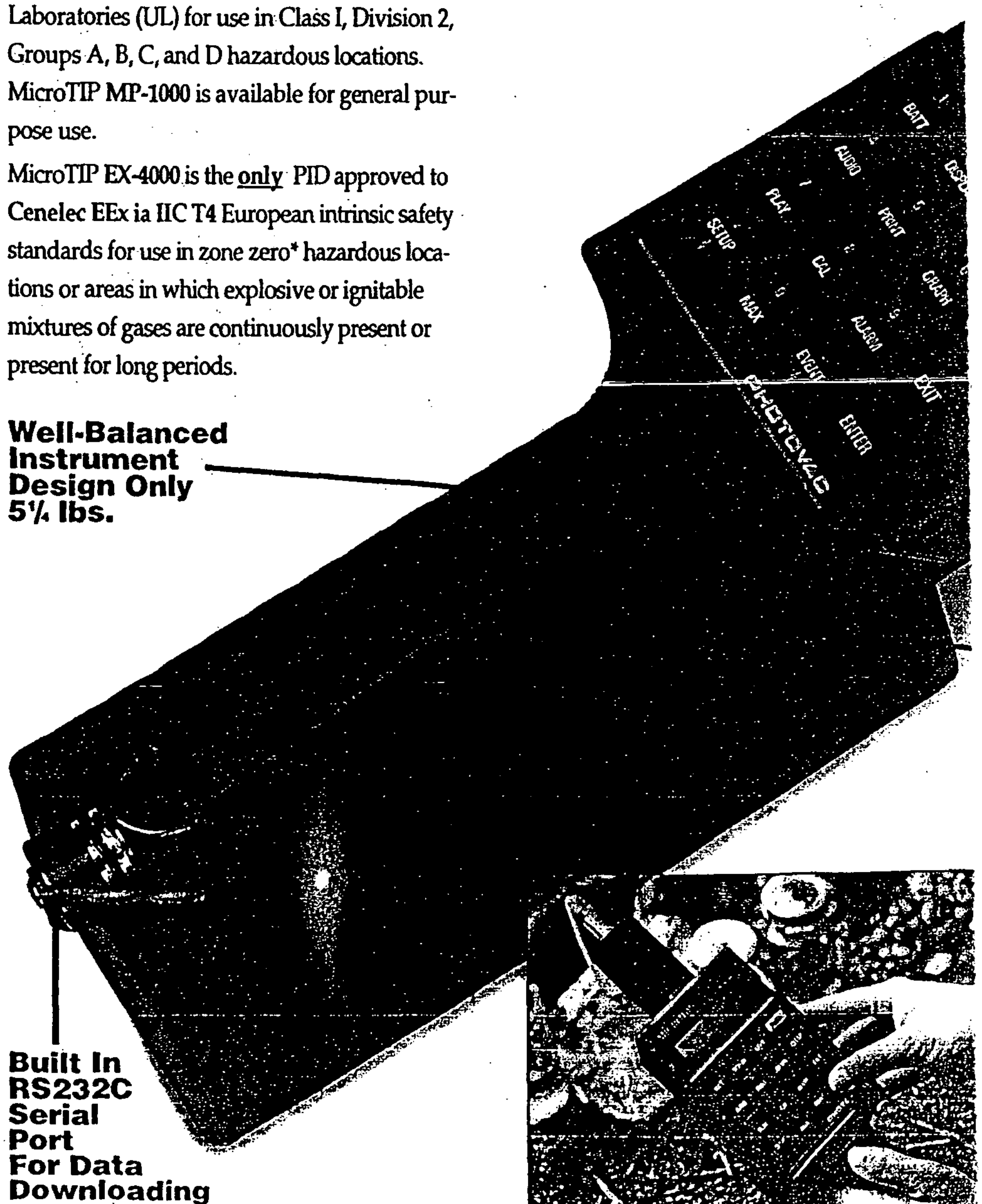
MicroTIP HL-2000 is classified by Underwriters Laboratories (UL) for use in Class I, Division 2, Groups A, B, C, and D hazardous locations.

MicroTIP MP-1000 is available for general purpose use.

MicroTIP EX-4000 is the <u>only</u> PID approved to Cenelec EEx ia IIC T4 European intrinsic safety standards for use in zone zero* hazardous locations or areas in which explosive or ignitable mixtures of gases are continuously present or present for long periods.

Fugitive Emissions Testin

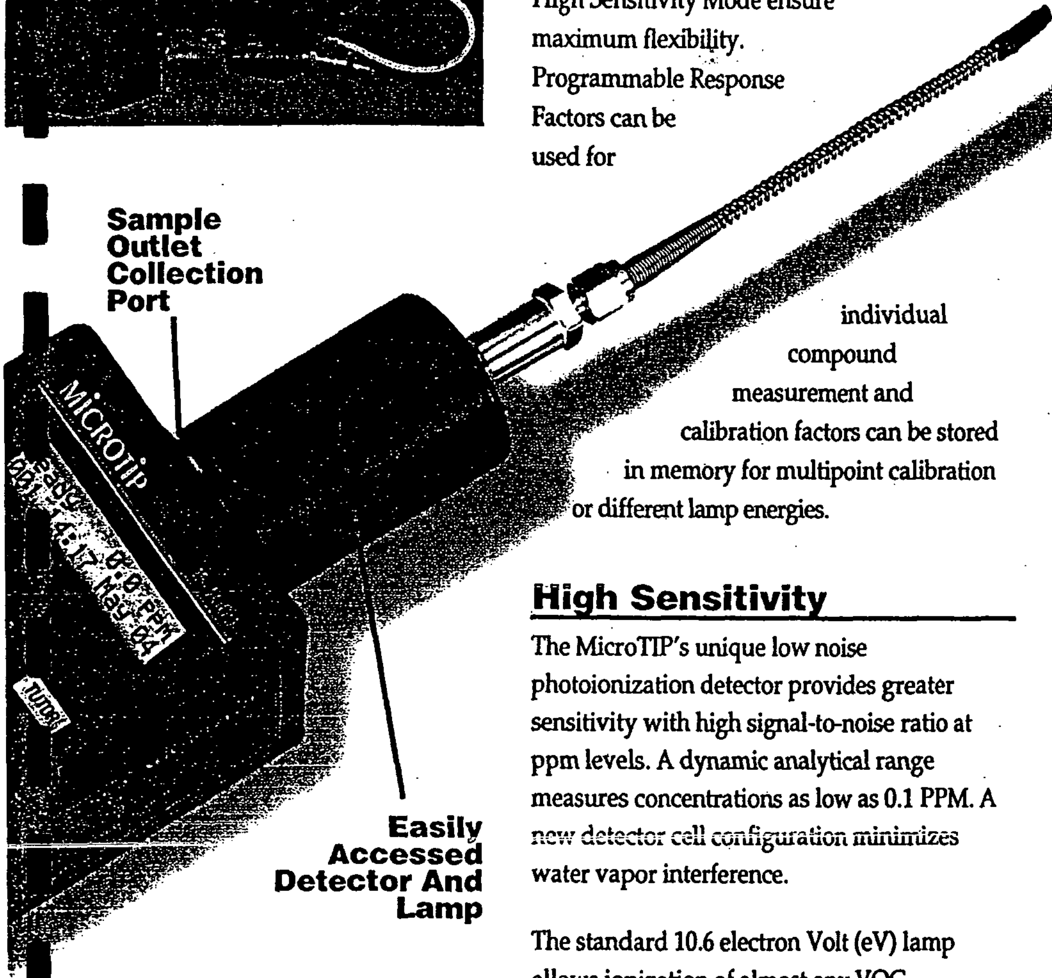
Now MicroTIP has extended range capability f <u>US EPA Method 21</u> **fugitive emissions and LDAR (Leak Detection and Repair) monitorin** as outlined in the National Emissions Standard for Hazardous Air Pollutants. Designed for use with the IS-3000 Intrinsically Safe rated MicroTIP, Photovac's new **Dilution Probe** acce sory enables measurement of VOC concentrations up to 10,000 PPM to meet all EPA compliance requirements. Mounting directly to the MicroTIP and featuring accurate concentration range adjustment, the Dilution Probe may be used with any MicroTIP model.



* Zone 0 requirements may vary in different countries

erforms All Other VOC Monitors...

Method 21 Dilution Probe



Removable Rechargeable Battery Pack

Rugged Field Usable

- Precision, injection-molded thermoplastic case resistant to water, impact, abrasion, solvent vapors and sunlight.
- Each battery pack gives 7-12 hours of field operation.
- No need for hazardous consumables such as hydrogen.
- Performance is independent of orientation. A sample probe extension allows monitoring of otherwise inaccessible places or dirty environments.

Simple Calibration

Display instructions guide the user through the easy-to-follow calibration procedure. MicroTIP's 10 Calibration Memories plus a High Sensitivity Mode ensure maximum flexibility. Programmable Response Factors can be used for individual compound measurement and calibration factors can be stored in memory for multipoint calibration or different lamp energies.

High Sensitivity

The MicroTIP's unique low noise photoionization detector provides greater sensitivity with high signal-to-noise ratio at ppm levels. A dynamic analytical range measures concentrations as low as 0.1 PPM. A new detector cell configuration minimizes water vapor interference.

The standard 10.6 electron Volt (eV) lamp allows ionization of almost any VOC.

Five detector lamp energies are available. MicroTIP's lamps are easily accessed for in-field servicing. Standard lamps are less costly to replace and are covered under separate warranty for one year.

Real Time Response

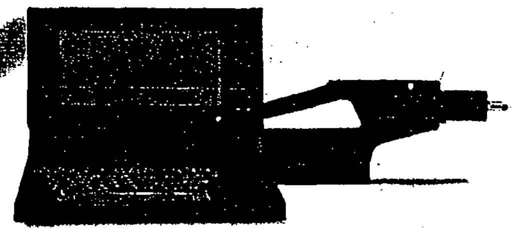
- Real time numeric or bar graph displays allow the user to make immediate determination of VOC contaminant levels with maximum concentration displayed on command.

Threshold Level Indicator

- User sets alarm level for visual display and audible output through optional headphone.

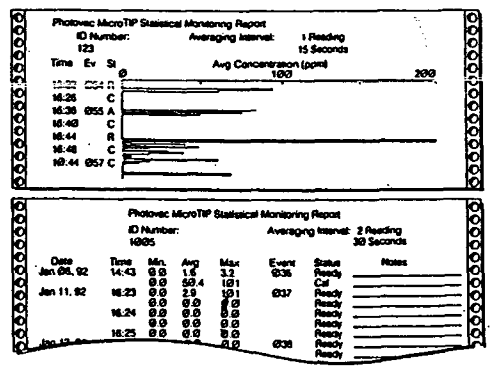
Effortless Operation

Easy-to-follow operating instructions appear on the display to guide the operator. The soft-touch, digital keypad is easy to use even when wearing protective gear.



Complete Storage And Retrieval Of Data

- The built-in, microprocessor-controlled datalogger provides the user with convenient software options and stores up to a full 12 hours of data.
- On command, the datalogger automatically records time, date, concentration and event/location.



Options Provided For Data Output

- The MicroTIP is equipped with a serial output.
- Data can be stored on disk or printed in tabular or graphic formats for Minimum, Maximum and Average concentrations.
- 0-1V analog output.

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Models Available

Listed on GSA Contract GS00F-2329A

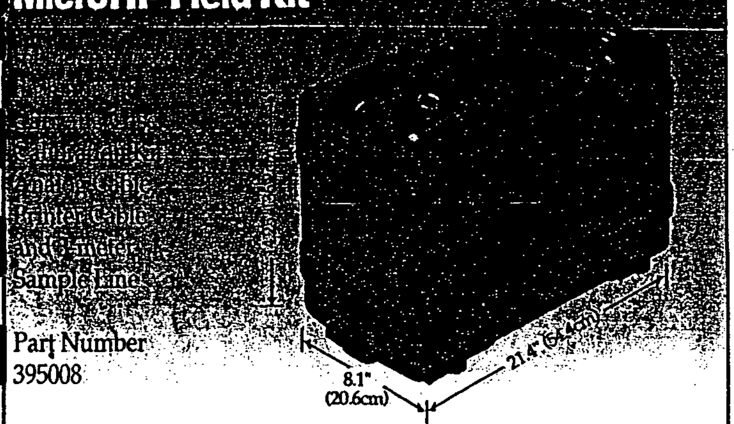
- **MicroTIP MP-1000**
  General Purpose Use
  Part Number 100033
- **MicroTIP HL-2000**
  UL Classified for Class I,
  Division 2, Groups A, B, C, D Hazardous Locations
  Part Number 100035
- **MicroTIP IS-3000**
  Intrinsically Safe UL Classified for Class I,
  Division 1, Groups A, B, C, D, T4 Hazardous Locations
  Part Number 100043

Also Available

- **MicroTIP EX-4000**
  Approved to Cenelec Intrinsic Safety Standards
  EN500014 and EN500020
  EEx ia IIC T4, BAS No Ex 92C2282
  Part Numbers: 100049 (220V) or 100048 (115V)

For a MicroTIP demonstration, please contact the Photovac office nearest you.

MicroTIP Field Kit



Part Number
395008

Specifications

Size:	16.8" (43 cm) long, 3.75" (9.5 cm) wide, 5.75" (14.6 cm) high
Weight:	5.25 lbs (2.38 kg)
Detector:	Photoionization, bypass-type, with 10.6 eV UHF-excited electrodeless discharge tube
Keyboard:	16 key silicone with tactile feedback
Display:	2 line, 16 character dot-matrix, liquid crystal with adjustable backlighting, for alphanumeric or bar graph readout Adjustable backlighting not available on Intrinsically Safe MicroTIP IS-3000
Battery Type:	Sealed lead-acid, field-replaceable pack
Charge/Discharge Time:	8 hour/7-12 hours
Battery Charger:	Automatically charges and maintains a full charge in battery pack
Datalogging Memory:	25k
Chart Recorder Output:	0-1V full scale
Serial Output:	RS232C (300-19200 baud) with odd, even, or no parity; for tabular and graphic printouts
Audio Output:	Continuous concentration-modulated tone or tone on alarm only
Inlet Connection:	1/8" (3.2 mm) stainless steel compression fitting
Inlet Filter:	Replaceable stainless steel, 2µm
Inlet Flowrate:	Exceeds 500 mL/min.
Outlet Connection:	1/8" (3.2 mm) stainless steel barb fitting
Materials in Sample Stream:	Stainless steel, Teflon®, Viton®
Operating Temperature Range:	32° F to 105° F (0° C to 40° C)
Operating Humidity Range:	0 to 100% RH (noncondensing)
Operating Concentration Range:	0.1 to 2000 ppm Isobutylene equivalent
Precision:	±1% (100 ppm Isobutylene)
Detection Limit:	0.1 ppm Isobutylene
Response Time:	Less than 3 seconds

Specifications may be revised without notice.

PHOTOVAC

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Sondervang 2, DK 4100
Ringsted, Denmark
Telephone: +45-5767-5008 • Fax: +45-5767-5018

Appendix C2 - SVE Pilot Test Results

Science Applications International Corporation
An Employee-Owned Company

March 25, 1999

Mr. Thomas Forbes, P.E.
Benchmark Environmental Engineering and Science
Key Tower, Suite 1350
50 Fountain Plaza
Buffalo, NY 14202

Re: SVE Remediation Design Parameters Report
Urbana Landfill, Steuben County, New York
SAIC Project No. 01-1408-00-3692-007

Dear Mr. Forbes:

Science Applications International Corporation (SAIC) is pleased to present to Benchmark Environmental Engineering and Science (BEES) this report presenting the results of the soil vapor extraction (SVE) pilot test conducted at the Urbana Landfill site in Steuben County, New York. Specifically, this report presents the results of the well and piezometer installation program, the results of the short term SVE pilot test performed, and the remedial design parameters for a full-scale system. The protocols used to complete the installation of the well and piezometers and perform the pilot test are consistent with SAIC's Soil Vapor Extraction Pilot Test Work Plan dated December 18, 1998 and the protocol modifications presented in a letter to BEES dated January 22,1999. The primary objective of the pilot testing activities was to collect the data needed to design a full-scale SVE remediation system for the site for the removal of volatile organic compounds (VOCs) from the soil. The VOCs consisted primarily of toluene, ethylbenzene, xylenes, trichloroethene, dichloroethene, and vinyl chloride.

INSTALLATION OF WELL AND PIEZOMETERS

On February 17, 1999, one SVE test well and four monitoring piezometers were installed in the area identified as Hot Spot No. 5. The SVE test well was located approximately 100 feet south of well MW-103S and near historical soil boring B14. Each six-inch diameter borehole was completed using an air rotary rig to approximately 10 feet below grade and a general description of the physical properties of the soil cuttings was completed. The test well (VEW-1) contains 2-inch diameter schedule 40 polyvinyl chloride (PVC) 20-slot screen from 2.7 to 9.7 feet below grade (bg). A sand pack was placed from 2.2 feet to 9.7 feet bg and a bentonite seal placed from the ground surface to 2.2 feet bg. The 4 monitoring piezometers are also constructed of 2-inch diameter schedule 40 PVC pipe and 20-slot PVC screen. The sand pack at each location is comprised of Morie #0 sand. Piezometer P-1 is located 5.5 feet north of VEW-1; P-2 is located 6.4 feet south of VEW-1; P-3 is located 9.1 feet east of VEW-1; and P-4 is located 15.7 feet north of VEW-1. The well and piezometers were completed at the surface with approximately two feet of unprotected PVC stick-up with a locking compression plug. A summary of the well and piezometer construction details is presented in Table 1.

During the completion of the five boreholes, each borehole was examined to determine the depth of the frost line, if present. At this time neither the ground surface or the shallow subsurface soil was frozen. The soil type was generally a lean sandy clay that was not saturated but contained a moisture content near field capacity. During the installation of piezometer P-1 one of the drill rig stabilizers sunk to approximately two feet below grade which indicated that the soil, at least to a depth to two feet below grade, was not very dense. The exposed subsurface consisted of primarily an olive-gray lean sandy clay with many gray and strong brown mottles. Fragments of trash were also evident in the hole and the subsurface contained approximately 5% rock fragments at this location.

SVE PILOT TEST

Methods

The SVE pilot test was performed on well VEW-1 on February 18, 1999. A five-horsepower regenerative blower was used to apply four different vacuum values on the wellhead. Each vacuum value was applied to the wellhead for one hour. The vacuum steps were conducted at vacuum values of 10 inches of water column (WC), 15 inches WC, 20 inches WC, and 31 inches WC. These four vacuum steps were selected based on the apparent radius of influence induced at each step and to minimize the volume of water extracted from the subsurface. The depth to groundwater was approximately nine feet bg prior to the test. Prior to starting the test, the depth to groundwater was determined at each location and the relative concentration of volatile organic compounds (VOCs) in the soil was determined at each location. Throughout the test an 85-gallon size granular activated carbon drum (GAC) was used to treat the off-gas from VEW-1 prior to discharge to the atmosphere.

During each step the wellhead vacuum, the vacuum at the four piezometers, the extraction flow rate from VEW-1, and the relative concentration of VOCs in the untreated and treated off-gas were determined at 15-minute intervals within each 1-hour step. The concentrations of oxygen, carbon dioxide, and methane were determined in the extracted gas at the beginning of step one and then at the conclusion of each step. The depth to groundwater was determined in test well VEW-1 and the four piezometers at the conclusion of the pilot test. The depth to groundwater was also determined in VEW-1 at the end of each step.

At the conclusion of the first step and the midpoint of the fourth step, an extracted soil gas sample was collected in a tedlar bag. The two samples were submitted to Center Analytical Laboratories for analysis of total VOCs by Environmental Protection Agency (EPA) Method T014.

When the fourth step was initiated at 31 inches WC, groundwater was extracted from the well and entered the blower. The test was then temporarily stopped and a water knockout tank was fabricated from a 55-gallon drum and placed in line between VEW-1 and the sampling port on the extraction piping leading to the blower. The purpose of putting the water knockout drum in line was to prevent the water from entering the blower and ultimately into the GAC drum used for off-gas treatment. The volume of water collected during the one-hour step was measured at the end of the fourth step. Weather conditions such as ambient temperature and precipitation amount were recorded during the pilot testing and well installation activities.

Magnahelic vacuum gauges were used to record vacuum values at the well and piezometer locations. A pitot tube located on the extraction piping between the wellhead and the atmospheric intake valve on the blower was used to determine the extraction flow rate. An organic vapor analyzer equipped with a photoionization detector (OVA-PID) was used to determine the relative concentrations of VOCs in the extracted gas. A landfill gas monitor was used to determine the percentage of oxygen, carbon dioxide, and methane in the extracted soil gas. A water level indicator was used to record the groundwater levels. A compression fitting at the top of the VEW-1 wellhead was used to adjust the depth of the water tape while maintaining the applied vacuum on the wellhead in order to record any possible upwelling of the groundwater table during the test.

Results

During the installation of the well and piezometers on February 17, 1999, the air temperature at noon-time was 40 degrees F with a very light rain. No measurable amount of precipitation occurred during the day. On February 18, 1999 (the day of the pilot test), the air temperature at noon-time was 36 degrees F with intermittent light snow and sleet. At the end of this day no measurable precipitation had accumulated.

Prior to pilot testing activities on February 18, 1999, the depth to groundwater at five locations was determined. Depth to groundwater in the test area was generally 9 feet below grade. Table 2 presents the depth to groundwater prior to the test and also after the test. Prior to the testing, the following relative concentrations of total VOCs within the well and piezometer pipes were determined:

- In well VEW-1, the VOC concentration was 3.3 parts per million (ppm).
- In P-1 the VOC concentration was 8.0 ppm.
- In P-2 the VOC concentration was 1.3 ppm.
- In P-3 the VOC concentration was 40.4 ppm.
- In P-4 the VOC concentration was 14.3 ppm.

The results of the SVE pilot test are presented in Table 3. The parameter values presented are the values recorded for each parameter at the conclusion of each step. Parameter stabilization with respect to applied vacuum and induced subsurface vacuum values were achieved within the first 15 minutes of each step. As the applied vacuum on the wellhead increased, a corresponding increase in the extraction flow rate occurred. Figure 1 presents a plot of the extraction flow rate versus the applied vacuum on VEW-1. As the applied vacuum on the well increased through the third step, there was a linear increase in the extraction flow rate. As the vacuum on the well increased from 20 inches WC to 31 inches WC during the fourth step, the curve departs from linearity which indicates the optimal applied vacuum on the wellhead is equal to or less than 20 inches of WC.

Table 3 also presents the stabilized subsurface vacuum values at the four monitoring points during each of the four steps. The measurable vacuum values recorded at P-1, P-3, and P-4 indicate that these piezometers were in communication with the extraction well with respect to subsurface airflow. An extremely low vacuum was recorded at piezometer P-2 throughout the four steps. This condition suggests that the screened interval for P-2 was installed in a material with a much lower air permeability than the subsurface material in the test area. The variability in subsurface airflow characteristics is consistent with the reported nature of the subsurface. The subsurface is reported to be comprised of disturbed soil and trash at the landfill. This variability is also evident in the fact that within a given step the subsurface vacuum at P-4, located 9.1 from the test well, was consistently greater than the vacuum recorded at P-1 located at only 5.5 feet from VEW-1. Based on the stabilized subsurface vacuum values, the most permeable soil in the test area is located east of VEW-1 and the least permeable soil is located south of VEW-1. The subsurface area north and east of the VEW-1 appear to have similar air permeabilities.

Figure 2 presents a plot of the stabilized subsurface vacuum values at each vacuum step versus distance from VEW-1. Using the data from P-1, P-3, and P-4, a best-fit straight line through the data points for steps two, three, and four suggest a possible radius of influence of up to 100 feet in this area. The radius of influence is based on maintaining a subsurface vacuum value of 0.5 inches WC at the outermost edge of the radius of influence. Using the data from step one, a radius of influence of approximately 20 feet is interpreted. Based on the incremental increases in the vacuum values at each piezometer within each step during the four steps, the optimal applied vacuum on VEW-1 is step two, or 15 inches WC. The greatest rate of increase in vacuum occurred between steps one and two with smaller increases occurring between steps three and four. Because a similar radius of influence could be achieved with steps two, three, and four and the optimal flow rate occurred at steps two or three, the optimal operational conditions were achieved with step two conditions.

The relative concentration of total VOCs as determined in the field with a OVA-PID remained relatively constant from step one through step three with values between 8.3 ppm and 8.5 ppm. At the conclusion of the fourth step, the VOC concentration was 15.2 ppm. The apparent increase in the relative VOC concentration is likely attributed to the increased moisture content in the extracted soil gas due to water collecting in the water knock-out drum during step four. The water knock-out drum was not used during steps one, two, and three as groundwater was not extracted from VEW-1 at these steps.

During step four (31 inches WC) on VEW-1, 20 gallons of groundwater was extracted from the test well during the one-hour step. During step three (20 inches WC), groundwater was not extracted from the well during the one-hour step. The extraction of groundwater during the higher vacuum steps further supports the condition that optimal operating conditions are at lower vacuum values (15 inches of WC). The depth to groundwater was 9.09 feet bg at VEW-1 prior to the test and rose to 8.54 feet bg at the end of step one. At the end of step two, the groundwater level rose to 7.59 feet bg and generally remained at this depth throughout the remainder of the test. Approximately 5 feet of screened interval in well VEW-1 remained above the groundwater zone throughout the test.

The concentrations of oxygen, carbon dioxide, and methane in the extracted gas were determined at the conclusion of each step and the results are presented in Table 3. The oxygen content in the soil gas at the end of the first step was 13.3 percent and increased to 17.9 percent at the end of the four-hour test. There was an actual uniform increase in the oxygen content during the four steps as the 20 inches WC step was actually completed prior to completing the 15 inches WC step. The carbon dioxide content decreased from 8.1 percent at step one to 3.8 percent at the end of the test. Likewise, the methane concentration decreased from 2.4 percent to 1.3 percent. The presence of carbon dioxide and methane in the subsurface indicate that both aerobic and anaerobic biodegradation of organic compounds in the subsurface, which may include the target contaminants, is occurring. The increasing oxygen content and decreasing carbon dioxide and methane contents indicate that there was an exchange of gases in the subsurface as the existing soil gas was removed from the ground and replenished with atmospheric air. This condition indicates that this technology is effective in exchanging the subsurface gases and replenishing the subsurface with oxygen to support contaminant removal through biodegradation, in addition to removal by vapor extraction.

At the conclusion of step one and at the mid point of step four, a soil gas sample was collected and submitted for laboratory analysis of total VOCs by Method TO-14. The results of the analyses are presented in Table 4 and laboratory reports are presented in Attachment A. The two compounds present at the greatest concentrations in these samples were dichlorodifluoromethane and trichlorofluoromethane. Chloroethane was also present in both samples. Non-chlorinated VOCs (toluene, etheylbenzene, and m,p-xylenes) were also present in both samples except that ethylbenzene was absent in the step four sample. The VOC concentrations were lower in step four than in the step one sample. It is likely that equilibrated soil gas concentrations existed at the start of the test and disequilibrium conditions were created as VOCs were removed from the ground. The declining VOC concentrations during the test is consistent with shifting from equilibrium conditions where the soil gas concentrations are greatest to disequilibrium where the soil gas concentrations decline.

REMEDIATION DESIGN PARAMETERS

Based on the results of the SVE pilot test, the remedial design parameters were developed for a planned full-scale system. Table 5 presents the remedial design parameters for each individual well and also for the full scale total system. The optimal applied wellhead vacuum is 15 inches of WC with a corresponding extraction flow rate of 43 scfm. The design radius of influence is recommended to be 50 feet. This value is half of the interpreted radius of influence of approximately 100 feet that was obtained during steps 2, 3, and 4. This conservative radius of influence is based on the variability in the subsurface permeability that would be expected in the landfill. Based on a radius of influence of approximately 50 feet, a well spacing of 40 feet is recommended. A forty-foot well spacing results in an approximate 10-foot overlap of the radii of influence from extraction wells to further insure extraction efficiency of soil gas from the subsurface. The initial VOC removal rate per well is estimated at 8.22 grams per day. Removal rate calculations are presented in Appendix B. The estimated removal rate is based on the soil gas data from the sample collected during step one which contained a higher concentration of VOCs.

The total system design parameters are based on an area of approximately 150 feet by 200 feet that requires remediation at the site. Based on this area, approximately five SVE wells would be required for the full-scale treatment system. The full-scale blower would need to extract approximately 215 scfm at a minimum applied vacuum of 15 inches WC. Based on the extraction piping design and construction, friction losses would require that the blower operate at slightly higher vacuum than 15 inches WC to generate the 250 scfm.

The VOC removal rate from the pilot test was 8.22 grams per day. The actual design VOC removal rate should be based on the results of this pilot test and also additional site data to include historical soil gas concentrations, historical total soil concentrations, and general distribution of the VOCs in the soil and waste across the entire remediation area.

SAIC appreciates the opportunity to provide BEES with our remediation pilot testing services. If you have any questions concerning the information presented in this report, please do not hesitate to contact either of the undersigned. SAIC would further welcome the opportunity to assist BEES with additional environmental services at the Urbana landfill site or any other site.

Respectfully submitted,

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION

Peter J Cagnetta

Peter J. Cagnetta, CPSSc
Project Manager/Soil Scientist

Gregory J. Burgdorf

Gregory J. Burgdorf, PG
Project Director

PJC:pjp

FIGURE 1. Applied Vacuum on VEW-1 vs Extraction Flow Rate
Benchmark Environmental Engineering and Science
Urbana Landfill Site

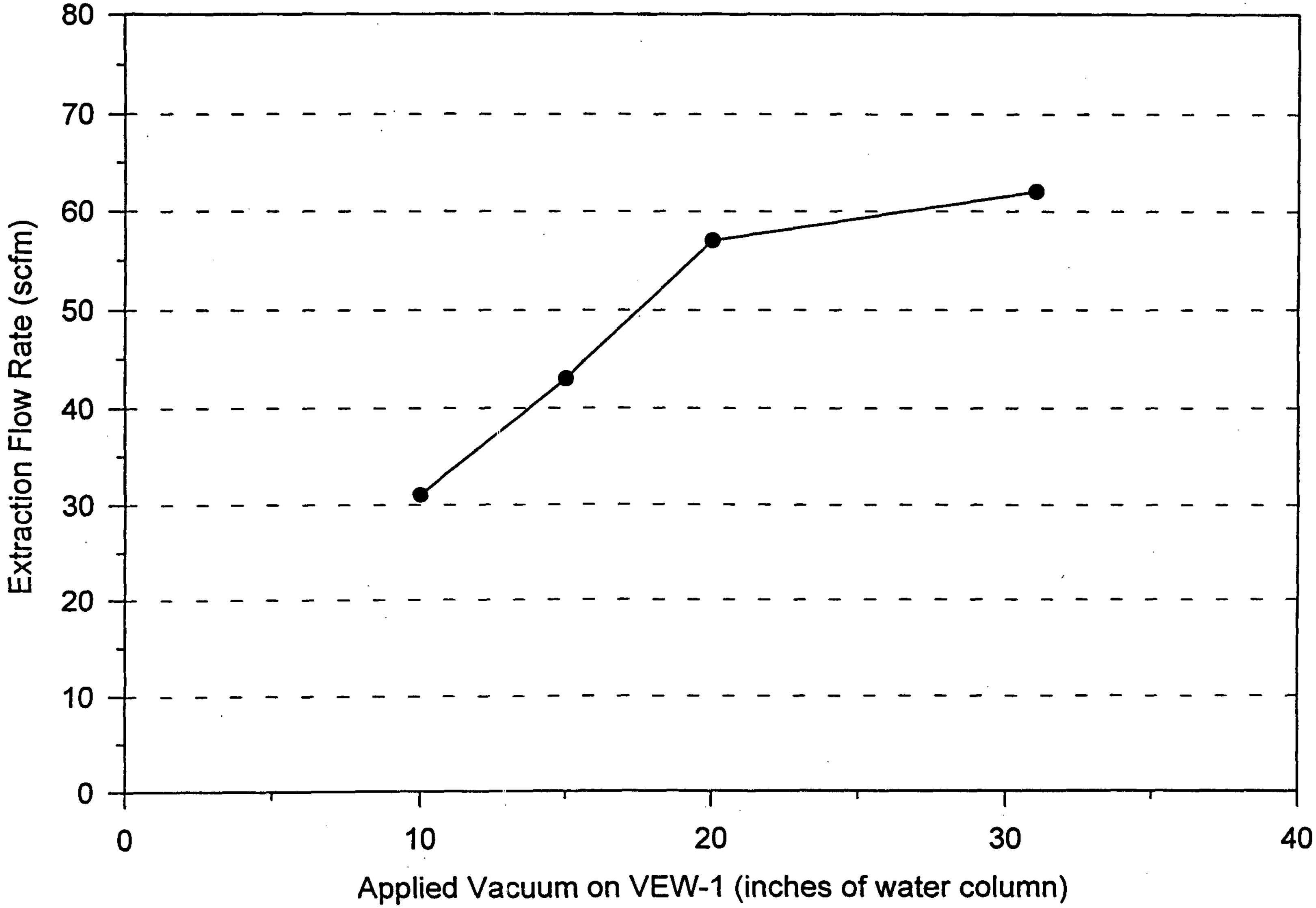

FIGURE 2. Stabilized Subsurface Vacuum vs Distance from VEW-1
Benchmark Environmental Engineering and Science
Urbana Landfill Site

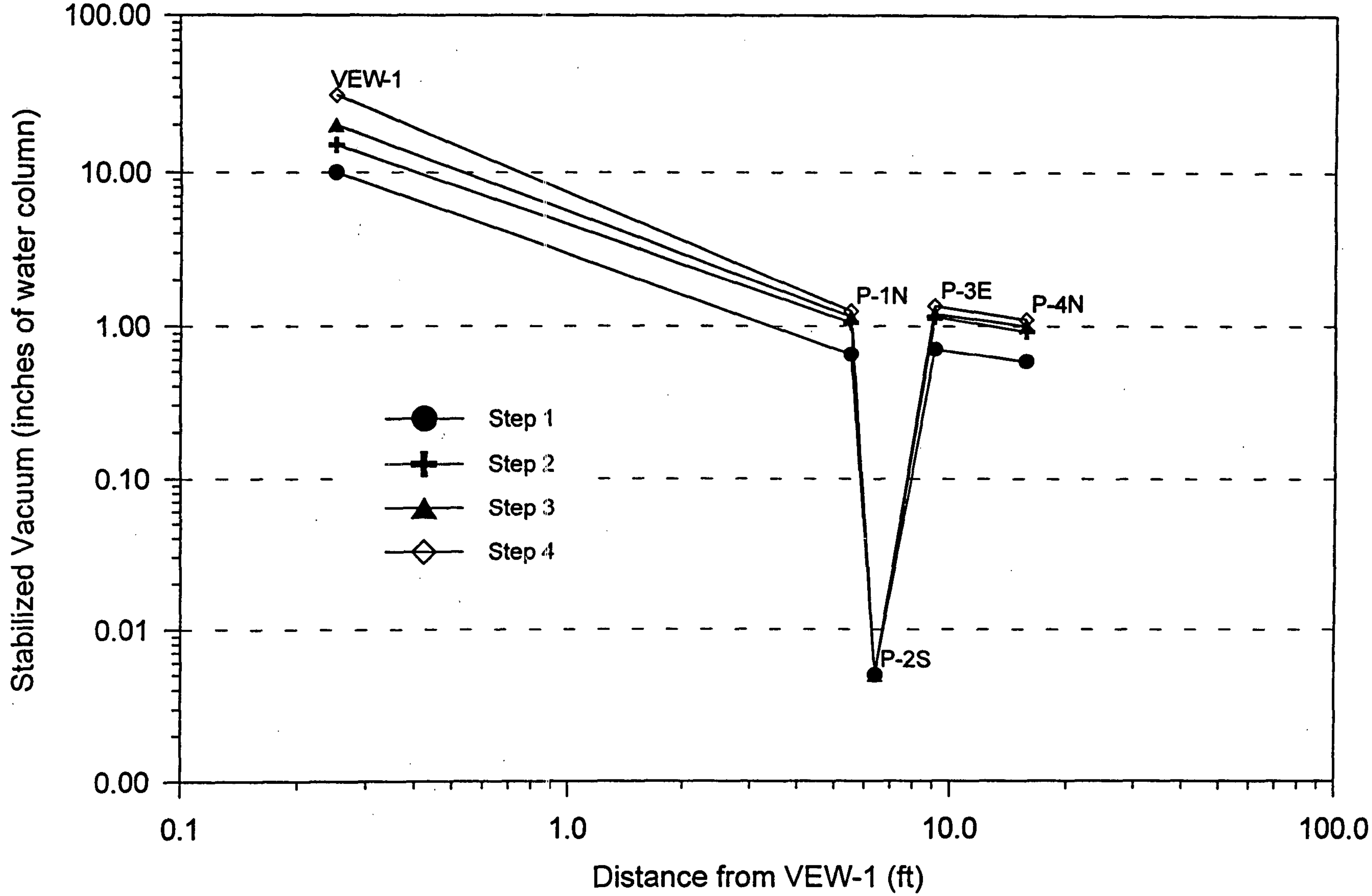

Table 1.
Summary of Well and Piezometer Construction Details
Benchmark Environmental Engineering and Science
Urbana Landfill Site
SAIC Project No. 01-1408-00-3692-007

Location	Distance to VEW-1 (Feet)	Screened Interval (Feet)	Sand Pack Interval (Feet)	Bentonite Seal (Feet)
VEW-1	0	2.7 – 9.7	2.2 – 9.7	0 – 2.2
P-1	5.5 North	2.9 – 9.9	2.4 – 9.9	0 – 2.4
P-2	6.4 South	2.0 – 9.0	1.5 – 9.0	0 – 1.5
P-3	9.1 East	2.9 – 9.9	2.5 – 9.9	0 – 2.5
P-4	15.7 North	2.9 – 9.9	2.5 – 9.9	0 – 2.5

Table 2.
Groundwater Conditions During Soil Vapor Extraction Pilot Test
Benchmark Environmental Engineering and Science
Urbana Landfill Site
SAIC Project No. 01-1408-00-3692-007

Location	Depth to Groundwater (feet below ground surface)	
	Pre-Test	Post-Test
VEW-1	9.09	9.14
P-1	8.82	8.85
P-2	>9.90	>9.90
P-3	8.97	9.00
P-4	>9.90	>9.90

Table 3.
Summary of Results of Soil Vapor Extraction Pilot Test
Benchmark Environmental Engineering and Science
Urbana Landfill Site
SAIC Project No. 01-1408-00-3692-007

VEW-1 Parameters	Units	Step 1	Step 2	Step 3	Step 4
Vacuum	" WC	10	15	20	31
Flow Rate	scfm	31	43	57	62
VOCS by PID					
Extracted Soil Gas	ppm	8.5	8.3	8.4	15.2
Treated Effluent	ppm	0	0	0	0
Oxygen	%	13.3	16.8	16.1	17.9
Carbon Dioxide	%	8.1	4.2	5.7	3.8
Methane	%	2.4	1.4	1.8	1.3
Depth to Groundwater	Ft(bTOC)	8.54	~7.59	~7.49	~7.39
Piezometer Location	**Distance to VEW-1 (Feet)**	**Stabilized Subsurface Vacuum (inches of water column)**			
		Step 1	**Step 2**	**Step 3**	**Step 4**
P-1	5.5 North	0.65	1.05	1.15	1.25
P-2	6.4 South	0.005	0.005	0.005	0.005
P-3	9.1 East	0.70	1.15	1.20	1.35
P-4	15.7 North	0.58	0.92	1.00	1.10

" WC = inches of water column
scfm = standard cubic feet per minute
ppm = parts per million
% = percent
Ft (bTOC) = feet below top of casing.

Table 4.
Summary of Detected VOCs in the Extracted Soil Gas
Benchmark Environmental Engineering and Science
Urbana Landfill Site
SAIC Project No. 01-1408-00-3692-007

Compound	VOC Concentration			
	Step 1		Step 2	
	ppbv	µg/L	ppbv	µg/L
Dichlorodifluoromethane	792	3.98	192	0.97
Trichlorofluormethane	54.4	0.31	24.1	0.14
Chloroethane	49.7	0.13	20.8	0.56
Toluene	15.9	0.01	13.2	0.05
Ethylbenzene	20.9	0.09	<1	NC
m,p-xylenes	38.8	0.17	13.8	0.06

ppbv = parts per billion-volume basis
µg/L = micrograms per liter
NC = not calculated
Note: µg/L = (molecular weight/24.05) x (ppbv/1000)

Table 5.
SVE Remedial Design Parameters
Benchmark Environmental Engineering and Science
Urbana Landfill Site
SAIC Project No. 01-1408-00-3692-007

Design Parameter	Units	Individual Well	Total System
Applied Vacuum	"WC	15	15[1]
Extraction Flow Rate	scfm	43	215[2]
Radius of Influence	Ft	50	50
Well Spacing	Ft	40	40

"WC = inches of water column
scfm = standard cubic foot per minute
Ft = Feet
Notes: 1. The total system applied vacuum does not include friction losses which will be based on extracting piping design.
2. The total system flow rate is based on five extraction wells.

ATTACHMENT A

Soil Gas Laboratory Reports

Centre Analytical Laboratories, Inc.
3048 Research Drive, State College PA 16801 814-231-8032 FAX 814-231-1253

SAIC
3240 SCHOOLHOUSE RD.
MIDDLETOWN, PA 17057
Account Number: 2132

Contact: PETER J. CAGNETTA

Date Received: 22-Feb-99
Date Reported: 05-Mar-99

Invoice Number: 20847

Date Collected: 18-Feb-99

Client ID: STEP 1

Lab ID: L21923-1

PARAMETER	UNITS	RESULT	LIMIT OF QUANTITATION	TEST METHOD	TEST DATE	ANALYST
VAPOR PHASE VOC						
DICHLORODIFLUOROMETHANE	ppbv	792	2	TO14	03-Mar-99	GS
CHLOROETHANE	ppbv	49.7	2	TO14	03-Mar-99	GS
TRICHLOROFLUOROMETHANE	ppbv	54.4	2	TO14	03-Mar-99	GS
1,1-DICHLOROETHENE	ppbv	< 1	1	TO14	03-Mar-99	GS
DICHLOROMETHANE	ppbv	< 1	1	TO14	03-Mar-99	GS
TRANS-1,2-DICHLOROETHENE	ppbv	< 1	1	TO14	03-Mar-99	GS
1,1-DICHLOROETHANE	ppbv	< 1	1	TO14	03-Mar-99	GS
2,2-DICHLOROPROPANE	ppbv	< 1	1	TO14	03-Mar-99	GS
CIS-1,2-DICHLOROETHENE	ppbv	< 1	1	TO14	03-Mar-99	GS
CHLOROFORM	ppbv	< 1	1	TO14	03-Mar-99	GS
BROMOCHLOROMETHANE	ppbv	< 1	1	TO14	03-Mar-99	GS
1,1,1-TRICHLOROETHANE	ppbv	< 1	1	TO14	03-Mar-99	GS
1,1-DICHLOROPROPENE	ppbv	< 1	1	TO14	03-Mar-99	GS
CARBON TETRACHLORIDE	ppbv	< 1	1	TO14	03-Mar-99	GS
BENZENE	ppbv	< 1	1	TO14	03-Mar-99	GS
1,2-DICHLOROETHANE	ppbv	< 1	1	TO14	03-Mar-99	GS
TRICHLOROETHENE	ppbv	< 1	1	TO14	03-Mar-99	GS
1,2-DICHLOROPROPANE	ppbv	< 1	1	TO14	03-Mar-99	GS
BROMODICHLOROMETHANE	ppbv	< 1	1	TO14	03-Mar-99	GS
DIBROMOMETHANE	ppbv	< 1	1	TO14	03-Mar-99	GS
CIS-1,3-DICHLOROPROPENE	ppbv	< 1	1	TO14	03-Mar-99	GS
TOLUENE	ppbv	15.9	1	TO14	03-Mar-99	GS
TRANS-1,3-DICHLOROPROPENE	ppbv	< 1	1	TO14	03-Mar-99	GS
1,1,2-TRICHLOROETHANE	ppbv	< 1	1	TO14	03-Mar-99	GS
TETRACHLOROETHENE	ppbv	< 1	1	TO14	03-Mar-99	GS
1,3-DICHLOROPROPANE	ppbv	< 1	1	TO14	03-Mar-99	GS
DIBROMOCHLOROMETHANE	ppbv	< 1	1	TO14	03-Mar-99	GS
1,2-DIBROMOMETHANE	ppbv	< 1	1	TO14	03-Mar-99	GS
CHLOROBENZENE	ppbv	< 1	1	TO14	03-Mar-99	GS
1,1,1,2-TETRACHLOROETHANE	ppbv	< 1	1	TO14	03-Mar-99	GS
ETHYL BENZENE	ppbv	20.9	1	TO14	03-Mar-99	GS
M,P-XYLENE	ppbv	38.8	1	TO14	03-Mar-99	GS
O-XYLENE	ppbv	< 1	1	TO14	03-Mar-99	GS
STYRENE	ppbv	< 1	1	TO14	03-Mar-99	GS
BROMOFORM	ppbv	< 1	1	TO14	03-Mar-99	GS
ISOPROPYLBENZENE	ppbv	< 1	1	TO14	03-Mar-99	GS
1,1,2,2-TETRACHLOROETHANE	ppbv	< 1	1	TO14	03-Mar-99	GS
BROMOBENZENE	ppbv	< 1	1	TO14	03-Mar-99	GS
1,2,3-TRICHLOROPROPANE	ppbv	< 1	1	TO14	03-Mar-99	GS

Centre Analytical Laboratories, Inc.

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Client ID: STEP 1

Lab ID: L21923-1

PARAMETER	UNITS	RESULT	LIMIT OF QUANTITATION	TEST METHOD	TEST DATE	ANALYST
N-PROPYLBENZENE	ppbv	< 1	1	TO14	03-Mar-99	GS
2-CHLOROTOLUENE	ppbv	< 1	1	TO14	03-Mar-99	GS
1,3,5-TRIMETHYLBENZENE	ppbv	< 1	1	TO14	03-Mar-99	GS
4-CHLOROTOLUENE	ppbv	< 1	1	TO14	03-Mar-99	GS
TERT-BUTYLBENZENE	ppbv	< 1	1	TO14	03-Mar-99	GS
1,3,4-TRIMETHYLBENZENE	ppbv	< 1	1	TO14	03-Mar-99	GS
SEC-BUTYLBENZENE	ppbv	< 1	1	TO14	03-Mar-99	GS
ISOPROPYLBENZENE	ppbv	< 1	1	TO14	03-Mar-99	GS
1,3-DICHLOROBENZENE	ppbv	< 1	1	TO14	03-Mar-99	GS
1,4-DICHLOROBENZENE	ppbv	< 1	1	TO14	03-Mar-99	GS
N-BUTYLBENZENE	ppbv	< 1	1	TO14	03-Mar-99	GS
1,2-DICHLOROBENZENE	ppbv	< 1	1	TO14	03-Mar-99	GS
VINYL CHLORIDE	ppbv	< 2	2	TO14	03-Mar-99	GS

Submitted by
Centre Analytical Labs, Inc.
Reviewed and Approved by:

Kevin J. Lloyd
Laboratory Supervisor

Centre Analytical Laboratories, Inc.
3048 Research Drive, State College PA 16801 814-231-8032 FAX 814-231-1253

SAIC
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Account Number: 2132

Contact: PETER J. CAGNETTA

Date Received: 22-Feb-99
Date Reported: 05-Mar-99

Invoice Number: 20847

Date Collected: 18-Feb-99

Client ID: STEP 4

Lab ID: L21923-2

PARAMETER	UNITS	RESULT	LIMIT OF QUANTITATION	TEST METHOD	TEST DATE	ANALYST
VAPOR PHASE VOC						
DICHLORODIFLUOROMETHANE	ppbv	192	2	TO14	03-Mar-99	GS
CHLOROETHANE	ppbv	20.8	2	TO14	03-Mar-99	GS
TRICHLOROFLUOROMETHANE	ppbv	24.1	2	TO14	03-Mar-99	GS
1,1-DICHLOROETHENE	ppbv	< 1	1	TO14	03-Mar-99	GS
DICHLOROMETHANE	ppbv	< 1	1	TO14	03-Mar-99	GS
TRANS-1,2-DICHLOROETHENE	ppbv	< 1	1	TO14	03-Mar-99	GS
1,1-DICHLOROETHANE	ppbv	< 1	1	TO14	03-Mar-99	GS
2,2-DICHLOROPROPANE	ppbv	< 1	1	TO14	03-Mar-99	GS
CIS-1,2-DICHLOROETHENE	ppbv	< 1	1	TO14	03-Mar-99	GS
CHLOROFORM	ppbv	< 1	1	TO14	03-Mar-99	GS
BROMOCHLOROMETHANE	ppbv	< 1	1	TO14	03-Mar-99	GS
1,1,1-TRICHLOROETHANE	ppbv	< 1	1	TO14	03-Mar-99	GS
1,1-DICHLOROPROPENE	ppbv	< 1	1	TO14	03-Mar-99	GS
CARBON TETRACHLORIDE	ppbv	< 1	1	TO14	03-Mar-99	GS
BENZENE	ppbv	< 1	1	TO14	03-Mar-99	GS
1,2-DICHLOROETHANE	ppbv	< 1	1	TO14	03-Mar-99	GS
TRICHLOROETHENE	ppbv	< 1	1	TO14	03-Mar-99	GS
1,2-DICHLOROPROPANE	ppbv	< 1	1	TO14	03-Mar-99	GS
BROMODICHLOROMETHANE	ppbv	< 1	1	TO14	03-Mar-99	GS
DIBROMOMETHANE	ppbv	< 1	1	TO14	03-Mar-99	GS
CIS-1,3-DICHLOROPROPENE	ppbv	< 1	1	TO14	03-Mar-99	GS
TOLUENE	ppbv	13.2	1	TO14	03-Mar-99	GS
TRANS-1,3-DICHLOROPROPENE	ppbv	< 1	1	TO14	03-Mar-99	GS
1,1,2-TRICHLOROETHANE	ppbv	< 1	1	TO14	03-Mar-99	GS
TETRACHLOROETHENE	ppbv	< 1	1	TO14	03-Mar-99	GS
1,3-DICHLOROPROPANE	ppbv	< 1	1	TO14	03-Mar-99	GS
DIBROMOCHLOROMETHANE	ppbv	< 1	1	TO14	03-Mar-99	GS
1,2-DIBROMOMETHANE	ppbv	< 1	1	TO14	03-Mar-99	GS
CHLOROBENZENE	ppbv	< 1	1	TO14	03-Mar-99	GS
1,1,1,2-TETRACHLOROETHANE	ppbv	< 1	1	TO14	03-Mar-99	GS
ETHYL BENZENE	ppbv	< 1	1	TO14	03-Mar-99	GS
M,P-XYLENE	ppbv	13.8	1	TO14	03-Mar-99	GS
O-XYLENE	ppbv	< 1	1	TO14	03-Mar-99	GS
STYRENE	ppbv	< 1	1	TO14	03-Mar-99	GS
BROMOFORM	ppbv	< 1	1	TO14	03-Mar-99	GS
ISOPROPYLBENZENE	ppbv	< 1	1	TO14	03-Mar-99	GS
1,1,2,2-TETRACHLOROETHANE	ppbv	< 1	1	TO14	03-Mar-99	GS
BROMOBENZENE	ppbv	< 1	1	TO14	03-Mar-99	GS
1,2,3-TRICHLOROPROPANE	ppbv	< 1	1	TO14	03-Mar-99	GS

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Lab ID: L21923-2

PARAMETER	UNITS	RESULT	LIMIT OF QUANTITATION	TEST METHOD	TEST DATE	ANALYST
N-PROPYLBENZENE	ppbv	< 1	1	TO14	03-Mar-99	GS
2-CHLOROTOLUENE	ppbv	< 1	1	TO14	03-Mar-99	GS
1,3,5-TRIMETHYLBENZENE	ppbv	< 1	1	TO14	03-Mar-99	GS
4-CHLOROTOLUENE	ppbv	< 1	1	TO14	03-Mar-99	GS
TERT-BUTYLBENZENE	ppbv	< 1	1	TO14	03-Mar-99	GS
1,3,4-TRIMETHYLBENZENE	ppbv	< 1	1	TO14	03-Mar-99	GS
SEC-BUTYLBENZENE	ppbv	< 1	1	TO14	03-Mar-99	GS
ISOPROPYLBENZENE	ppbv	< 1	1	TO14	03-Mar-99	GS
1,3-DICHLOROBENZENE	ppbv	< 1	1	TO14	03-Mar-99	GS
1,4-DICHLOROBENZENE	ppbv	< 1	1	TO14	03-Mar-99	GS
N-BUTYLBENZENE	ppbv	< 1	1	TO14	03-Mar-99	GS
1,2-DICHLOROBENZENE	ppbv	< 1	1	TO14	03-Mar-99	GS
VINYL CHLORIDE	ppbv	< 2	2	TO14	03-Mar-99	GS

Submitted by
Centre Analytical Labs, Inc.
Reviewed and Approved by:

Kevin J. Lloyd
Laboratory Supervisor

ATTACHMENT B

VOC Mass Removal Rate Calculations

Calculations to Estimate VOC Mass Removal Rates
Benchmark Environmental Engineering and Science
Urbana Landfill Site
SAIC Project No. 01-1408-00-3692-007

Compound	Molecular Weight (g/mole)	Step 1 Sample	
		(ppbv)	(μg/L)
Dichlorodifluoroemethane	120.9	792	3.98
Trichlorofluoromethane	137.2	54.4	0.31
Chloroethane	64.4	49.7	0.13
Toluene	92.1	15.9	0.01
Ethylbenzene	106.2	20.9	0.09
m,p-xylenes	106.2	38.8	0.17

The conversion of soil gas VOC concentrations in ppbv to μg/L is based on the following formula:

μg/L = (MW/24.05)(ppbv/1000)

MW = molecular weight in grams per mole
24.05 = unitless constant
ppbv = parts per billion – volume basis

Reference: Rong, Y. and C.T. Yu, "Conversion Unmasked--What is the Relationship Between mg/L and ppmV?", In Soil and Groundwater Cleanup, April 1996.

Example Calculation for Dichlorofluoromethane:

$$\mu g / L = \left[(120.9 \ g / mole) / 24.05\right] x \ (792 \ ppbv / 1000) = 3.98 \ \mu g / L$$

Using the flow rate from step 2 of 43 scfm, the mass removal rate for Dichlorodifluoromethane is calculated as follows:

$$\frac{3.98 \ \mu g}{L} x \frac{28.3 \ L}{Ft^3} x \frac{43 \ Ft^3}{min} x \frac{1{,}440 \ mins}{day} x \frac{1 \ g}{10^6 \ \mu g} = 6.97 \ grams / day$$

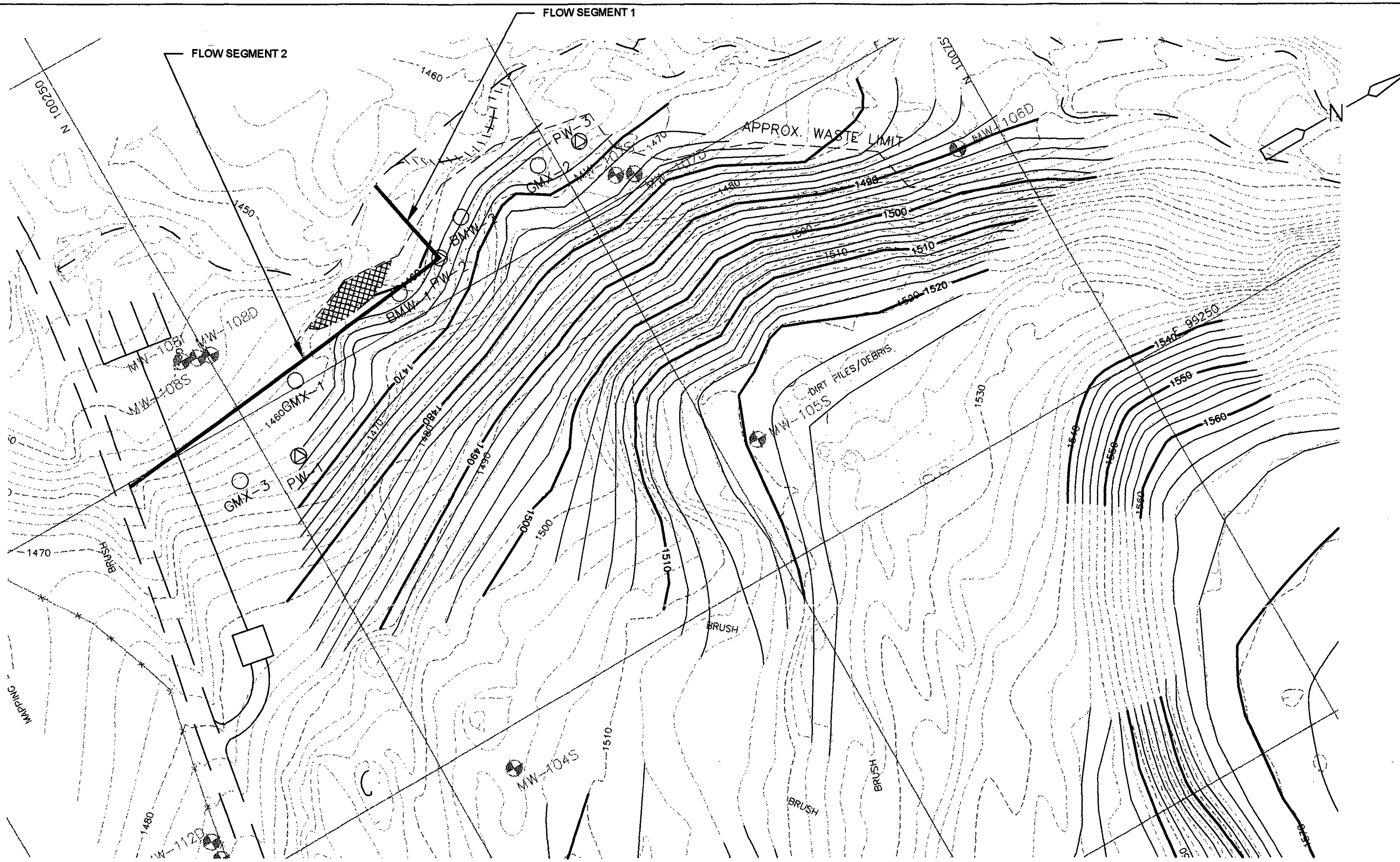
The mass removal rates for all the remaining VOCs are as follows:

Dichlorodifluoromethane	=	6.97 grams/day
Trichlorofluoromethane	=	0.54 grams/day
Chloroethane	=	0.23 grams/day
Toluene	=	0.02 grams/day
Ethylbenzene	=	0.16 grams/day
m,p-xylenes	=	0.30 grams/day
Total VOCs	=	8.22 grams/day

APPENDIX D

Appendix D1 - Illustration of Groundwater Outflow Segments for VOC Mass Balance
Appendix D2 - HELP Model Summary for Existing Cover
Appendix D3 - HELP Model Summary for Preferred Cover
Appendix D4 - HELP Model Summary for Part 360 Cover

Appendix D1 - Illustration of Groundwater Outflow Segments for VOC Mass Balance



0' 60' 120'

SCALE: 1 INCH = 60 FEET

LEGEND

- EXISTING GROUNDWATER RECOVERY WELL
- PRE-DESIGN PIEZOMETER
- EXISTING GROUNDWATER MONITORING WELL
- FINAL CONTOUR

Benchmark Environmental Engineering & Science, PLLC

REVISIONS

NO.	BY	DATE	REMARKS

DES ____
DRN ____
CKD ____

URBANA, NEW YORK

REMEDIAL ACTION WORK PLAN FOR URBANA LANDFILL SITE

NYSDEC SITE NO. 8-51-007

REMEDIAL ACTION WORK PLAN

FLOW SEGMENTS

DATE MARCH 2000

SHEET ___ OF ___

CAD REF. NO. FIG2_1.DWG

Appendix D2 - HELP Model Summary for Existing Cover

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******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                 DEVELOPED BY ENVIRONMENTAL LABORATORY                    **
**                   USAE WATERWAYS EXPERIMENT STATION                      **
**              FOR USEPA RISK REDUCTION ENGINEERING LABORATORY             **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:      C:\HELP3\DATA4.D4
TEMPERATURE DATA FILE:        C:\HELP3\DATA7.D7
SOLAR RADIATION DATA FILE:    C:\HELP3\DATA13.D13
EVAPOTRANSPIRATION DATA:      C:\HELP3\DATA11.D11
SOIL AND DESIGN DATA FILE:    C:\HELP3\UPEXIST.D10
OUTPUT DATA FILE:             C:\HELP3\UPEXIST.OUT


TIME:  15:22     DATE:   5/11/1999


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     TITLE:  URBANA LANDFILL - UPPER TERRACE (EXISTING COVER)

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     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                  LAYER  1
                                  --------

                       TYPE 1 - VERTICAL PERCOLATION LAYER
                           MATERIAL TEXTURE NUMBER   5
           THICKNESS                  =       6.00   INCHES
           POROSITY                   =       0.4570 VOL/VOL
           FIELD CAPACITY             =       0.1310 VOL/VOL
           WILTING POINT              =       0.0580 VOL/VOL
           INITIAL SOIL WATER CONTENT =       0.3301 VOL/VOL
           EFFECTIVE SAT. HYD. COND.  =   0.100000005000E-02 CM/SEC
         NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  4.63
                FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.
```

LAYER 2

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	12.00 INCHES
POROSITY	=	0.4730 VOL/VOL
FIELD CAPACITY	=	0.2220 VOL/VOL
WILTING POINT	=	0.1040 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4730 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.350000005000E-05 CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE # 5 WITH A FAIR STAND OF GRASS, A SURFACE SLOPE OF 4.% AND A SLOPE LENGTH OF 390. FEET.

SCS RUNOFF CURVE NUMBER	=	64.30	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	4.000	ACRES
EVAPORATIVE ZONE DEPTH	=	6.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	1.980	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	2.742	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	0.348	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	7.656	INCHES
TOTAL INITIAL WATER	=	7.656	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
ITHACA NEW YORK

STATION LATITUDE	=	42.40	DEGREES
MAXIMUM LEAF AREA INDEX	=	3.50	
START OF GROWING SEASON (JULIAN DATE)	=	130	
END OF GROWING SEASON (JULIAN DATE)	=	279	
EVAPORATIVE ZONE DEPTH	=	6.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	10.30	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	74.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	69.00	%

AVERAGE 3RD QUARTER RELATIVE HUMIDITY = 75.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY = 76.00 %

NOTE: PRECIPITATION DATA FOR ITHACA NEW YORK
WAS ENTERED FROM THE DEFAULT DATA FILE.

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ITHACA NEW YORK

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
22.20	22.70	32.20	44.50	54.80	64.30
68.80	67.10	60.20	49.60	39.30	27.60

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ITHACA NEW YORK
AND STATION LATITUDE = 42.40 DEGREES

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ANNUAL TOTALS FOR YEAR 1974

	INCHES	CU. FEET	PERCENT
PRECIPITATION	37.02	537530.312	100.00
RUNOFF	6.675	96927.625	18.03
EVAPOTRANSPIRATION	19.338	280793.594	52.24
PERC./LEAKAGE THROUGH LAYER 2	10.995975	159661.562	29.70
AVG. HEAD ON TOP OF LAYER 2	0.3222		
CHANGE IN WATER STORAGE	0.010	147.640	0.03
SOIL WATER AT START OF YEAR	7.656	111168.117	
SOIL WATER AT END OF YEAR	7.666	111315.758	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.125	0.00

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ANNUAL TOTALS FOR YEAR 1975

	INCHES	CU. FEET	PERCENT
PRECIPITATION	40.98	595029.625	100.00
RUNOFF	7.513	109085.992	18.33
EVAPOTRANSPIRATION	21.187	307629.000	51.70
PERC./LEAKAGE THROUGH LAYER 2	10.832273	157284.609	26.43
AVG. HEAD ON TOP OF LAYER 2	0.3106		
CHANGE IN WATER STORAGE	1.448	21030.113	3.53
SOIL WATER AT START OF YEAR	7.666	111315.758	
SOIL WATER AT END OF YEAR	6.792	98618.312	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	2.323	33727.559	5.67
ANNUAL WATER BUDGET BALANCE	0.0000	-0.055	0.00

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ANNUAL TOTALS FOR YEAR 1976

	INCHES	CU. FEET	PERCENT
PRECIPITATION	44.45	645414.062	100.00
RUNOFF	10.758	156212.797	24.20
EVAPOTRANSPIRATION	23.027	334354.469	51.80
PERC./LEAKAGE THROUGH LAYER 2	11.498481	166957.937	25.87
AVG. HEAD ON TOP OF LAYER 2	0.4564		
CHANGE IN WATER STORAGE	-0.834	-12111.264	-1.88
SOIL WATER AT START OF YEAR	6.792	98618.312	

SOIL WATER AT END OF YEAR	6.626	96210.258	
SNOW WATER AT START OF YEAR	2.323	33727.559	5.23
SNOW WATER AT END OF YEAR	1.655	24024.352	3.72
ANNUAL WATER BUDGET BALANCE	0.0000	0.138	0.00

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ANNUAL TOTALS FOR YEAR 1977

	INCHES	CU. FEET	PERCENT
PRECIPITATION	46.30	672276.125	100.00
RUNOFF	12.747	185092.922	27.53
EVAPOTRANSPIRATION	20.517	297902.906	44.31
PERC./LEAKAGE THROUGH LAYER 2	13.036163	189285.094	28.16
AVG. HEAD ON TOP OF LAYER 2	0.6077		
CHANGE IN WATER STORAGE	0.000	-4.872	0.00
SOIL WATER AT START OF YEAR	6.626	96210.258	
SOIL WATER AT END OF YEAR	8.015	116373.164	
SNOW WATER AT START OF YEAR	1.655	24024.352	3.57
SNOW WATER AT END OF YEAR	0.266	3856.573	0.57
ANNUAL WATER BUDGET BALANCE	0.0000	0.055	0.00

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ANNUAL TOTALS FOR YEAR 1978

	INCHES	CU. FEET	PERCENT
PRECIPITATION	32.04	465220.750	100.00
RUNOFF	8.905	129295.359	27.79

EVAPOTRANSPIRATION	15.988	232146.984	49.90
PERC./LEAKAGE THROUGH LAYER 2	6.731838	97746.281	21.01
AVG. HEAD ON TOP OF LAYER 2	0.1727		
CHANGE IN WATER STORAGE	0.415	6032.147	1.30
SOIL WATER AT START OF YEAR	8.015	116373.164	
SOIL WATER AT END OF YEAR	6.790	98586.766	
SNOW WATER AT START OF YEAR	0.266	3856.573	0.83
SNOW WATER AT END OF YEAR	1.906	27675.123	5.95
ANNUAL WATER BUDGET BALANCE	0.0000	-0.014	0.00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1974 THROUGH 1978

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	2.80	2.09	2.65	2.37	3.03	4.00
	4.17	4.03	5.43	4.15	2.36	3.07
STD. DEVIATIONS	2.10	0.80	0.63	0.94	0.94	1.09
	2.81	0.59	2.99	1.70	1.22	0.78
RUNOFF						
TOTALS	0.680	0.582	3.629	2.431	0.000	0.000
	0.358	0.000	0.963	0.322	0.000	0.354
STD. DEVIATIONS	0.973	0.692	1.324	2.529	0.000	0.000
	0.801	0.000	1.327	0.457	0.000	0.759
EVAPOTRANSPIRATION						
TOTALS	0.435	0.476	0.409	1.080	2.715	3.205
	3.161	2.897	2.590	1.513	1.068	0.464
STD. DEVIATIONS	0.055	0.051	0.128	0.508	0.679	0.618
	1.399	0.811	0.614	0.258	0.113	0.119

PERCOLATION/LEAKAGE THROUGH LAYER 2

TOTALS	0.0420	0.0366	0.1718	1.1467	1.0953	0.7675
	0.7513	0.8006	1.5345	2.5544	1.1801	0.5383
STD. DEVIATIONS	0.0711	0.0503	0.1641	0.6678	0.5068	0.6063
	0.8341	0.4646	1.0709	1.3602	0.8841	0.6686

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 2

AVERAGES	0.0005	0.0005	0.0021	0.6413	0.3778	0.2544
	0.2816	0.2317	0.9819	1.3023	0.3106	0.1018
STD. DEVIATIONS	0.0009	0.0007	0.0020	0.4695	0.3635	0.3424
	0.4045	0.1765	1.0617	1.0477	0.3193	0.2139

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1974 THROUGH 1978

	INCHES		CU. FEET	PERCENT
PRECIPITATION	40.16	(5.757)	583094.2	100.00
RUNOFF	9.320	(2.4621)	135322.94	23.208
EVAPOTRANSPIRATION	20.011	(2.6159)	290565.41	49.832
PERCOLATION/LEAKAGE THROUGH LAYER 2	10.61895	(2.34061)	154187.094	26.44291
AVERAGE HEAD ON TOP OF LAYER 2	0.374	(0.165)		
CHANGE IN WATER STORAGE	0.208	(0.8292)	3018.75	0.518

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PEAK DAILY VALUES FOR YEARS 1974 THROUGH 1978

	(INCHES)	(CU. FT.)
PRECIPITATION	3.13	45447.602
RUNOFF	2.218	32207.1445
PERCOLATION/LEAKAGE THROUGH LAYER 2	0.177574	2578.36987
AVERAGE HEAD ON TOP OF LAYER 2	5.898	
SNOW WATER	7.10	103103.5620

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4570
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0580

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FINAL WATER STORAGE AT END OF YEAR 1978

LAYER	(INCHES)	(VOL/VOL)
1	1.1138	0.1856
2	5.6760	0.4730
SNOW WATER	1.906	

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**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07   (1 NOVEMBER 1997)               **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**              FOR USEPA RISK REDUCTION ENGINEERING LABORATORY             **
**                                                                          **
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PRECIPITATION DATA FILE:      C:\HELP3\DATA4.D4
TEMPERATURE DATA FILE:        C:\HELP3\DATA7.D7
SOLAR RADIATION DATA FILE:    C:\HELP3\DATA13.D13
EVAPOTRANSPIRATION DATA:      C:\HELP3\DATA11.D11
SOIL AND DESIGN DATA FILE:    C:\HELP3\L1EXIST.D10
OUTPUT DATA FILE:             C:\HELP3\LIEXIST.OUT


TIME:  10:53       DATE:   4/ 2/1999


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     TITLE:  URBANA LANDFILL - LOWER TERRACE 1 (EXISTING COVER)

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     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                  LAYER  1
                                  --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER   5
           THICKNESS                     =       6.00   INCHES
           POROSITY                      =       0.4570 VOL/VOL
           FIELD CAPACITY                =       0.1310 VOL/VOL
           WILTING POINT                 =       0.0580 VOL/VOL
           INITIAL SOIL WATER CONTENT    =       0.4027 VOL/VOL
           EFFECTIVE SAT. HYD. COND.     =   0.100000005000E-02 CM/SEC
         NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  4.63
                FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.
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LAYER 2

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	24.00 INCHES
POROSITY	=	0.4730 VOL/VOL
FIELD CAPACITY	=	0.2220 VOL/VOL
WILTING POINT	=	0.1040 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4730 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.999999997000E-06 CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE # 5 WITH A FAIR STAND OF GRASS, A SURFACE SLOPE OF 8.% AND A SLOPE LENGTH OF 220. FEET.

SCS RUNOFF CURVE NUMBER	=	66.40	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.620	ACRES
EVAPORATIVE ZONE DEPTH	=	6.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	2.416	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	2.742	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	0.348	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	13.768	INCHES
TOTAL INITIAL WATER	=	13.768	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
ITHACA NEW YORK

STATION LATITUDE	=	42.40 DEGREES
MAXIMUM LEAF AREA INDEX	=	3.50
START OF GROWING SEASON (JULIAN DATE)	=	130
END OF GROWING SEASON (JULIAN DATE)	=	279
EVAPORATIVE ZONE DEPTH	=	6.0 INCHES
AVERAGE ANNUAL WIND SPEED	=	10.30 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	74.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	69.00 %

AVERAGE 3RD QUARTER RELATIVE HUMIDITY = 75.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY = 76.00 %

NOTE: PRECIPITATION DATA FOR ITHACA NEW YORK
WAS ENTERED FROM THE DEFAULT DATA FILE.

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ITHACA NEW YORK

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
22.20	22.70	32.20	44.50	54.80	64.30
68.80	67.10	60.20	49.60	39.30	27.60

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ITHACA NEW YORK
AND STATION LATITUDE = 42.40 DEGREES

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ANNUAL TOTALS FOR YEAR 1974

	INCHES	CU. FEET	PERCENT
PRECIPITATION	37.02	217699.766	100.00
RUNOFF	8.940	52570.187	24.15
EVAPOTRANSPIRATION	20.696	121704.133	55.90
PERC./LEAKAGE THROUGH LAYER 2	7.384537	43425.508	19.95
AVG. HEAD ON TOP OF LAYER 2	1.2936		
CHANGE IN WATER STORAGE	0.000	0.000	0.00
SOIL WATER AT START OF YEAR	13.768	80963.539	
SOIL WATER AT END OF YEAR	13.768	80963.539	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.050	0.00

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ANNUAL TOTALS FOR YEAR 1975

	INCHES	CU. FEET	PERCENT
PRECIPITATION	40.98	240987.016	100.00
RUNOFF	9.192	54054.301	22.43
EVAPOTRANSPIRATION	22.549	132603.187	55.03
PERC./LEAKAGE THROUGH LAYER 2	8.052833	47355.488	19.65
AVG. HEAD ON TOP OF LAYER 2	1.2840		
CHANGE IN WATER STORAGE	1.186	6973.969	2.89
SOIL WATER AT START OF YEAR	13.768	80963.539	
SOIL WATER AT END OF YEAR	12.631	74277.844	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	2.323	13659.662	5.67
ANNUAL WATER BUDGET BALANCE	0.0000	0.067	0.00

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ANNUAL TOTALS FOR YEAR 1976

	INCHES	CU. FEET	PERCENT
PRECIPITATION	44.45	261392.703	100.00
RUNOFF	13.539	79618.625	30.46
EVAPOTRANSPIRATION	25.228	148358.641	56.76
PERC./LEAKAGE THROUGH LAYER 2	6.463036	38006.531	14.54
AVG. HEAD ON TOP OF LAYER 2	1.2126		
CHANGE IN WATER STORAGE	-0.781	-4591.223	-1.76
SOIL WATER AT START OF YEAR	12.631	74277.844	

SOIL WATER AT END OF YEAR	12.519	73616.422	
SNOW WATER AT START OF YEAR	2.323	13659.662	5.23
SNOW WATER AT END OF YEAR	1.655	9729.862	3.72
ANNUAL WATER BUDGET BALANCE	0.0000	0.132	0.00

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ANNUAL TOTALS FOR YEAR 1977

	INCHES	CU. FEET	PERCENT
PRECIPITATION	46.30	272271.812	100.00
RUNOFF	18.324	107756.219	39.58
EVAPOTRANSPIRATION	21.878	128656.391	47.25
PERC./LEAKAGE THROUGH LAYER 2	6.237450	36679.945	13.47
AVG. HEAD ON TOP OF LAYER 2	1.4516		
CHANGE IN WATER STORAGE	-0.140	-820.834	-0.30
SOIL WATER AT START OF YEAR	12.519	73616.422	
SOIL WATER AT END OF YEAR	13.768	80963.539	
SNOW WATER AT START OF YEAR	1.655	9729.862	3.57
SNOW WATER AT END OF YEAR	0.266	1561.912	0.57
ANNUAL WATER BUDGET BALANCE	0.0000	0.112	0.00

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ANNUAL TOTALS FOR YEAR 1978

	INCHES	CU. FEET	PERCENT
PRECIPITATION	32.04	188414.406	100.00
RUNOFF	8.930	52510.824	27.87

EVAPOTRANSPIRATION	17.489	102845.867	54.58
PERC./LEAKAGE THROUGH LAYER 2	5.283319	31069.088	16.49
AVG. HEAD ON TOP OF LAYER 2	0.6632		
CHANGE IN WATER STORAGE	0.338	1988.637	1.06
SOIL WATER AT START OF YEAR	13.768	80963.539	
SOIL WATER AT END OF YEAR	12.466	73305.664	
SNOW WATER AT START OF YEAR	0.266	1561.912	0.83
SNOW WATER AT END OF YEAR	1.906	11208.426	5.95
ANNUAL WATER BUDGET BALANCE	0.0000	0.000	0.00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1974 THROUGH 1978

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	2.80	2.09	2.65	2.37	3.03	4.00
	4.17	4.03	5.43	4.15	2.36	3.07
STD. DEVIATIONS	2.10	0.80	0.63	0.94	0.94	1.09
	2.81	0.59	2.99	1.70	1.22	0.78
RUNOFF						
TOTALS	0.754	0.622	3.706	2.580	0.000	0.000
	0.482	0.000	1.471	1.240	0.222	0.707
STD. DEVIATIONS	1.012	0.697	1.322	2.848	0.000	0.000
	1.077	0.000	1.856	1.526	0.394	0.989
EVAPOTRANSPIRATION						
TOTALS	0.435	0.476	0.410	1.121	2.983	3.668
	3.541	3.204	2.717	1.457	1.090	0.467
STD. DEVIATIONS	0.055	0.051	0.127	0.539	0.571	0.757
	1.641	0.939	0.654	0.239	0.149	0.126

PERCOLATION/LEAKAGE THROUGH LAYER 2

TOTALS	0.0724	0.0446	0.1899	0.6535	0.9510	0.4410
	0.3145	0.3363	0.6712	1.0657	1.1383	0.8059
STD. DEVIATIONS	0.1030	0.0458	0.1657	0.3528	0.1834	0.2271
	0.2963	0.2000	0.4197	0.2663	0.0756	0.2977

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 2

AVERAGES	0.0017	0.0012	0.0078	1.0846	1.6436	0.4202
	0.5384	0.5226	1.7557	3.7007	3.1279	1.3678
STD. DEVIATIONS	0.0025	0.0012	0.0078	0.7850	0.9682	0.3354
	0.7492	0.4599	1.5259	1.3928	1.1222	1.2172

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1974 THROUGH 1978

	INCHES	CU. FEET	PERCENT
PRECIPITATION	40.16 (5.757)	236153.1	100.00
RUNOFF	11.785 (4.1476)	69302.03	29.346
EVAPOTRANSPIRATION	21.568 (2.8221)	126833.64	53.708
PERCOLATION/LEAKAGE THROUGH LAYER 2	6.68423 (1.06942)	39307.309	16.64484
AVERAGE HEAD ON TOP OF LAYER 2	1.181 (0.302)		
CHANGE IN WATER STORAGE	0.121 (0.7206)	710.11	0.301

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PEAK DAILY VALUES FOR YEARS 1974 THROUGH 1978

	(INCHES)	(CU. FT.)
PRECIPITATION	3.13	18406.279
RUNOFF	2.299	13520.2695
PERCOLATION/LEAKAGE THROUGH LAYER 2	0.042511	249.99187
AVERAGE HEAD ON TOP OF LAYER 2	5.995	
SNOW WATER	7.10	41756.9453

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4570
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0580

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FINAL WATER STORAGE AT END OF YEAR 1978

LAYER	(INCHES)	(VOL/VOL)
1	1.1138	0.1856
2	11.3520	0.4730
SNOW WATER	1.906	

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**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**            FOR USEPA RISK REDUCTION ENGINEERING LABORATORY               **
**                                                                          **
**                                                                          **
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PRECIPITATION DATA FILE:     C:\HELP3\DATA4.D4
TEMPERATURE DATA FILE:       C:\HELP3\DATA7.D7
SOLAR RADIATION DATA FILE:   C:\HELP3\DATA13.D13
EVAPOTRANSPIRATION DATA:     C:\HELP3\DATA11.D11
SOIL AND DESIGN DATA FILE:   C:\HELP3\L2EXIST.D10
OUTPUT DATA FILE:            C:\HELP3\L2EXIST.OUT


TIME: 13:36     DATE:  5/11/1999


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     TITLE:  URBANA LANDFILL - LOWER TERRACE 2 (EXISTING COVER)

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     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                  LAYER  1
                                  --------

                      TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER   5
           THICKNESS                  =       6.00   INCHES
           POROSITY                   =       0.4570 VOL/VOL
           FIELD CAPACITY             =       0.1310 VOL/VOL
           WILTING POINT              =       0.0580 VOL/VOL
           INITIAL SOIL WATER CONTENT =       0.4515 VOL/VOL
           EFFECTIVE SAT. HYD. COND.  =    0.100000005000E-02 CM/SEC
         NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  4.63
                  FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.
```

LAYER 2

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	4.50	INCHES
POROSITY	=	0.4730	VOL/VOL
FIELD CAPACITY	=	0.2220	VOL/VOL
WILTING POINT	=	0.1040	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4730	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000001000E-06	CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE # 5 WITH A FAIR STAND OF GRASS, A SURFACE SLOPE OF 9.% AND A SLOPE LENGTH OF 100. FEET.

SCS RUNOFF CURVE NUMBER	=	68.20	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	0.420	ACRES
EVAPORATIVE ZONE DEPTH	=	6.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	2.709	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	2.742	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	0.348	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	4.838	INCHES
TOTAL INITIAL WATER	=	4.838	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
ITHACA NEW YORK

STATION LATITUDE	=	42.40	DEGREES
MAXIMUM LEAF AREA INDEX	=	3.50	
START OF GROWING SEASON (JULIAN DATE)	=	130	
END OF GROWING SEASON (JULIAN DATE)	=	279	
EVAPORATIVE ZONE DEPTH	=	6.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	10.30	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	74.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	69.00	%

AVERAGE 3RD QUARTER RELATIVE HUMIDITY = 75.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY = 76.00 %

NOTE: PRECIPITATION DATA FOR ITHACA NEW YORK
WAS ENTERED FROM THE DEFAULT DATA FILE.

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ITHACA NEW YORK

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
22.20	22.70	32.20	44.50	54.80	64.30
68.80	67.10	60.20	49.60	39.30	27.60

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ITHACA NEW YORK
AND STATION LATITUDE = 42.40 DEGREES

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ANNUAL TOTALS FOR YEAR 1974

	INCHES	CU. FEET	PERCENT
PRECIPITATION	37.02	56440.680	100.00
RUNOFF	13.621	20766.863	36.79
EVAPOTRANSPIRATION	21.629	32975.031	58.42
PERC./LEAKAGE THROUGH LAYER 2	1.769744	2698.152	4.78
AVG. HEAD ON TOP OF LAYER 2	2.5782		
CHANGE IN WATER STORAGE	0.000	0.656	0.00
SOIL WATER AT START OF YEAR	4.837	7375.154	
SOIL WATER AT END OF YEAR	4.838	7375.811	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.024	0.00

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ANNUAL TOTALS FOR YEAR 1975

	INCHES	CU. FEET	PERCENT
PRECIPITATION	40.98	62478.109	100.00
RUNOFF	12.895	19659.715	31.47
EVAPOTRANSPIRATION	23.985	36567.219	58.53
PERC./LEAKAGE THROUGH LAYER 2	1.800692	2745.335	4.39
AVG. HEAD ON TOP OF LAYER 2	2.5645		
CHANGE IN WATER STORAGE	2.300	3505.832	5.61
SOIL WATER AT START OF YEAR	4.838	7375.811	
SOIL WATER AT END OF YEAR	4.815	7340.249	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	2.323	3541.394	5.67
ANNUAL WATER BUDGET BALANCE	0.0000	0.009	0.00

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ANNUAL TOTALS FOR YEAR 1976

	INCHES	CU. FEET	PERCENT
PRECIPITATION	44.45	67768.477	100.00
RUNOFF	16.990	25902.902	38.22
EVAPOTRANSPIRATION	26.719	40735.395	60.11
PERC./LEAKAGE THROUGH LAYER 2	1.676210	2555.550	3.77
AVG. HEAD ON TOP OF LAYER 2	2.0732		
CHANGE IN WATER STORAGE	-0.935	-1425.396	-2.10
SOIL WATER AT START OF YEAR	4.815	7340.249	

SOIL WATER AT END OF YEAR	4.548	6933.690	
SNOW WATER AT START OF YEAR	2.323	3541.394	5.23
SNOW WATER AT END OF YEAR	1.655	2522.557	3.72
ANNUAL WATER BUDGET BALANCE	0.0000	0.024	0.00

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ANNUAL TOTALS FOR YEAR 1977

	INCHES	CU. FEET	PERCENT
PRECIPITATION	46.30	70588.984	100.00
RUNOFF	22.481	34274.578	48.56
EVAPOTRANSPIRATION	23.293	35512.203	50.31
PERC./LEAKAGE THROUGH LAYER 2	1.652650	2519.630	3.57
AVG. HEAD ON TOP OF LAYER 2	2.1119		
CHANGE IN WATER STORAGE	-1.126	-1717.456	-2.43
SOIL WATER AT START OF YEAR	4.548	6933.690	
SOIL WATER AT END OF YEAR	4.810	7333.851	
SNOW WATER AT START OF YEAR	1.655	2522.557	3.57
SNOW WATER AT END OF YEAR	0.266	404.940	0.57
ANNUAL WATER BUDGET BALANCE	0.0000	0.032	0.00

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ANNUAL TOTALS FOR YEAR 1978

	INCHES	CU. FEET	PERCENT
PRECIPITATION	32.04	48848.180	100.00
RUNOFF	9.665	14735.141	30.17

EVAPOTRANSPIRATION	19.200	29272.713	59.93
PERC./LEAKAGE THROUGH LAYER 2	1.491846	2274.468	4.66
AVG. HEAD ON TOP OF LAYER 2	1.8246		
CHANGE IN WATER STORAGE	1.683	2565.845	5.25
SOIL WATER AT START OF YEAR	4.810	7333.851	
SOIL WATER AT END OF YEAR	4.853	7398.748	
SNOW WATER AT START OF YEAR	0.266	404.940	0.83
SNOW WATER AT END OF YEAR	1.906	2905.888	5.95
ANNUAL WATER BUDGET BALANCE	0.0000	0.011	0.00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1974 THROUGH 1978

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	2.80	2.09	2.65	2.37	3.03	4.00
	4.17	4.03	5.43	4.15	2.36	3.07
STD. DEVIATIONS	2.10	0.80	0.63	0.94	0.94	1.09
	2.81	0.59	2.99	1.70	1.22	0.78
RUNOFF						
TOTALS	0.880	0.791	3.922	2.784	0.151	0.249
	0.664	0.000	1.759	1.897	0.873	1.161
STD. DEVIATIONS	1.027	0.781	1.178	3.074	0.194	0.346
	1.485	0.000	2.150	1.724	0.910	1.424
EVAPOTRANSPIRATION						
TOTALS	0.435	0.476	0.410	1.131	2.998	4.305
	4.053	3.392	2.786	1.457	1.059	0.464
STD. DEVIATIONS	0.055	0.051	0.127	0.534	0.653	0.470
	1.617	1.072	0.667	0.193	0.149	0.123

PERCOLATION/LEAKAGE THROUGH LAYER 2

TOTALS	0.1210	0.1054	0.1147	0.1437	0.1970	0.1562
	0.0589	0.0592	0.1226	0.1981	0.2179	0.1836
STD. DEVIATIONS	0.0021	0.0022	0.0020	0.0253	0.0094	0.0280
	0.0536	0.0377	0.0696	0.0492	0.0100	0.0281

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 2

AVERAGES	0.6654	0.4447	0.3955	1.8384	3.9050	2.7041
	0.8719	0.7176	2.2705	4.5111	5.1086	3.3330
STD. DEVIATIONS	0.0880	0.0870	0.0856	1.1138	0.4017	0.8482
	1.1221	0.5800	1.8759	1.3458	0.4393	1.1972

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1974 THROUGH 1978

	INCHES		CU. FEET	PERCENT
PRECIPITATION	40.16	(5.757)	61224.9	100.00
RUNOFF	15.130	(4.8640)	23067.84	37.677
EVAPOTRANSPIRATION	22.965	(2.7927)	35012.51	57.187
PERCOLATION/LEAKAGE THROUGH LAYER 2	1.67823	(0.12121)	2558.627	4.17906
AVERAGE HEAD ON TOP OF LAYER 2	2.230	(0.330)		
CHANGE IN WATER STORAGE	0.384	(1.5431)	585.90	0.957

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PEAK DAILY VALUES FOR YEARS 1974 THROUGH 1978

	(INCHES)	(CU. FT.)
PRECIPITATION	3.13	4771.998
RUNOFF	2.722	4149.4878
PERCOLATION/LEAKAGE THROUGH LAYER 2	0.007937	12.10087
AVERAGE HEAD ON TOP OF LAYER 2	6.000	
SNOW WATER	7.10	10825.8730
MAXIMUM VEG. SOIL WATER (VOL/VOL)		0.4570
MINIMUM VEG. SOIL WATER (VOL/VOL)		0.0580

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FINAL WATER STORAGE AT END OF YEAR 1978

LAYER	(INCHES)	(VOL/VOL)
1	2.7245	0.4541
2	2.1285	0.4730
SNOW WATER	1.906	

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**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**               HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                 **
**                DEVELOPED BY ENVIRONMENTAL LABORATORY                     **
**                  USAE WATERWAYS EXPERIMENT STATION                       **
**          FOR USEPA RISK REDUCTION ENGINEERING LABORATORY                 **
**                                                                          **
**                                                                          **
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PRECIPITATION DATA FILE:      C:\HELP3\DATA4.D4
TEMPERATURE DATA FILE:        C:\HELP3\DATA7.D7
SOLAR RADIATION DATA FILE:    C:\HELP3\DATA13.D13
EVAPOTRANSPIRATION DATA:      C:\HELP3\DATA11.D11
SOIL AND DESIGN DATA FILE:    C:\HELP3\MIDDLE.D10
OUTPUT DATA FILE:             C:\HELP3\MIDDLE.OUT


TIME:  13:54     DATE:   5/11/1999


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    TITLE:  URBANA LANDFILL - MIDDLE TERRACE (EXIST. & PREFERRED COVER)

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    NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
             COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                              LAYER  1
                              --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                       MATERIAL TEXTURE NUMBER   5
       THICKNESS                    =       6.00   INCHES
       POROSITY                     =       0.4570 VOL/VOL
       FIELD CAPACITY               =       0.1310 VOL/VOL
       WILTING POINT                =       0.0580 VOL/VOL
       INITIAL SOIL WATER CONTENT   =       0.4027 VOL/VOL
       EFFECTIVE SAT. HYD. COND.    =   0.100000005000E-02 CM/SEC
     NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  4.63
              FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.
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LAYER 2

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	30.00 INCHES
POROSITY	=	0.4730 VOL/VOL
FIELD CAPACITY	=	0.2220 VOL/VOL
WILTING POINT	=	0.1040 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4730 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.150000005000E-05 CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE # 5 WITH A FAIR STAND OF GRASS, A SURFACE SLOPE OF 13.% AND A SLOPE LENGTH OF 195. FEET.

SCS RUNOFF CURVE NUMBER	=	67.20	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.720	ACRES
EVAPORATIVE ZONE DEPTH	=	6.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	2.416	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	2.742	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	0.348	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	16.606	INCHES
TOTAL INITIAL WATER	=	16.606	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
ITHACA NEW YORK

STATION LATITUDE	=	42.40	DEGREES
MAXIMUM LEAF AREA INDEX	=	3.50	
START OF GROWING SEASON (JULIAN DATE)	=	130	
END OF GROWING SEASON (JULIAN DATE)	=	279	
EVAPORATIVE ZONE DEPTH	=	6.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	10.30	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	74.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	69.00	%

AVERAGE 3RD QUARTER RELATIVE HUMIDITY = 75.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY = 76.00 %

NOTE: PRECIPITATION DATA FOR ITHACA NEW YORK
WAS ENTERED FROM THE DEFAULT DATA FILE.

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ITHACA NEW YORK

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
22.20	22.70	32.20	44.50	54.80	64.30
68.80	67.10	60.20	49.60	39.30	27.60

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ITHACA NEW YORK
AND STATION LATITUDE = 42.40 DEGREES

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ANNUAL TOTALS FOR YEAR 1974

	INCHES	CU. FEET	PERCENT
PRECIPITATION	37.02	231138.031	100.00
RUNOFF	8.007	49991.285	21.63
EVAPOTRANSPIRATION	20.319	126865.469	54.89
PERC./LEAKAGE THROUGH LAYER 2	8.693927	54281.402	23.48
AVG. HEAD ON TOP OF LAYER 2	0.8270		
CHANGE IN WATER STORAGE	0.000	0.000	0.00
SOIL WATER AT START OF YEAR	16.606	103680.633	
SOIL WATER AT END OF YEAR	16.606	103680.633	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.119	0.00

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ANNUAL TOTALS FOR YEAR 1975

	INCHES	CU. FEET	PERCENT
PRECIPITATION	40.98	255862.750	100.00
RUNOFF	8.456	52793.152	20.63
EVAPOTRANSPIRATION	22.115	138075.359	53.96
PERC./LEAKAGE THROUGH LAYER 2	9.386908	58608.098	22.91
AVG. HEAD ON TOP OF LAYER 2	0.8849		
CHANGE IN WATER STORAGE	1.023	6386.093	2.50
SOIL WATER AT START OF YEAR	16.606	103680.633	
SOIL WATER AT END OF YEAR	15.306	95563.875	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	2.323	14502.852	5.67
ANNUAL WATER BUDGET BALANCE	0.0000	0.054	0.00

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ANNUAL TOTALS FOR YEAR 1976

	INCHES	CU. FEET	PERCENT
PRECIPITATION	44.45	277528.062	100.00
RUNOFF	12.670	79108.437	28.50
EVAPOTRANSPIRATION	24.722	154357.078	55.62
PERC./LEAKAGE THROUGH LAYER 2	7.758196	48439.074	17.45
AVG. HEAD ON TOP OF LAYER 2	0.9850		
CHANGE IN WATER STORAGE	-0.701	-4376.668	-1.58
SOIL WATER AT START OF YEAR	15.306	95563.875	

SOIL WATER AT END OF YEAR	15.273	95359.586	
SNOW WATER AT START OF YEAR	2.323	14502.852	5.23
SNOW WATER AT END OF YEAR	1.655	10330.472	3.72
ANNUAL WATER BUDGET BALANCE	0.0000	0.131	0.00

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ANNUAL TOTALS FOR YEAR 1977

	INCHES	CU. FEET	PERCENT
PRECIPITATION	46.30	289078.719	100.00
RUNOFF	16.857	105248.172	36.41
EVAPOTRANSPIRATION	21.509	134293.500	46.46
PERC./LEAKAGE THROUGH LAYER 2	7.997731	49934.637	17.27
AVG. HEAD ON TOP OF LAYER 2	1.2844		
CHANGE IN WATER STORAGE	-0.064	-397.589	-0.14
SOIL WATER AT START OF YEAR	15.273	95359.586	
SOIL WATER AT END OF YEAR	16.598	103634.141	
SNOW WATER AT START OF YEAR	1.655	10330.472	3.57
SNOW WATER AT END OF YEAR	0.266	1658.326	0.57
ANNUAL WATER BUDGET BALANCE	0.0000	0.012	0.00

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ANNUAL TOTALS FOR YEAR 1978

	INCHES	CU. FEET	PERCENT
PRECIPITATION	32.04	200044.922	100.00
RUNOFF	8.919	55688.016	27.84

EVAPOTRANSPIRATION	17.100	106766.211	53.37
PERC./LEAKAGE THROUGH LAYER 2	5.675001	35432.437	17.71
AVG. HEAD ON TOP OF LAYER 2	0.4684		
CHANGE IN WATER STORAGE	0.346	2158.277	1.08
SOIL WATER AT START OF YEAR	16.598	103634.141	
SOIL WATER AT END OF YEAR	15.304	95550.445	
SNOW WATER AT START OF YEAR	0.266	1658.326	0.83
SNOW WATER AT END OF YEAR	1.906	11900.304	5.95
ANNUAL WATER BUDGET BALANCE	0.0000	-0.006	0.00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1974 THROUGH 1978

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	2.80	2.09	2.65	2.37	3.03	4.00
	4.17	4.03	5.43	4.15	2.36	3.07
STD. DEVIATIONS	2.10	0.80	0.63	0.94	0.94	1.09
	2.81	0.59	2.99	1.70	1.22	0.78
RUNOFF						
TOTALS	0.752	0.615	3.675	2.556	0.000	0.000
	0.437	0.000	1.354	0.997	0.110	0.485
STD. DEVIATIONS	1.011	0.684	1.360	2.802	0.000	0.000
	0.977	0.000	1.738	1.371	0.210	0.775
EVAPOTRANSPIRATION						
TOTALS	0.435	0.476	0.410	1.119	2.900	3.578
	3.434	3.126	2.664	1.470	1.080	0.462
STD. DEVIATIONS	0.055	0.051	0.127	0.535	0.574	0.710
	1.614	0.879	0.652	0.244	0.124	0.117

PERCOLATION/LEAKAGE THROUGH LAYER 2

TOTALS	0.0719	0.0450	0.1860	0.7943	1.0226	0.4477
	0.4366	0.4451	0.9349	1.4253	1.4300	0.6630
STD. DEVIATIONS	0.1017	0.0463	0.1851	0.4606	0.3720	0.3472
	0.4202	0.2585	0.6112	0.3944	0.3630	0.5287

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 2

AVERAGES	0.0000	0.0001	0.0000	0.9373	1.0840	0.3309
	0.4664	0.4524	1.5457	3.0754	2.1341	0.6528
STD. DEVIATIONS	0.0000	0.0003	0.0000	0.6636	0.7910	0.3190
	0.6485	0.4013	1.3689	1.7820	1.3237	0.9467

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1974 THROUGH 1978

	INCHES		CU. FEET	PERCENT
PRECIPITATION	40.16	(5.757)	250730.5	100.00
RUNOFF	10.982	(3.7701)	68565.81	27.346
EVAPOTRANSPIRATION	21.153	(2.7800)	132071.53	52.675
PERCOLATION/LEAKAGE THROUGH LAYER 2	7.90235	(1.39834)	49339.129	19.67815
AVERAGE HEAD ON TOP OF LAYER 2	0.890	(0.294)		
CHANGE IN WATER STORAGE	0.121	(0.6301)	754.02	0.301

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PEAK DAILY VALUES FOR YEARS 1974 THROUGH 1978

	(INCHES)	(CU. FT.)
PRECIPITATION	3.13	19542.469
RUNOFF	2.229	13914.3994
PERCOLATION/LEAKAGE THROUGH LAYER 2	0.061227	382.27963
AVERAGE HEAD ON TOP OF LAYER 2	6.000	
SNOW WATER	7.10	44334.5312
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4570	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0580	

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FINAL WATER STORAGE AT END OF YEAR 1978

LAYER	(INCHES)	(VOL/VOL)
1	1.1138	0.1856
2	14.1900	0.4730
SNOW WATER	1.906	

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**                                                                          **
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**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**              FOR USEPA RISK REDUCTION ENGINEERING LABORATORY             **
**                                                                          **
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PRECIPITATION DATA FILE:      C:\HELP3\DATA4.D4
TEMPERATURE DATA FILE:        C:\HELP3\DATA7.D7
SOLAR RADIATION DATA FILE:    C:\HELP3\DATA13.D13
EVAPOTRANSPIRATION DATA:      C:\HELP3\DATA11.D11
SOIL AND DESIGN DATA FILE:    C:\HELP3\WESTEXIS.D10
OUTPUT DATA FILE:             C:\HELP3\WESTEXIS.OUT


TIME:  14:47     DATE:   5/11/1999


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     TITLE:  URBANA LANDFILL - WESTERN TERRACE (EXISTING COVER)

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     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                   LAYER  1
                                   --------

                         TYPE 1 - VERTICAL PERCOLATION LAYER
                            MATERIAL TEXTURE NUMBER   5
          THICKNESS                   =       6.00   INCHES
          POROSITY                    =       0.4570 VOL/VOL
          FIELD CAPACITY              =       0.1310 VOL/VOL
          WILTING POINT               =       0.0580 VOL/VOL
          INITIAL SOIL WATER CONTENT  =       0.2609 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =    0.100000005000E-02 CM/SEC
      NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  4.63
               FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.
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GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE # 5 WITH A FAIR STAND OF GRASS, A SURFACE SLOPE OF 23.% AND A SLOPE LENGTH OF 260. FEET.

SCS RUNOFF CURVE NUMBER	=	67.20	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	2.050	ACRES
EVAPORATIVE ZONE DEPTH	=	6.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	1.565	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	2.742	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	0.348	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	1.565	INCHES
TOTAL INITIAL WATER	=	1.565	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM ITHACA NEW YORK

STATION LATITUDE	=	42.40	DEGREES
MAXIMUM LEAF AREA INDEX	=	3.50	
START OF GROWING SEASON (JULIAN DATE)	=	130	
END OF GROWING SEASON (JULIAN DATE)	=	279	
EVAPORATIVE ZONE DEPTH	=	6.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	10.30	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	74.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	69.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	75.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	76.00	%

NOTE: PRECIPITATION DATA FOR ITHACA NEW YORK WAS ENTERED FROM THE DEFAULT DATA FILE.

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR ITHACA NEW YORK

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
22.20	22.70	32.20	44.50	54.80	64.30
68.80	67.10	60.20	49.60	39.30	27.60

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ITHACA NEW YORK
AND STATION LATITUDE = 42.40 DEGREES

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ANNUAL TOTALS FOR YEAR 1974

	INCHES	CU. FEET	PERCENT
PRECIPITATION	37.02	275484.281	100.00
RUNOFF	6.582	48982.195	17.78
EVAPOTRANSPIRATION	18.628	138618.969	50.32
PERC./LEAKAGE THROUGH LAYER 1	11.808211	87870.805	31.90
CHANGE IN WATER STORAGE	0.002	12.361	0.00
SOIL WATER AT START OF YEAR	1.565	11649.141	
SOIL WATER AT END OF YEAR	1.567	11661.501	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.057	0.00

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ANNUAL TOTALS FOR YEAR 1975

	INCHES	CU. FEET	PERCENT
PRECIPITATION	40.98	304952.687	100.00
RUNOFF	5.403	40206.641	13.18
EVAPOTRANSPIRATION	20.902	155544.500	51.01

PERC./LEAKAGE THROUGH LAYER 1	12.726725	94705.922	31.06
CHANGE IN WATER STORAGE	1.948	14495.646	4.75
SOIL WATER AT START OF YEAR	1.567	11661.501	
SOIL WATER AT END OF YEAR	1.192	8871.771	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	2.323	17285.375	5.67
ANNUAL WATER BUDGET BALANCE	0.0000	-0.007	0.00

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ANNUAL TOTALS FOR YEAR 1976

	INCHES	CU. FEET	PERCENT
PRECIPITATION	44.45	330774.687	100.00
RUNOFF	8.766	65229.312	19.72
EVAPOTRANSPIRATION	22.444	167019.484	50.49
PERC./LEAKAGE THROUGH LAYER 1	14.141560	105234.414	31.81
CHANGE IN WATER STORAGE	-0.902	-6708.583	-2.03
SOIL WATER AT START OF YEAR	1.192	8871.771	
SOIL WATER AT END OF YEAR	0.959	7136.084	
SNOW WATER AT START OF YEAR	2.323	17285.375	5.23
SNOW WATER AT END OF YEAR	1.655	12312.479	3.72
ANNUAL WATER BUDGET BALANCE	0.0000	0.078	0.00

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ANNUAL TOTALS FOR YEAR 1977

	INCHES	CU. FEET	PERCENT
PRECIPITATION	46.30	344541.500	100.00

RUNOFF	9.273	69002.406	20.03
EVAPOTRANSPIRATION	20.205	150354.562	43.64
PERC./LEAKAGE THROUGH LAYER 1	16.774141	124824.773	36.23
CHANGE IN WATER STORAGE	0.048	359.622	0.10
SOIL WATER AT START OF YEAR	0.959	7136.084	
SOIL WATER AT END OF YEAR	2.396	17831.691	
SNOW WATER AT START OF YEAR	1.655	12312.479	3.57
SNOW WATER AT END OF YEAR	0.266	1976.494	0.57
ANNUAL WATER BUDGET BALANCE	0.0000	0.128	0.00

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ANNUAL TOTALS FOR YEAR 1978

	INCHES	CU. FEET	PERCENT
PRECIPITATION	32.04	238425.641	100.00
RUNOFF	9.339	69498.242	29.15
EVAPOTRANSPIRATION	15.823	117750.250	49.39
PERC./LEAKAGE THROUGH LAYER 1	6.431264	47858.250	20.07
CHANGE IN WATER STORAGE	0.446	3318.924	1.39
SOIL WATER AT START OF YEAR	2.396	17831.691	
SOIL WATER AT END OF YEAR	1.202	8943.608	
SNOW WATER AT START OF YEAR	0.266	1976.494	0.83
SNOW WATER AT END OF YEAR	1.906	14183.501	5.95
ANNUAL WATER BUDGET BALANCE	0.0000	-0.021	0.00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1974 THROUGH 1978

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	2.80	2.09	2.65	2.37	3.03	4.00
	4.17	4.03	5.43	4.15	2.36	3.07
STD. DEVIATIONS	2.10	0.80	0.63	0.94	0.94	1.09
	2.81	0.59	2.99	1.70	1.22	0.78
RUNOFF						
TOTALS	0.647	0.581	3.635	2.568	0.000	0.000
	0.033	0.000	0.046	0.006	0.000	0.356
STD. DEVIATIONS	0.988	0.700	1.309	2.585	0.000	0.000
	0.073	0.000	0.102	0.014	0.000	0.772
EVAPOTRANSPIRATION						
TOTALS	0.435	0.476	0.409	0.959	2.651	3.133
	3.063	2.833	2.576	1.525	1.077	0.464
STD. DEVIATIONS	0.055	0.051	0.128	0.500	0.763	0.675
	1.244	0.806	0.550	0.259	0.098	0.119
PERCOLATION/LEAKAGE THROUGH LAYER 1						
TOTALS	0.0000	0.0000	0.0000	1.5769	0.8497	0.8313
	1.1891	0.9530	2.7052	2.6108	1.0354	0.6251
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.9550	0.6953	0.7582
	1.7357	0.3979	2.6216	1.6004	0.8745	0.8985

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1974 THROUGH 1978

	INCHES	CU. FEET	PERCENT
PRECIPITATION	40.16 (5.757)	298835.7	100.00
RUNOFF	7.873 (1.7799)	58583.76	19.604
EVAPOTRANSPIRATION	19.601 (2.5179)	145857.55	48.809
PERCOLATION/LEAKAGE THROUGH LAYER 1	12.37638 (3.81596)	92098.828	30.81921

CHANGE IN WATER STORAGE	0.308	(1.0408)	2295.59	0.768

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PEAK DAILY VALUES FOR YEARS 1974 THROUGH 1978

	(INCHES)	(CU. FT.)
PRECIPITATION	3.13	23291.895
RUNOFF	2.218	16503.1230
PERCOLATION/LEAKAGE THROUGH LAYER 1	2.088974	15545.09670
SNOW WATER	7.10	52840.5742
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4501	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0580	

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FINAL WATER STORAGE AT END OF YEAR 1978

LAYER	(INCHES)	(VOL/VOL)
1	1.2019	0.2003

SNOW WATER 1.906

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Appendix D3 - HELP Model Summary for Preferred Cover

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**                                                                          **
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**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07   (1 NOVEMBER 1997)               **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
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PRECIPITATION DATA FILE:     C:\HELP3\DATA4.D4
TEMPERATURE DATA FILE:       C:\HELP3\DATA7.D7
SOLAR RADIATION DATA FILE:   C:\HELP3\DATA13.D13
EVAPOTRANSPIRATION DATA:     C:\HELP3\DATA11.D11
SOIL AND DESIGN DATA FILE:   C:\HELP3\UPPREFER.D10
OUTPUT DATA FILE:            C:\HELP3\UPPREFER.OUT


TIME: 15:26     DATE:  5/11/1999


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     TITLE:  URBANA LANDFILL - UPPER TERRACE (PREFERRED COVER)

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     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                   LAYER  1
                                   --------

                       TYPE 1 - VERTICAL PERCOLATION LAYER
                           MATERIAL TEXTURE NUMBER   5
           THICKNESS                    =        6.00   INCHES
           POROSITY                     =        0.4570 VOL/VOL
           FIELD CAPACITY               =        0.1310 VOL/VOL
           WILTING POINT                =        0.0580 VOL/VOL
           INITIAL SOIL WATER CONTENT   =        0.4024 VOL/VOL
           EFFECTIVE SAT. HYD. COND.    =    0.100000005000E-02 CM/SEC
         NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  4.63
                  FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.
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LAYER 2

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	24.00	INCHES
POROSITY	=	0.4730	VOL/VOL
FIELD CAPACITY	=	0.2220	VOL/VOL
WILTING POINT	=	0.1040	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4730	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999999000E-05	CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE # 5 WITH A FAIR STAND OF GRASS, A SURFACE SLOPE OF 4.% AND A SLOPE LENGTH OF 390. FEET.

SCS RUNOFF CURVE NUMBER	=	64.30	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	4.000	ACRES
EVAPORATIVE ZONE DEPTH	=	6.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	2.414	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	2.742	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	0.348	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	13.766	INCHES
TOTAL INITIAL WATER	=	13.766	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM ITHACA NEW YORK

STATION LATITUDE	=	42.40	DEGREES
MAXIMUM LEAF AREA INDEX	=	3.50	
START OF GROWING SEASON (JULIAN DATE)	=	130	
END OF GROWING SEASON (JULIAN DATE)	=	279	
EVAPORATIVE ZONE DEPTH	=	6.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	10.30	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	74.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	69.00	%

AVERAGE 3RD QUARTER RELATIVE HUMIDITY = 75.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY = 76.00 %

NOTE: PRECIPITATION DATA FOR ITHACA NEW YORK
WAS ENTERED FROM THE DEFAULT DATA FILE.

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ITHACA NEW YORK

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
22.20	22.70	32.20	44.50	54.80	64.30
68.80	67.10	60.20	49.60	39.30	27.60

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ITHACA NEW YORK
AND STATION LATITUDE = 42.40 DEGREES

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ANNUAL TOTALS FOR YEAR 1974

	INCHES	CU. FEET	PERCENT
PRECIPITATION	37.02	537530.312	100.00
RUNOFF	7.392	107324.711	19.97
EVAPOTRANSPIRATION	20.112	292023.781	54.33
PERC./LEAKAGE THROUGH LAYER 2	9.520172	138232.906	25.72
AVG. HEAD ON TOP OF LAYER 2	0.5720		
CHANGE IN WATER STORAGE	-0.004	-51.000	-0.01
SOIL WATER AT START OF YEAR	13.766	199887.281	
SOIL WATER AT END OF YEAR	13.763	199836.281	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.083	0.00

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ANNUAL TOTALS FOR YEAR 1975

	INCHES	CU. FEET	PERCENT
PRECIPITATION	40.98	595029.625	100.00
RUNOFF	7.983	115910.219	19.48
EVAPOTRANSPIRATION	21.819	316814.250	53.24
PERC./LEAKAGE THROUGH LAYER 2	10.150141	147380.047	24.77
AVG. HEAD ON TOP OF LAYER 2	0.6752		
CHANGE IN WATER STORAGE	1.028	14925.143	2.51
SOIL WATER AT START OF YEAR	13.763	199836.281	
SOIL WATER AT END OF YEAR	12.468	181033.875	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	2.323	33727.559	5.67
ANNUAL WATER BUDGET BALANCE	0.0000	0.000	0.00

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ANNUAL TOTALS FOR YEAR 1976

	INCHES	CU. FEET	PERCENT
PRECIPITATION	44.45	645414.062	100.00
RUNOFF	11.855	172138.609	26.67
EVAPOTRANSPIRATION	24.216	351612.531	54.48
PERC./LEAKAGE THROUGH LAYER 2	9.115090	132351.109	20.51
AVG. HEAD ON TOP OF LAYER 2	0.8207		
CHANGE IN WATER STORAGE	-0.736	-10688.421	-1.66
SOIL WATER AT START OF YEAR	12.468	181033.875	

SOIL WATER AT END OF YEAR	12.400	180048.656	
SNOW WATER AT START OF YEAR	2.323	33727.559	5.23
SNOW WATER AT END OF YEAR	1.655	24024.352	3.72
ANNUAL WATER BUDGET BALANCE	0.0000	0.249	0.00

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ANNUAL TOTALS FOR YEAR 1977

	INCHES	CU. FEET	PERCENT
PRECIPITATION	46.30	672276.125	100.00
RUNOFF	15.427	223994.031	33.32
EVAPOTRANSPIRATION	21.158	307208.844	45.70
PERC./LEAKAGE THROUGH LAYER 2	9.813376	142490.219	21.20
AVG. HEAD ON TOP OF LAYER 2	1.0994		
CHANGE IN WATER STORAGE	-0.098	-1417.108	-0.21
SOIL WATER AT START OF YEAR	12.400	180048.656	
SOIL WATER AT END OF YEAR	13.691	198799.328	
SNOW WATER AT START OF YEAR	1.655	24024.352	3.57
SNOW WATER AT END OF YEAR	0.266	3856.573	0.57
ANNUAL WATER BUDGET BALANCE	0.0000	0.125	0.00

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ANNUAL TOTALS FOR YEAR 1978

	INCHES	CU. FEET	PERCENT
PRECIPITATION	32.04	465220.750	100.00
RUNOFF	8.902	129261.391	27.78

EVAPOTRANSPIRATION	16.713	242678.984	52.16
PERC./LEAKAGE THROUGH LAYER 2	6.009542	87258.547	18.76
AVG. HEAD ON TOP OF LAYER 2	0.3457		
CHANGE IN WATER STORAGE	0.415	6021.866	1.29
SOIL WATER AT START OF YEAR	13.691	198799.328	
SOIL WATER AT END OF YEAR	12.466	181002.641	
SNOW WATER AT START OF YEAR	0.266	3856.573	0.83
SNOW WATER AT END OF YEAR	1.906	27675.123	5.95
ANNUAL WATER BUDGET BALANCE	0.0000	-0.035	0.00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1974 THROUGH 1978

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	2.80	2.09	2.65	2.37	3.03	4.00
	4.17	4.03	5.43	4.15	2.36	3.07
STD. DEVIATIONS	2.10	0.80	0.63	0.94	0.94	1.09
	2.81	0.59	2.99	1.70	1.22	0.78
RUNOFF						
TOTALS	0.748	0.612	3.674	2.536	0.000	0.000
	0.397	0.000	1.249	0.725	0.002	0.369
STD. DEVIATIONS	1.004	0.680	1.361	2.758	0.000	0.000
	0.887	0.000	1.631	1.141	0.004	0.753
EVAPOTRANSPIRATION						
TOTALS	0.435	0.476	0.410	1.117	2.831	3.496
	3.349	3.053	2.625	1.483	1.067	0.462
STD. DEVIATIONS	0.055	0.051	0.127	0.536	0.590	0.695
	1.573	0.846	0.633	0.245	0.109	0.116

PERCOLATION/LEAKAGE THROUGH LAYER 2

TOTALS	0.0615	0.0446	0.1853	0.8915	1.0544	0.5004
	0.5502	0.5491	1.1422	1.7943	1.4968	0.6513
STD. DEVIATIONS	0.0846	0.0461	0.1839	0.5181	0.4345	0.3512
	0.5511	0.3195	0.7503	0.7032	0.6318	0.6100

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 2

AVERAGES	0.0005	0.0004	0.0016	0.8344	0.7861	0.2779
	0.4146	0.3919	1.3260	2.6442	1.4491	0.3046
STD. DEVIATIONS	0.0008	0.0006	0.0024	0.5819	0.5923	0.2799
	0.5748	0.3459	1.2249	1.8057	1.2536	0.4881

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1974 THROUGH 1978

	INCHES		CU. FEET	PERCENT
PRECIPITATION	40.16	(5.757)	583094.2	100.00
RUNOFF	10.312	(3.3348)	149725.80	25.678
EVAPOTRANSPIRATION	20.804	(2.7389)	302067.66	51.804
PERCOLATION/LEAKAGE THROUGH LAYER 2	8.92166	(1.67185)	129542.562	22.21641
AVERAGE HEAD ON TOP OF LAYER 2	0.703	(0.281)		
CHANGE IN WATER STORAGE	0.121	(0.6532)	1758.10	0.302

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PEAK DAILY VALUES FOR YEARS 1974 THROUGH 1978

	(INCHES)	(CU. FT.)
PRECIPITATION	3.13	45447.602
RUNOFF	2.226	32326.9727
PERCOLATION/LEAKAGE THROUGH LAYER 2	0.085038	1234.75378
AVERAGE HEAD ON TOP OF LAYER 2	6.000	
SNOW WATER	7.10	103103.5620

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4570
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0580

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FINAL WATER STORAGE AT END OF YEAR 1978

LAYER	(INCHES)	(VOL/VOL)
1	1.1138	0.1856
2	11.3520	0.4730
SNOW WATER	1.906	

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**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                 DEVELOPED BY ENVIRONMENTAL LABORATORY                    **
**                   USAE WATERWAYS EXPERIMENT STATION                      **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
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PRECIPITATION DATA FILE:    C:\HELP3\DATA4.D4
TEMPERATURE DATA FILE:      C:\HELP3\DATA7.D7
SOLAR RADIATION DATA FILE:  C:\HELP3\DATA13.D13
EVAPOTRANSPIRATION DATA:    C:\HELP3\DATA11.D11
SOIL AND DESIGN DATA FILE:  C:\HELP3\L1PREFER.D10
OUTPUT DATA FILE:           C:\HELP3\L1PREFER.OUT


TIME:  11:47     DATE:   5/11/1999


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     TITLE:  URBANA LANDFILL - LOWER TERRACE 1 (PREFERRED COVER)

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     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                LAYER  1
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                    TYPE 1 - VERTICAL PERCOLATION LAYER
                        MATERIAL TEXTURE NUMBER   5
          THICKNESS                    =       6.00   INCHES
          POROSITY                     =       0.4570 VOL/VOL
          FIELD CAPACITY               =       0.1310 VOL/VOL
          WILTING POINT                =       0.0580 VOL/VOL
          INITIAL SOIL WATER CONTENT   =       0.4027 VOL/VOL
          EFFECTIVE SAT. HYD. COND.    =   0.100000005000E-02 CM/SEC
      NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  4.63
               FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.
```

LAYER 2

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	30.00	INCHES
POROSITY	=	0.4730	VOL/VOL
FIELD CAPACITY	=	0.2220	VOL/VOL
WILTING POINT	=	0.1040	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4730	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.999999997000E-06	CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE # 5 WITH A FAIR STAND OF GRASS, A SURFACE SLOPE OF 8.% AND A SLOPE LENGTH OF 220. FEET.

SCS RUNOFF CURVE NUMBER	=	66.40	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.620	ACRES
EVAPORATIVE ZONE DEPTH	=	6.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	2.416	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	2.742	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	0.348	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	16.606	INCHES
TOTAL INITIAL WATER	=	16.606	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM ITHACA NEW YORK

STATION LATITUDE	=	42.40	DEGREES
MAXIMUM LEAF AREA INDEX	=	3.50	
START OF GROWING SEASON (JULIAN DATE)	=	130	
END OF GROWING SEASON (JULIAN DATE)	=	279	
EVAPORATIVE ZONE DEPTH	=	6.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	10.30	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	74.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	69.00	%

AVERAGE 3RD QUARTER RELATIVE HUMIDITY = 75.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY = 76.00 %

NOTE: PRECIPITATION DATA FOR ITHACA NEW YORK
WAS ENTERED FROM THE DEFAULT DATA FILE.

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ITHACA NEW YORK

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
22.20	22.70	32.20	44.50	54.80	64.30
68.80	67.10	60.20	49.60	39.30	27.60

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ITHACA NEW YORK
AND STATION LATITUDE = 42.40 DEGREES

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ANNUAL TOTALS FOR YEAR 1974

	INCHES	CU. FEET	PERCENT
PRECIPITATION	37.02	217699.766	100.00
RUNOFF	9.030	53103.312	24.39
EVAPOTRANSPIRATION	20.697	121709.586	55.91
PERC./LEAKAGE THROUGH LAYER 2	7.292957	42886.961	19.70
AVG. HEAD ON TOP OF LAYER 2	1.3309		
CHANGE IN WATER STORAGE	0.000	0.000	0.00
SOIL WATER AT START OF YEAR	16.606	97652.687	
SOIL WATER AT END OF YEAR	16.606	97652.687	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.081	0.00

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ANNUAL TOTALS FOR YEAR 1975

	INCHES	CU. FEET	PERCENT
PRECIPITATION	40.98	240987.016	100.00
RUNOFF	9.235	54306.953	22.54
EVAPOTRANSPIRATION	22.565	132695.641	55.06
PERC./LEAKAGE THROUGH LAYER 2	7.949899	46750.176	19.40
AVG. HEAD ON TOP OF LAYER 2	1.3070		
CHANGE IN WATER STORAGE	1.230	7234.200	3.00
SOIL WATER AT START OF YEAR	16.606	97652.687	
SOIL WATER AT END OF YEAR	15.513	91227.227	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	2.323	13659.662	5.67
ANNUAL WATER BUDGET BALANCE	0.0000	0.036	0.00

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ANNUAL TOTALS FOR YEAR 1976

	INCHES	CU. FEET	PERCENT
PRECIPITATION	44.45	261392.703	100.00
RUNOFF	13.608	80020.703	30.61
EVAPOTRANSPIRATION	25.291	148727.266	56.90
PERC./LEAKAGE THROUGH LAYER 2	6.369128	37454.297	14.33
AVG. HEAD ON TOP OF LAYER 2	1.2244		
CHANGE IN WATER STORAGE	-0.818	-4809.762	-1.84
SOIL WATER AT START OF YEAR	15.513	91227.227	

SOIL WATER AT END OF YEAR	15.364	90347.266	
SNOW WATER AT START OF YEAR	2.323	13659.662	5.23
SNOW WATER AT END OF YEAR	1.655	9729.862	3.72
ANNUAL WATER BUDGET BALANCE	0.0000	0.213	0.00

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ANNUAL TOTALS FOR YEAR 1977

	INCHES	CU. FEET	PERCENT
PRECIPITATION	46.30	272271.812	100.00
RUNOFF	18.442	108448.273	39.83
EVAPOTRANSPIRATION	21.872	128622.016	47.24
PERC./LEAKAGE THROUGH LAYER 2	6.132705	36063.988	13.25
AVG. HEAD ON TOP OF LAYER 2	1.4653		
CHANGE IN WATER STORAGE	-0.147	-862.525	-0.32
SOIL WATER AT START OF YEAR	15.364	90347.266	
SOIL WATER AT END OF YEAR	16.606	97652.687	
SNOW WATER AT START OF YEAR	1.655	9729.862	3.57
SNOW WATER AT END OF YEAR	0.266	1561.912	0.57
ANNUAL WATER BUDGET BALANCE	0.0000	0.081	0.00

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ANNUAL TOTALS FOR YEAR 1978

	INCHES	CU. FEET	PERCENT
PRECIPITATION	32.04	188414.406	100.00
RUNOFF	8.932	52523.102	27.88

EVAPOTRANSPIRATION	17.497	102893.727	54.61
PERC./LEAKAGE THROUGH LAYER 2	5.273090	31008.936	16.46
AVG. HEAD ON TOP OF LAYER 2	0.6748		
CHANGE IN WATER STORAGE	0.338	1988.631	1.06
SOIL WATER AT START OF YEAR	16.606	97652.687	
SOIL WATER AT END OF YEAR	15.304	89994.805	
SNOW WATER AT START OF YEAR	0.266	1561.912	0.83
SNOW WATER AT END OF YEAR	1.906	11208.426	5.95
ANNUAL WATER BUDGET BALANCE	0.0000	0.022	0.00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1974 THROUGH 1978

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	2.80	2.09	2.65	2.37	3.03	4.00
	4.17	4.03	5.43	4.15	2.36	3.07
STD. DEVIATIONS	2.10	0.80	0.63	0.94	0.94	1.09
	2.81	0.59	2.99	1.70	1.22	0.78
RUNOFF						
TOTALS	0.755	0.623	3.712	2.581	0.000	0.000
	0.483	0.000	1.478	1.259	0.231	0.728
STD. DEVIATIONS	1.012	0.698	1.312	2.851	0.000	0.000
	1.079	0.000	1.864	1.540	0.407	1.014
EVAPOTRANSPIRATION						
TOTALS	0.435	0.476	0.410	1.121	2.987	3.673
	3.544	3.208	2.719	1.456	1.089	0.467
STD. DEVIATIONS	0.055	0.051	0.127	0.539	0.582	0.760
	1.642	0.941	0.656	0.238	0.150	0.126

PERCOLATION/LEAKAGE THROUGH LAYER 2

TOTALS	0.0720	0.0447	0.1933	0.6447	0.9479	0.4423
	0.3105	0.3318	0.6572	1.0345	1.1187	0.8058
STD. DEVIATIONS	0.1023	0.0460	0.1625	0.3464	0.1675	0.2237
	0.2897	0.1969	0.4078	0.2564	0.0583	0.2819

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 2

AVERAGES	0.0022	0.0006	0.0089	1.0907	1.6772	0.4242
	0.5392	0.5253	1.7671	3.7375	3.2143	1.4184
STD. DEVIATIONS	0.0030	0.0007	0.0071	0.7905	0.9741	0.3356
	0.7485	0.4629	1.5377	1.3831	1.1067	1.2365

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1974 THROUGH 1978

	INCHES		CU. FEET	PERCENT
PRECIPITATION	40.16	(5.757)	236153.1	100.00
RUNOFF	11.849	(4.1787)	69680.46	29.506
EVAPOTRANSPIRATION	21.584	(2.8407)	126929.64	53.749
PERCOLATION/LEAKAGE THROUGH LAYER 2	6.60356	(1.04100)	38832.871	16.44394
AVERAGE HEAD ON TOP OF LAYER 2	1.200	(0.306)		
CHANGE IN WATER STORAGE	0.121	(0.7492)	710.11	0.301

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PEAK DAILY VALUES FOR YEARS 1974 THROUGH 1978

	(INCHES)	(CU. FT.)
PRECIPITATION	3.13	18406.279
RUNOFF	2.308	13572.4971
PERCOLATION/LEAKAGE THROUGH LAYER 2	0.040816	240.02507
AVERAGE HEAD ON TOP OF LAYER 2	5.998	
SNOW WATER	7.10	41756.9453

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4570
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0580

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FINAL WATER STORAGE AT END OF YEAR 1978

LAYER	(INCHES)	(VOL/VOL)
1	1.1138	0.1856
2	14.1900	0.4730
SNOW WATER	1.906	

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**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**               HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                 **
**                DEVELOPED BY ENVIRONMENTAL LABORATORY                     **
**                  USAE WATERWAYS EXPERIMENT STATION                       **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
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PRECIPITATION DATA FILE:      C:\HELP3\DATA4.D4
TEMPERATURE DATA FILE:        C:\HELP3\DATA7.D7
SOLAR RADIATION DATA FILE:    C:\HELP3\DATA13.D13
EVAPOTRANSPIRATION DATA:      C:\HELP3\DATA11.D11
SOIL AND DESIGN DATA FILE:    C:\HELP3\L2PREFER.D10
OUTPUT DATA FILE:             C:\HELP3\L2PREFER.OUT


TIME:  13:34     DATE:   5/11/1999


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     TITLE:  URBANA LANDFILL - LOWER TERRACE 2 (PREFERRED COVER)

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     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                   LAYER  1
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                       TYPE 1 - VERTICAL PERCOLATION LAYER
                          MATERIAL TEXTURE NUMBER   5
           THICKNESS                    =       6.00   INCHES
           POROSITY                     =       0.4570 VOL/VOL
           FIELD CAPACITY               =       0.1310 VOL/VOL
           WILTING POINT                =       0.0580 VOL/VOL
           INITIAL SOIL WATER CONTENT   =       0.4522 VOL/VOL
           EFFECTIVE SAT. HYD. COND.    =    0.100000005000E-02 CM/SEC
         NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  4.63
                  FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.
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LAYER 2

TYPE 3 - BARRIER SOIL LINER

MATERIAL TEXTURE NUMBER 0

THICKNESS	=	18.00	INCHES
POROSITY	=	0.4730	VOL/VOL
FIELD CAPACITY	=	0.2220	VOL/VOL
WILTING POINT	=	0.1040	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4730	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000001000E-06	CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE # 5 WITH A FAIR STAND OF GRASS, A SURFACE SLOPE OF 9.% AND A SLOPE LENGTH OF 100. FEET.

SCS RUNOFF CURVE NUMBER	=	68.20	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	0.420	ACRES
EVAPORATIVE ZONE DEPTH	=	6.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	2.713	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	2.742	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	0.348	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	11.227	INCHES
TOTAL INITIAL WATER	=	11.227	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
ITHACA NEW YORK

STATION LATITUDE	=	42.40	DEGREES
MAXIMUM LEAF AREA INDEX	=	3.50	
START OF GROWING SEASON (JULIAN DATE)	=	130	
END OF GROWING SEASON (JULIAN DATE)	=	279	
EVAPORATIVE ZONE DEPTH	=	6.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	10.30	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	74.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	69.00	%

AVERAGE 3RD QUARTER RELATIVE HUMIDITY = 75.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY = 76.00 %

NOTE: PRECIPITATION DATA FOR ITHACA NEW YORK
WAS ENTERED FROM THE DEFAULT DATA FILE.

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ITHACA NEW YORK

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
22.20	22.70	32.20	44.50	54.80	64.30
68.80	67.10	60.20	49.60	39.30	27.60

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ITHACA NEW YORK
AND STATION LATITUDE = 42.40 DEGREES

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ANNUAL TOTALS FOR YEAR 1974

	INCHES	CU. FEET	PERCENT
PRECIPITATION	37.02	56440.680	100.00
RUNOFF	14.114	21518.420	38.13
EVAPOTRANSPIRATION	21.665	33029.969	58.52
PERC./LEAKAGE THROUGH LAYER 2	1.240696	1891.566	3.35
AVG. HEAD ON TOP OF LAYER 2	2.6488		
CHANGE IN WATER STORAGE	0.000	0.718	0.00
SOIL WATER AT START OF YEAR	11.227	17117.014	
SOIL WATER AT END OF YEAR	11.228	17117.732	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.004	0.00

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ANNUAL TOTALS FOR YEAR 1975

	INCHES	CU. FEET	PERCENT
PRECIPITATION	40.98	62478.109	100.00
RUNOFF	13.362	20372.453	32.61
EVAPOTRANSPIRATION	24.042	36653.973	58.67
PERC./LEAKAGE THROUGH LAYER 2	1.272813	1940.530	3.11
AVG. HEAD ON TOP OF LAYER 2	2.6189		
CHANGE IN WATER STORAGE	2.303	3511.154	5.62
SOIL WATER AT START OF YEAR	11.228	17117.732	
SOIL WATER AT END OF YEAR	11.208	17087.492	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	2.323	3541.394	5.67
ANNUAL WATER BUDGET BALANCE	0.0000	0.002	0.00

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ANNUAL TOTALS FOR YEAR 1976

	INCHES	CU. FEET	PERCENT
PRECIPITATION	44.45	67768.477	100.00
RUNOFF	17.323	26410.627	38.97
EVAPOTRANSPIRATION	26.715	40730.203	60.10
PERC./LEAKAGE THROUGH LAYER 2	1.250743	1906.882	2.81
AVG. HEAD ON TOP OF LAYER 2	2.1430		
CHANGE IN WATER STORAGE	-0.839	-1279.246	-1.89
SOIL WATER AT START OF YEAR	11.208	17087.492	

SOIL WATER AT END OF YEAR	11.037	16827.084	
SNOW WATER AT START OF YEAR	2.323	3541.394	5.23
SNOW WATER AT END OF YEAR	1.655	2522.557	3.72
ANNUAL WATER BUDGET BALANCE	0.0000	0.009	0.00

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ANNUAL TOTALS FOR YEAR 1977

	INCHES	CU. FEET	PERCENT
PRECIPITATION	46.30	70588.984	100.00
RUNOFF	22.889	34896.762	49.44
EVAPOTRANSPIRATION	23.408	35688.047	50.56
PERC./LEAKAGE THROUGH LAYER 2	1.225175	1867.901	2.65
AVG. HEAD ON TOP OF LAYER 2	2.1848		
CHANGE IN WATER STORAGE	-1.222	-1863.725	-2.64
SOIL WATER AT START OF YEAR	11.037	16827.084	
SOIL WATER AT END OF YEAR	11.204	17080.975	
SNOW WATER AT START OF YEAR	1.655	2522.557	3.57
SNOW WATER AT END OF YEAR	0.266	404.940	0.57
ANNUAL WATER BUDGET BALANCE	0.0000	0.003	0.00

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ANNUAL TOTALS FOR YEAR 1978

	INCHES	CU. FEET	PERCENT
PRECIPITATION	32.04	48848.180	100.00
RUNOFF	9.889	15076.019	30.86

EVAPOTRANSPIRATION	19.353	29505.113	60.40
PERC./LEAKAGE THROUGH LAYER 2	1.120654	1708.549	3.50
AVG. HEAD ON TOP OF LAYER 2	1.8775		
CHANGE IN WATER STORAGE	1.678	2558.495	5.24
SOIL WATER AT START OF YEAR	11.204	17080.975	
SOIL WATER AT END OF YEAR	11.241	17138.521	
SNOW WATER AT START OF YEAR	0.266	404.940	0.83
SNOW WATER AT END OF YEAR	1.906	2905.888	5.95
ANNUAL WATER BUDGET BALANCE	0.0000	0.003	0.00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1974 THROUGH 1978

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	2.80	2.09	2.65	2.37	3.03	4.00
	4.17	4.03	5.43	4.15	2.36	3.07
STD. DEVIATIONS	2.10	0.80	0.63	0.94	0.94	1.09
	2.81	0.59	2.99	1.70	1.22	0.78
RUNOFF						
TOTALS	0.899	0.796	3.936	2.792	0.190	0.288
	0.692	0.000	1.780	1.960	0.952	1.231
STD. DEVIATIONS	1.023	0.783	1.179	3.064	0.217	0.401
	1.546	0.000	2.174	1.739	0.966	1.420
EVAPOTRANSPIRATION						
TOTALS	0.435	0.476	0.410	1.131	2.993	4.346
	4.073	3.402	2.785	1.460	1.061	0.464
STD. DEVIATIONS	0.055	0.051	0.127	0.534	0.662	0.415
	1.622	1.081	0.670	0.194	0.152	0.124

PERCOLATION/LEAKAGE THROUGH LAYER 2

TOTALS	0.1096	0.0986	0.1081	0.1128	0.1290	0.1128
	0.0440	0.0470	0.0842	0.1193	0.1315	0.1252
STD. DEVIATIONS	0.0005	0.0015	0.0004	0.0064	0.0022	0.0118
	0.0344	0.0299	0.0392	0.0256	0.0023	0.0070

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 2

AVERAGES	0.7041	0.5035	0.4468	1.8923	4.0266	2.8927
	0.8955	0.7297	2.3000	4.5680	5.1958	3.3800
STD. DEVIATIONS	0.0781	0.0693	0.0732	1.1247	0.3728	0.7932
	1.1596	0.5938	1.9065	1.3571	0.4092	1.1991

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1974 THROUGH 1978

	INCHES		CU. FEET	PERCENT
PRECIPITATION	40.16	(5.757)	61224.9	100.00
RUNOFF	15.515	(4.8964)	23654.86	38.636
EVAPOTRANSPIRATION	23.037	(2.7448)	35121.46	57.365
PERCOLATION/LEAKAGE THROUGH LAYER 2	1.22202	(0.05924)	1863.086	3.04302
AVERAGE HEAD ON TOP OF LAYER 2	2.295	(0.332)		
CHANGE IN WATER STORAGE	0.384	(1.5477)	585.48	0.956

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PEAK DAILY VALUES FOR YEARS 1974 THROUGH 1978

	(INCHES)	(CU. FT.)
PRECIPITATION	3.13	4771.998
RUNOFF	2.722	4149.3071
PERCOLATION/LEAKAGE THROUGH LAYER 2	0.004535	6.91463
AVERAGE HEAD ON TOP OF LAYER 2	6.000	
SNOW WATER	7.10	10825.8730

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4570
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0580

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FINAL WATER STORAGE AT END OF YEAR 1978

LAYER	(INCHES)	(VOL/VOL)
1	2.7274	0.4546
2	8.5140	0.4730
SNOW WATER	1.906	

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**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                 DEVELOPED BY ENVIRONMENTAL LABORATORY                    **
**                   USAE WATERWAYS EXPERIMENT STATION                      **
**              FOR USEPA RISK REDUCTION ENGINEERING LABORATORY             **
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PRECIPITATION DATA FILE:     C:\HELP3\DATA4.D4
TEMPERATURE DATA FILE:       C:\HELP3\DATA7.D7
SOLAR RADIATION DATA FILE:   C:\HELP3\DATA13.D13
EVAPOTRANSPIRATION DATA:     C:\HELP3\DATA11.D11
SOIL AND DESIGN DATA FILE:   C:\HELP3\MIDDLE.D10
OUTPUT DATA FILE:            C:\HELP3\MIDDLE.OUT


TIME:  13:54      DATE:   5/11/1999


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     TITLE:  URBANA LANDFILL - MIDDLE TERRACE (EXIST. & PREFERRED COVER)

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     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                  LAYER  1
                                  --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER   5
           THICKNESS                   =       6.00    INCHES
           POROSITY                    =       0.4570 VOL/VOL
           FIELD CAPACITY              =       0.1310 VOL/VOL
           WILTING POINT               =       0.0580 VOL/VOL
           INITIAL SOIL WATER CONTENT  =       0.4027 VOL/VOL
           EFFECTIVE SAT. HYD. COND.   =    0.100000005000E-02 CM/SEC
         NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  4.63
                  FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.
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LAYER 2

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	30.00 INCHES
POROSITY	=	0.4730 VOL/VOL
FIELD CAPACITY	=	0.2220 VOL/VOL
WILTING POINT	=	0.1040 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4730 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.150000005000E-05 CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE # 5 WITH A FAIR STAND OF GRASS, A SURFACE SLOPE OF 13.% AND A SLOPE LENGTH OF 195. FEET.

SCS RUNOFF CURVE NUMBER	=	67.20	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.720	ACRES
EVAPORATIVE ZONE DEPTH	=	6.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	2.416	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	2.742	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	0.348	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	16.606	INCHES
TOTAL INITIAL WATER	=	16.606	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
ITHACA NEW YORK

STATION LATITUDE	=	42.40 DEGREES
MAXIMUM LEAF AREA INDEX	=	3.50
START OF GROWING SEASON (JULIAN DATE)	=	130
END OF GROWING SEASON (JULIAN DATE)	=	279
EVAPORATIVE ZONE DEPTH	=	6.0 INCHES
AVERAGE ANNUAL WIND SPEED	=	10.30 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	74.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	69.00 %

AVERAGE 3RD QUARTER RELATIVE HUMIDITY = 75.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY = 76.00 %

NOTE: PRECIPITATION DATA FOR ITHACA NEW YORK
WAS ENTERED FROM THE DEFAULT DATA FILE.

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ITHACA NEW YORK

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
22.20	22.70	32.20	44.50	54.80	64.30
68.80	67.10	60.20	49.60	39.30	27.60

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ITHACA NEW YORK
AND STATION LATITUDE = 42.40 DEGREES

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ANNUAL TOTALS FOR YEAR 1974

	INCHES	CU. FEET	PERCENT
PRECIPITATION	37.02	231138.031	100.00
RUNOFF	8.007	49991.285	21.63
EVAPOTRANSPIRATION	20.319	126865.469	54.89
PERC./LEAKAGE THROUGH LAYER 2	8.693927	54281.402	23.48
AVG. HEAD ON TOP OF LAYER 2	0.8270		
CHANGE IN WATER STORAGE	0.000	0.000	0.00
SOIL WATER AT START OF YEAR	16.606	103680.633	
SOIL WATER AT END OF YEAR	16.606	103680.633	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.119	0.00

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ANNUAL TOTALS FOR YEAR 1975

	INCHES	CU. FEET	PERCENT
PRECIPITATION	40.98	255862.750	100.00
RUNOFF	8.456	52793.152	20.63
EVAPOTRANSPIRATION	22.115	138075.359	53.96
PERC./LEAKAGE THROUGH LAYER 2	9.386908	58608.098	22.91
AVG. HEAD ON TOP OF LAYER 2	0.8849		
CHANGE IN WATER STORAGE	1.023	6386.093	2.50
SOIL WATER AT START OF YEAR	16.606	103680.633	
SOIL WATER AT END OF YEAR	15.306	95563.875	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	2.323	14502.852	5.67
ANNUAL WATER BUDGET BALANCE	0.0000	0.054	0.00

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ANNUAL TOTALS FOR YEAR 1976

	INCHES	CU. FEET	PERCENT
PRECIPITATION	44.45	277528.062	100.00
RUNOFF	12.670	79108.437	28.50
EVAPOTRANSPIRATION	24.722	154357.078	55.62
PERC./LEAKAGE THROUGH LAYER 2	7.758196	48439.074	17.45
AVG. HEAD ON TOP OF LAYER 2	0.9850		
CHANGE IN WATER STORAGE	-0.701	-4376.668	-1.58
SOIL WATER AT START OF YEAR	15.306	95563.875	

SOIL WATER AT END OF YEAR	15.273	95359.586	
SNOW WATER AT START OF YEAR	2.323	14502.852	5.23
SNOW WATER AT END OF YEAR	1.655	10330.472	3.72
ANNUAL WATER BUDGET BALANCE	0.0000	0.131	0.00

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ANNUAL TOTALS FOR YEAR 1977

	INCHES	CU. FEET	PERCENT
PRECIPITATION	46.30	289078.719	100.00
RUNOFF	16.857	105248.172	36.41
EVAPOTRANSPIRATION	21.509	134293.500	46.46
PERC./LEAKAGE THROUGH LAYER 2	7.997731	49934.637	17.27
AVG. HEAD ON TOP OF LAYER 2	1.2844		
CHANGE IN WATER STORAGE	-0.064	-397.589	-0.14
SOIL WATER AT START OF YEAR	15.273	95359.586	
SOIL WATER AT END OF YEAR	16.598	103634.141	
SNOW WATER AT START OF YEAR	1.655	10330.472	3.57
SNOW WATER AT END OF YEAR	0.266	1658.326	0.57
ANNUAL WATER BUDGET BALANCE	0.0000	0.012	0.00

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ANNUAL TOTALS FOR YEAR 1978

	INCHES	CU. FEET	PERCENT
PRECIPITATION	32.04	200044.922	100.00
RUNOFF	8.919	55688.016	27.84

EVAPOTRANSPIRATION	17.100	106766.211	53.37
PERC./LEAKAGE THROUGH LAYER 2	5.675001	35432.437	17.71
AVG. HEAD ON TOP OF LAYER 2	0.4684		
CHANGE IN WATER STORAGE	0.346	2158.277	1.08
SOIL WATER AT START OF YEAR	16.598	103634.141	
SOIL WATER AT END OF YEAR	15.304	95550.445	
SNOW WATER AT START OF YEAR	0.266	1658.326	0.83
SNOW WATER AT END OF YEAR	1.906	11900.304	5.95
ANNUAL WATER BUDGET BALANCE	0.0000	-0.006	0.00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1974 THROUGH 1978

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	2.80	2.09	2.65	2.37	3.03	4.00
	4.17	4.03	5.43	4.15	2.36	3.07
STD. DEVIATIONS	2.10	0.80	0.63	0.94	0.94	1.09
	2.81	0.59	2.99	1.70	1.22	0.78
RUNOFF						
TOTALS	0.752	0.615	3.675	2.556	0.000	0.000
	0.437	0.000	1.354	0.997	0.110	0.485
STD. DEVIATIONS	1.011	0.684	1.360	2.802	0.000	0.000
	0.977	0.000	1.738	1.371	0.210	0.775
EVAPOTRANSPIRATION						
TOTALS	0.435	0.476	0.410	1.119	2.900	3.578
	3.434	3.126	2.664	1.470	1.080	0.462
STD. DEVIATIONS	0.055	0.051	0.127	0.535	0.574	0.710
	1.614	0.879	0.652	0.244	0.124	0.117

PERCOLATION/LEAKAGE THROUGH LAYER 2

TOTALS	0.0719	0.0450	0.1860	0.7943	1.0226	0.4477
	0.4366	0.4451	0.9349	1.4253	1.4300	0.6630
STD. DEVIATIONS	0.1017	0.0463	0.1851	0.4606	0.3720	0.3472
	0.4202	0.2585	0.6112	0.3944	0.3630	0.5287

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 2

AVERAGES	0.0000	0.0001	0.0000	0.9373	1.0840	0.3309
	0.4664	0.4524	1.5457	3.0754	2.1341	0.6528
STD. DEVIATIONS	0.0000	0.0003	0.0000	0.6636	0.7910	0.3190
	0.6485	0.4013	1.3689	1.7820	1.3237	0.9467

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1974 THROUGH 1978

	INCHES		CU. FEET	PERCENT
PRECIPITATION	40.16	(5.757)	250730.5	100.00
RUNOFF	10.982	(3.7701)	68565.81	27.346
EVAPOTRANSPIRATION	21.153	(2.7800)	132071.53	52.675
PERCOLATION/LEAKAGE THROUGH LAYER 2	7.90235	(1.39834)	49339.129	19.67815
AVERAGE HEAD ON TOP OF LAYER 2	0.890	(0.294)		
CHANGE IN WATER STORAGE	0.121	(0.6301)	754.02	0.301

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PEAK DAILY VALUES FOR YEARS 1974 THROUGH 1978

	(INCHES)	(CU. FT.)
PRECIPITATION	3.13	19542.469
RUNOFF	2.229	13914.3994
PERCOLATION/LEAKAGE THROUGH LAYER 2	0.061227	382.27963
AVERAGE HEAD ON TOP OF LAYER 2	6.000	
SNOW WATER	7.10	44334.5312
MAXIMUM VEG. SOIL WATER (VOL/VOL)		0.4570
MINIMUM VEG. SOIL WATER (VOL/VOL)		0.0580

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FINAL WATER STORAGE AT END OF YEAR 1978

LAYER	(INCHES)	(VOL/VOL)
1	1.1138	0.1856
2	14.1900	0.4730
SNOW WATER	1.906	

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**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                 DEVELOPED BY ENVIRONMENTAL LABORATORY                    **
**                   USAE WATERWAYS EXPERIMENT STATION                      **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
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PRECIPITATION DATA FILE:      C:\HELP3\DATA4.D4
TEMPERATURE DATA FILE:        C:\HELP3\DATA7.D7
SOLAR RADIATION DATA FILE:    C:\HELP3\DATA13.D13
EVAPOTRANSPIRATION DATA:      C:\HELP3\DATA11.D11
SOIL AND DESIGN DATA FILE:    C:\HELP3\WESTPREF.D10
OUTPUT DATA FILE:             C:\HELP3\WESTPREF.OUT


TIME:  14:39      DATE:   5/11/1999


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     TITLE:  URBANA LANDFILL - WESTERN TERRACE (PREFERRED COVER)

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     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                  LAYER  1
                                  --------

                       TYPE 1 - VERTICAL PERCOLATION LAYER
                           MATERIAL TEXTURE NUMBER   5
           THICKNESS                    =       6.00    INCHES
           POROSITY                     =       0.4570 VOL/VOL
           FIELD CAPACITY               =       0.1310 VOL/VOL
           WILTING POINT                =       0.0580 VOL/VOL
           INITIAL SOIL WATER CONTENT   =       0.4522 VOL/VOL
           EFFECTIVE SAT. HYD. COND.    =   0.100000005000E-02 CM/SEC
         NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  4.63
                  FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.
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LAYER 2

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	18.00	INCHES
POROSITY	=	0.4730	VOL/VOL
FIELD CAPACITY	=	0.2220	VOL/VOL
WILTING POINT	=	0.1040	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4730	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000001000E-06	CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE # 5 WITH A FAIR STAND OF GRASS, A SURFACE SLOPE OF 23.% AND A SLOPE LENGTH OF 260. FEET.

SCS RUNOFF CURVE NUMBER	=	67.20	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	2.050	ACRES
EVAPORATIVE ZONE DEPTH	=	6.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	2.713	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	2.742	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	0.348	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	11.227	INCHES
TOTAL INITIAL WATER	=	11.227	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
ITHACA NEW YORK

STATION LATITUDE	=	42.40	DEGREES
MAXIMUM LEAF AREA INDEX	=	3.50	
START OF GROWING SEASON (JULIAN DATE)	=	130	
END OF GROWING SEASON (JULIAN DATE)	=	279	
EVAPORATIVE ZONE DEPTH	=	6.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	10.30	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	74.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	69.00	%

AVERAGE 3RD QUARTER RELATIVE HUMIDITY = 75.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY = 76.00 %

NOTE: PRECIPITATION DATA FOR ITHACA NEW YORK
WAS ENTERED FROM THE DEFAULT DATA FILE.

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ITHACA NEW YORK

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
22.20	22.70	32.20	44.50	54.80	64.30
68.80	67.10	60.20	49.60	39.30	27.60

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ITHACA NEW YORK
AND STATION LATITUDE = 42.40 DEGREES

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ANNUAL TOTALS FOR YEAR 1974

	INCHES	CU. FEET	PERCENT
PRECIPITATION	37.02	275484.281	100.00
RUNOFF	14.114	105030.359	38.13
EVAPOTRANSPIRATION	21.665	161217.750	58.52
PERC./LEAKAGE THROUGH LAYER 2	1.240697	9232.646	3.35
AVG. HEAD ON TOP OF LAYER 2	2.6488		
CHANGE IN WATER STORAGE	0.000	3.506	0.00
SOIL WATER AT START OF YEAR	11.227	83547.328	
SOIL WATER AT END OF YEAR	11.228	83550.836	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.014	0.00

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ANNUAL TOTALS FOR YEAR 1975

	INCHES	CU. FEET	PERCENT
PRECIPITATION	40.98	304952.687	100.00
RUNOFF	13.362	99436.875	32.61
EVAPOTRANSPIRATION	24.042	178906.297	58.67
PERC./LEAKAGE THROUGH LAYER 2	1.272826	9471.736	3.11
AVG. HEAD ON TOP OF LAYER 2	2.6191		
CHANGE IN WATER STORAGE	2.303	17137.775	5.62
SOIL WATER AT START OF YEAR	11.228	83550.836	
SOIL WATER AT END OF YEAR	11.208	83403.242	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	2.323	17285.375	5.67
ANNUAL WATER BUDGET BALANCE	0.0000	0.008	0.00

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ANNUAL TOTALS FOR YEAR 1976

	INCHES	CU. FEET	PERCENT
PRECIPITATION	44.45	330774.687	100.00
RUNOFF	17.323	128909.094	38.97
EVAPOTRANSPIRATION	26.715	198802.187	60.10
PERC./LEAKAGE THROUGH LAYER 2	1.250731	9307.317	2.81
AVG. HEAD ON TOP OF LAYER 2	2.1428		
CHANGE IN WATER STORAGE	-0.839	-6243.940	-1.89
SOIL WATER AT START OF YEAR	11.208	83403.242	

SOIL WATER AT END OF YEAR	11.037	82132.195	
SNOW WATER AT START OF YEAR	2.323	17285.375	5.23
SNOW WATER AT END OF YEAR	1.655	12312.479	3.72
ANNUAL WATER BUDGET BALANCE	0.0000	0.056	0.00

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ANNUAL TOTALS FOR YEAR 1977

	INCHES	CU. FEET	PERCENT
PRECIPITATION	46.30	344541.500	100.00
RUNOFF	22.889	170329.437	49.44
EVAPOTRANSPIRATION	23.408	174191.656	50.56
PERC./LEAKAGE THROUGH LAYER 2	1.225175	9117.139	2.65
AVG. HEAD ON TOP OF LAYER 2	2.1848		
CHANGE IN WATER STORAGE	-1.222	-9096.755	-2.64
SOIL WATER AT START OF YEAR	11.037	82132.195	
SOIL WATER AT END OF YEAR	11.204	83371.422	
SNOW WATER AT START OF YEAR	1.655	12312.479	3.57
SNOW WATER AT END OF YEAR	0.266	1976.494	0.57
ANNUAL WATER BUDGET BALANCE	0.0000	0.012	0.00

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ANNUAL TOTALS FOR YEAR 1978

	INCHES	CU. FEET	PERCENT
PRECIPITATION	32.04	238425.641	100.00
RUNOFF	9.889	73585.328	30.86

EVAPOTRANSPIRATION	19.353	144013.062	60.40
PERC./LEAKAGE THROUGH LAYER 2	1.120654	8339.348	3.50
AVG. HEAD ON TOP OF LAYER 2	1.8775		
CHANGE IN WATER STORAGE	1.678	12487.891	5.24
SOIL WATER AT START OF YEAR	11.204	83371.422	
SOIL WATER AT END OF YEAR	11.241	83652.305	
SNOW WATER AT START OF YEAR	0.266	1976.494	0.83
SNOW WATER AT END OF YEAR	1.906	14183.501	5.95
ANNUAL WATER BUDGET BALANCE	0.0000	0.014	0.00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1974 THROUGH 1978

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	2.80	2.09	2.65	2.37	3.03	4.00
	4.17	4.03	5.43	4.15	2.36	3.07
STD. DEVIATIONS	2.10	0.80	0.63	0.94	0.94	1.09
	2.81	0.59	2.99	1.70	1.22	0.78
RUNOFF						
TOTALS	0.899	0.796	3.936	2.792	0.190	0.288
	0.692	0.000	1.780	1.960	0.952	1.231
STD. DEVIATIONS	1.023	0.783	1.179	3.064	0.217	0.401
	1.546	0.000	2.174	1.739	0.966	1.420
EVAPOTRANSPIRATION						
TOTALS	0.435	0.476	0.410	1.131	2.993	4.346
	4.073	3.402	2.785	1.460	1.061	0.464
STD. DEVIATIONS	0.055	0.051	0.127	0.534	0.662	0.415
	1.622	1.081	0.670	0.194	0.152	0.124

PERCOLATION/LEAKAGE THROUGH LAYER 2

TOTALS	0.1096	0.0986	0.1081	0.1128	0.1290	0.1128
	0.0440	0.0470	0.0842	0.1193	0.1315	0.1252
STD. DEVIATIONS	0.0005	0.0015	0.0004	0.0064	0.0022	0.0118
	0.0344	0.0299	0.0392	0.0256	0.0023	0.0070

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 2

AVERAGES	0.7041	0.5035	0.4468	1.8923	4.0267	2.8927
	0.8955	0.7297	2.3000	4.5681	5.1958	3.3800
STD. DEVIATIONS	0.0781	0.0693	0.0732	1.1250	0.3729	0.7932
	1.1596	0.5938	1.9065	1.3571	0.4092	1.1991

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1974 THROUGH 1978

	INCHES		CU. FEET	PERCENT
PRECIPITATION	40.16	(5.757)	298835.7	100.00
RUNOFF	15.515	(4.8964)	115458.23	38.636
EVAPOTRANSPIRATION	23.037	(2.7447)	171426.19	57.365
PERCOLATION/LEAKAGE THROUGH LAYER 2	1.22202	(0.05924)	9093.637	3.04302
AVERAGE HEAD ON TOP OF LAYER 2	2.295	(0.332)		
CHANGE IN WATER STORAGE	0.384	(1.5477)	2857.70	0.956

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PEAK DAILY VALUES FOR YEARS 1974 THROUGH 1978

	(INCHES)	(CU. FT.)
PRECIPITATION	3.13	23291.895
RUNOFF	2.722	20252.5703
PERCOLATION/LEAKAGE THROUGH LAYER 2	0.004535	33.74998
AVERAGE HEAD ON TOP OF LAYER 2	6.000	
SNOW WATER	7.10	52840.5742

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4570
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0580

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FINAL WATER STORAGE AT END OF YEAR 1978

LAYER	(INCHES)	(VOL/VOL)
1	2.7274	0.4546
2	8.5140	0.4730
SNOW WATER	1.906	

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Appendix D4 - HELP Model Summary for Part 360 Cover

```
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07   (1 NOVEMBER 1997)               **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**            FOR USEPA RISK REDUCTION ENGINEERING LABORATORY               **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:     C:\HELP3\DATA4.D4
TEMPERATURE DATA FILE:       C:\HELP3\DATA7.D7
SOLAR RADIATION DATA FILE:   C:\HELP3\DATA13.D13
EVAPOTRANSPIRATION DATA:     C:\HELP3\DATA11.D11
SOIL AND DESIGN DATA FILE:   C:\HELP3\360COVER.D10
OUTPUT DATA FILE:            C:\HELP3\360COVER.OUT


TIME:  10: 8      DATE:   5/13/1999


******************************************************************************

     TITLE:  URBANA LANDFILL - 360 COVER

******************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                  LAYER  1
                                  --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                        MATERIAL TEXTURE NUMBER   5
            THICKNESS                    =      6.00   INCHES
            POROSITY                     =      0.4570 VOL/VOL
            FIELD CAPACITY               =      0.1310 VOL/VOL
            WILTING POINT                =      0.0580 VOL/VOL
            INITIAL SOIL WATER CONTENT   =      0.4525 VOL/VOL
            EFFECTIVE SAT. HYD. COND.    =  0.100000005000E-02 CM/SEC
          NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  4.63
                 FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.
```

LAYER 2

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	24.00	INCHES
POROSITY	=	0.4730	VOL/VOL
FIELD CAPACITY	=	0.2220	VOL/VOL
WILTING POINT	=	0.1040	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4684	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.999999997000E-06	CM/SEC
SLOPE	=	10.00	PERCENT
DRAINAGE LENGTH	=	770.0	FEET

LAYER 3

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.06	INCHES
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12	CM/SEC
FML PINHOLE DENSITY	=	1.00	HOLES/ACRE
FML INSTALLATION DEFECTS	=	1.00	HOLES/ACRE
FML PLACEMENT QUALITY	=	6 - W/ GEOTEXTILE	
GEOTEXTILE TRANSMISSIVITY	=	0.100000	CM*CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE # 5 WITH A FAIR STAND OF GRASS, A SURFACE SLOPE OF 10.% AND A SLOPE LENGTH OF 770. FEET.

SCS RUNOFF CURVE NUMBER	=	63.80	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	9.800	ACRES
EVAPORATIVE ZONE DEPTH	=	20.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	9.328	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	9.364	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	1.804	INCHES
INITIAL SNOW WATER	=	0.000	INCHES

INITIAL WATER IN LAYER MATERIALS = 13.956 INCHES
TOTAL INITIAL WATER = 13.956 INCHES
TOTAL SUBSURFACE INFLOW = 0.00 INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
ITHACA NEW YORK

STATION LATITUDE	=	42.40 DEGREES
MAXIMUM LEAF AREA INDEX	=	3.50
START OF GROWING SEASON (JULIAN DATE)	=	130
END OF GROWING SEASON (JULIAN DATE)	=	279
EVAPORATIVE ZONE DEPTH	=	20.0 INCHES
AVERAGE ANNUAL WIND SPEED	=	10.30 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	74.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	69.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	75.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	76.00 %

NOTE: PRECIPITATION DATA FOR ITHACA NEW YORK
WAS ENTERED FROM THE DEFAULT DATA FILE.

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ITHACA NEW YORK

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
22.20	22.70	32.20	44.50	54.80	64.30
68.80	67.10	60.20	49.60	39.30	27.60

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ITHACA NEW YORK
AND STATION LATITUDE = 42.40 DEGREES

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ANNUAL TOTALS FOR YEAR 1974

	INCHES	CU. FEET	PERCENT
PRECIPITATION	37.02	1316949.250	100.00

RUNOFF	8.595	305747.406	23.22
EVAPOTRANSPIRATION	24.569	874027.687	66.37
DRAINAGE COLLECTED FROM LAYER 2	0.5539	19702.885	1.50
PERC./LEAKAGE THROUGH LAYER 3	3.299311	117369.687	8.91
AVG. HEAD ON TOP OF LAYER 3	14.1165		
CHANGE IN WATER STORAGE	0.003	101.846	0.01
SOIL WATER AT START OF YEAR	16.176	575459.687	
SOIL WATER AT END OF YEAR	16.179	575561.562	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.263	0.00

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ANNUAL TOTALS FOR YEAR 1975

	INCHES	CU. FEET	PERCENT
PRECIPITATION	40.98	1457822.620	100.00
RUNOFF	6.623	235603.531	16.16
EVAPOTRANSPIRATION	26.986	959985.937	65.85
DRAINAGE COLLECTED FROM LAYER 2	1.6099	57269.930	3.93
PERC./LEAKAGE THROUGH LAYER 3	3.835799	136454.719	9.36
AVG. HEAD ON TOP OF LAYER 3	17.7283		
CHANGE IN WATER STORAGE	1.926	68508.039	4.70
SOIL WATER AT START OF YEAR	16.179	575561.562	
SOIL WATER AT END OF YEAR	15.782	561437.062	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	2.323	82632.523	5.67
ANNUAL WATER BUDGET BALANCE	0.0000	0.492	0.00

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ANNUAL TOTALS FOR YEAR 1976

	INCHES	CU. FEET	PERCENT
PRECIPITATION	44.45	1581264.500	100.00
RUNOFF	12.031	427994.594	27.07
EVAPOTRANSPIRATION	29.174	1037844.690	65.63
DRAINAGE COLLECTED FROM LAYER 2	1.0878	38698.738	2.45
PERC./LEAKAGE THROUGH LAYER 3	3.690389	131281.922	8.30
AVG. HEAD ON TOP OF LAYER 3	16.7249		
CHANGE IN WATER STORAGE	-1.534	-54556.070	-3.45
SOIL WATER AT START OF YEAR	15.782	561437.062	
SOIL WATER AT END OF YEAR	14.917	530653.875	
SNOW WATER AT START OF YEAR	2.323	82632.523	5.23
SNOW WATER AT END OF YEAR	1.655	58859.660	3.72
ANNUAL WATER BUDGET BALANCE	0.0000	0.594	0.00

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ANNUAL TOTALS FOR YEAR 1977

	INCHES	CU. FEET	PERCENT
PRECIPITATION	46.30	1647076.500	100.00
RUNOFF	15.449	549567.687	33.37
EVAPOTRANSPIRATION	25.986	924417.937	56.12
DRAINAGE COLLECTED FROM LAYER 2	1.4640	52079.832	3.16
PERC./LEAKAGE THROUGH LAYER 3	3.562871	126745.586	7.70

AVG. HEAD ON TOP OF LAYER 3	15.8527		
CHANGE IN WATER STORAGE	-0.161	-5735.288	-0.35
SOIL WATER AT START OF YEAR	14.917	530653.875	
SOIL WATER AT END OF YEAR	16.145	574329.625	
SNOW WATER AT START OF YEAR	1.655	58859.660	3.57
SNOW WATER AT END OF YEAR	0.266	9448.604	0.57
ANNUAL WATER BUDGET BALANCE	0.0000	0.653	0.00

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ANNUAL TOTALS FOR YEAR 1978

	INCHES	CU. FEET	PERCENT
PRECIPITATION	32.04	1139790.870	100.00
RUNOFF	9.602	341587.156	29.97
EVAPOTRANSPIRATION	21.861	777671.625	68.23
DRAINAGE COLLECTED FROM LAYER 2	0.1640	5835.783	0.51
PERC./LEAKAGE THROUGH LAYER 3	2.875637	102297.898	8.98
AVG. HEAD ON TOP OF LAYER 3	11.2187		
CHANGE IN WATER STORAGE	-2.463	-87601.812	-7.69
SOIL WATER AT START OF YEAR	16.145	574329.625	
SOIL WATER AT END OF YEAR	12.042	428372.375	
SNOW WATER AT START OF YEAR	0.266	9448.604	0.83
SNOW WATER AT END OF YEAR	1.906	67804.055	5.95
ANNUAL WATER BUDGET BALANCE	0.0000	0.221	0.00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1974 THROUGH 1978

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	2.80	2.09	2.65	2.37	3.03	4.00
	4.17	4.03	5.43	4.15	2.36	3.07
STD. DEVIATIONS	2.10	0.80	0.63	0.94	0.94	1.09
	2.81	0.59	2.99	1.70	1.22	0.78
RUNOFF						
TOTALS	0.833	0.706	3.990	2.686	0.000	0.000
	0.442	0.000	0.026	0.802	0.253	0.721
STD. DEVIATIONS	1.087	0.659	1.238	2.722	0.000	0.000
	0.988	0.000	0.059	1.640	0.567	1.117
EVAPOTRANSPIRATION						
TOTALS	0.438	0.476	0.418	1.111	2.952	4.685
	6.277	4.079	2.668	1.310	0.876	0.426
STD. DEVIATIONS	0.055	0.051	0.121	0.505	0.587	0.261
	0.755	1.505	0.652	0.087	0.096	0.076
LATERAL DRAINAGE COLLECTED FROM LAYER 2						
TOTALS	0.0002	0.0002	0.0002	0.0812	0.1735	0.0698
	0.0333	0.0003	0.0228	0.2015	0.2482	0.1448
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0624	0.1115	0.0868
	0.0731	0.0001	0.0413	0.2623	0.2253	0.1224
PERCOLATION/LEAKAGE THROUGH LAYER 3						
TOTALS	0.2172	0.1889	0.1986	0.2672	0.4144	0.3630
	0.3103	0.2468	0.2472	0.3353	0.3599	0.3041
STD. DEVIATIONS	0.0016	0.0036	0.0014	0.0729	0.0203	0.0427
	0.0608	0.0324	0.0303	0.1198	0.1107	0.0586

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 3						
AVERAGES	9.0581	8.2489	7.4758	13.6942	24.9058	21.8488
	16.6673	11.5219	12.1894	18.5091	21.4077	16.0118

STD. DEVIATIONS	0.1324	0.1250	0.1180	6.1033	1.5766	3.4624
	4.8460	2.6730	2.5480	9.4945	9.0939	4.6560

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1974 THROUGH 1978

	INCHES		CU. FEET	PERCENT
PRECIPITATION	40.16	(5.757)	1428580.7	100.00
RUNOFF	10.460	(3.4019)	372100.12	26.047
EVAPOTRANSPIRATION	25.715	(2.7305)	914789.50	64.035
LATERAL DRAINAGE COLLECTED FROM LAYER 2	0.97592	(0.61031)	34717.434	2.43020
PERCOLATION/LEAKAGE THROUGH LAYER 3	3.45280	(0.37813)	122829.961	8.59804
AVERAGE HEAD ON TOP OF LAYER 3	15.128	(2.556)		
CHANGE IN WATER STORAGE	-0.446	(1.6701)	-15856.66	-1.110

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PEAK DAILY VALUES FOR YEARS 1974 THROUGH 1978

	(INCHES)	(CU. FT.)
PRECIPITATION	3.13	111346.625
RUNOFF	2.326	82737.7969
DRAINAGE COLLECTED FROM LAYER 2	0.02028	721.35760
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.015533	552.55835
AVERAGE HEAD ON TOP OF LAYER 3	30.000	
MAXIMUM HEAD ON TOP OF LAYER 3	52.297	
LOCATION OF MAXIMUM HEAD IN LAYER 2 (DISTANCE FROM DRAIN)	92.1 FEET	
SNOW WATER	7.10	252603.7190

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4682
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0902

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 1978

LAYER	(INCHES)	(VOL/VOL)
1	1.1540	0.1923
2	8.6678	0.3612
3	0.0000	0.0000
SNOW WATER	1.906	

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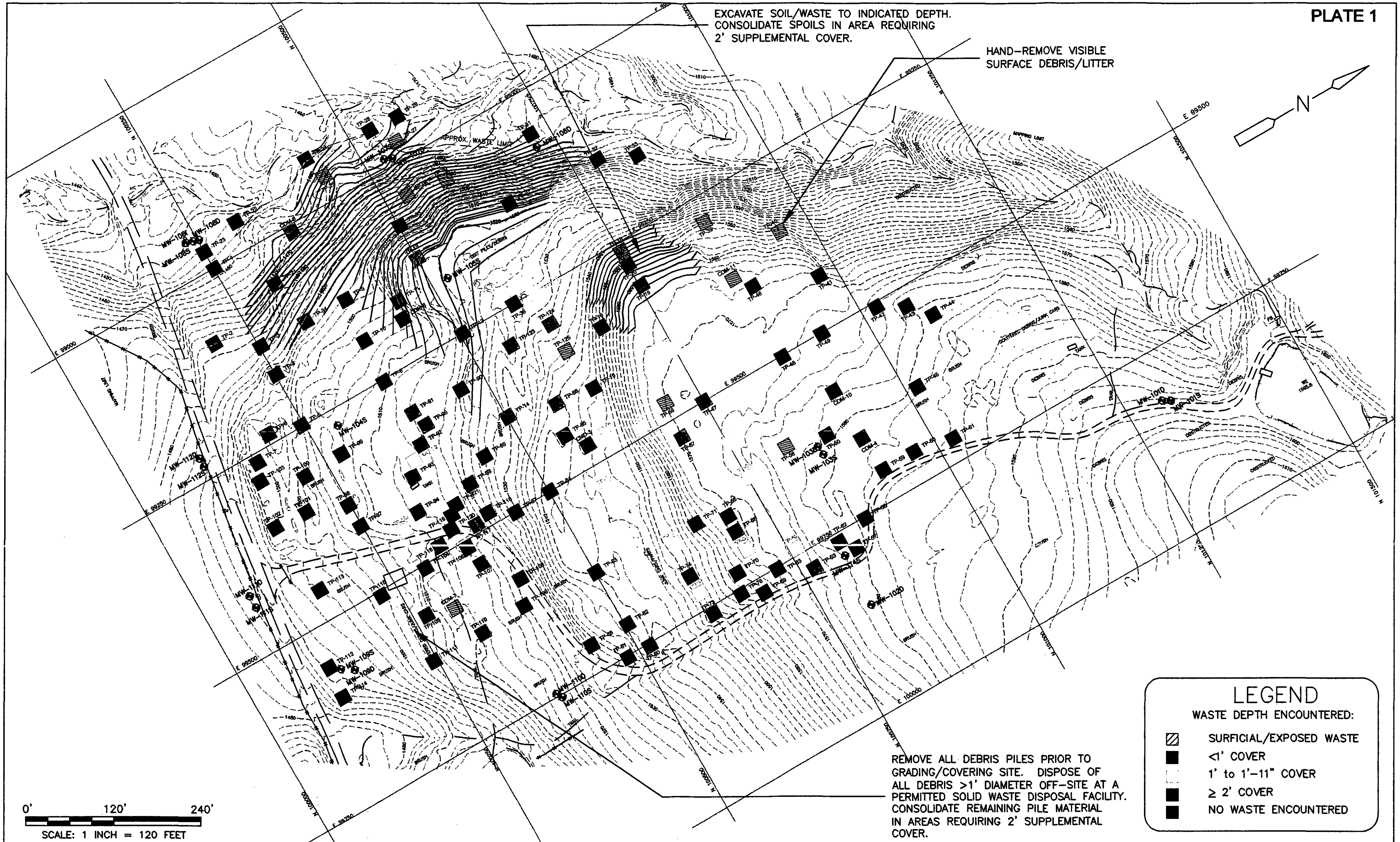
PLATES



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REVISIONS

NO.	BY	DATE	REMARKS

DES ______
DWN ______
CKD ______

URBANA, NEW YORK

REMEDIAL ACTION WORK PLAN FOR URBANA LANDFILL SITE

NYSDEC SITE NO. 8-51-007

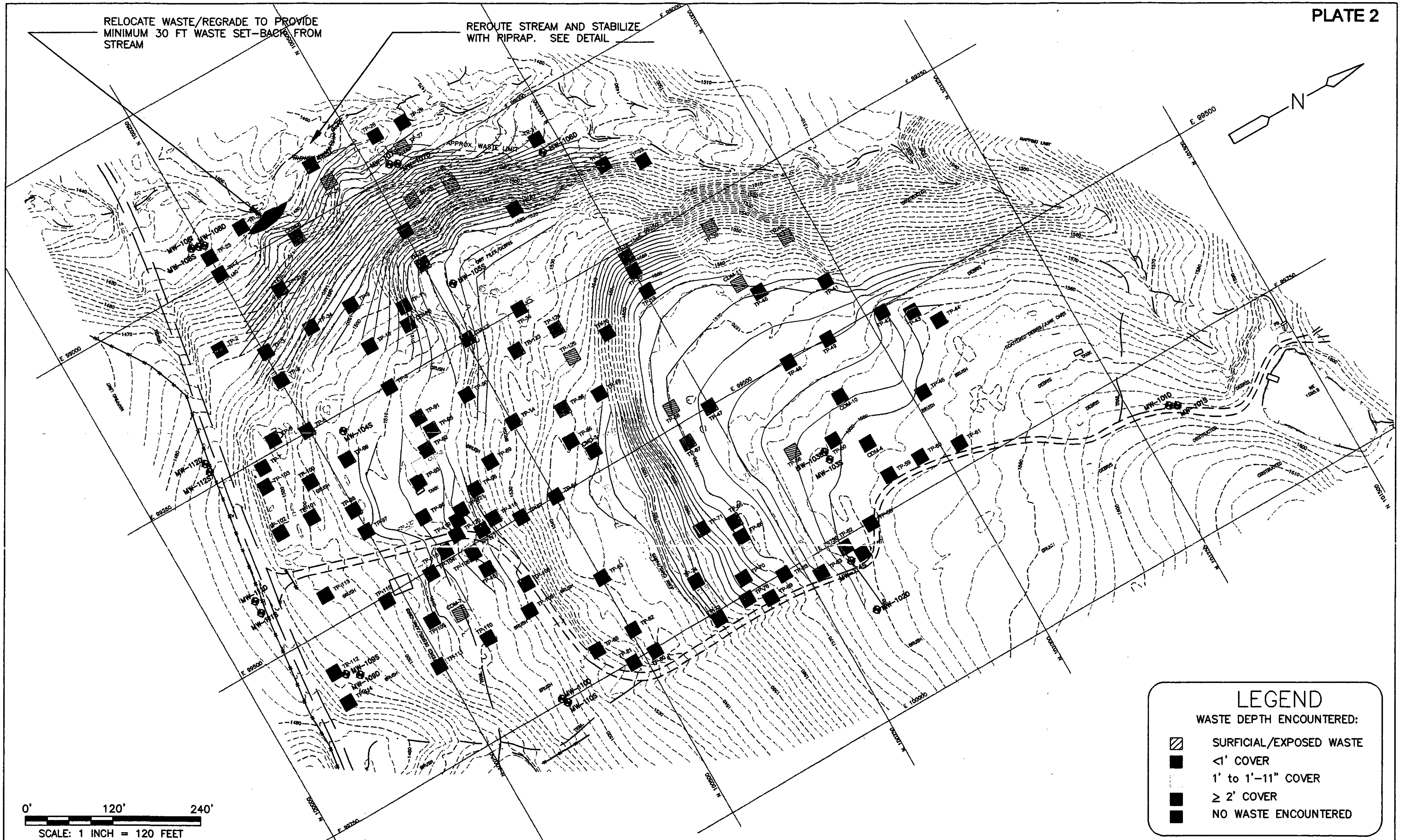
REMEDIAL ACTION WORK PLAN

SUBGRADE GRADING PLAN

DATE FEBRUARY 1999

SHEET ____ OF ____

CAD REF. NO. PLATE1.DWG



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DES ____
DWN ____
CKD ____

URBANA, NEW YORK
REMEDIAL ACTION WORK PLAN FOR URBANA LANDFILL SITE
NYSDEC SITE NO. 8-51-007

REMEDIAL ACTION WORK PLAN
FINAL GRADING PLAN

DATE FEBRUARY 1999
SHEET ___ OF ___
CAD REF. NO. PLATE2.DWG

PLATE 3

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REMEDIAL ACTION WORK PLAN FOR URBANA LANDFILL SITE
NYSDEC SITE NO. 8-51-007

REMEDIAL ACTION WORK PLAN

LANDFILL TERRACES

DATE FEBRUARY 1999
SHEET ___ OF ___
CAD REF. NO. PLATE3.DWG