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**FINAL REMEDIAL INVESTIGATION
& RISK ASSESSMENT REPORT
CENTRAL LANDFILL OPERABLE UNIT 2
JOHNSTON, RHODE ISLAND
VOLUME IV OF V**

PREPARED FOR:
Rhode Island Resource Recovery Corporation
Johnston, Rhode Island

PREPARED BY:
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File No. 31866.2

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APPENDIX A
REFERENCES

REFERENCES

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APPENDIX B

OUI RI REPORT SECTION 10 - CONCLUSIONS

10.00 CONCLUSIONS

The Remedial Investigation (RI) at the Central Landfill was separated into two parts. On-site source control issues were addressed in Operable Unit One (OU1) studies, and are described in this report. Issues associated with off-site impacts and ecological concerns are being addressed in Operable Unit Two (OU2) studies. This approach expedited the remedial process by allowing Feasibility Studies (FS), required to address clearly identified remedial needs to proceed, as other RI tasks were being performed

In reviewing our conclusions it is important to note that while the RI/FS process has proceeded, RISWMC has undertaken a number of actions to reduce the potential risks to human health and the environment posed by site conditions. Most notable are: 1) making public water available to residents in proximity to the site; 2) the installation of a landfill gas (LFG) collection and electrical power generating facility which burns the LFG; 3) the taking of land within 1,000 feet of the licensed landfill to expand the buffer zone; and, 4) the capping of landfill areas as they reach design elevations. Capping was particularly significant in the northeast portion of the landfill where groundwater flow is towards the Almy Reservoir, See Section 10.30.

Our conclusions are based on factual information, scientific principals, and judgement. In order to understand how we reached these and other conclusions, the report must be read in it's entirety. Note that all our conclusions are subject to the Limitations presented in Section 11.00 of this report.

Four overall purposes of the OU1 RI were to: 1) evaluate the sources nature, and extent of environmental contamination; 2) characterize potential routes for off-site contaminant migrations; 3) identify potential receptors of contamination which originates at the site; and, 4) identify unresolved issues and make recommendations to help formulate the scope of the OU2 RI. The following subsections describe our major conclusions regarding each of these study objectives.

10.10 SOURCES OF CONTAMINATION

We identified four potential sources of environmental contamination at the Central Landfill site. These were, municipal wastes found both above and below the water table and industrial/hazardous wastes also found above and below the water table. More specifically:

- Disposal of municipal wastes began at the site in 1955. Based on February 1988 site topography, and assuming that the area had been excavated to bedrock, there are more than 17,000,000 cubic yards of refuse at the site. Using the same assumption regarding the depth of fill, and extrapolated groundwater contours, it appears that approximately 2,000,000 cubic yards of refuse lie below the water table.

- The refuse is a significant source of metals contamination in groundwater. Total metal concentrations in groundwater samples are typically higher than dissolved concentrations in the same samples. This suggests that the migration of metals is being attenuated by absorption onto other metals or organic matter.
- Prior to 1980 treated and untreated septage wastes were disposed of at the site. The portion of the site which received that material was subsequently covered with refuse. This area reportedly covered five to ten acres, and held septage up to fifteen feet in thickness.
- At some time in the mid to late 1970's the site received an estimated 1.5 to 2.5 million gallons of industrial hazardous waste. A significant portion of that waste was reportedly disposed of in trenches cut to or into bedrock. Within the context of CERCLA guidance documents, that area is a "Hot Spot." Closure activities in 1981 did not address the area of those trenches. The trenches were located during the RI. In this report the area of the trenches is identified as Hazardous Waste Disposal Area Two (HWDA2). Only one Hot Spot was identified. The designation HWDA2 was used to distinguish it from the area closed in 1981 and does not mean two hazardous waste disposal areas were identified.
- Dense non-aqueous phase liquids (DNAPLs) and sludges in HWDA2 are a major source of volatile organic compound (VOC) contamination in groundwater. DNAPLs are a more significant source of VOCs in groundwater than are either the chemical or septage sludges, and chemical sludges are a more significant source of VOCs than are septage sludges.
- HWDA2 was identified as the most significant source of groundwater VOC contamination. The general areal distribution of VOCs, however, also indicates that the landfill as a whole is a source of generally lower concentrations of VOCs.
- A review of files at the RIDEM indicates there are a number of other sources of groundwater contamination in the area of the CLF. Consequently, all groundwater contamination identified in the area cannot be attributed to activities at the CLF. Also, over the course of the study sampling and analytical procedures have changed. Consequently, not all reported variations in contaminant concentrations should be attributed to site conditions.

10.20 POTENTIAL CONTAMINANT PATHWAYS

We evaluated three pathways by which contaminants at the site could migrate into the surrounding environment. These were groundwater, surface water, and air. We found groundwater migration in bedrock to be the most significant contaminant pathway. More Specifically:

- We have located lineaments (or fracture traces) which may be associated with bedrock fracture zones which cross the site (a lineament is line, possibly representing a structural bedrock fracture, which is observed on aerial imagery). A statistical analyses of data obtained by drilling at the site indicates that the frequency of bedrock fracturing in the area of lineaments is not significantly different from other locations at the site.
- The frequency of bedrock fracturing at depths of less than 150 feet is on the order of inches to feet. Statistical analyses of data on bedrock fracturing versus depth indicates that the frequency of fracturing decreases with depth. Furthermore, these analyses suggest that at depths on the order of two to four hundred feet the frequency of fracturing should be much less (on the order of tens of feet) than observed in the upper thirty feet. No test drilling was performed to confirm that trend.
- On a site wide basis the orientations of fractures were found to lie in directions which are generally in agreement with the orientations identified by the fracture trace analyses. However, analyses of data on a borehole specific basis did not, in all cases, indicate a preferential orientation of fractures consistent with nearby lineaments. Consequently, we believe that the bedrock structure does not support a preferred direction of flow in a horizontal direction.
- Bedrock was identified as the major pathway for off-site migration of groundwater; and for the purposes of this report the bedrock aquifer can be analyzed as a porous media. Hydraulic testing and piezometer measurements indicate that the lineaments have hydraulic properties similar to other portions of the bedrock mass. Therefore, these geologic features are not acting as a pathway for interbasin groundwater flow.
- The hydraulic conductivity of the rock in the horizontal direction is believed to average approximately 0.5 feet/day. The average transmissivity of the rock was estimated in a very preliminary way (without the benefit of pumping test data) to be on the order of 150 to 300 feet²/day. This is in keeping with fracture frequency data indicating the depth of the flow field is on the order of 200 to 400 feet.
- The decreases in VOC concentrations observed with increasing distances from HWDA2 cannot be explained by dispersion alone. The groundwater beneath the site is anoxic and it appears anaerobic biodegradation is responsible for some of the observed decreases. Volatilization may also be responsible for some of the observed decreases in VOC concentrations. It also appears, however, that the contaminant plume from HWDA2 is narrow and has not been intercepted by a monitoring well at the toe of the landfill.

- Because they receive contaminated groundwater, the Quarry Stream and Cedar Swamp Brook are pathways for off-site contaminant migration. There are no surface releases of contaminants to these surface waters.
- Based on the results of air monitoring and air dispersion modeling, we believe that the CLF, with the electrical power generating facility operating, does not have a significant adverse effect on local ambient air quality. That facility has a Rhode Island Air Permit. We found no data, however, indicating that stack testing for VOCs has been performed.

10.30 RECEPTORS

Based on identified contaminant pathways, we estimated contaminant loading at the two major receptors, the Upper Simmons and the Almy Reservoirs. In reviewing this and related sections note that we designed and executed studies to assess the potential of the Scituate Reservoir being a receptor. These studies have established that the Scituate Reservoir is not a receptor of groundwater contamination which originates at the CLF. The Army Corp of Engineers, the United States Geological Survey, and CH2M Hill (consultants for the Providence Water Supply Board owners of the Scituate Reservoir), agree with that finding.

- Based on the site's history of waste disposal and computed contaminant transport velocities, it appears that the VOCs which are contaminants of concern are, on average, in dynamic equilibrium with the groundwater flow system. That is, steady state conditions have been achieved and no significant increases in VOC loading to the Upper Simmons Reservoir should occur. Statistical analyses of time-contaminant concentration relationships did not confirm this opinion. We attributed this lack of statistical evidence to complex contaminant release mechanism and changes due to sampling/analytical procedures.
- The groundwater transport rate for the semi-volatile organic compounds (SVOCs) of concern was computed to be slow. That is, for these contaminants steady state conditions may not have been established in 1990. Consequently, the loading rate of these contaminants to the Upper Simmons Reservoir could increase with time.
- Based on the limited area of the site which supports groundwater migration towards the Almy Reservoir, the capping of that portion of the landfill, and the observed concentrations of contaminants in groundwater samples collected from wells located between the site and the Almy Reservoir, we believe site conditions pose no unacceptable incremental risk to that surface water body. That opinion needs to be substantiated by OU2 studies.
- There are no public wells in the area where groundwater was or will be degraded by activities at the CLF. The closest public well is more than a mile from the site, and the soil and bedrock in the vicinity of the site are not generally conducive to the development of wells with a yield of more than a few gallons per minute.

- Public water has been made available to residents in the areas which could be affected by activities at the CLF. No door to door studies have been performed to be sure all residents have connected to the public system and have abandoned their private water supply wells.

10.40 RECOMMENDED STUDIES

During the course of completing the OU1 Remedial Investigation, we identified a number of issues which were not fully resolved by the data provided in this report. The studies required to address these issues will be performed either during the OU2 Remedial Investigation, or during the Remedial Design/Remedial Action (RD/RA) Phase of work. The following provides an overview of these needs. The specifics of suggested studies will be described in specific work plans.

- 1- The depth to which groundwater contamination extends has not been confirmed. One additional well extending to a depth of at least elevation zero MSL is recommended. We believe that well should be located near the toe of the landfill between wells WE87-ML4 and MW90-29, downgradient of HWDA2.
- 2- Additional information on contaminant concentrations in groundwater, as the groundwater migrates towards the Almy and Upper Simmons Reservoir, is needed. We believe two to three wells both south and north east of the landfill (4 to 6 wells total), extended 30 feet into bedrock, will address those needs.
- 3- Studies undertaken to date have not provided direct measurements of the transmissivity of the bedrock. We believe two or three pumping tests, 24 to 72 hours in duration, should provide adequate information to allow for design of required withdrawal systems.
- 4- Estimates of flows to the Upper Simmons Reservoir have been based on empirical relations. Data needs to be collected on actual stream flows to substantiate those estimates.
- 5- Studies need to be undertaken to address that affects of the CLF has had on the ecological systems of the Almy and Upper Simmons Reservoirs. We believe these efforts should begin with additional sediment and surface water sampling programs, and be expanded (if necessary) based on the potential risks demonstrated by those findings.
- 6- The effects, if any, activities at the CLF have had on nearby wetlands, and the ecology of adjacent woodlands need to be established. We believe that a wetland delineation and ecological characterization of the areas surrounding CLF to

identify potential off-site receptors is needed. This may be followed by sampling and analysis of media representing potential pathways of off-site contaminant migration to ecological receptors.

- 7- There is a possibility that residents in the vicinity of the site not have taken advantage of public water. We believe a lot by lot canvassing of all properties within two thousand feet of the site, to document water use and assess what institutional controls are most applicable, is an appropriate OU2 task.

APPENDIX C
BORING LOGS &
HYDRAULIC CALCULATIONS

C-1
BORING LOGS

GZA GEOENVIRONMENTAL, INC.
 140 BROADWAY, PROVIDENCE, RHODE ISLAND
 GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT
 CENTRAL LANDFILL-OJ2 - TASK 4
 JOHNSTON, RHODE ISLAND

REPORT OF BORING No. MW95-47
 SHEET 1 OF 2
 FILE No. 31479.2
 CHKD. BY EAS

BORING Co. D.L. MAHER DRILLING COMPANY
 FOREMAN JOHN BOWEN
 GZA ENGINEER MARK DALPE

BORING LOCATION SEE EXPLORATION LOCATION PLAN
 GROUND SURFACE ELEVATION 310.55 DATUM NGVD
 DATE START 1-31-95 DATE END 2-2-95

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 in.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 in.

CASING SIZE: 6" ID OTHER: 9 7/8" AIR HAMMER AND 6" AIR HAMMER

GROUNDWATER READINGS				
DATE	TIME	WATER	CASING	STABILIZATION TIME
2-6-95		11.4	33'	4 DAYS
3-9-95		13.5	33'	1 MONTH

DEPTH	C A S I N G S	SAMPLE				SAMPLE DESCRIPTION Burmister CLASSIFICATION	STRATUM DESCRIPTION	EQUIPMENT INSTALLED Locking Guard Pipe	FIELD SCREENING	REMARKS
		No.	PEN./REC.	DEPTH (Ft.)	BLOWS/6"					
5		S-1	24/16	0-2	6-22	Dense tan, coarse to fine SAND, some+ Gravel, trace+ Silt, trace+ Organics with REFUSE (FILL)	GRAVELLY SAND AND REFUSE FILL	R I S E R	ND	1
					19-7					
10		S-2	24/7	5-7	2-5	Medium dense, black, coarse to fine SAND AND SILT, trace fine Gravel, changing at 6' to tan/brown, coarse to fine SAND, trace+ Gravel with REFUSE (FILL)	SILTY SAND AND REFUSE FILL	B E N S E A L	7.0	
					5-10					
15		S-3	24/6	13-15	10-22	Very dense gray, coarse to fine SAND AND GRAVEL, trace Silt (TILL)	WOOD FILL	A Q U A	0.2	
					30-20					
20		S-4	24/11	21-23	7-19	Dense, gray, coarse to fine SAND, trace Gravel, trace Silt (TILL)	BOULDER	G R O U T	ND	
					11-27					
25						Stratigraphic descriptions are based on the examination of drill cuttings and air hammer response.	B O U L D E R S			
30		S-5	GRAB	31'	MIN/FT	Tan/White GRANITE	BOULDERY TILL		0.2	2
					1.5					
					1.5					
					1.3					
					1.3					
35		S-6	GRAB	35'	1.0	Highly weathered GRANITE (Feldspars are kaolinized)	BOULDERY TILL	B E N T	ND	3
					0.3					
					1.0					
					1.0					
					1.0					
40						6" casing to 33 Feet	B E N T	S E A L		

REMARKS: 1. Field screening performed with HNU, Photoionization Detector (PID) with a 11.7 eV lamp. Readings in parts per million (ppm); ND indicates less than 0.1 ppm.
 2. Using a 9 7/8" air hammer, a 10" steel casing was spun to a depth of 33' where a 6" steel casing was set and grouted 2 ft into bedrock. The 10" casing was pulled and the grout seal was allowed to set up for a minimum of 12 hrs, before the boring was advanced to 55' using a 6" air hammer.
 3. Pink kaolinized rock from 36-37': "silty sand-like wash".

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
 2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED. FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS

GZA GEOENVIRONMENTAL INC. 140 BROADWAY, PROVIDENCE, RHODE ISLAND GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS		PROJECT CENTRAL LANDFILL - OJ2 - TASK 4 JOHNSTON, RHODE ISLAND	REPORT OF BORING No. MW95-47S SHEET 1 OF 1 FILE No. 31479.3 CHKD. BY EAS							
BORING Co. D.L. MAHER DRILLING COMPANY FOREMAN JOHN BOWEN GZA ENGINEER MARK DALPE		BORING LOCATION SEE EXPLORATION LOCATION PLAN GROUND SURFACE ELEVATION 310.68 DATUM NGVD DATE START 2/8/95 DATE END 2/8/95								
SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 LB. HAMMER FALLING 30 IN. CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 LB. HAMMER FALLING 24 IN. CASING SIZE: 6" ID OTHER: 6" AIR HAMMER		GROUNDWATER READINGS								
		DATE	TIME	WATER	CASING	STABILIZATION TIME				
		2-9-95	0850	10'	10'	2 MIN				
DEPTH	C B A S W N G S	No.	PEN./REC.	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION <u>Burmister CLASSIFICATION</u>	STRATUM DESCRIPTION	EQUIPMENT INSTALLED Locking Guard PVC RISER BENTONITE PVC FILTER SAND	FIELD SCREENING OVM	REMARKS
							FILL	Cem. Seal 3' BEN SEAL AQUA GROUT		1
							6' REFUSE: PLASTIC, GLASS, PAPER ETC.			
							9' - - - - 10' TILL		3.0	
		S-1	24/16	10-12	4-6 10-16	Medium dense, brown TOPSOIL: medium to fine SAND, some+ glass/ roots, little- Silt, changing at 10.5' to gray/tan, coarse to fine+ SAND, some- Gravel, little- Silt				
							15' (COBBLES)		NO	
		S-2	24/5	15-17	10-28 33-20	Very dense, gray/tan GRAVEL (angular; apparent cobble zone), little- medium to fine+ SAND, trace- Silt		16' BENT.	SEAL	
							TILL	18' 20' PVC FILTER SAND	NO	2
		S-3	24/14	25-27	13-40 40-42	Very dense, tan, coarse to fine SAND AND GRAVEL, little- Silt		30'		
							32' GRANITE			3
						End of Exploration at 34'+				
REMARKS: 1. Soil TVOC headspace screening was performed employing a TEI 580B OVM Photoionization Detector equipped with an 11.8 eV lamp. 2. Mild leachate odor during drilling operations. 3. 10' of .01" slotted, 2.0" diam., Sch 40, PVC wellscreen was placed from 30'+ up to 20'+ and topped with 22.5' (above G.S.) of solid PVC riser tube. Filter sand was placed. See equipment diagram for further details.										
NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL. 2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED. FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE										
GZA										BORING No. MW95-47S

GZA GEOTECHNICAL/GEOPHYSICAL CONSULTANTS
 140 BROADWAY, PROVIDENCE, RHODE ISLAND

PROJECT
 CENTRAL LANDFILL - CU2 - TASK 4
 JOHNSTON, RHODE ISLAND

REPORT OF BORING No. MM95-48
 SHEET 2 OF 2
 FILE No. 31479.2
 CHKD. BY EAS

DEPTH (FT.)	CORRECTION	SAMPLE			SAMPLE DESCRIPTION Burmister CLASSIFICATION	STRATUM DESCRIPTION	EQUIPMENT INSTALLED		FIELD TESTING	REMARKS
		No.	PEN./REC.	DEPTH (Ft.)			MIN/FT			
45					Gray GRANITE (rock cuttings)	41'	VOLCLAY RISER	GROUT	ND	5
				1.0		Fractured Zone				
				1.0						
				1.0						
		S-8	GRAB	43'						
				1.0						
				1.0						
				1.0						
				1.0						
				1.0						
50					Gray GRANITE (rock cuttings)	42'	PVC FILTER SAND SCREEN	SEAL	ND	6
				1.0		SCITUATE GRANITE				
				1.0						
				1.0						
		S-9	GRAB	52'						
				1.0						
				1.0						
				1.0						
				1.0						
				1.0						
55					Gray GRANITE (rock cuttings)	48'	BENT.	SEAL	ND	6
				1.2						
				1.2						
				1.2						
				1.2						
				1.2						
				1.2						
				1.2						
				1.2						
				1.2						
60					Gray GRANITE (rock cuttings)	50'	PVC FILTER SAND SCREEN	SEAL	ND	6
				1.2						
				1.2						
				1.2						
		S-10	GRAB	63'						
				1.2						
				1.2						
				1.2						
				1.2						
				1.2						
65					End of Exploration at 68.5'±	60'	BENTONITE SEAL	ND	7	
				1.2		WEATHERED ZONE				
				1.2						
				1.2						
				1.2						
				1.2						
				1.2						
				1.2						
				1.2						
				1.0						
70					End of Exploration at 68.5'±	62'	BENTONITE SEAL	ND	7	
				1.2		SCITUATE GRANITE				
				1.2						
				1.2						
				1.2						
				1.2						
				1.2						
				1.2						
				1.2						
				1.0						
75					End of Exploration at 68.5'±		BENTONITE SEAL	ND	7	
				1.2						
				1.2						
				1.2						
				1.2						
				1.2						
				1.2						
				1.2						
				1.2						
				1.0						
80					End of Exploration at 68.5'±		BENTONITE SEAL	ND	7	
				1.2						
				1.2						
				1.2						
				1.2						
				1.2						
				1.2						
				1.2						
				1.2						
				1.0						

- REMARKS:
5. Large fracture at 42'±.
 6. Color change in rock cuttings from gray to tan/brown (Fe staining?) from 60-62'±.
 7. Borehole was "flushed" with compressed air for 10 minutes±.
 8. A minimum of water was lost to the borehole during drilling. On 2/2/95, prior to in situ testing the borehole was developed using a submersible pump. Approximately 225 gallons of 2.5 standing well volumes of water were developed with a final turbidity of 15 NTU.
 9. On 2/2/95 and 2/3/95, the borehole was packer tested from 68.5 to 37.7 using a 5 ft test interval. Upon completion of packer testing the contractor purged a volume of water equal to that lost to formation during testing.
 10. On 2/13/95, one shallow bedrock monitoring well constructed of 2" ID Sch. 40 PVC well pipe was installed with a 10' screened section beginning at a depth of 62' and topped with 54.8' of solid PVC riser (extending approximately 2.8' above ground surface). The well is protected by a 6" Sch. 40 steel locking guard pipe which extends approximately 3.0' above ground surface. See equipment diagram for further construction details.

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITIONS MAY BE GRADUAL.
 2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED. FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

BORING No. MM95-48

GZA

GZA GEOTECHNICAL/GEOPROLOGICAL CONSULTANTS
 140 BROADWAY, PROVIDENCE, RHODE ISLAND

PROJECT
 CENTRAL LANDFILL - OJ2 - TASK 4
 JOHNSTON, RHODE ISLAND

REPORT OF BORING No. MW95-48S
 SHEET 1 OF 1
 FILE No. 31479.3
 CHKD. BY EAS

BORING Co. D.L. MAHER DRILLING COMPANY
 FOREMAN JOHN BOWEN
 GZA ENGINEER MARK DALPE

BORING LOCATION SEE EXPLORATION LOCATION PLAN
 GROUND SURFACE ELEVATION 307.75 DATUM NGVD
 DATE START 2-7-95 DATE END 2-7-95

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: 6" ID OTHER: 6" AIR STRAIGHT HAMMER

GROUNDWATER READINGS				
DATE	TIME	WATER	CASING	STABILIZATION TIME
2-7-95	1100	7.5	15	5 MIN

DEPTH	CASSINGS	SAMPLE			SAMPLE DESCRIPTION <u>Burmister</u> CLASSIFICATION	STRATUM DESCRIPTION	EQUIPMENT INSTALLED LOCKING GUARD PIPE	FIELD SCREENING HNU(11.7)	REMARKS	
		No.	PEN./REC.	DEPTH (Ft.)						BLOWS/6"
5						SAND AND GRAVEL FILL	Cem. Seal		1	
						3' COBBLES	PVC RISER	BEN SEAL AQUA GROUT		
						7' WOOD (NON-LUMBER)				
10		S-1	14/3	10-11.2	4-45 100 61/2"	10' SAND AND GRAVEL FILL				0.2
15						15'+ TILL	17' BENT.	SEAL		
20						BOULDERS	19'			
25								21' FILTER SAND		
30		S-2	17/4	28-29.4	15-60 100 61/5"	Very dense gray coarse to fine SAND AND GRAVEL/COBBLE, little Silt			ND	
35						End of Exploration at 33'			2 3	
40										

REMARKS: 1. Soil headspace TVOC readings were collected employing a HNU Systems Model PI-101 Photoionization Detector, equipped with a 11.7 eV lamp.
 2. 10' of .01" slotted, 20" diam. Sch 40, PVC wellscreen was placed from 31'+ up to 21'+ and topped with 23.5' of solid PVC riser tube (extended above GS). See equipment diagram for further details.
 3. During drilling a mild leachate odor was noted from ground surface to 33'.

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITIONS MAY BE GRADUAL.
 2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED. FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

GZA

BORING No. MW95-48S

DEPTH	C A S I N G	SAMPLE			SAMPLE DESCRIPTION Burmister CLASSIFICATION	STRATUM DESCRIPTION	EQUIPMENT INSTALLED	FIELD SCREENING	RE M A R K S
		No.	PEN./ REC.	DEPTH (Ft.)					
					Pink GRANITE	PINK GRANITE	BENSEAL AQUA-GROUT		
45						+46' GRAY (DARK GRAY)		ND	5
		S-8	Grab	48	Dark Gray GRANITE				6
					End of Exploration at +48.4'				7
50									
55									
60									
65									
70									
75									
80									

REMARKS: 4. (con'd) Placed 2 bags of finish bentonite chips into annulus around 6" casing brought level to 9' below ground surface. Finished grouting in casing and then advanced boring to 48.4 ft using a 6" air hammer.

5. A minimal amount of water was lost to the borehole during drilling. On 1/31/95, prior to in situ testing, the borehole was developed using surge blocks and a submersible pump. Approximately 105 gallons or 1.9 standing well volumes of water were developed with a final turbidity of 3 NTU.

6. On 2/1/95 and 2/2/95, the borehole was packer tested from 48.4' to 18' using a 5 foot test interval. Upon completion of packer testing, the contractor purged a volume of water equal to that lost to the formation during testing.

7. On 2/14/95, one shallow bedrock monitoring well constructed of 2" ID Sch. 40 PVC well pipe was installed with a 10' screened section beginning at a depth of 30.0' and topped with 22.8' of solid PVC riser (extending approximately 2.8' above ground surface). The well is protected by a 6" Sch. 40 steel locking guard pipe which extends approximately 3.0' above ground surface. See equipment diagram for further construction details.

BORING Co. MAHER DRILLING COMPANY FOREMAN JOHN BOWENS GZA ENGINEER STEPHEN KLINE	BORING LOCATION SEE EXPLORATION LOCATION PLAN GROUND SURFACE ELEVATION 407.30 DATUM NGVD DATE START 1/26/95 DATE END 1/27/95
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SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 LB. HAMMER FALLING 30 in. CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 in. CASING SIZE: 6" CASING OTHER: 9 7/8" STRAIGHT HAMMER 6" AIR HAMMER	GROUNDWATER READINGS <table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>DATE</th> <th>TIME</th> <th>WATER</th> <th>CASING</th> <th>STABILIZATION TIME</th> </tr> </thead> <tbody> <tr> <td>1/26/95</td> <td></td> <td>42.1'</td> <td>14</td> <td>2 DAYS</td> </tr> <tr> <td>1/30/95</td> <td></td> <td>37.5'</td> <td>14</td> <td>6 DAYS</td> </tr> <tr> <td>2/7/95</td> <td></td> <td>32.0'</td> <td>14</td> <td>5 DAYS</td> </tr> </tbody> </table>	DATE	TIME	WATER	CASING	STABILIZATION TIME	1/26/95		42.1'	14	2 DAYS	1/30/95		37.5'	14	6 DAYS	2/7/95		32.0'	14	5 DAYS
DATE	TIME	WATER	CASING	STABILIZATION TIME																	
1/26/95		42.1'	14	2 DAYS																	
1/30/95		37.5'	14	6 DAYS																	
2/7/95		32.0'	14	5 DAYS																	

DEPTH	CASINGS	SAMPLE			SAMPLE DESCRIPTION <u>Burmister CLASSIFICATION</u>	STRATUM DESCRIPTION	EQUIPMENT INSTALLED Locking Guard Pipe	FIELD SCREENING	REMARKS
		No.	PEN./REC.	DEPTH (Ft.)					
5		S-1	24/6	0-2	6-12	Dense, dark brown SILT AND SAND changing after 3" to gray/tan medium to coarse SAND, little Gravel	SEEDED COVER GRAY GRAVELLY SAND	ND	1
					18-17				
10		S-2	1/0	5-5.1	100/1"	No Recovery	8' LIGHT BROWN GRAVELLY SAND (TILL)	ND	
		S-3	GRAB	6		Gray Granite Boulder			
15		S-4	GRAB	9.5		Stratigraphic descriptions are based on the examination of drilling cuttings and air hammer response. Gray coarse to fine Gravel, little(-) red SILT (weathered rock)	9.5' WEATHERED BEDROCK	ND	
						Dry fracture at 11.5'			
20		S-5	GRAB	13.5		Highly weathered rock; brown with powdery, fine SAND AND SILT consistency. Harder gray and brown Granite at 13.75' (6" casing to 14 feet)	11.5' FRACTURE ZONE	ND	3
						Dry fracture at 17'			
25		S-6	GRAB	25		Gray GRANITE (with red and black flecks)	13.75' GRAY ROCK	ND	
						Dry Fracture at 26'			
30							17' GRAY ROCK	ND	
35							+26'	ND	
40		S-7	GRAB	35		Fracture zone at 35': Red/Brown SILTS (iron staining ?)	+32'	ND	
							SOFT ROCK		
							+34'		
							+35'		
							+37' SOFTER ROCK		
							39'		

REMARKS:

- Field screening performed with a TEI 5808 OVM, Photoionization Dectector (PID) with a 11.8 eV lamp. Readings are in parts per million (ppm).
- Broke 97.8" roller bit trying to core through boulder; switched to 9 7/8 straight hammer at 5 ft.
- Using a 9 7/8" air hammer, a 10" steel casing was spun to a depth of 9.5 ft. Then the boring was advanced 14 additional feet, where a 6" steel casing was set and grouted 4.5' into bedrock. The 10" casing was pulled and grout seal was allowed to set up for a min. of 12 hrs, before the boring was advanced to 44' using a 6" air hammer.

NOTES:

- STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITIONS MAY BE GRADUAL.
- WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED. FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No. MW95-51

DEPTH	C B A S W S N O W S	SAMPLE			SAMPLE DESCRIPTION Burmister CLASSIFICATION	STRATUM DESCRIPTION	EQUIPMENT INSTALLED	FIELD SCREENING	REMARKS
		No.	PEN./ REC.	DEPTH (Ft.)					
					WEATHERED ZONE at 41 to 43: Red rock fragments and brown Silts	41' - - - - - WEATHERED ZONE 43' - - - - -	FILTER PVC SCREEN SAND Centralizer 49.6'	ND	
45		S-9	GRAB	44	Gray/White GRANITE				
50		S-10	GRAB	50	Gray/White GRANITE		53'	ND	
55							BENTONITE SEAL		6
60		S-11	GRAB	60	Gray/White GRANITE		AQUA GROUP BENSEAL	ND	
65									
70		S-12	GRAB	68	Gray/White GRANITE			ND	7 8
75									
80					End of Exploration at +69.5'				9

REMARKS:

4. Borehole makes very little water; Was blown dry in 3 minutes by air hammer development. Did not recover in 3 hrs.
5. Overdrilled borehole on 2/2/95. Advanced 6" borehole to 69.5 feet.
6. Very little fracturing noted during drilling borehole, making very little water.
7. A minimal amount of water was lost to the borehole during drilling. On 2/7/95, prior to in situ testing, the borehole was developed using surge blocks and a submersible pump. Approximately 46 gallons (or 0.82 standing well volumes of water) were developed with a final turbidity of 40 NTU. Pumping was terminated due to slow well recovery.
8. On 2/7/95 and 2/8/95, the borehole was packer tested from 69.8' to 25.0' using a 5 foot test interval. Upon completion of packer testing, the contractor purged a volume of water equal to that lost to the formation during testing.
9. On 2/14/95, one shallow bedrock monitoring well constructed of 2" ID Sch. 40 PVC well pipe was installed with a 10' screened section beginning at a depth of 49.6' and topped with 42.4' of solid PVC riser (extending approximately 2.8' above ground surface). The well is protected by a 6" Sch. 40 steel locking guard pipe which extends approximately 3.0' above ground surface. See equipment diagram for further construction details.

GZA GEOENVIRONMENTAL INC.
 140 BROADWAY, PROVIDENCE, RHODE ISLAND
 GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT
 CENTRAL LANDFILL - OIJ - TASK/4
 JOHNSTON, RHODE ISLAND

REPORT OF BORING No. MW95-51
 SHEET 1 OF 2
 FILE No. 31479.2
 CHKD. BY EAS

BORING Co. MAHER DRILLING COMPANY
 FOREMAN JOHN BOWENS
 GZA ENGINEER STEPHEN KLINE

BORING LOCATION SEE EXPLORATION LOCATION PLAN
 GROUND SURFACE ELEVATION 399.51 DATUM
 DATE START 1/26/95 DATE END 1/27/95

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 in.		GROUNDWATER READINGS			
DATE	TIME	WATER	CASING	STABILIZATION TIME	
2/9/95		20.0	15	13 DAYS	
2/13/95		18.5	15	3 DAYS	

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 in.
 CASING SIZE: 6" CASING OTHER: 9 7/8" STRAIGHT HAMMER 6" AIR HAMMER

DEPTH	CLOGGING	SAMPLE			SAMPLE DESCRIPTION <u>Burmister CLASSIFICATION</u>	STRATUM DESCRIPTION	EQUIPMENT INSTALLED LOCKING GUARD PIPE	FIELD SCREENING	REMARKS
		No.	PEN./REC.	DEPTH (FT.)					
5		S-1	24/16	0-2	11-17	Medium dense, dark brown, fine SAND, some organics changing after 6 inches to tan, fine to coarse SAND, little(-) Gravel	BENSEAL RISER	ND	1
					4-28	(VERY SOFT) (COBBLES) FILL			2
10		S-2	18/12	5-6.5	17-50	Very dense, tan, fine to coarse SAND, some Gravel, trace Silt (rock chips in soil catch)	AQUA GROUT	ND	3
					100/6"	6.5' VOID 7.5' COBBLES			4
15		S-3	GRAB	10-10.5		Highly weathered bedrock (Brown Silts and fine Sand cuttings)	AQUA GROUT	ND	5
						9.5' HIGHLY WEATHERED BEDROCK			
20		S-4	GRAB	14		Still highly weathered bedrock and slightly harder rock (cuttings with more red Silt) 6" casing to 15'	AQUA GROUT	ND	
						21' HARDER ROCK WEATHERED ROCK 23'			
25		S-5	GRAB	20		Red weathered bedrock (very silty)	AQUA GROUT	ND	
						WEATHERED ZONE from 22' to 23' (Red/Brown Silts)			
30		S-6	GRAB	30		Tan/Gray GRANITE (with red/black and blue flecks)	BENT. SEAL FILT SAND 31' 33' CENTRALIZER	ND	
						26' SOFTER ROCK 38' PINK/BROWN			
40						Fracture Zone 38' (Pink/Brown Silts)			

REMARKS: 1. Field screening performed with a TEI 580B OVM, Photoionization Detector (PID) with a 11.8 eV lamp. Readings are in parts per million (ppm). Nd indicates less than 0.1 ppm.
 2. 2-4" of frost for first sample, may have created higher blow counts.
 3. Easy drilling (VOID?); covered 1 foot in less than 15 seconds.
 4. Dropped-like a VOID from 6.5 to 7.5'.
 5. Using a 9 7/8" air hammer, a 10" steel casing was spun to a depth of 13.7'. Then the boring was advanced to

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
 2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED. FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

DEPTH	CASING	SAMPLE			SAMPLE DESCRIPTION <u>Burmister CLASSIFICATION</u>	STRATUM DESCRIPTION	EQUIPMENT INSTALLED	FIELD SCREENING	REMARKS
		No.	PEN./REC.	DEPTH (Ft.)					
		S-7	GRAB	40				NO	678
					Fracture at 42': (Brown Silts)	42'	 43' SAND		
45					End of Exploration at +45.5'			45.5'	
50									
55									
60									
65									
70									
75									
80									

REMARKS: 5. (cont.'d) 15' where a 6" steel casing was set and grouted 5.5' into the bedrock. Could not pull the 10" casing; was grouted in place and the grout seal was allowed to set up for a minimum of 12 hrs. before the boring was advanced to 45.5' using 6' air hammer.

6. A minimal amount of water was lost to the borehole during drilling. On 2/8/95, prior to in situ testing, the borehole was developed using surge blocks and a submersible pump. Approximately 42 gallons or 1.1 standing well volumes of water were developed with a final turbidity of 35 NTU. Pumping was terminated due to slow well recovery.

7. On 2/9/95 and 2/10/95, the borehole was packer tested from 45.5' to 15' using a 5 foot test interval. Upon completion of packer testing, the contractor purged a volume of water equal to that lost to the formation during testing.

8. On 2/15/95, one shallow bedrock monitoring well constructed of 2" ID Sch. 40 PVC well pipe was installed with a 10' screened section beginning at a depth of 43.0' and topped with 35.7' of solid PVC riser (extending approx. 2.7' above ground surface). The well is protected by a 6" Sch. 40 steel locking guard pipe which extends approximately 3.0' above ground surface. See equipment diagram for further construction details.

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL. WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED. FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No. MW95-51

GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS
 BORING Co. D.L. MAHER DRILLING COMPANY
 FOREMAN JOHN BOWEN
 GZA ENGINEER STEPHEN KLINE
 BORING LOCATION SEE EXPLORATION LOCATION PLAN
 GROUND SURFACE ELEVATION 382.09 DATUM NGVD
 DATE START 1/19/95 DATE END 1/23/95

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 in.		GROUNDWATER READINGS			
DATE	TIME	WATER	CASING	STABILIZATION TIME	
1/23/95	10:30	12.2	18	1 HOUR	
3/8/95		11.9	18	1.5 MONTHS	
3/29/95		11.2	18	2 MONTHS	

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 in.
 CASING SIZE: 6" ID OTHER: 9 7/8" AIR HAMMER AND 6" AIR HAMMER

DEPTH	CBL AL S W G S	SAMPLE			SAMPLE DESCRIPTION <u>Burmister CLASSIFICATION</u>	STRATUM DESCRIPTION	EQUIPMENT INSTALLED Locking Guard Pipe	FIELD SCREENING	RE M K S
		No.	PEN./ REC.	DEPTH (Ft.)					
5		S-1	15/12	0.5-1.25	9-18 100/3"	TAN GRAVELLY SAND	BENTONITE SEAL AQUA GROUT	ND	1
						FILL BROKEN CONCRETE CONSTRUCTION DEBRIS BROWN FILL CONSTRUCTION DEBRIS		ND	2
15		S-2	24/10	6-8	5-11 18-20	Medium dense, brown, fine to medium SAND, little silt, trace Gravel, trace Wood	BENTONITE SEAL AQUA GROUT	ND	
						VOID BOULDERY TILL			
25		S-3	GRAB	16	15.5'	Grey/Red, highly weathered GRANITE (Has consistency of coarse SAND and fine GRAVEL, some Silt) 6" casing to 18 feet	BENTONITE SEAL AQUA GROUT	ND	3
						HIGHLY WEATHERED BEDROCK			
35					MIN/FT	20'	BENTONITE SEAL AQUA GROUT		
						0.8 0.5 1.0 1.0		19'	
40		S-4	GRAB	24	0.5	Fracture at 24': Brown Silts	BENTONITE SEAL AQUA GROUT	3	
						1.0 1.0 1.0 1.0		21'	
45						Fracture zone at 31 to 32'	BENTONITE SEAL AQUA GROUT		
						0.8 0.8 0.8 1.0		22'	
50		S-5	GRAB	36	1.0	Gray GRANITE (some weathering)	BENTONITE SEAL AQUA GROUT	1.0	
						1.0 0.5 1.0 1.0		24'	
55						Fracture at 38' (Red/Brown Silts)	BENTONITE SEAL AQUA GROUT		
						1.0		26'	
60							BENTONITE SEAL AQUA GROUT		
								27'	
65							BENTONITE SEAL AQUA GROUT		
								28'	
70							BENTONITE SEAL AQUA GROUT		
								29'	
75							BENTONITE SEAL AQUA GROUT		
								30'	
80							BENTONITE SEAL AQUA GROUT		
								31'	
85							BENTONITE SEAL AQUA GROUT		
								32'	
90							BENTONITE SEAL AQUA GROUT		
								33'	
95							BENTONITE SEAL AQUA GROUT		
								34'	
100							BENTONITE SEAL AQUA GROUT		
								35'	
105							BENTONITE SEAL AQUA GROUT		
								36'	
110							BENTONITE SEAL AQUA GROUT		
								37'	
115							BENTONITE SEAL AQUA GROUT		
								38'	

REMARKS: 1. Split-spoon refusal (rock chips in the soil catch).
 2. Field screening performed with HNU, Photoionization Detector (PID) with a 11.7 eV lamp. Reading in parts per million (ppm). ND indicates less than 0.1 ppm.
 3. Using a 9 7/8" air hammer, a 10" steel casing was spun to a depth of 15.5'. then drilled openhole to 18' where a 6" steel casing was set and grouted 2.5' into bedrock. An unacceptable amount of grout was being lost to the formation, therefore bentonite chips were placed around 6" casing from 12' to 10' to bridge the void. The 10" casing was pulled and the grout was allowed set up for a minimum of 12 hrs, before boring was advanced to 47.9 using a 6" air hammer.

NOTES 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITIONS MAY BE GRADUAL.
 2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED. FLUCTUATIONS OF GW MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

DEPTH	C A L S O W S	SAMPLE			SAMPLE DESCRIPTION Burmister CLASSIFICATION	STRATUM DESCRIPTION	EQUIPMENT INSTALLED	FIELD SCREENING	SPERMETER	
		No.	PEN./REC.	DEPTH (FT.)						MIN/FT
45					Fracture Zone at 41' and 43' (Brown Silts)	41'	AQUA GROUT	1.0	4	
						FRACTURE ZONE				
		S-6	GRAB	43		1.0				43'
						1.0				
						1.0				
						1.0				
						1.0				
50					Fracture at 47': (Brown Silts)	47'		1.0	5	
		S-7	GRAB	47		0.8				
55					End of Exploration at 47.9'				6	
60									7	
65									7	
70									7	
75									7	
80									7	
85									7	

REMARKS:

4. Dirty fractures water highly silty.
5. Tools have rock debris on them (fractures may be silting in the borehole).
6. On 2/13/95, obstructions in the well were discovered at 22' and 38' below ground surface which hampered borehole development. On 2/21/95, the borehole was reamed out by drill rig. A least 1-foot of sediments were removed from bottom of well. Rig developed well for 15 minutes with air to clean out sediments. Well making approximately 2 gpm.
7. By 3/8/95, the borehole caved-in a second time. On 3/19/95 using an auger rig, GZA spun 4-inch casing, and installed a well with a 16 foot screen starting at 37'. See equipment diagram for further details.

GZA GEOENVIRONMENTAL, INC.
 140 BROADWAY, PROVIDENCE, RHODE ISLAND
 GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT
 CENTRAL LANDFILL - OU2 - TASK 4
 JOHNSTON, RHODE ISLAND

REPORT OF BORING No. MW95-53
 SHEET 1 OF 1
 FILE No. 31479.3
 CHKD. BY EAS

BORING Co. D.L. MAHER DRILLING COMPANY
 FOREMAN JOHN BOWEN
 GZA ENGINEER MARK DALPE

BORING LOCATION SEE EXPLORATION LOCATION PLAN
 GROUND SURFACE ELEVATION 307.94 DATUM NGVD
 DATE START 2/9/95 DATE END 2/9/95

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 in.
 CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 in.
 CASING SIZE: 6" ID OTHER: 6" AIR HAMMER

GROUNDWATER READINGS				
DATE	TIME	WATER	CASING	STABILIZATION TIME
2-9-95	0850	10'	10'	2 MIN

DEPTH H	C A S I N G S	SAMPLE			SAMPLE DESCRIPTION Burmister CLASSIFICATION	STRATUM DESCRIPTION	EQUIPMENT INSTALLED Locking Guard PVC RISER AQUA GROUT SEAL PVC SCREEN FILTER SAND	FIELD SCREENING HNU(11.7)	REMARKS
		No.	PEN./ REC.	DEPTH (Ft.)					
		S-1	9/5	0-0.8	35-100/3"	FILL	Cem. Seal 2'	ND	1
5		S-2	24/4	5-7	3-7 17-4	REFUSE	8' BENT.	6.8	
10		S-3	24/16	10-12	7-17 25-14	SAND AND GRAVEL	10'	1.6	
15		S-4	24/22	15-17	8-26 15-16	MEDIUM TO FINE+ SAND	14'	1.2	
20		S-5	24/2	21-23	2-3 4-7	SAND AND GRAVEL	16'+		
20					Loose, gray, fine SAND, trace Silt	FINE SAND	20'	ND	2/3
25					End of Exploration at 25'+	24' GRANITE (BEDROCK)	24'		
25						BENTONITE	25'		
30									
35									
40									

REMARKS: 1. Soil TVOC headspace screening was performed employing a HNU Systems Model PI-101 Photoionization Detector equipped with an 11.7 eV lamp.
 2. Strong leachate odor noted at 20-25'.
 3. 10' of .01" slotted, 2.0" diam. Sch 40, PVC wellscreen was placed from 22'+ up to 12'+ and topped with 14.5' (above G.S.) of solid PVC riser tube. See equipment diagram for further details.

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
 2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

GZA

BORING No. MW95-53S

DEPTH	CASINGS	SAMPLE			SAMPLE DESCRIPTION Burmister CLASSIFICATION	STRATUM DESCRIPTION	EQUIPMENT INSTALLED			OBSERVATIONS	
		No.	PEN./REC.	DEPTH (FT.)			A	B	C		
45										BENTONITE AQUA GROUT	
50						47'				4	
						WEATHERED ZONE					
						48'					
		S-6	GRAB	49	2.0	Tan/Gray GRANITE cuttings, very highly WEATHERED AND FRACTURED ZONE at 50 to 55' (1.3)	50'				
					1.0		FRACTURE ZONE				
55										5	
60										6	
		S-7	GRAB	59	1.0	Tan/Gray GRANITE Cuttings (0.5)					
					1.0						
					1.5						
65										7	
70						66'				8	
						FRACTURE ZONE					
						67'					
		S-8	GRAB	67	1.5	Highly weathered, gray GRANITE rock fragments (0.3)					
					1.0		GRAY GRANITE				
75						70'				9	
						FRACTURE ZONE					
80						73'				BENTONITE SEAL	
		S-9	GRAB	80	2.0	Harder rock (small pieces) still a lot of weathering evident (ND)					
					2.0	6" casing to 82.5'					
85											

REMARKS: 4. Drill water effluent is slightly "FOAMY" (making approx. 30 gpm and borehole collapses at the Fracture Zone.
 5. Began open-hole drilling with 9 7/8 straight hammer. Advanced to 81'.
 6. Large fracture between 70' and 73' making less water.
 7. 6" ID steel casing spun into rock to a depth of 82.5'; on 2/20/95 began drilling open borehole with 6" straight hammer.
 8. On 2/21/95 the decision was made to leave the 10" steel casing in the ground. In order to protect nearby borings MW95-47 and MW94-47S, the 6" casing was sealed with a layer of bentonite chips from 82.5' to 54'; above which the annular space between the 10" and 6" casings were filled with "High Early" grout to ground surface.

DEPTH	C B A L L S O W S	SAMPLE			SAMPLE DESCRIPTION Burmister CLASSIFICATION	STRATUM DESCRIPTION	EQUIPMENT INSTALLED			REMARKS
		No.	PEN./ REC.	DEPTH (Ft.)			MIN/FT	A	B	
90					Fracture at 86': Brown Silts	GRAY GRANITE	93'	R I S E R	R I S E R	F I L T E R S A N D
				1.0						
				1.0						
				1.0						
				1.0						
		S-10	GRAB	90	Gray GRANITE Bedrock (High Quartz) (ND)					
				0.7						
				0.8						
				0.5						
				0.5						
95					Fracture 96': Brown Silts	96'	R I S E R	R I S E R	B E N T. S E A L	
				0.5						
				0.5						
				0.5						
				0.5						
				0.5						
100					Fracture at 100': Pink Silts	100'	R I S E R	R I S E R	B E N T. S E A L	
				1.0						
		S-11	GRAB	102	Gray GRANITE (ND)					
				1.0						
				1.0						
				1.0						
105					Fracture at 108': Tan Silts	108'	R I S E R	R I S E R	B E N T. S E A L	
				1.0						
				1.0						
				1.0						
				1.0						
				0.5						
110					Fracture at 111': Tan/Brown Silts	111'	R I S E R	R I S E R	B E N T. S E A L	
				1.0						
		S-12	GRAB	110	Gray GRANITE (ND)					
				1.0						
				1.0						
				0.8						
115					Fracture at 118': Tan/Brown Silts	118'	R I S E R	R I S E R	B E N T. S E A L	
				0.5						
				0.5						
				0.5						
				0.5						
				0.5						
120					Weathered GRANITE (Tan/Brown Silts) (ND)	LIGHT BROWN ROCK SOFTER ROCK	128.5'	R I S E R	R I S E R	B E N T. S E A L
				0.5						
		S-13	GRAB	120						
				0.4						
				0.4						
				0.4						
125					Gray/Cream GRANITE (ND)	CHANGES FROM LIGHT BROWN TO CREAM AT 126'	128.5'	R I S E R	R I S E R	B E N T. S E A L
				0.4						
		S-14	GRAB	126						
				0.5						
				0.8						
				0.8						
130					Olive/Tan GRANITE (possible fracture at 129')					Flint Shot. Seal.

REMARKS: 9. Large weathered seam from 118' to 129' (borehole remains open).

GZA GEOENVIRONMENTAL, INC.
140 BROADWAY, PROVIDENCE, RHODE ISLAND
GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT
CENTRAL LANDFILL - OU2 - TASK 4
JOHNSTON, RHODE ISLAND

REPORT OF BORING No. MW95-ML9
SHEET 5 OF 8
FILE No. ST479.2
CHKD. BY EAS

DEPTH	CASINGS	SAMPLE			SAMPLE DESCRIPTION <u>Burmister</u> CLASSIFICATION	STRATUM DESCRIPTION	EQUIPMENT INSTALLED		REMARKS	
		No.	PEN./REC.	DEPTH (Ft.)			MIN/FT	C		
180						176'		B E N E S E A L A Q U A G R O U T R I S E R	12	

							PINK/CREAM SILT			
185						183'				

							LIGHT BROWN SILT			
190										
195						194'				

							BROWN/ORANGE			
200										
205						199'				

							LIGHT BROWN			
210										
215						205'				

							BROWN/RED SILTS			
220						209'				

							GRAY/CREAM SILTS			
225						211'				

							BRIGHT RED SILTS			
230						213'				

							GRADING INTO PINK WITH MORE LIGHT GRAY			

REMARKS: 12. Borehole remains open despite very weathered, soft rock with high silt content.

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED. FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

GZA BORING No. MW95-ML9

DEPTH	C B A S E S	SAMPLE			SAMPLE DESCRIPTION Burmister CLASSIFICATION	STRATUM DESCRIPTION	EQUIPMENT INSTALLED		REMARKS
		No.	PEN./ REC.	DEPTH (Ft.)			MIN/FT	C	
225						221' - - - - WHITE LIGHT GRAY		B E N S E A L A C Q U A R I T S E R C R O U T	13
	S-23	GRAB	222	1.0	White/Light Gray (white/cream Silts) (ND) Fractured Zone at 226' to 228: Bright Red Silts Soft Zone 228 to 234: Green rock chips (Tan Silts)				
				1.0					
				1.0					
				0.5					
				0.5					
				0.5					
				0.5					
				0.8					
				0.8					
			0.8						
230				1.0					
				1.5					
				1.5					
				1.5					
				1.5					
235	S-24	GRAB	235	1.5	White/Light Green/Dark Gray chips (Olive/Tan Silts) (ND)	234' - - - - OLIVE/TAN HARDER ROCK GRADING TO LIGHT GRAY			
				1.5					
				1.5					
				1.5					
				1.5					
240				1.5					
				1.0					
				1.0					
				1.0					
				1.5					
245	S-25	grab	245	1.5	Gray/White with Black Flecks (Gray Silts) (ND)	LIGHT GRAY			
				1.5					
				1.5					
				1.5					
				1.5					
250				1.5		GRAY SILT GRAY/WHITE BLACK ROCK			
				1.5					
				1.5					
				1.5					
				1.5					
255				1.5					
				1.5					
				1.5					
				1.5					
				1.5					
260	S-26	GRAB	258	1.0	Green/Gray/Black Rock Fragments (Tan/Olive Silts) - Possible Fractured Zone (ND)	257' - - - - TAN/OLIVE SILTS			
				1.0					
				1.0					
				1.0					
				1.0					
265				1.0		260' - - - - BLUE/GRAY			
				1.0					
				1.0					
				1.0					
				1.0					

REMARKS: 13. Deepest observed fracture zone 226' to 228'; more bright red Silts.

DEPTH	CASINGS	SAMPLE			SAMPLE DESCRIPTION	STRATUM DESCRIPTION	EQUIPMENT INSTALLED	REMARKS
		No.	PEN./REC.	DEPTH (FT.)	MIN/FT	<u>Burmister</u> CLASSIFICATION		

REMARKS: 18. cont.'d. testing, the borehole was developed using surge blocks and a centrifugal pump. Approximately 870 gallons or 1.9 standing well volumes of water were developed with a final turbidity of 20 NTU.

19. From 3/14/95 to 3/21/95, the borehole was packer tested from 82.5' to 310.5' using a 10 foot test interval. Upon completion of packer testing, the contractor purged a volume of water equal to that lost to the formation during testing.

20. Based on the results of the borehole geophysics, packer testing and discrete zone analytical sampling, 2 2.0-inch ID Sch 80 wells were installed to depths of 293.5 feet and 143.4 feet with a 20 foot and a 10 foot 0.01-inch slotted screen. In addition, 1 1.0-inch ID Sch 40 well was installed to a depth of 93.1 feet with 10 feet of screen. See equipment diagram for further details.

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
 2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING CO. <u>D.L. MAHER ENVIRONMENTAL</u>	BORING LOCATION <u>SEE EXPLORATION LOCATION PLAN</u>	DATE START <u>1/21/97</u>
FOREMAN <u>DENNIS DUCHNOWSKI</u>	GROUND SURFACE ELEV. <u>294.66'</u>	DATE END <u>1/22/97</u>
GZA ENGINEER <u>STEPHEN KLINE</u>		

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb HAMMER FALLING 30 IN

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 LB HAMMER FALLING 24 IN

CASING SIZE: 6" OTHER 5 7/8" PNEUMATIC AIR HAMMER

GROUNDWATER READINGS				
DATE	TIME	WATER	CASING	STABILIZATION TIME
1/22/97	07:00	7.2'	50.5	OPEN BORE-HOLE

DPTH (FT)	CASING BLOWS	SAMPLE			SAMPLE DESCRIPTION BURMISTER CLASSIFICATION	STRATUM DESCRIPTION	EQUIPMENT INSTALLED	FIELD TESTING	R K
		NO	PEN/REC	DEPTH (FT)					
5					Stratum descriptions based on air hammer cuttings and drill rig response	1' TOPSOIL			1
						SAND AND GRAVEL FILL			
								6' BOULDER	
10		G-1	8-10		Brown/gray, fine to coarse SAND, little Gravel, trace Silt	9' NATURAL SAND GRADING TO GRAVEL		6.0	2
15		G-2	15+		Brown, fine Gravel and medium to coarse Sand, trace Silt, trace Organics (roots and twigs)	FINE SAND & SILT		1.5	
20		G-3	20+		Olive/gray, fine to coarse SAND, little fine Gravel, little+ Silt (organic odor)	SAND AND GRAVEL (COBBLES)		1.1	3
25		G-4	25+		Olive (silt color), medium to coarse SAND and fine Gravel, little- Silt			ND	
30					Brown/tan, fine to coarse SAND, trace Gravel	31' (COBBLES)	Bent Seal		
35					Tan, fine to coarse SAND, little Gravel, trace Silt	STRATIFIED SAND AND GRAVEL		ND	4
		S-1	18/3	35-36.5		Pushed			

REMARKS

- Field screening performed with a Thermo Environmental Instruments Model 580 Organic Vapor Monitor (OVM) Photoionization Detector (PID) equipped with an 11.8 eV lamp. Readings are in parts per million (ppm). ND indicates less than 0.1 ppm in soil sample headspace.
- Estimated bottom of earthen dam.
- Making more water at 17'+.
- Pushed 3" split spoon. Consolidated material. Very dense 1,000 lbs. pressure could only move 18" into material.

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITIONS MAY BE GRADUAL.
 2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED. FLUCTUATIONS OF GROUNDWATER TABLE MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

DEPTH	CASING BLOWS	SAMPLE				SAMPLE DESCRIPTION BURMISTER CLASSIFICATION	STRATUM DESCRIPTION	EQUIPMENT INSTALLED	FIELD TESTING	R K
		NO	PEN/REC	DEPTH (FT)	BLOWS/6"					
						(More Gravelly)				
45		G-5		44-45	Cream/Tan, medium to coarse SAND and fine Gravel, little Silt	(More Silty)		ND		
		G-5		46	Tan, fine to coarse SAND, little Gravel, little Silt	48'	47.5'	ND		5
50		S-2	6/4	51-51.5	Tan, fine to coarse SAND and sections of Granite cemented with Silts	ROTTEN ROCK	BENTONITE SEAL	ND		6
					END OF EXPLORATION AT 51.5'					7
55										
60										
65										
70										
75										
80										

REMARKS:

5. Air hammer on-soil holds more air after 48'.
6. Push 3" split spoon with 1,000 lbs. pressure only able to work 6"+ into strata.
7. A groundwater monitoring well constructed of 2" ID Sch. 40 PVC was installed with a 15' (10 slot) screen section to a depth of 47' and topped with 34 0' of solid riser pipe (2.0' above ground surface) on 1/22/97. The borehole annulus was backfilled with 4' of bentonite chips (51.5' to 47.5'), 16.5' of filter sand around screen section (47.5' to 31'), a 3' bentonite seal (31' to 28'), and 28' of cement/bentonite ground (28' to 0'). The well is protected by a 4" ID x 5' locking, steel guard pipe set 2.5' below ground surface in a concrete seal.

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL
 2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER TABLE MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

GZA GEOENVIRONMENTAL INC 140 BROADWAY, PROVIDENCE, RHODE ISLAND GEOTECH/GEOHYDROLOGICAL CONSULTANTS	PROJECT	REPORT OF BORING NO. MW97-54A
	CENTRAL LANDFILL OU2/TASK 4A	SHEET 1 OF 2
	JOHNSTON, RHODE ISLAND	FILE NO. 31842
		CHKD BY EAS

BORING CO. D.L. MAHER ENVIRONMENTAL	BORING LOCATION SEE EXPLORATION LOCATION PLAN	
FOREMAN DENNIS DUCHNOWSKI	GROUND SURFACE ELEV. 293.5'	DATUM NGVD
GZA ENGINEER STEPHEN KLINE	DATE START 1/20/97	DATE END 1/21/97

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb HAMMER FALLING 30 IN CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 LB HAMMER FALLING 24 IN CASING SIZE: 6" OTHER 5 7/8" PNEUMATIC AIR HAMMER	GROUNDWATER READINGS				
	DATE	TIME	WATER	CASING	STABILIZATION TIME
	1/20/97	1630	7.76	34	0.5 HOURS
	1/21/97		7.72	34	17 HOURS

DPTH (FT)	CASING BLOWS	SAMPLE				SAMPLE DESCRIPTION BURMISTER CLASSIFICATION	STRATUM DESCRIPTION	EQUIPMENT INSTALLED	FIELD TESTING	R K
		NO	PEN/REC	DEPTH (FT)	BLOWS/6"					
5						Stratum descriptions determined from air hammer cuttings and drill rig response	1' TOPSOIL	G R O U T		1
						Yellow/brown, fine to coarse SAND, some fine to coarse Gravel, trace Silt	SAND AND GRAVEL FILL (COBBLES)			
							9'			
						Olive/brown, fine to coarse SAND, some Silt, little fine Gravel	NATURAL GRAVELLY SAND (COBBLES)			
							15'			
20						Gray, fine to medium GRAVEL, little medium to coarse Sand, little Silt	GRAY GRAVEL AND SILTY SAND			
						Gray, fine Silty SAND, trace coarse Sand				
							21'			
						Tan, fine to coarse SAND and fine Gravel	SAND WITH ORGANIC ODOR			
						Olive/green, fine to medium SAND, little Silt	25'			
30						Olive/brown, fine to coarse SAND, some Silt, little fine Gravel	26' BOULDER SAND WITH ORGANIC ODOR			3
						Tan/orange, medium to fine SAND and fine GRAVEL, little Silt	32'			
							STRATIFIED SAND AND GRAVEL			
						Gray/brown, fine to coarse Gravel and medium to fine SAND (Gravel is blue/gray), little- Silt				
						Brown, fine to coarse SAND and fine to medium Gravel, little Silt				

REMARKS

- No field screening was performed
- Estimated bottom of earthen dam.
- Very easy drilling.
- Making significant volumes of water, easy drilling drop 3 feet in 30 sec.

DEPTH	CASING BLOWS	SAMPLE				SAMPLE DESCRIPTION BURMISTER CLASSIFICATION	STRATUM DESCRIPTION	EQUIPMENT INSTALLED		FIELD TESTING	R K
		NO	PEN/REC	DEPTH (FT)	BLOWS/6"						
						Brown, fine to coarse SAND, little Silt, little fine Gravel	STRATIFIED SAND AND GRAVEL	G R O U T			5
45						Material grades to coarse Sand and Gravel					6
50						END OF EXPLORATION AT 47'					7
55											
60											
65											
70											
75											
80											

REMARKS

5. Zone is producing a significant volume of water.
6. Neither rotten rock nor bedrock interface encountered by 47'.
7. Casing separated 13' from bottom of borehole - could not retrieve - borehole was abandoned and sealed using tremied in place bentonite/cement grout on 1/21/97.

NOTES:

- 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES; TRANSITIONS MAY BE GRADUAL.
- 2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED. FLUCTUATIONS OF GROUNDWATER TABLE MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

GZA GEOENVIRONMENTAL INC 140 BROADWAY, PROVIDENCE, RHODE ISLAND				PROJECT CENTRAL LANDFILL OU2/TASK 4A JOHNSTON, RHODE ISLAND		REPORT OF BORING NO. MW97-ML10 SHEET 1 OF 8 FILE NO. 31842 CHKD BY EAS							
GEO TECH/GEOHYDROLOGICAL CONSULTANTS				BORING LOCATION SEE EXPLORATION LOCATION PLAN									
BORING CO. D.L. MAHER ENVIRONMENTAL		FOREMAN DENNIS DUCHNOWSKI		GROUND SURFACE ELEV. 294.35'		DATUM NGVD							
GZA ENGINEER STEPHEN KLINE				DATE START 1/8/97		DATE END 1/15/97							
SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 3" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 IN				GROUNDWATER READINGS									
CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 LB HAMMER FALLING 24 IN.				DATE	TIME	WATER	CASING	STABILIZATION TIME					
CASING SIZE 10 7/8" OTHER 9 7/8 & 5 7/8" PNEUMATIC AIR HAMMER				1/8/97	13:00	5.0	10.0	0.5 HOURS					
				1/16/97	08:00	5.9	70.0	1 DAY					
DPTH (FT)	CASING BLOWS	SAMPLE			SAMPLE DESCRIPTION BURMISTER CLASSIFICATION	STRATUM DESCRIPTION	EQUIPMENT INSTALLED			FIELD TESTING	R K		
		NO	PEN/REC	DEPTH (FT)			BLOWS/6"	A	B				
5		S-1	24/16	0-2	8-9	Medium dense, dark brown, fine to medium SAND, some silt (roots and other organics) changing after 10" to tan, fine to coarse SAND, some fine to coarse Gravel	10" TOPSOIL				55	1	
					12-7		SAND AND GRAVEL					2	
							FILL (Cobbles)	B				3	
		S-2	24/2	5-7	32-26	Very dense, olive/brown, fine to medium SAND and fine to medium Gravel, little + silt (saturated)	8'	E	R	R		16	
		G-1		6	28-36			S	S	S			
10							A	R	R			4	
		S-3	24/8	10-12	3-6	Medium dense, olive/brown, fine to coarse SAND, some fine to coarse Gravel, trace silt	STRATIFIED SANDS	A			1.5		
					4-10		(COBBLES)	Q					
15							U						
		S-4	24/20	15-17	21-23	Dense, olive/green, fine SAND, little - silt interbedded with layers of coarse Sand, some fine to medium Gravel		G			ND		
					18-19			R					
20							O					5	
		S-5	20/2	20-21.7	9-3	Dense, gray, fine SAND, trace silt	21'	T			1.5		
					40-50/2"		GRAVEL						
25							24.5'						
							BOULDER					6	
		S-6	24/7	27.5-29.5	2	Very loose, fine SAND, changing after 4" to gray, fine to coarse SAND, little blue and orange, fine Gravel	27.5'				ND	7	
30							SANDY GRAVEL						
					2-2		BOULDER						
					3		COBBLES						
35							31'						
							STRATIFIED SAND AND GRAVEL				1.6	8	
		S-7	5/0	35-35.5	50+5"	Very dense, gray, fine to coarse GRAVEL, trace fine to coarse Sand, trace silt							
	G-2		35										

- Field screening performed with a Thermo Environmental Instruments organic vapor monitor (OVM) Photoionization Detector (PID) equipped with an 11.8 eV lamp. Readings are in parts per million (ppm). ND indicates less than 0.1 ppm in soil sample headspace. Based on subsequent analytical testing it appears that the elevated headspace readings were potentially caused by water vapor and extreme cold.
- Frost to 8 inches
- Sample is saturated. Poor recovery - took grab sample (G-1) from hammer may have been pushing a cobble. Sample has organic odor (like black licorish)
- Approximately 1.5" rounded gravel in soil catch of sampler resulted in low sample recovery.
- Split spoon refusal - very poor recovery - drill cuttings indicate fine to coarse gravel (quartz, mica granite) rounded edges, trace fine sand, trace silt.
- Encountered granite boulder from 24.5' to 27.5' - Cyclone returned angular granite chips. Borehole making much more water.
- Began with split spoon sample on 1/9/97 only 8' of water in casing (i.e., DTW=19.5') at 27.5ft - hydrostatic surface at 5'.
- Split spoon refusal at S-7 took grab sample G-2 at 35' from cyclone.

DPTH	MIN/FT	SAMPLE				SAMPLE DESCRIPTION BURMISTER CLASSIFICATION	STRATUM DESCRIPTION	EQUIPMENT INSTALLED			FIELD TESTING	R K
		NO	PEN/REC	DEPTH (FT)	BLOWS/6"			A	B			
40						STRATIFIED SAND AND GRAVEL	B E N S E A L	A	R	S E E R	7.0	8
		G-5		40+	Light brown, fine GRAVEL and medium to coarse Sand, trace Silt							
45						Yellowish brown fine to coarse SAND and Gravel, little (-) Silt	A Q U A				ND	
		G-6		45+								
50		1				White and black GRANITE Fragments Yellowish brown Silts	G R O U T				ND	
		1	G-7		51+							
		2										
		2										
55		2				White, GRANITE Fragments, cream colored Silts (more sand consistency)					ND	9
		3	G-8		55+							
		2										
60		2				10" ID steel casing installed to 60'					ND	10
		2	G-9		58+							
		2										
		2	G-10		60+							
65		2				Fracture zone: (Red Silt 63' to 64' borehole remains open)	F R A C T U R E Z O N E				ND	11
		2										
		2	G-11		65+							
		2										
70		2				Light gray GRANITE (consistency of coarse Sand with cream/white Silts)	67'	69'	70'		ND	12
		2										
		2	G-12		70+							
		2										
75		2				Light gray GRANITE (cream/white Silts)	F S I C L R T E R				ND	13
		2										
		3										
		3	G-13		75+							
		3										
	3				Fracture zone (brown silts - easier drilling)	77'	78'	80'				

REMARKS:

8. Air hammer returns are very silty. Borehole making approximately 10+ gpm.
9. Rock increases in hardness at 55'
10. On 1/9/97, spun casing to 58'. Advanced bit in front of casing 2'-borehole is not self supporting.
11. On 1/10/97, spun casing to 60' borehole making less water - silts are cream colored - competent rock drilled open borehole 10' and rock remains open-grouted in 6-inch casing
12. During the grouting of the 6" casing, the 10" casing became stuck - could not be removed.
13. Grout allowed to set up over weekend before advancing 6-inch ID open borehole drilling on 1/13/97.

GZA GEOENVIRONMENTAL INC.
140 BROADWAY, PROVIDENCE, RHODE ISLAND

GEOTECH/GEOHYDROLOGICAL CONSULTANTS

PROJECT
CENTRAL LANDFILL OU2/TASK 4A
JOHNSTON, RHODE ISLAND

REPORT OF BORING NO. MW97-ML10
SHEET 3 OF 8
FILE NO. 31842
CHKD BY EAS

DPTH	MIN/FT	SAMPLE				SAMPLE DESCRIPTION BURMISTER CLASSIFICATION	STRATUM DESCRIPTION	EQUIPMENT INSTALLED	FIELD TESTING	R K
		NO	PEN/REC	DEPTH (FT)	BLOWS/6"					
81	1	G-14		80+				B	ND	
	4									
	2				Fracture: brown Silts larger red granite	83'	83'			
	2				fragments (83'+)					
85	2					GRAY GRANITE	85'	Be Seal		
	1									
	1									
	1					88'				
90	4	G-15		90+		FRACTURE ZONE	90'	B	ND	
	4				Fracture: brown Silts larger red granite					
	4				fragments (erratic hammer movement)					
	1					GRAY GRANITE	92'	N		
95	1									
	2				Granite: gray Silts (quartz sand fragments)					
	2									
	2									
100	1				Fracture: (98'+) brown silts		98'			
	1									
	1					SOFT GRAY GRANITE				
	1									
105	1	G-16		105+		GRADUALLY HARDER GRAY GRANITE			ND	
	2				Gray GRANITE (fine to coarse Sand fragment - gray Silts)					
	2									
	2									
110	2									
	2									
	2									
	2									
115	1	G-17		115+			115'			
	2				Fracture zone: red/orange GRANITE fragments with brown Silts					
	2					FRACTURES			ND	
	2					GRAY GRANITE				
120	1									

REMARKS:
14. Drilling bucking- softer rock.

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES; TRANSITIONS MAY BE GRADUAL.
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MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

GZA

BORING NO. MW97-ML10

DPTH	MIN/FT.	SAMPLE				SAMPLE DESCRIPTION BURMISTER CLASSIFICATION	STRATUM DESCRIPTION	EQUIPMENT INSTALLED	FIELD TESTING	R K
		NO	PEN/REC	DEPTH (FT)	BLOWS/6"					
121	1					Fracture: Brown Silt red/orange granite fragments	B			
	2									
	1.5									
125	1.5	G-18		125+		Large granite fragments (more orange pink/gray Silts)	R I S E R	ND		
	1.5									
	1									
	1									
	1									
130	1					Siltier discharge, GRANITE is blue/black/dark gray	B E N S E A L			
	1									
	0.5									
	0.5									
	1									
135	1					Fracture zone: Tan/yellow/black GRANITE Fragments, tan Silts (132' to 133')	A Q U A			
	1									
	1.5									
	2.0	G-18		138+						
	8.0									
140	5.0					Black and white GRANITE with gray Silts	G R O U T		15	
	5.0									
	12.0									
	3.0									
	3.0									
145	3.0					Black and white GRANITE with green tint to quartz - gray Silts				
	3.0									
	3.0									
	3.0									
	3.0									
150	3.0	G-20		150+		Black and white GRANITE - gray Silts			ND	
	3.0									
	3.0									
	0.5									
	5.0									
155	5.0					Fracture: Large pieces in return with gray Silts (152'+)			16	
	5.0									
	5.0									
	5.0									
	5.0									
160	5.0									

REMARKS:
 15. Granite became very hard hammer not progressing. Pulled pneumatic hammer from 142. Replaced bit - continued drilling.
 16. Drill head dropped 6"+ in approximately 30 seconds and then slowed again.

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BORING NO. MW97-ML10

GZA GEOENVIRONMENTAL INC.
 140 BROADWAY, PROVIDENCE, RHODE ISLAND
 GEOTECH/GEOHYDROLOGICAL CONSULTANTS

PROJECT
 CENTRAL LANDFILL OU2/TASK 4A
 JOHNSTON, RHODE ISLAND

REPORT OF BORING NO. MW97-ML10
 SHEET 5 OF 8
 FILE NO. 31842
 CHKD BY EAS

DPTH	MIN.FT.	SAMPLE				SAMPLE DESCRIPTION BURMISTER CLASSIFICATION	STRATUM DESCRIPTION	EQUIPMENT INSTALLED	FIELD TESTING	R K
		NO	PEN/REC	DEPTH (FT)	BLOWS/6"					
161	5	G-21		160+		Black and white GRANITE - gray Silts		B	ND	
	3									
	3					Small fractures? - drill rig jumped	162' ----- 163' FRACTURES ----- GRAY GRANITE			
165	3							R		
	4							I		
	3					Fracture: (168'+)	168'	S	ND	17
170	3							E		
	3	G-22		170+		Black and white GRANITE fragments (fine to coarse SAND sized particles- slight green tint to white fragments).		R		18
	4									
175	5									
	5									
	5									
180	5									
	5	G-23		180+		White and gray GRANITE (still tint of green) white/gray Silts trace black/yellow and orange fragments			1.1	19
	4									
185	3					Not making any more water, slightly siltier				
	3									
	3						SOFTER ROCK			
190	4									
	4									
	5									
195	5	G-24		190+		White and gray GRANITE (still tint of green) white/gray Silts trace black/yellow and orange fragments			1.1	
	5									
	5						HARDER AGAIN			
200	5									
	5									
	5									

REMARKS:

- 17. Drill rig jumped at 168'+ larger rock fragments. Borehole appears to be making more water.
- 18. Driller has increased pressure on downward head (he says won't drag along the inside of borehole when questioned).
- 19. PID reading may be affected by moisture on the lamp, however, PID calibration check was acceptable.

NOTES:

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GZA

BORING NO. MW97-ML10

GZA GEOENVIRONMENTAL INC.
140 BROADWAY, PROVIDENCE, RHODE ISLAND

PROJECT
CENTRAL LANDFILL OU2/TASK 4A
JOHNSTON, RHODE ISLAND

REPORT OF BORING NO. MW97-ML10
SHEET 7 OF 8
FILE NO. 31842
CHKD BY EAS

GEOTECH/GEOHYDROLOGICAL CONSULTANTS

DPTH	MIN/FT.	SAMPLE				SAMPLE DESCRIPTION BURMISTER CLASSIFICATION	STRATUM DESCRIPTION	EQUIPMENT INSTALLED	FIELD TESTING	R K
		NO	PEN/REC	DEPTH (FT)	BLOWS/6"					
241	3	G-29		240+		Black and white grained GRANITE (slight gray/green tint, fine to coarse Sand-sized grains).	SOFTER COARSER GRAINED GRANITE	B	ND	
	2									
	2									
245	2						R I S E R	B E N S E A L	ND	
	2									
	2									
250	3						A Q U A G R O U T	ND		
	3									
	3									
255	4	G-30		250+		Black and white grained GRANITE	253' SOFT 255' ZONE HARDER ROCK	A Q U A G R O U T	ND	
	3					More gray Silt, larger granite fragments (no green)				
	2									
260	2						268'	A Q U A G R O U T	ND	
	5									
	3									
265	3						272' 273' FRACTURES	A Q U A G R O U T	ND	
	3									
	3									
270	4					Large fragment, more white silt, drill rig	275'	A Q U A G R O U T	ND	
	5					bucks and grinds, purple and green crystals				
	2									
275	2	G-32		270+		Green to gray GRANITE with little black and trace purple large flat fragments)	275'	275'	ND	
	2									
	1									
275	2					Fracture: (275'+)	SOFTER	275'	ND	
	1									
	2									
280	1						279'	A Q U A G R O U T	ND	
	2									

REMARKS:

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES; TRANSITIONS MAY BE GRADUAL.
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GZA

BORING NO. MW97-ML10

GZA GEOENVIRONMENTAL INC.
 140 BROADWAY, PROVIDENCE, RHODE ISLAND
 GEOTECH/GEOHYDROLOGICAL CONSULTANTS

PROJECT
 CENTRAL LANDFILL OJ2/TASK 4A
 JOHNSTON, RHODE ISLAND

REPORT OF BORING NO. MW97-ML10
 SHEET 8 OF 8
 FILE NO. 31842
 CHKD BY EAS

DPTH	MIN/ FT	SAMPLE				SAMPLE DESCRIPTION BURMISTER CLASSIFICATION	STRATUM DESCRIPTION	EQUIPMENT INSTALLED	FIELD TESTING	R K
		NO	PEN/REC	DEPTH (FT)	BLOWS/6"					
281	2	G-33		280+		GRAY GRANITE	B S C R E E N			
	2				Silts					
	3									
285	3					287'	S A N D		21	
	3									
	2				FRACTURE (287'+)					
290	2					290'	S A N D			
	2	G-34		290+	Green black/gray GRANITE fragments, gray Silts (fragments as large as fine GRAVEL)					
	3									
295	3					GRADUALLY HARDER GRANITE				
	5									
	7				White/gray trace black GRANITE					
300	5								22	
	3									
	3				Green/gray/black GRANITE, fragments gray Silts					
	3	G-35		300+					23	
					END OF EXPLORATION AT 300'±				24	
									25	
									26	
									27	

REMARKS:

21. Air hammer returns medium to coarse GRAVEL fragments of broken rock
22. Reached bottom 300' at 11:10 hours on 1/15/97 - developed borehole for 4 hours pumping and surging with 6-inch surge blocks. Borehole makes ±1.5 gpm, water is clear with rust tint
23. On 1/16/97 Colog, Inc. performed geophysical logging including 3-arm borehole caliper, fluid temperature and resistivity, acoustic borehole televiewer, and heat-pulse flow meter logging
24. Between 1/29 and 2/5/97, the borehole was packer tested using 16 10-foot long test intervals, selected based on geophysical logging, from 70 to 300 feet
25. On 2/24/97 a short duration specific capacity test was performed while purging a volume of water equal to that lost to the formation during packer testing
26. Based on the results of borehole geophysics, packer testing and discrete zone analytical sampling, two 2-inch ID Sch. 80 monitoring wells were installed to depths of 300' and 80' with 20' and 10' of 0.01" slot screen, respectively. See equipment diagram for further installation details.
27. On 3/11/97, GZA installed QED "Well Wizard" dedicated bladder pump sampling systems in each monitoring well.

NOTES

- 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
- 2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED. FLUCTUATIONS OF GROUNDWATER TABLE MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

GZA

BORING NO. MW97-ML10

GUILD DRILLING CO., INC.

100 WATER STREET EAST PROVIDENCE, R I

TO C E Maguire, Inc. ADDRESS Providence, R.I.
 PROJECT NAME Hazardous Waste Closing LOCATION Johnston, R.I.
 REPORT SENT TO above / R.I. SWMC PROJ. NO. 3869
 SAMPLES SENT TO " OUR JOB NO. 82-54

SHEET 1 OF 1
 DATE WELL J
 HOLE NO. BH-J
 LINE & STA. _____
 OFFSET _____
 SURF. ELEV. _____

GROUND WATER OBSERVATIONS		CASING Type Size ID Hammer Wt Hammer Fall	SAMPLER S/S 1 3/8" 300# 24"	CORE BAR NXD3 BIT Dia.	Date	Time
At <u>11'2"</u>	after _____ Hours				START <u>8/25/81</u>	a.m. p.m.
At _____	after _____ Hours	COMPLETE <u>8/26/81</u>		TOTAL HRS. _____		
		BORING FOREMAN <u>F. Ricci</u>		INSPECTOR <u>K.Z.</u>		
		SOILS ENGR. _____				

LOCATION OF BORING

DEPTH	Casing Blows Per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler			Moisture Density or Consist.	Strata Change Elev.	SOIL IDENTIFICATION Remarks include color, gradation, Type of soil etc. Rock-color, type, condition, hardness, Drilling time, seams and etc	SAMPLE		
				From 0-6	To 6-12	To 12-18				No	Pen	Rec
		0'-1'6"	D	9	9	12	Dry medium dense		Loam - Brown fine Sand & Gravel (Road Fill)	1	18'	12"
		5'-6'6"	D	18	22	37	Wet very dense		Brown fine to coarse SAND & fine to medium Gravel, some silt	2	18'	7"
		10'-11'6"	D	20	22	25	Wet dense		" color change to Gray Brown	3	18'	7"
		13'6"-18'6"	C					13'6"	Top of Rock	C1	60'	60"
		18'6"-22'6"	C					22'6"	Gray GRANITE, very hard	C2	48'	45"
									Bottom of Boring 22'6"			

GROUND SURFACE TO <u>13'6"</u>		USED <u>HW</u>	"CASING: THEN <u>Cored</u>
Sample Type D=Dry C=Cored W=Washed UP=Undisturbed Piston TP=Test Pit A=Auger V=Vane Test UT=Undisturbed Thin soil	Proportions Used trace 0 to 10% little 10 to 20% some 20 to 35% and 35 to 50%	140 lb Wt. x 30" fall on 2" O.D. Sampler Cohesionless Density 0-10 Loose 10-30 Med. Dense 30-50 Dense	Cohesive Consistency 0-4 Soft 30 + Hard 4-8 M/Stiff 8-15 Stiff
		SUMMARY: Earth Boring <u>13'6"</u> Rock Coring <u>9'</u> Samples <u>3</u>	
		HOLE NO BH-J	

GOLDBERG-ZOINO & ASSOCIATES, INC.
 140 BROADWAY, PROVIDENCE, RHODE ISLAND
 GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT
 CENTRAL LANDFILL/RI/FS
 Johnston, RI

REPORT OF BORING No. WE87-4
 SHEET 1 OF 2
 FILE No. C-30027.8
 CHKD. BY EAS

BORING Co. Guild Drilling Co.
 FOREMAN Paul Brescia
 GZA ENGINEER Mike Sherrill

BORING LOCATION Refer to Exploration Location Plan
 GROUND SURFACE ELEVATION 587.0 DATUM NAVD
 DATE START 8-17-87 DATE END 8-21-87

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 in.
 CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 in.
 CASING SIZE: PW 5", HW 4" OTHER: Core Barrel HX, Double Tube 3.8" O.D.
 Drilled Casing

GROUNDWATER READINGS			
8-19	23'	16'	17 Hours
8-19	27.7'	16'	End of Core Drill
8-20	23.4'	16'	16 Hours
8-21	23.1'	16'	16 Hours

DEPTH	CBL S N G S	SAMPLE			SAMPLE DESCRIPTION <u>Burmister CLASSIFICATION</u>	STRATUM DESCRIPTION	EQUIPMENT INSTALLED		REMARKS
		No.	PEN./ REC.	DEPTH (Ft.)			BLOWS/6"		
5		S-1	18/13	0.0-1.5	17-25-42	GRANULAR FILL 2.0'	Guardpipe	1.	
		R-1	37"	1.9-5	Roller Bit				2.
10		S-2	6/5	5-5.5	82/Refusal	BOULDER and GRAVELLY SAND (TILL)	2.0" ID PVC Riser Pipe	4.0'	
		R-2	42"	5.5-9	Roller Bit				4.
15		S-3	24/15	9-11	23-41	14'+	Native Sand Backfill	5.	
				51-63	Roller Bit				
20		S-4	11/4	15-15.9	27-30/5"	ROTTEN ROCK 16.0'	Bentonite Seal	15'	
		C-1	54/54	16.5-21	4.5 Min				18'
25				RQD 57%	4.5	BEDROCK	20'	3.	
					5				
30		C-2	60/60	21-26	5	Moderately Weathered To Fresh, Light Gray, Medium- Grained, SCITUATE GRANITE GNEISS	2.0" Slotted PVC Screen with Filter Sand Pack	36'	
				RQD 58%	4.5				37'
35					4.1	C-3: Same to 28 ft; Quartz zone from 28' to 29.3'; From 28 ft, rock is fresh with weathering limited to staining of joint surfaces; Tight vertical joint 27' to 28'; low angle, slightly open joints at 28.2', 28.7' and 29'.	Bentonite Seal	39.5'	
					5.9				
40		C-4	60/59	31-36	5.5	C-4: Fresh rock, with stained tight, horizontal fractures at 31.9', 33.5' and 34'.			
				RQD 93%	4.3				
					3.7	C-5 and C-6: Same: Tight low angle fracture at 37.7' and tight, vertical fracture from 38.5' to 41.0'.			
					3.7				
		C-5	20/20	36-37.7	6				
				RQD 100%	8				
		C-6	39/39	37.7-41	6.5				
				RQD 52%	5.0				

REMARKS: 1. Drilled HW casing behind roller bit through bouldery soils to 16 feet; Roller bit advanced to 16.5 ft; Rock coring started at 16.5 feet.

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITIONS MAY BE GRADUAL.
 2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED. FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

GZA

BORING No. WE87-4

GOLDBERG-ZOINO & ASSOCIATES, INC.
 140 BROADWAY, PROVIDENCE, RHODE ISLAND
 GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT
 CENTRAL LANDFILL/RIFS
 Johnston, RI

REPORT OF BORING No. WEB7-4
 SHEET 2 OF 2
 FILE No. C-30027.8
 CHKD. BY EAS

DEPTH	C A S I N G S	SAMPLE			SAMPLE DESCRIPTION Burmister CLASSIFICATION	STRATUM DESCRIPTION	EQUIPMENT INSTALLED		REMARKS
		No.	PEN./ REC.	DEPTH (Ft.)			BLOWS/6"		
		C-7	60/59	41-46	4.3	C-7: Same; tight, low angle stained fractures at 41.4' and 45'.	SCITUATE GRANITE GNEISS	Filter Sand	
				RQD 94%	5.5				
					6.5				
					5.5				
					6.5				
45					7.5				
50									
55									
60									
65									
70									
75									
80									
85									

REMARKS: 2. Cored bedrock from 16.5 feet to 46 feet. Lost drilling water at 23.7 foot depth, with no subsequent return.
 3. Bedrock zone between 21.9 feet and 43.5 feet was Packer pressure tested to evaluate bedrock hydraulic conductivity; Injected a total of 232 gallons; Bailed approximately 280 gallons.
 4. Installed one observation well which consists of 16' of 2.0" I.D. PVC screen (0.01 inch slot) installed from 20' to 36' with 2.0" I.D. PVC riser pipe to ground surface. One 7' by 4" locking guard pipe was then installed to 3' above ground surface and cemented in place. Refer to figure for additional details.

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
 2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED. FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

GZA

BORING No. WEB7-4

APPENDIX C-2

DEVELOP BUFFER ZONE FOR OU2 AREA



DEVELOP BUFFER ZONE FOR CUZ AREA

- 1 ASSUME UNIFORM FLOW FIELD,
USE CROSS GRADIENT DISTANCE
PUMPING RATE OF 56 GPM = 7200 GPD = 960 FT³/day
GRADIENT OF 0.04
TRANSMISSIVITY OF 90 FT²/day / 2 = 45 FT²/day

SEE PAGE 2 ANS: 267 FEET

- 2 CHECK DROWDOWN IN WELL TO
BE SURE WELL CAN SUPPORT THIS CONDITION
YES SEE PAGES 3 AND 4

- 3 LOOK AT A NOT WATER TABLE
AND USE RECHARGE OF 9"/YR
SEE PAGE 3 ANS: 385 FEET

- 4 ESTIMATE TIME TO STABILIZATION
ANS. 3 WEEKS OF PUMPING SEE PAGE 4

USE 385 FEET OUTSIDE AMBIENT GROUNDWATER FLOW
--



GZA GEOTECHNICAL, INC.
Engineers and Scientists

140 BROADWAY PROVIDENCE, RHODE ISLAND 02903
(401) 421-4140

JOB CLF 017 ET
SHEET NO. 140 OF 4
CALCULATED BY DM DATE 9/2/97
CHECKED BY SMK DATE 9/3/97
SCALE _____

USE $\frac{1}{2}$ FOR AVAILABLE TRANSMISSIVITY

$$T = 90 \frac{\text{FEET}^2}{\text{DAY}}$$

$$Q = v \cdot T \cdot L$$

$$v = \frac{Q}{T \cdot L}$$

$$\frac{T}{2} = 45 \frac{\text{FT}^2}{\text{DAY}}$$

$$i = 0.04$$

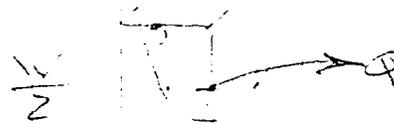
$$Q = 56 \text{ GPM}$$

$$= 960 \frac{\text{FT}^3}{\text{DAY}}$$

$$v = \frac{960}{45 \cdot 0.04}$$

$$= 533 \text{ FEET}$$

$$\frac{\text{FT}^3/\text{DAY}}{\text{FT}^2/\text{DAY}}$$



ASSUME RADIUS OF INFLUENCE EQUALS $\frac{v}{2}$ ($R_o =$)

$$R_o = 533/2 = 267 \text{ FT}$$

CHECK Drawdown in well

$$Q = \frac{K \cdot \pi (h^2 - h_w^2)}{\ln(R_o/r_w)}$$

$$h^2 - h_w^2 = (h - h_w)(h + h_w)$$

drawdown $h - h_w = s$

$$\frac{K(h + h_w) \cdot 2T}{K(h + h_w) \cdot T} = T$$

$$Q = \frac{2\pi T s}{\ln(R_o/r_w)}$$

$$s = \frac{Q \cdot \ln(R_o/r_w)}{2\pi T}$$



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Engineers and Scientists

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JOB CLF 022 R1
SHEET NO. THREE OF Four
CALCULATED BY MA DATE 9/2/97
CHECKED BY SMK DATE 9/3/97
SCALE _____

$$s = \frac{960 \cdot \ln\left(\frac{267}{.25}\right)}{2 \cdot \pi \cdot 45 \frac{\text{ft}^3}{\text{day}}}$$

$$= 24 \text{ FEET}$$

LOOK AT CIRCLE

$$Q = P \cdot A \quad P = 9''/\text{year}$$

$$\frac{\text{ft}^3}{\text{year}} = \frac{\text{ft}}{\text{yr}} \cdot \text{ft}^2$$

$$960 \cdot 365 = 9/12 \cdot A$$

$$A = 467,200 \text{ ft}^2$$

$$A = \pi r^2$$

$$r^2 = 149,000$$

$$r = 385 \text{ FEET}$$

USE 385 FEET

ASSUMES
THAT WASTE TABLE
AREA OF RECHARGE
AT 9''/YEAR TO SUBST +
A FLOW OF 56 GPM

THE WASTE TABLE IS AT A SLIKE OF 0.04

$$k1 = \frac{Q}{T \cdot L}$$

$$T = \frac{Q}{k1 \cdot L} = \frac{960}{\pi \times 0.04}$$

EQUIVALENT TO USING T $\Rightarrow T = 31 \text{ FT}^2/\text{DAY}$



GZA GEENVIRONMENTAL, INC.
Engineers and Scientists
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(401) 421-4140

JOB CLF, 012 (2)
SHEET NO. 1/012 OF 4
CALCULATED BY NAJ DATE 9/2/97
CHECKED BY JMK DATE 9/3/97
SCALE _____

ESTIMATE TIME TO STABILIZATION

USE $T = 31 \text{ FT}^2/\text{DAY}$
 $= 232 \text{ GPD/FT}$

$$R_0 = \sqrt{\frac{0.37E}{S}}$$

$T = 232 \text{ GPD/FT}$
 $R_0 = 385 \text{ FEET}$
 $S = 0.01$

$$X = \frac{R_0^2 \cdot S}{0.37}$$

$\approx 21 \text{ DAYS (3 WEEKS)}$

$5 \text{ GPM} = 7,200 \text{ GALLONS/DAY}$

USE FAMILY OF 4 = 172 GPM
25 TIMES WHAT A
FAMILY OF 4 WOULD
BE REQUESTED TO USE

ESTIMATE DRAWDOWN IN WELL

PUMPING 5 GPM WITH TRANSMISSIVITY OF $31 \text{ FT}^2/\text{DAY}$

$$s = \frac{Q \ln(R/r_w)}{2\pi T} \quad (\text{SEE SHEET 2})$$

$$= \frac{960 \text{ FT}^3/\text{DAY} \left(\frac{385}{0.25}\right)}{2\pi \cdot 31}$$

$= 36 \text{ FEET}$

Appendix C:
Boring Logs & Hydraulic Calculations (Continued),
Appendix D: Residential Well Summary, and
Appendix E: Human Health Risk Data
(pages 62-126)
are available
in a separate file (size: 2.5 MB).

[Click here to view.](#)

Appendix E:
Human Health Risk Data (Continued)
(pages 127-218)
is available
in a separate file (size: 4 MB).

[Click here to view.](#)

Appendix E:
Human Health Risk Data (Continued)
(pages 219-289)
is available
in a separate file (size: 2.5 MB).

[Click here to view.](#)