Aquifer Variance Report

Part 360 Application to Construct and Operate a Solid Waste Management Facility

Proposed Eastern Expansion
City of Albany
County of Albany, New York

CHA Project Number: 12206

Prepared for:

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1.0 INTRODUCTION

The City of Albany has applied to expand its existing landfill located on Rapp Road in the City of Albany. In conjunction with that request, the City has requested a variance from the provisions of 6 NYCRR 360-2.12(c)(1)(i), which prohibits siting a landfill over a primary water supply aquifer or principal aquifer. The purpose of this report is to provide the basis for the City's request for the variance, based upon the unique circumstances associated with the characteristics of the Albany Pine Bush Formation, which underlies the site, and the unique circumstances facing the City as well as the communities that make up the Albany New York Solid Waste Energy Recovery System (ANSWERS) Planning Unit.

As required by 6 NYCRR Part 360-1.7(c)(2), this Aquifer Variance Report has been prepared to

i. Identify the specific provisions of 6 NYCRR Part 360 from which a variance is sought;
ii. Demonstrate that compliance with the identified provisions would impose an unreasonable economic burden on the public; and
iii. Demonstrate that the proposed activity will have no significant adverse impact on the public health, safety or welfare, the environment or natural resources, and will be consistent with the Environmental Conservation Law and the performance expected from the application of the 6 NYCRR Regulations.

2.0 HISTORICAL SOLID WASTE MANAGEMENT BACKGROUND

2.1 General

The proposed project involves the expansion of the existing City of Albany Rapp Road Landfill onto City-owned lands, located east of the existing landfill (Eastern Expansion), in order to continue to meet the solid waste disposal needs of City residents and businesses as well as the communities that make up the Albany New York Solid Waste Energy Recovery System (ANSWERS) Solid Waste Management Planning Unit, and the Capital Region as a whole. ANSWERS is comprised of a consortium of communities that include the cities of Albany, Rensselaer and Watervliet, the towns of Berne, Bethlehem, Guilderland, Knox, New Scotland, Rensselaerville, and Westerlo, and the Villages of Green Island and Altamont.

The Eastern Expansion of the landfill involves an overfill of approximately 23 acres of the existing landfill and a lateral expansion of approximately 15 acres that includes 2 acres within the existing landfill operations area (existing disturbed/developed lands) and 13 acres within undeveloped City-owned property directly to the northeast. Existing landfill infrastructure including offices, the recycling building, and other accessory uses will be relocated to two parcels totaling approximately 3.5 acres located directly east of the landfill entrance road off of Rapp Road.

An integral part of the Eastern Expansion proposal is a Habitat Plan. There is a significant opportunity to re-establish linkages from west to east in the Albany Pine Bush Preserve through the existing mobile home park property and over portions of the closed landfill. Implementation of the plan would be an ongoing process, beginning with wetland mitigation and stream restoration on the mobile home park property and demonstration plots on the existing landfill; and continuing with habitat restoration efforts on closed portions the existing landfill as well as surrounding areas of currently degraded habitat. It is envisioned that the landfill can be blended into the Albany Pine Bush Preserve landscape, providing critical habitat for rare ecological communities and threatened and endangered species.

The Habitat Plan is also designed to address other influences on the natural communities within the Pine Bush. These influences include the mobile home park and the grading and sand mining that removed Pine Bush habitat and changed the landscape, the relocation and ditching of natural streams that are tributary to Lake Rensselaer, and the draining and ditching of large wetland

areas for past agricultural purposes, all of which contribute to poor water quality and the loss of natural/native Pine Bush communities.

The Habitat Plan and the Eastern Expansion are intertwined in terms of construction phasing, financing, and closure. Restoration, mitigation, and enhancement projects will begin during the first year of the landfill expansion and will be phased over the anticipated 6.6-year life of the project, with the final phase a component of the closure plan. The end result converts the entire Rapp Road Landfill complex and surrounding lands, with the exception of landfill operations structures that will be needed to continue to address gas and leachate collection, odor abatement, and possible transfer station operations, into Pine Bush habitat. This expansion project provides the financial means to restore and enhance approximately 250 acres of land. With limited State and local funding sources, the ability of the Pine Bush Preserve Commission to achieve the goals of the Habitat Plan is significantly diminished if not impossible. The Habitat Plan is discussed in greater detail in Section 6.0, as well as the September 2008 *Fourth Supplemental Draft Environmental Impact Statement* for the proposed Eastern Expansion.

2.2 Purpose and Need

The Rapp Road Landfill is an important public facility providing an essential waste disposal service to residents, businesses and institutions throughout the Capital Region. The additional capacity that will be realized by the proposed Eastern Expansion will provide the time needed for the City to plan, site and develop the next generation of waste management facilities for the Capital Region. The landfill is also an important and essential revenue source that supports numerous City services. Current revenue is approximately $13 million per year. Therefore, the purposes of the proposed expansion include the following:

- Maintain essential, uninterrupted waste disposal services to the City and Capital Region;
- Maximize landfill space to continue the revenue stream to support City services;
- Maximize landfill life to provide sufficient time to allow for budgetary adjustments and to find alternative revenue sources to prevent an abrupt end to certain services;
- Maximize landfill life to provide time to prepare for and begin implementation of alternative waste disposal options, understanding that no further expansions can occur, including no further overfill options (City will cease acceptance of solid waste for landfilling at the Rapp Road facility).

The City, as well as all the ANSWERS communities, would like sufficient time to address their fiscal situation and achieve a budgetary solution that will minimize the impact on services provided to residents. Currently, the operation of the landfill provides revenues sufficient to pay for the City's solid waste and recyclables collection services ($3,069,000) and annual debt service for bonds issued for solid waste related projects ($2,376,100), for a total of $5,445,100. To the extent revenue from the operation of the landfill exceeds this amount, the revenue is paid into the general fund to reduce the total tax burden on the residents of the City of Albany. In the event the Eastern Expansion was not approved, the City would have to find an alternative source of revenues for these costs and it would also incur an additional $4,705,000 per year in transfer and hauling costs and the operation of a transfer station (see Section 5.0 – Economic Background). Other beneficiaries would also suffer. The portion of the tipping fee that currently goes to the Albany Pine Bush Preserve would be eliminated and funding would not be available for the Habitat Plan discussed in Section 6.0.

The tool to define the future solid waste disposal solutions for the City and Capital Region is the Solid Waste Management Plan (SWMP). The City has recently prepared a modification to their existing SWMP (see below in this section for further details) and is now in the early stages of preparing a new SWMP. It is estimated that the new SWMP will not be fully approved until 2011, at which time the City would begin implementation efforts and funding in accordance with the new SWMP, which may include the construction of new infrastructure such as a transfer station. With the budgetary implications of the final closure of the Rapp Road Landfill and the long range planning and implementation efforts to address solid waste management, a reasonable goal of 7-10 years of landfill life was set.

The City of Albany currently operates the Rapp Road Landfill on behalf of the Capital Region Solid Waste Management Partnership Planning Unit (formerly known as ANSWERS) Prior to development of the ANSWERS system, the region was served by approximately 12 separate solid waste landfills.

A detailed review of the recent history of solid waste disposal is provided in the recently prepared SDEIS for the proposed Eastern Expansion of the Rapp Road Landfill.

As a product of the planning unit's original SWMP, a new landfill site was identified in the Town of Coeymans that was intended to be used to service the City's long-term solid waste management needs. The site was identified as Site C-2. However, the City's attempt to permit a new landfill facility on behalf of the planning unit was met with significant opposition from the Town of Coeymans. This opposition resulted in a number of lawsuits against the City, which delayed the permitting and development of the Site C-2.

In an effort to provide reliable, reasonably priced waste disposal for the region, the City expanded the Rapp Road landfill on several occasions. Following resolution of the lawsuits that were filed against the City, site investigations and the development of preliminary design plans at Site C-2 resumed in 2004. Between 2004 and 2005, the following activities were conducted in association with Site C-2:

- Perform a literature review, well survey's, desktop hydrogeologic study, and prepare a Draft Hydrogeologic Investigation Work Plan (CHA; 2004);
- Prepare a Site survey;
- Perform preliminary traffic studies;
- Perform a site stormwater evaluation;
- Delineate the extent of wetlands on the Site;
- Complete a water and wastewater study; and
- Develop preliminary plans including draft site plans and proposed grading plans.

It should be noted that the above activities were performed in support of an Environmental Impact Statement and Part 360 Permit Application for Site C-2. However, due to a number of permitting issues, which are described later in this Section, permitting of Site C-2 was placed on hold. As a result, the above studies/activities have not been progressed to the point of developing a final report.

Based on the investigations for site C-2, wetland delineation of the site revealed that the project could impact over 80 acres of wetland. Preliminary pre-application meetings were held with NYSDEC and the U.S. Army Corps of Engineers (USACE). Based on these initial discussions, it became clear approvals for development of the entire facility could take in the range of 10-20 years as it would be necessary to implement and prove the success of mitigation prior to the regulatory agencies issuing approval for impacts. Therefore, it would not be possible to permit

C-2 prior to landfill space running out. It is estimated that the P-4 Expansion has capacity until November 2009 based on the current rate of disposal (approximately 1,050 tons per day).

With Site C-2 mired in permitting issues and dwindling space in the P-4 Expansion combined with an obligation to provide solid waste disposal needs for the Wasteshed, the public need for a new solid waste management solution is well established. Although in 2005, site C-2 was still considered the City's preferred alternative, the time required to permit site C-2 could not completed before the available space at the Rapp Road facility would run out. Likewise, embarking on a renewed search for a landfill site would be an equally time-consuming task. This leaves the expansion of the existing landfill or the shipping of wastes to a large out-of-Wasteshed landfill as the two potential solutions.

The latter may be a valid alternative but will require considerable investigation and reconsideration of costs and revenue streams. Revenue associated with tipping fees at the landfill support many services provided by the City and are also the source of considerable funding, including $250,000 per year for the operation and management of the Albany Pine Bush Preserve. Additionally, the City and the ANSWERS communities would be faced with greater costs for solid waste disposal.

Waste reduction through recycling is also an important consideration for the extension of existing landfill life. The City and most of the ANSWERS communities have recycling programs, as do most other communities in the State. Therefore, recycling has already been factored into the waste stream.

Based on the above conditions, the most feasible short term solution to meet public need is the expansion of the existing landfill, specifically the proposed Eastern Expansion. In the fall of 2005, after the City realized that Site C-2 was not a feasible solution, and that alternative waste management solutions could also not be cost effectively implemented in the short-term, the City began investigating a number of alternatives for the expansion of the Rapp Road facility. From 2005 to 2007, the City evaluated the potential landfill expansion to the north, west and east of the facility with the Eastern Expansion being considered the preferred alternative based on a number of factors which are discussed in detail in the SDEIS. In addition to the various expansion scenarios, a number of other potential alternatives were also evaluated, including shipping and off-site disposal, as part of the SDEIS. However, all of the other alternatives pose a significant short-term economic burden to the City. These alternatives are discussed in detail in the SDEIS.

The economic burden associated with the off-shipping and off-site disposal alternative is also discussed in Section 5.0.

At current rates of disposal, the proposed Eastern Expansion will provide 6-7 years of landfill life. However, unlike previous expansion efforts, the option for an additional future expansion will be foreclosed by virtue of both the fact that all surrounding lands are dedicated to the APBPC and the proposed Habitat Plan that will be phased in during construction and operation of this expansion, with the last phase of the Habitat Plan encompassing the Eastern Expansion after closure. The result would be a landfill transformed into Pine Bush habitat with some remaining landfill infrastructure such as landfill offices, a possible future transfer station, and gas to energy facilities. Therefore, the majority of the landfill, as well as the surrounding lands, will be committed to habitat, leaving no room for further expansion.

2.3 Long Term Solid Waste Disposal

As noted previously, the most feasible short-term alternative for solid waste disposal for the City of Albany and the ANSWERS communities is expansion to the existing Rapp Road Solid Waste Management Facility. The long term solution to solid waste management for Albany and the ANSWERS communities will be the subject of the ongoing revisions to the Solid Waste Management Plan (SWMP) that was initially prepared in 1990-91. This plan laid the framework (criteria) for a landfill siting study that would address the long term needs of ANSWERS. This led to the initial development activities associated with Site C-2.

The new SWMP will evaluate all possible options for long term solid waste management. Each option will be evaluated with regard to economic feasibility, treatment feasibility, and ability to be sited and permitted, among others. Some of these options, including long haul of wastes, are discussed in greater detail in Section 5.0. At present, it appears that the most likely solution will involve a combination of several options including more aggressive waste reduction methods/enforcement and the transport of waste to a large regional facility.

3.0 OVERVIEW OF THE PINE BUSH FORMATION

3.1 Hydrogeologic Conditions

The Pine Bush Formation is an unconsolidated (i.e., surficial) sand deposit that is located in the mid-Hudson section of the Hudson-Champlain lowlands within a +/-40 square mile mixed urban/suburban area in Albany County between Albany and Schenectady. The land use associated with the formation has been developed for primarily residential and commercial land uses. The name for the Pine Bush is taken from its dominant and unique pitch pine and scrub oak vegetative community. The Pine Bush is part of an extensive sand dune field and swamp area that extends from South Glens Falls to Delmar. This extensive dune field developed on top of a series of interconnected glacial lake sediments that occupied the Hudson River Valley from approximately Glens Falls to Newburgh. The glacial lakes developed in front of the ablating continental ice sheet during and after the Late Wisconsinan deglaciation.

As noted, much of the Pine Bush is covered by sand dunes of light yellow-brown to light gray very fine to medium grained sand deposits. The dune sands are a discontinuous, irregular mantle over underlying glacial lake sand deposits (Dineen; 1982). The dunes are reported to range from five and 50 feet high. Beneath the dune sands, as well as in areas where dune sands are absent, a sequence of glacial lake sediments associated with former glacial Lake Albany, are present. The Lake Albany sequence includes an uppermost fine sand unit, an intermediate silty sand unit, and a deep silt and clay unit. The thickest sand deposit is located in the northwestern and central parts of the Pine Bush. The thickness and aerial extent of the dune sands and the silt is highly variable and in some areas, streams have eroded completely through the sand formation and into the underlying clay (C.T. Male, 1999).

Based on subsurface geologic data obtained from the soil borings installed within the proposed Eastern Expansion Area, brown to gray, fine sand deposits with varying percentages of silt, were encountered to a depth of approximately 44 feet bgs at boring/monitoring well locations MW-14D and MW-15D (Figure 1). Below a depth of 44 feet, a finer grained unit consisting of fine sand and silt was encountered to a depth of approximately 54 feet bgs, after which a clayey silt unit with interbedded layers of fine sand and silt were encountered. Copies of the soil boring logs for monitoring wells MW-14D and MW-15D are included as Appendix A. This sequence is consistent with a number of historical soil boring logs relative to the Pine Bush Formation that are included in the *Groundwater Appraisal of the Pine Bush Area* (Snavely; 1983). However,

the uppermost fine sand unit observed in the Eastern Expansion Area was generally thinner than the sequence identified in most of the soil boring logs included in the Snavely Report. This is attributable to the fact that the brown dune sands are largely absent in the proposed Eastern Expansion Area. Although some brown sands were identified near the surface, the thickness of these sands were less than five feet throughout the Expansion Area. For reference, a series of geologic cross-sections for the landfill site are included as Figures 3 through 6. The cross-section locations are illustrated by Figure 2.

Groundwater in the Pine Bush formation in the vicinity of the Rapp Road landfill facility occurs in the upper, unconfined fine sand unit and ranges in depth from approximately 1.5 feet below ground surface (bgs) in the area of the proposed Eastern Expansion, to just over 30 feet bgs in areas adjacent to the existing Albany Interim Landfill. Although the actual groundwater elevation across the landfill facility (including the Eastern Expansion area) does not change considerably, the variability associated with the depth to water, as measured from ground surface, is attributable to the ground surface elevation at each well location.

3.2 Potential Groundwater Availability of the Pine Bush Formation

Based on the New York State Department of Environmental Conservation's (NYSDEC) October 1990 Division of Water Technical and Operational Guidance Series (TOGS) 2.1.3, the portion of the Pine Bush formation that underlies the proposed Eastern Expansion Area is considered a Principal Aquifer. Based on the criteria outlined in TOGS 2.1.3, the term Principal Aquifer refers to aquifers that are "*known to be highly productive or whose geology suggests that abundant potential waster supply, but which are not intensively used as sources of water supply for major municipalities*". TOGS 2.1.3 also presents a series of factors that should be considered when determining if an aquifer is a Principal Aquifer. These include:

- productivity and natural water quality;
- vulnerability of the aquifer to contamination; and
- whether or not the aquifer is currently designated as a USEPA sole source aquifer.

Although the Pine Bush Formation has been designated as a Principal Aquifer by TOGS 2.1.3, published research, the potential for future use as a municipal water supply source and actual site specific data collected for the Rapp Road facility demonstrate that the aquifer in the vicinity of

the landfill does not have the distinguishing productivity characteristics, and to a lesser extent the water quality characteristics of a Principal Aquifer.

According to the report entitled *"The Geology of the Pine Bush Aquifer, North-Central Albany County, New York"* (Dineen 1982), the Pine Bush Aquifer is reportedly comprised of the silty sand, lake sand, and dune sand geologic units. At a maximum, the Pine Bush Aquifer in the vicinity of the proposed Eastern Expansion could be interpreted to include the upper 44 feet of fine sand deposits that underlie the proposed Eastern Expansion Area (Refer to soil boring logs included as Appendix A). However, the finer grained units below a depth of 44 feet would not be considered part of the productive aquifer. Based on the maps entitled *"Availability of Ground Water in the Unconsolidated Aquifers of the Mid-Hudson River Basin"* (Bugliosi; 1987) and *"Availability of Water From Aquifers in Upstate New York"* (Kantrowitz and Snavely; 1982) the potential yield of the unconsolidated deposits underlying the Rapp Road facility are estimated between 10-100 gallons per minute (gpm). Kantrowitz and Snavely also estimate the specific capacity of the unconsolidated sediments at two to five gpm per foot of drawdown.

Although the potential yield of the underlying Pine Bush formation is estimated to be up to 100 gpm, actual site specific data for the Rapp Road facility demonstrates that the yield of the formation is on the low end of the range (10-20 gpm). In addition, the aquifer is relatively shallow and the natural water quality of the aquifer in the vicinity of the landfill is commonly characterized as poor. These characteristics are recognized by NYSDEC based on the February 2000 Findings Statement for the P-4 Expansion Project, which also required the approval of a variance request to construct the expansion over a "Principal Aquifer". More specifically, in support of the variance approval for the P-4 Expansion project, NYSDEC noted the following:

- *"The lack of any demonstrated groundwater impacts associated with the AIL operation on the aquifer".*

- *"The Pine Bush Formation has limited utility as a potential source of groundwater. The municipalities in the Pine Bush have focused their efforts to develop public water supplies in more highly productive aquifers or surface waters outside the Pine Bush Formation. The Pine Bush is low yielding; Latham Water District abandoned wells on Morris Road in the 60's due to low yield and poor water quality."*

- *"The potential negative impacts to the Albany Pine Bush habitat which would result should a public water supply be developed utilizing the Pine Bush Formation. In order to develop a public water supply in the Pine Bush Formation of sufficient quantity to provide approximately 200 to 400 gpm, would require 6 to 14 individual wells, which could result in the lowering of the static water level more than 10-feet across an area as large as 77 acres. This would leave the root systems of the Pine Bush Formation with negative consequences."*

The data presented in the remaining sections of this report provide additional justification for the variance. With respect to the groundwater availability from the Pine Bush Formation in the vicinity of the landfill, the data presented in Section 4.0 demonstrates that the Pine Bush Formation in the vicinity of the landfill has limited utility as a groundwater source and does not exhibit the distinguishing characteristics of a "Principal Aquifer" as outlined in by TOGS 2.1.3. Pursuant to 6 NYCRR Part 360-1.7(c)(2), this Variance Report also provides additional information and pertinent data to satisfy 6 NYCRR Part 360-1.7(c)(2), which identifies the specific requirements for any Variance Application. Section 5.0 of this report provides a summary of the economic hardship that the City would incur if the landfill expansion were not approved and Section 6.0 of the potential impacts to the Pine Bush Habitat if a water supply was to be developed in the Pine Bush Formation. Section 7.0 provides a summary of the proposed Habitat Plan that will be implemented to enhance existing and recreate Pine Bush habitat in the vicinity of the Rapp Road facility. Section 8.0 summarizes the conditions in support of the variance as well as the double liner system that will be used in the construction of the proposed Eastern Expansion which has been demonstrated to be effective in preventing impacts to the Pine Bush Formation from the existing AIL.

4.0 CURRENT AND POTENTIAL USAGE OF THE PINE BUSH FORMATION

4.1 General

Based on published information relative to the Pine Bush Formation, combined with site specific hydrogeologic data collected as part of current and previous investigations for the Rapp Road facility, the Pine Bush Formation is considered to have limited utility as a source of water supply, especially considering the fact that other, more viable alternate sources of water supply have been identified by local municipalities.

In support of the variance request, the following sections provide a summary of the current and potential usage of the Pine Bush Formation as a source of significant water supply for the region. More specifically, these sections provide an overview of the water supply sources that are currently used by local municipalities (as well as their potential for exploiting a new groundwater source from the Pine Bush Formation), a summary of the existing water quality of the Pine Bush Formation, a quantitative evaluation of the potential for developing a groundwater source within the fine sand unit that underlies the Rapp Road Facility, and a general summary of a number of constraints that further support the limited utility of the Pine Bush Formation as an aquifer. Since the Pine Bush Formation in the vicinity of the landfill is not currently used as a source of water supply by any municipalities, and since there is no significant potential for future use as a significant water source, this information is intended to support the requirements of a variance application, which pursuant to the Part 360 regulations, must demonstrate that granting the variance would have no significant adverse impacts on the public health, safety, welfare, the environmental, or natural resources.

4.2 Municipal Water Supply Investigation

In late 1998, C.T. Male evaluated the current and potential usage of the Pine Bush Formation as a municipal groundwater supply source (*Pine Bush Declassification Study* - C.T. Male; January 1999). This evaluation included an assessment of the areas in the vicinity of the AIL, both upgradient and downgradient of the existing landfill and at that time, the proposed P-4 landfill expansion. This municipal water supply evaluation included a determination of whether public water is available in areas in the vicinity of the landfill, and also evaluated the potential future development of new water sources by the water districts that service the area in the vicinity of

the AIL. Specifically, C.T. Male contacted each of the water districts and obtained information regarding their current production capacity, the amount of growth which could be managed using the existing system, the number of years the existing system is expected to serve the district's needs, and whether there are any existing plans for use of the Pine Bush formation as a water source.

To further evaluate the current and potential usage of the Pine Bush Formation as a municipal water source, CHA updated the information presented by C.T. Male by contacting each of the four water districts that service the area in the vicinity of the landfill. These water districts include the City of Albany, the Town of Colonie (Latham Water), Village of Colonie, and the Town of Guilderland. This information is provided in the following sections of this report.

4.2.1 Existing Water Supply Districts and Areas Covered

Based on CHA's conversations with each of the water districts that service the areas in the vicinity of the landfill, there are currently no existing sources of public municipal water within one mile of the Rapp Road Landfill Facility, either upgradient or downgradient. The nearest source of municipal water is the Town of Guilderland deep well field located approximately 3 miles west (upgradient) of the Rapp Road facility.

The sources of water for the four districts are located as follows:

- Town of Guilderland: Based on CHA's conversations with Mr. Bill West of the Town of Guilderland in July 2007, the Town uses three wells located approximately 3 miles west (upgradient) of the landfill, at the intersection of Route 155 and Nott Road. The Town of Guilderland also obtains additional source water from an interconnect with the City of Albany.

- City of Albany: According to Mr. John Kosa with the City of Albany, Department of Water supply, the City's primary source of drinking water is obtained from the Alcove reservoir. A secondary supply of drinking water is also supplied from the Basic Reservoir. Both reservoirs are located approximately 20 miles southwest of the landfill.

- Town/Village of Colonie (Latham Water District): Both the Town and Village of Colonie are serviced with water by the Latham Water District (Latham Water). According to Mr. John Frazer of Latham Water, there are no sources located within the vicinity of the landfill. Latham Water currently obtains its water from groundwater wells located near the Mohawk River, the Stony Creek River, and the Mohawk River itself.

According to C.T. Male, the Latham Water District owns land on Morris Road that formerly was used for pumping groundwater from two wells. These two wells are reported to have been installed within the Pine Bush Formation and were abandoned in the 1960's due to their low well yields in comparison with new groundwater wells installed proximal to the Mohawk River, thus rendering the Pine Bush Formation wells unnecessary. Additional factors for the abandonment of the two wells included poor water quality and the need to treat groundwater to remove fine particulates (C.T. Male, 1999).

With the exception of two private wells located on Pine Lane in Guilderland (refer to Section 4.3), according to personnel from each of the water districts, it appears that all areas in the vicinity of the landfill are currently serviced by municipal water derived from sources outside of the Pine Bush.

4.2.2 Current Municipal Needs for Alternate Water Source

According to personnel from each of the contacted water districts, none of the water districts are actively seeking a new water source, or have plans for the development of a public water source within the Pine Bush Formation. Even if any of the major municipalities in the area elected to pursue an alternate source of water, there are other sources of both surface water and groundwater available that are more viable alternatives than the Pine Bush Formation. For example, treatment of local surface water sources and more productive groundwater aquifer supplies such as the Great Flats Sole Source and Schenectady Primary Aquifers.

4.3 Private Water Supplies

Within New York State, there are very few historical records pertaining to the location and construction of existing private water supply wells. Historically, well completion reports have not been consistently maintained by any specific regulatory agency. However, recent changes to

the water well drilling regulations now require that all well completion reports be submitted to NYSDEC. These records, which generally only include relatively recent information, are maintained within the NYSDEC water supply well database.

Based on a review of the NYSDEC water supply well database, there are no recently completed private wells reported within the vicinity of the site. However, due to the fact that the well records database is limited, CHA also contacted Mr. Cliff Forando of the Albany County Department of Health (ACDOH) to determine if the ACDOH was aware of any private wells within the vicinity of the landfill. According to Mr. Forando, he is aware of two private water supply wells located in the vicinity of Pine Lane in Guilderland. Pine Lane is located approximately 0.75 miles in a cross-gradient direction of groundwater flow relative to the Rapp Road facility (Figure 7). These wells are reportedly used for individual domestic water supplies for private residences and are not currently connected to a municipal system. In addition to the private wells located on Pine Lane, Mr. John Kosa of the City of Albany Water Department indicated that there are one or more private wells on Karner Road in Colonie.

No other areas with private water supplies were identified in the vicinity of the Rapp Road facility. While these records suggest that the Pine Bush Formation can provide a source of water supply for domestic use, in general, the formation is not a significant source for private/domestic use.

4.4 Existing Water Quality

The existing water quality of the Pine Bush Formation in the vicinity of the landfill is known to be poor based on previous studies and the historical water quality results from the groundwater monitoring wells which surround the City's landfills at the Rapp Road facility. In addition, regional studies have also been conducted in the vicinity of the landfill, which have also identified somewhat poor water quality within the Pine Bush Formation on a regional level.

Based on groundwater quality data collected from newly installed expansion area monitoring wells MW-14S and MW-15S (Figure 1), elevated levels of ammonia have been detected in both of these monitoring wells. The level of ammonia in these monitoring wells is summarized in the table below:

Date	*Ammonia Concentration (mg/l)* *MW-14S*	*MW-15S*
January 2007	<0.5	2.14
April 2007	0.751	1.99
September 2007	<0.5	2.15
December 2007	0.765	1.54
January 2008	0.536	1.71
March 2008	0.44	1.74
June 2008	0.38	1.2
September 2008	0.41	1.3

Note: A less than sign indicates that the parameter was not detected

Based on the historical water quality data collected for the Rapp Road facility, the presence of ammonia is not attributable to impacts from either the AIL or the GAL in the Eastern Expansion Area. Two potential sources of the ammonia include the run-off from a horse-farm located to the east of the expansion area and/or the highly organic natural soils within the expansion area.

Based on visual observations during a recent inspection, the horse farm is located only a few hundred feet to the east of monitoring well MW-15S. The horse farm is bounded further to the east by Rapp Road. Although the topography is relatively flat, the area between monitoring well MW-15S and the horse farm is slightly depressed. During CHA's most recent inspection of the area in March of 2008, standing water was observed throughout the entire area between the horse farm and monitoring well MW-15S. Seasonal high groundwater levels indicate that the groundwater table at both monitoring well location MW-14S and MW-15S can be at ground surface elevation. This would suggest that run-off from the horse farm could potentially be directed towards MW-15S and is impacting this well, and to a lesser extent well MW-14S. This is further supported by the elevated levels of sodium and chloride in well MW-15S, which suggest that road salt impacts from run-off from Rapp Road could also be influencing well MW-15S. Sodium and chloride levels in wells MW-15S are higher than any of the newly installed monitoring wells and the existing AIL upgradient monitoring well MW-1S.

The other potential source of ammonia in the shallow groundwater of the Eastern Expansion Area includes the highly organic (muck type) soils within the expansion area. Organic nitrogen in soils is transformed by microorganisms in the soil to ammonium, which is available to plants. However, ammonium nitrogen can be transformed via ammonia volatilization into ammonia gas, especially in soils with a pH higher than 7.5. Typically the ammonia gas is in equilibrium with the ammonium and excess ammonia gas is generally released to the atmosphere. However, due to the fact that the seasonal high groundwater table can be close to the ground surface, it is possible that the gaseous ammonia is dissolving into the shallow groundwater. Regardless of the source of the ammonia in the shallow monitoring wells, the water quality of the Pine Bush Formation in the vicinity of the landfill is of relatively poor quality.

Regionally, areas of relatively poor groundwater quality of the Pine Bush Formation have also been identified. According to the report entitled *Groundwater Appraisal of the Pine Bush Area* (Snavely; 1983), both elevated nitrogen (nitrate plus nitrite) and chloride has been identified at several location within the Pine Bush Aquifer. The elevated levels of these parameters are considered to be attributable to impacts from septic system effluent and road salt application. This relatively poor existing water quality both locally and regionally further supports the conclusion that the Pine Bush Formation has limited utility as a public water supply.

4.5 Potential for Groundwater Under the Direct Influence of Surface Water

Due to the shallow nature of the fine sand unconfined unit in the vicinity of the Eastern Expansion Area, the shallow water table formation is likely to be at a high risk of being under the direct influence of surface water. This condition significantly limits the formation's use as a potential groundwater source. Pursuant to the guidelines presented in the October 2001 New York State Department of Health Technical Reference entitled *"Identification of Groundwater Sources Under the Direct Influence of Surface Water"* (Publication/Item No. PWS 42), a production well that is installed in a shallow unit such as the Pine Bush Formation would be subject to a comprehensive review to determine if the source was under the direct influence of surface water. The primary factors resulting in a comprehensive review are:

1. The source is located 200 feet or less from a surface water body or recharge boundary, and

2. The groundwater source (when completed) would have less than 50 feet of casing, which is the minimum casing length that is required by the Health Department for public supply wells. .

The assumption that the well would have less than 50 feet of casing is based on the maximum thickness of the fine sand unit, which was on the order of 44 feet in thickness as measured from ground surface. Assuming that a minimum of five to ten feet of well screen would be installed in the fine sand formation, the casing depth would not exceed 39 feet.

Although a groundwater under the direct influence (GUIDI) evaluation has not been performed for the Expansion Area, the characteristics of the aquifer and the existing water quality data for the expansion area monitoring wells suggest that the Pine Bush Formation is at a high risk of GUIDI. If a production well system was installed in the Pine Bush Formation that was identified as GUIDI, pursuant to the USEPA Surface Water Treatment Rule (40 CFR Parts 141 and 142), treatment would be required to adequately inactivate and/or remove various pathogenic organisms. This treatment would require a combination of filtration and disinfection, whereas a groundwater source that is not GUIDI, would require only disinfection. The cost for filtration would further limit the feasibility of utilizing the Pine Bush Formation as a source of public water supply, especially considering the relatively low yield potential of the formation (refer to Section 4.6). Considering that there are alternate sources of groundwater supply in the area that would not be under the direct influence of surface water while at the same time achieving the Health Department requirement of 50 feet of well casing, it is unlikely that a well would be installed in the Pine Bush Formation in the vicinity of the proposed Eastern Expansion Area to service a public water supply system.

4.6 Site Specific Yield Potential of the Pine Bush Formation

Although the information presented in the previous sections identifies a number of factors that support of the Variance request, this section presents a quantitative summary of site specific potential yield of the underlying Pine Bush Formation. The information presented in this section is based on site specific hydrogeologic data collected as part of the investigations associated with the Eastern Expansion as well as pump test data that was collected as part of C.T. Male's February 2002, Feasibility Study that evaluated the potential use of a groundwater pumping system to intercept contaminated groundwater downgradient of the GAL.

In support of the P-4 Expansion Project that was approved by NYSDEC in February 2000, C.T. Male prepared an Aquifer Variance Report in February 1999 that suggested a maximum long-term well yield for wells installed in the Pine Bush formation near the landfill would be on the order of approximately 35 gallons per minute (gpm) per well given the saturated thickness and nature of the surficial deposits. C.T. Male also suggested that a relatively small municipal groundwater source of 200 to 400 gpm would require approximately 6 to 14 individual pumping wells would be needed to meet this theoretical municipal requirement. It should however, be noted that the municipal groundwater requirement used by C.T. Male is considered conservatively low. According to TOGS 2.1.3, the term "highly productive" is used to define the term Principal Aquifer. Based on the interpretation presented in TOGS 2.1.3, highly productive means "*aquifers with the capability to provide water for public water supply of a quantity and natural background quality which is of regional significance*". TOGS 2.1.3 also notes that the range of populations currently served by the Primary Water Supply Aquifers serves to illustrate the intended meaning of the term highly productive. Based on tabulated data presented in TOGS 2.1.3, the smallest water supply served by a Primary Aquifer is listed at an average daily pumpage of 1.6 million gallons per day, or just over 1,100 gallons per minute.

In addition to the conservative estimate of potential municipal demand requirement, C.T. Male's estimate of potential well yield for wells installed in the vicinity of the landfill was based not only on site specific soil boring information, but also data obtained from United States Geological Survey (USGS) pump test data for two wells that were installed in the thickest known locations of the Pine Bush Formation (Snavely 1983). However, subsequent site specific data collected from two test wells that were installed at the Rapp Road Facility as part of the February 2002 Feasibility Study provide additional data that demonstrates that wells installed in the Pine Bush Formation in the vicinity of the aquifer would be significantly less than 35 gpm each. The locations of the test wells are illustrated by Figure 8.

As part of the February 2002 pump testing activities, two 6-inch diameter wells (PW-1 and PW-2) were developed and tested for a period of 24 hours each. These test wells were installed to depths of 26 and 38 feet, respectively in the underlying fine sand unit. During the tests, well PW-1 was pumped at a rate of 10.3 gpm and well PW-2 was pumped at a rate of 10.5 gpm.

Since the objective of the Feasibility Study was to evaluate the feasibility of intercepting the impacted groundwater and not to evaluate the maximum pumping rate of the underlying

formation, CHA utilized the data collected from the test to calculate the specific capacity for both wells to determine the maximum potential yield of a well installed in the Pine Bush Formation in the vicinity of the landfill. Specific capacity is an expression of the capacity of a well and its relationship to drawdown. A summary of the pertinent data from the February 2002 pump tests and the resultant specific capacity is presented in the table below:

Summary of Specific Capacity Data

Well Location	Pump Tested Flow Rate (gpm)	Observed Drawdown (ft.)	Calculated Specific Capacity (gpm/ft.)
PW-1	10.3	6.22	1.66
PW-2	10.5	7.85	1.34

Notes:

1. Calculated specific capacity equals the pumping rate divided by the total drawdown.

In theory, based on the above data, a well installed in the Pine Bush Formation will yield between 1.34 and 1.66 gallons for every foot of available drawdown provided that the aquifer is not dewatered. As noted previously, the Pine Bush Formation is an unconfined aquifer and the portion of the formation within the cone of depression is naturally dewatered over time during pumping and therefore, specific capacity will decrease over time in direct proportion with drawdown unless a recharge boundary is encountered. Based on the drawdown data and graphs from the Feasibility Study (Appendix B), a recharge boundary was not encountered and drawdown continued to increase over time.

According to *"Groundwater and Wells"* (Driscoll; 1986), the relationship between drawdown and yield can be used to estimate the maximum potential yield of a well based on yield versus drawdown curves for an ideal aquifer (Page 217, Driscoll; 1986). At location PW-1, which was the higher yielding well, the total drawdown was measured at 6.22 total feet. Considering the bottom of the well was at a depth of 25 feet below ground surface and the static water level was approximately 11.25 feet below the top of the well casing, a total available drawdown of 13.75 feet is calculated (assumes 100% drawdown is at the bottom of the well). As a result, the total observed drawdown of 6.22 total feet during the pump test was 45.2% of the total available drawdown of 28.25 feet. According to Driscoll, 45.2% of the total drawdown is approximately equal to 70% of the maximum potential well yield, and therefore 100% yield is calculated to be 14.7 gpm (refer to calculations presented in Appendix C). This maximum potential yield assumes that the well can be pumped to the point at which the drawdown reaches the very

bottom of the well (100% drawdown). In reality the need for a well screen and the length of the pumping equipment must be considered and therefore, the actual maximum pumping rate would be somewhat less than 14.7 gpm.

This estimated maximum yield presented above should not be confused with the term maximum safe yield. Since a recharge boundary was not encountered, water levels in the pumping wells continued to decrease during the latter stages of the pump test. Since the Pine Bush Formation relies on precipitation as it's primary source of recharge (Dineen; 1982), in the absence of a recharge boundary, the pumping water level would continue to decrease over time and continue to decrease available drawdown. This decrease would also reduce the pumping wells long-term capacity. During drought periods, the maximum safe yield could be significantly lower that the maximum theoretical yield of 14.7 gpm.

4.6.1 Relationship of Pump Tested Wells to the Expansion Area

Subsurface soil boring data indicates that the geology in the vicinity of the Eastern Expansion Area is very similar to the adjacent Rapp Road facility, including the geology in the vicinity of the pump tested wells. However, particle size analysis for several soil samples collected from depths of 26-28, 28-30, and 50-52 feet below ground surface in Eastern Expansion Area boring EE-B-2, indicate that the soils in the fine sand unit beneath the Expansion Area are finer grained than the formation in which pumping wells PW-1 and PW-2 are located. A copy of the particle size analysis for expansion area boring location EE-B-2 is presented in Appendix D. The particle size data for the expansion area indicates that a 0.005 inch slot size well screen would need to be utilized for a production well installed in the fine sand unit beneath the Eastern Expansion Area. Based on the particle size analysis used to size the well screens for wells PW-1 and PW-2 (Appendix D), a screen slot size of 0.008 inches was selected to be installed in both pumping wells. Based on the above particle size and screen sizing information, the soils underlying the Eastern Expansion Area have a slightly higher percentage of fine soils. Due to the fact that permeability is directly related to conductivity and well yield, the specific capacity for a well installed in the proposed expansion area would not be expected to exceed that of PW-1.

It is recognized that pump tested well PW-1 was only installed to a maximum depth of 25 feet and the formation in the area of the proposed Eastern Expansion is on the order of 44 feet thick.

The static water level in the Eastern Expansion Area is also slightly higher. After a well screen and associated pumping equipment is installed, the total available drawdown would be comparable to the calculations used for well PW-1, which assumed that the well could be pumped until the drawdown reached the bottom of the well. For example, a production well installed in the Eastern Expansion Area to a total depth of 44 feet would be fitted with a five to ten foot section of well screen. A well pump would then be installed with the intake located a minimum of four feet above the screen. To minimize the potential for cavitation, the pumping water level would need to be maintained at least two feet above the pump. Accounting for the screen, the location of the pump intake, and the pumping water level (total of 11-16 feet), the maximum pumping level would be 28 to 33 feet below ground surface.

Considering that the particle size analysis suggests that the are soils in the expansion area are comparable to, or slightly finer grained than the subsurface soils at the location of the Feasibility Study pump tested wells, it is expected that the specific capacity and drawdown characteristics for a well installed in the expansion area would not be significantly different than the area of the Feasibility Study. Using the observed drawdown and specific capacity for pump tested well PW-1, and extrapolating the observed drawdown data for a well completed to 44 feet (33 ft. pumping level), the maximum potential yield of a well installed in the expansion area would be 28.6 gpm (refer to Appendix C for calculations).

4.6.2 Distance Drawdown Effects

The variance report prepared by C.T. Male for the P-4 Expansion originally estimated that a potential well yield of 35 gpm could be realized for a well installed in the Pine Bush Formation in the vicinity of the Rapp Road landfill. This estimate was based on conservative assumptions in the absence of site specific pump test data. C.T. Male also estimated that to achieve a combined well field pumping rate of 200 to 400 gpm, approximately 6 to 14 individual wells would need to be installed to meet the demands of a relatively small municipal system. C.T. Male also assumed that the wells could be spaced at a distance of 100 feet apart. However, as previously noted, based on actual site specific pump test data that was collected as part of the February 2002 Feasibility Study, the actual potential yield of wells installed in the Pine Bush Formation in the vicinity of the landfill expansion area are realistically less than 28 gpm, rather than the previous estimate of 35 gpm. As a result, it would take at least 8 to 15 wells to meet the demands of a small municipal system.

Distance drawdown data from observation wells that were monitored during the Feasibility Study pump testing demonstrated that the radius of influence relative to the cone of depression for the pumping wells was approximately 245 feet. Copies of the distance drawdown graphs from the Feasibility Pump Test are included as Appendix E. As a result, a more realistic well spacing is considered to be between 200 and 250 feet, rather than 100 feet, since any well interference would reduce to total pumping capacity of the wells.

Considering the site specific potential yield of wells installed in the Pine Bush Formation in the vicinity of the landfill, as well as a minimum well spacing of 200 feet, a potential well field would encompass an area of up to 9 acres. Short-term water level drawdown within the well field would be on the order of 33 feet to maximize the production capacity of the well field.

4.6.3 Additional Constraints

Although the previous sections of this report identify the relatively low productivity of the Pine Bush Formation in the vicinity of the landfill, it is theoretically possible to withdrawal water from the Pine Bush Formation at the previously identified rates. However, if an attempt was made to develop a groundwater source in the Pine Bush Formation neat the landfill, there are inherent constraints associated with operating such a large well field comprised of numerous low yielding wells. These constraints include the a relatively high capital investment to install and develop numerous wells, the associated infrastructure that would be needed for a relatively low total yield, the relatively high scheduled and unscheduled maintenance cost, and well screen fouling due to the low yield and fine sand formation. A brief discussion of each of these considerations is provided below to further support the fact that the Pine Bush Formation is not suitable for significant source water development.

Due to the fact that it would take approximately 20 wells to achieve a potential yield of 400 gpm, the cost to install such a large number of wells to obtain a relatively low yield is cost prohibitive. Not only is there a significant capitol investment associated with the installation of 20 wells, but the costs for piping, pumps and associated control systems, and treatment is also significant. These capital costs would further limit the feasibility of developing a groundwater source in the Pine Bush Formation, especially when there are other documented groundwater sources in the area of the local municipalities that are capable of supplying 400 gpm with significantly fewer wells.

Over time, all production wells require regular maintenance. Nearly all wells will also require regular redevelopment to prevent the well screen from fouling due to fine sediments that clog the well screen, or from encrustation and biofouling of the screen. Fine sand formations such as the Pine Bush only exacerbate well screen fouling. As a result it is anticipated that to maintain the capacity of a low yielding well field in the Pine Bush Formation, a continuous maintenance program of regular well redevelopment would be necessary. Maintenance including pump repair and/or replacement, and routine infrastructure repairs would also be necessary. Similar to the capital costs, the maintenance costs further limit the potential development of a groundwater source in the Pine Bush Formation. It is understood that maintenance costs are inherent to any groundwater source, however, the maintenance required for the number of low yielding wells required to meet a relatively low demand would be especially cost intensive.

5.0 ECONOMIC BACKGROUND

5.1 General Overview

This section summarizes the economic impact that would be incurred by the City of Albany if the Eastern Expansion of the Landfill is not constructed. Currently, the City of Albany's waste disposal costs are subsidized by tipping fees paid by other users of the Rapp Road landfill. Following the conclusion of the September 2008 SDEIS, the City's only viable short-term alternative to landfilling at the Rapp Road facility is to transport and dispose of Albany waste to an off-site permitted facility. If the Eastern Expansion is not approved and future waste must be exported and disposed to a commercially available site, the City of Albany would incur additional cost to transfer, transport, and dispose of its own residential collected MSW at a commercially available landfill site hundreds of miles away, and would incur additional costs for various recycling and waste collection services which are currently funded from revenue derived from landfill tipping fees. The breakdown of costs associated with landfilling versus shipping and off-site disposal are further detailed within this section.

5.2 Current Economics of City Waste Management

5.2.1 Basic Landfill Operations and Revenue

The current operation of the Rapp Road Landfill is a net revenue-producing project for the City of Albany and an important, local collection site for Capital District municipalities, residents, businesses and institutions. Typical annual collection at the Landfill, based on the Landfill's 2005 Annual Report, was 236,157 tons, which includes approximately 32,120 tons delivered by the City of Albany DGS. Current gross revenue generated by Landfill operation is approximately **$13 million** per year, generated primarily from tipping fees paid by other users. These funds generated by the Landfill's operation pay for all solid waste-related services and programs for the City of Albany including the operation of the Landfill. In addition to landfill operating costs, other solid waste related costs total approximately $5.4 million. In addition, $250,000 is annually contributed to the Pine Bush Preserve Commission, with the remaining revenue contributed back to the City's General fund to ease taxpayer burden.

5.2.2 City Waste Services and Expenses

The City of Albany provides several solid waste services for residents. These include: 1) separate curbside collection of MSW, yard waste, and recyclables, 2) yard waste compost facility, 3) special material collection (scrap metal/appliance, yard waste), and 4) household hazardous waste collection days. These services are funded by the operation of the Rapp Road Landfill and would continue to be funded through revenue derived from the proposed Eastern Expansion.

The costs of these programs include the capital cost, labor, tipping fees, and equipment. The projected annual cost of MSW curbside collection, based on an estimate prepared by the City for the fiscal year 2007 is: **$1,687,300** (excluding management costs). The projected total annual cost for fiscal year 2007 to run the recycling program (also excluding management costs) is **$1,381,700** based on the following breakdown:

• Recycling Collection	$738,900
• Compost Facility and operations	$109,600
• Special Collection	$338,200
• Household Hazardous Waste	$140,000
• Other Recycling Program Costs	$55,000
Total Recycling Services Cost	$1,381,700

Combining the total curbside and recycling costs ($1,687,300 + $1,381,700), the total expense of solid waste services is **$3,069,000**.

Long term debt service from the existing operation of the Rapp Road Landfill and other solid waste related projects is also funded through revenue derived from the operation of the Rapp Road Landfill. The approximate cost of the debt service for these bonds in the fiscal year 2007 was **$2,376,100.** If the Eastern Expansion Project is not permitted, it would be necessary to pay City residential solid waste services and the debt service using an alternative revenue source or the City of Albany's General Fund.

Thus, the **total current expenses related to City solid waste management for MSW, recycling programs, and debt service that are funded by Rapp Road Landfill revenues are $5,445,100**. This estimate does not include the current landfill operating expenses.

5.3 Economics of an Offsite Disposal Alternative

5.3.1 Background

The September 2008 SDEIS reviewed the complete history of alternatives to and rationale behind the preferred Eastern Expansion option (sections 2.0 and 5.0). Proposed alternatives have included: 1) alternative onsite expansion layouts/locations, 2) new local landfill site locations and 3) other, offsite and currently operating disposal locations in New York State. The conclusion presented in the SDEIS is that the most viable short-term alternative to the Eastern Expansion is to construct a new transfer station for the City of Albany at the Rapp Road facility, and transport the waste to a landfill in central/western New York State. This alternative would be required because there are no local landfills or existing Capital District transfer stations that have the capacity to accept the waste volume currently accepted by the Rapp Road facility, which is permitted for 277,200 TPY. The full review and discussion of offsite disposal options, including much of the economics presented here, is available in section 5.5 of the SDEIS. The following section reviews the economics of the most viable offsite alternative.

5.3.2 Cost of Alternative to Eastern Expansion

The off-site disposal alternative to the Eastern Expansion would introduce two new major expenses for the City of Albany including: 1) the cost of construction/modification of the existing tipping floor building at the landfill for operation of a new, up to 1,000 TPD-capable transfer station, and 2) the cost of transport and disposal of waste to a different, operating landfill. These costs would be additional to the existing costs of City MSW and recycling programs outlined above that are currently funded by Landfill revenue. It is noted that the City currently holds a permit for the operation of a 1,000 TPD transfer station at the Rapp Road site.

The costs of construction/modification and operation of a new transfer station include the necessary modifications of the Rapp Road site and the purchase of new operating equipment. The modification of the Rapp Road site to create an efficient waste transfer facility is estimated to cost approximately $2.9 million. The total initial capital cost to open the new transfer station, including new operating equipment, will be approximately $4,825,400. When amortized, these capital expenses will represent an annual expense of approximately $520,500. Operation of an up to **1,000 TPD transfer station is estimated by CHA to cost $2,039,000 per year**, including the $520,000 annual amortized capital cost, but excluding cost associated with transport and

disposal. When this annual transfer station operating cost is spread over the full tonnage capacity of the facility, 260,000 TPY (1,000 TPD times 260 days per year), it represents an average of $7.84 per ton. For purposes of this analysis the cost was rounded down to **$7 per ton**.

The costs of transport and disposal of City waste are based on the acquisition and operation of tractor-trailers and payment of tipping fees at the new disposal site. Acquiring and operating the tractor-trailers is estimated to cost approximately $45/ton. Tipping fees reported for permitted New York state MSW landfills range from $24 to $75 per ton. As noted in the SDEIS, all disposal sites with enough available capacity to accept a significant amount of Albany waste are outside of Albany County and require long distance transport. High Acres Landfill in Monroe County was used as a target disposal site for the purposes of the SDEIS analysis. High Acres reported a $40/ton tipping fee and requires a round trip of 415 miles. It is assumed that a volume-based discount can be applied at the disposal site, reducing the disposal cost to $38/ton. Therefore, total transport and disposal (T&D) costs are estimated at $83/ton. Addition of the $7/ton cost of transfer station construction and operation discussed above **brings the total operating cost of this alternative to the Eastern Expansion to $90/ton**. The reliability of this estimate is supported by the 2006 City of Schenectady transfer station's Annual Report to DEC for 2006. In the report the city reported a tipping fee of $90/ton, and noted that its waste delivery was primarily to the Seneca Meadows Landfill in Seneca County.

If the Eastern Expansion is not approved and future waste must be exported and disposed at a commercially available site, the estimated cost for the City of Albany to transfer, transport, and dispose of its own residential collected MSW would be $**2,890,000** per year. This value is based on the $90/ton cost of transfer, transport, and disposal as noted above multiplied by the approximately 32,120 tons of waste delivered to the Landfill by the City of Albany DGS in the year 2005.

Beyond the City of Albany, other members of the local Planning Unit and local users of the landfill will also incur additional costs if the proposed Eastern Expansion is not approved. The current tipping fee at the Rapp Road facility is $52/ton for these users. The increase in cost from the existing $52/ton tipping fee at the landfill to the estimated $90/ton tipping fee at the new transfer station would result in a total increase in cost for these users that could be as high as $3,114,590, based on the 81,963 tons of MSW delivered to the landfill from these sources in 2005. Other sources of local waste from outside the Planning Unit (approximately 114,080 tons) may also incur increases in cost, but these values are not estimated here.

In addition, there would be cost increases associated with the disposal of petroleum contaminated soils (PCS), currently at $25/ton, and Alternative Daily Cover Material (ADCM). These additional cost increases are not quantified in this report.

5.4 Economics Summary

The total cost to the City of Albany for Solid Waste Management activities if the Eastern Expansion is not permitted are summarized below. These costs include existing expenses such as curbside collection, recycling, composting and long-term debt service, as well as new expenses associated with use of a new transfer station (construction, transfer, transport and off-site disposal costs). Without the revenue from the Rapp Road Landfill, it would be necessary to pay this cost using an alternative revenue source or the City of Albany's General Fund.

• Curbside collection of MSW	**$ 1,687,300**
• Recycling related services	**$ 1,381,700**
• Long term debt service	**$ 2,376,100**
• Transfer, transport and off-site disposal of DGS waste	**$ 2,890,000**
Total Estimated Annual Cost =	**$ 8,335,100**

This estimate does not include other associated future costs such as landfill closure and post closure care. It is possible that a portion of this cost could be funded by tipping fees generated from a transfer station operated by the City of Albany. However, without the City's own landfill, the revenue generated from tipping fees would be heavily dependent upon the cost of transportation and disposal at other facilities. It is also unknown how many current users of the Rapp Road facility would use a Rapp Road transfer facility given the substantial increase in tipping fees discussed above. This does not guarantee a fixed revenue stream for the City of Albany.

In summary, the operation of the landfill provides revenues sufficient to pay for the City's solid waste and recyclables collection services ($3,069,000) and annual debt service for bonds issued for solid waste related projects ($2,376,100), for a total of **$5,445,100**. To the extent revenues from the operation of the landfill exceed this amount, the leftover revenue is paid into the general

fund to reduce the total tax burden on the residents of the City of Albany. If the Eastern Expansion were not approved, the City would not only have to find an alternative source of revenues for these costs, it would incur an **additional $2,890,000** per year in transfer and hauling costs and the operation of a transfer station. The effect of the simultaneous loss of funds from Landfill operation and the addition of new expenses for solid waste exportation would put a substantial new economic burden on the City of Albany.

Other economic hardships would include the increase in tipping fee expenses for other local users of the Rapp Road facility discussed above, the loss of funding ($250,000) for the Albany Pine Bush Preserve Commission, and the loss of several jobs at the landfill site which would no longer be necessary upon its closure. There will also be additional negative economic multiplier effects, such as the local contractors and subcontractors typically utilized by the City in connection with the construction and operation of the landfill who will experience a business downturn when the landfill stops operating.

6.0 EFFECTS ON DEVELOPMENT OF A PUBLIC WATER SUPPLY ON THE PINE BUSH HABITAT

Based on NYSDEC's February 2000 Findings Statement for the P-4 Expansion Project, it was recognized that withdrawal of groundwater for a municipal source from the Pine Bush Aquifer could result in potential negative impacts to the Albany Pine Bush habitat. As noted in Section 4.0 a small municipal water supply capable of a total well field yield of 200 to 400 gpm, would require 8 to 15 individual wells. To minimize well interference effects during pumping, the wells would need to be spaced approximately 200 feet apart resulting in a minimum well field size of 9-acres. Static water levels within the well field would be lowered by more than 30-feet within the well field. Water levels will also be impacted and minimum of 200-feet beyond the limits of the well field. This may leave the root systems of the Pine Bush Formation with negative consequences.

The direct impact of pumping groundwater on a continuous basis within this unconfined, fine grained sand water table formation may result in a permanent lowering of groundwater elevations both within and beyond the limits of the well field. Without the presence of a recharge boundary, the cone of depression associated with the well field would continue to expand resulting in dewatering and lowering of the water table within the Pine Bush Formation well beyond the limits of the well field. Secondary impacts may include altering the distribution of flora and associated fauna within a protected ecological area. In general, the impact of a lowered water table within a wetland area would be more profound over a relatively shorter time frame than for an uplands area. However, due to the deep root zone development of various upland trees, shrubs, and other plants in the Pine Bush, including the food-source of the Karner blue butterfly, the blue lupine plant, and the sensitivity of these flora to water table lowering, it is a plausible theory that continuous groundwater withdrawal, given enough time, could eventually effect the distribution of uplands plant species in the Pine Bush. This is particularly true for tree and shrub species with lateral root growth at depth that "tap" the water table (C.T. Male; 1999).

In general, the depth to groundwater in the Pine Bush Formation ranges from 10 to 15 feet below ground surface and rarely exceeds 20 feet. A critical exception to these groundwater depths is the open water and wetland areas where the water table is at or close to the surface for much of the year. Due to the fact that aquatic resources are known to be at a premium within the Pine

Bush habitat, lowering the water table by 30 feet across such a large area, would have a significant negative impact on these open water and wetland resources.

Aquatic resources are scarce in pine barren ecosystems such as the Pine Bush, and therefore, existing open water and wetland resources are a critical habitat for a number of wildlife species. A decrease in the elevation of the groundwater table would decrease the duration and extent of open water within the Pine Bush, consequently reducing critical habitat areas.

Wetlands in the Pine Bush ecosystem are dependent on groundwater. A number of unique wetland communities are located within the Pine Bush, including State wetlands mapped by the DEC for their particular habitat value. A reduction in the water table would alter the hydrology of these habitats, likely reducing their overall extent. In addition, the drier environment would facilitate the colonization of the wetland by drought tolerant non-wetland species or less desirable invasive species, therefore shifting the community composition and reducing overall habitat value (C.T. Male; 1999).

Upland Pine Bush plants are known to have various adaptations to xeric conditions including deep root systems to tap into the water table. Plants are adapted to the current water table and are able to thrive despite relatively dry conditions. A drastic permanent reduction in the water table would increase stress to vegetation, and lead to increased plant mortality. The gaps created by the loss of vegetation, particularly trees, would increase the colonization of these areas by undesirable pioneer species, such as black locust (*Robinia pseudoacacia*) and quaking aspen (*Populus tremula*), altering the unique biology of the Pine Bush ecosystem. In addition, losses of critical plants such as the blue lupine, which serves as the sole food source for the endangered Karner blue butterfly, would further impact the diversity of the Pine Bush ecosystem (C.T. Male, 1999).

Due to the significant decrease in groundwater level across such a wide area, the development of a public source in the Pine Bush has the potential to have significant adverse impacts on the Pine Bush habitat. A decrease in water level could result in dewatering of wetland, streams that could seasonally run dry, the duration and frequency of vernal pools could be diminished, certain species of trees and plants could progressively die off, and rare and protected species unique to the Pine Bush could be significantly impacted.

7.0 ENVIRONMENTAL BENEFIT

Proposed Habitat Restoration and Enhancement Plan

As discussed in Section 2.0, there is a significant opportunity to re-establish linkages from west to east in the Albany Pine Bush Preserve over portions of the closed landfill, as well as through the adjacent mobile home park located to the north of the landfill through the implementation of the proposed Habitat Restoration and Enhancement Plan. Implementation of this plan would re-establish Pine Bush communities both on the landfill and in the areas surrounding the landfill.

Several previous attempts to establish some types of Pine Bush communities at the landfill have met with mixed success. For example, vegetative test plots were located on the landfill clay cap but did not establish well as the soil types were not the necessary sand soils found in the Pine Bush. A mitigation pond was also constructed to serve as habitat for amphibians. This has been relatively successful but the depth of the pond has supported fish that have either made their way upstream from Lake Rensselaer or were released into the pond by others. The fish prey on some amphibians and their eggs, which is contrary to the purpose of the mitigation. The mobile home park to the north of the landfill was dedicated to the APBPC but there never was, nor is there now, a comprehensive plan for how that parcel would be restored.

The current Eastern Expansion proposal presented a unique opportunity to the City to look at the landfill, the mobile home park, and the Pine Bush Preserve as a whole in developing a long-term restoration strategy. As a result, the City of Albany retained Applied Ecological Services, Inc. (AES), a nationally recognized ecological restoration firm with specific expertise in pine barren communities. After an initial field visit, AES identified issues and concerns within the landfill and surroundings and developed some restoration concepts that were used to begin dialog with the Albany Pine Bush Preserve Commission (APBPC), the Nature Conservancy (TNC) and NYSDEC technical staff. Next, the project team began detailed investigations of the vegetation, soils and hydrology within project impact areas, degraded areas, and high quality reference areas and used this data to refine concepts and to further engage the APBPC, TNC and NYSDEC technical staff. This resulted in the Habitat Restoration, Enhancement and Mitigation Plan for the landfill and surrounding areas which is outlined herein.

The sections to follow provide greater detail on the elements of the Plan.

7.1 Plan Recommendations

The overriding purpose of the Mitigation, Restoration & Enhancement Plan is to reclaim the landfill and the mobile home park as a part of the Pine Bush ecology and improve the water quality of the Lake Rensselaer watershed. Therefore, with the exception of the obvious topographic difference, the intent is to blend the landfill and vicinity back into Pine Bush habitat, and restore and enhance surrounding lands to create viable Pine Bush and re-establish the habitat connection between viable Pine Bush to the east and west.

The goals of the Mitigation, Restoration & Enhancement Plan (AES; 2008) are as follows:

- Eliminate habitat fragmentation by restoring Pine Bush habitat across both the mobile home park and the closed landfill and enhancing adjacent lands that have not been maintained due to the proximity of development and past private land ownership.
- Restore degraded aquatic resources by reconnecting natural drainage courses and restoring wetland functions.
- Reduce the Landfill "edge effect" by collecting, treating and diverting landfill stormwater runoff and improving landfill operations to address odors and blowing trash.
- Mitigate for wetland impacts associated with the proposed Eastern Expansion of the Landfill by creating new riparian wetlands and bogs.

The following sections provide details on the Habitat Plan elements.

7.2 Habitat Restoration and Enhancement

This section presents a discussion of the proposed restoration and enhancements that are outlined in the Habitat Restoration and Enhancement Plan. For the purpose of this discussion, restoration refers to the process of re-establishing an ecological community type that once existed in a given area but was previously eliminated in favor of other uses. By this definition, restoration is planned to take place on the landfill and within the mobile home park. Considering the existing development as a landfill and mobile home park, successful re-establishment of Pine Bush ecology will require the establishment of the appropriate soils, hydrology, and vegetation. Enhancement is the process of improving upon the ecological elements already present and involves far less construction and site manipulation than restoration. For degraded Pine Bush habitat, enhancement will involve the removal of invasive and other non-fire tolerant species to

re-establish pine barrens. Within the wetland located on State land east of the landfill, enhancement will include the re-establishment of hydrology that was manipulated many years ago through ditching and the installation of drain tiles. More specifically, much of the wetlands on the State land east of the landfill has been dewatered due to a series of drain tile installations and ditching that was completed as part of historic agricultural operations. Section 7.3 of this report summarizes the activities that are planned for the degraded wetland mitigation under the Habitat Restoration Plan.

To restore the landfill cap, approximately 2 feet of sand will be placed over the existing surface and roughly graded to provide microtopography as is found in natural conditions. Soils are a critical element for the success of the restoration project. The simplest way to ensure proper soil conditions is to use the existing Pine Bush soils. Some of the soils are expected to come from the expansion area but more soil will be needed. Since the project will be phased over the 6-7 year life of the landfill expansion, it is anticipated that soils can be "collected" from other areas within the Pine Bush as projects occur. These soils would be stockpiled and used as each phase progresses. A detailed schedule associated with restoration activities is presented in the Albany *Rapp Road Landfill Ecosystem Mitigation, Restoration & Enhancement Plan* dated September 2008.

The overall intent is to create pine barrens across the landfill cap to provide Karner blue butterfly (*Lycaeides melissa samuelis*) habitat for this federally and State listed endangered species, as well as habitat for other State listed species unique to the pine barrens community. This community type includes dry grasslands punctuated by occasional pitch pine trees and scrub oak (*Quercus ilicifolia* and Q. *prinoides*)

7.3 Repair of Degraded Aquatic Resources

Natural drainage in the project area has been impacted by construction of the landfill and mobile home park, old agricultural activities, and the railroad. Specific to the project area, there are two stream corridors, tributary to Lake Rensselaer, that have been significantly manipulated over the years. It is the intent of the Habitat Plan to reconnect the streams in a manner that will improve upon water quality.

Both streams will be reconnected across the existing mobile home park through riparian wetland corridors. This will be part of the overall integration of the mobile home park back into the Pine

Bush Preserve. The southern stream currently originates from the mitigation pond located on Preserve lands to the west. Its new channel will meander through a riparian floodplain, relocated to the north of the proposed landfill expansion area. The stream will eventually reconnect to its existing channel within the wetland located on State lands to the east of the landfill. From its reconnection to the culvert at Rapp Road, the stream bed will be partially filled to eliminate the draining effect it is having on the wetland. Weirs will also be installed in selected locations along the stream to further promote an extended hydroperiod. The purpose of this effort is to re-saturate the organic soils comprising the wetland and reduce the accelerated decay of this material. The organic material is a primary suspect of nutrient loading and a potential cause of eutrophication in Lake Rensselaer.

The northern stream will reconnect to the enhanced forested wetland located on the west side of the mobile home park. Drainage from the wetland area southward to the southern stream will be eliminated in order to separate these two streams. The northern stream will pass through a proposed forested riparian corridor that will improve water quality over the current road and mobile home park runoff. Additional detail regarding the repair of these degraded resources is presented in the Habitat Restoration Plan.

7.4 Reducing the "Edge Effect"

The primary issues associated with the interface between the landfill and the Pine Bush Preserve from an ecological perspective are stormwater runoff and lack of fire maintenance. Other issues such as blowing trash (primarily plastic bags) and odors have an impact on the Preserve as a recreational resource.

Stormwater runoff will be addressed by the design and installation of a stormwater management system that will collect runoff from the landfill slopes and redirect it to a biofilter that will treat the runoff before it enters the Pine Bush Preserve. The current issues with stormwater runoff are associated with earlier phases of the landfill when stormwater and landfill regulations did not require the capture and treatment of runoff.

Lack of maintenance along the landfill edge, particularly to the west of the landfill has resulted in the spread of poplar (*Populus spp.*) and black locust. Fire management has not been used in this area on the belief that methane was migrating from the landfill. This belief has since been shown to be unfounded. Recent conversations between APBPC staff and landfill personnel

suggest that controlled burning is possible in the area. Therefore, between the elimination of stormwater runoff impacts and the renewed potential for maintenance by APBPC staff, the "edge effect" could be significantly reduced. Restoration efforts on the landfill cap will further contribute to a blending of existing pine barrens with the created habitat.

Through the development of the Habitat Plan, a more specific analysis of the "edge effect" will be conducted. The protocols for sampling have been established and will use the same methods used in establishing the baseline study of reference natural areas and other areas included in the Habitat Plans. These methods include sampling of soils, hydrology, topography, vegetation, and the development of criteria for minimizing impacts to the Pine Bush with future mitigation plans. The following specific evaluations will be provided by the methods that have been established with the protocols:

- Soil chemistry impact evaluation
- Vegetation and invasive plant impact evaluation
- Fire suppression impact evaluation
- Buffer effectiveness evaluation
- Establish criteria for minimizing impacts

7.5 Mitigating Direct Expansion Impacts

Mitigation expansion area impacts is an essential component of the Plan. The project will impact approximately 5.6 acres of forested riparian wetland. This loss can be compensated through the creation of forested riparian corridors associated with the reconnected streams. By integrating new restored wetlands with proposed stream reconnections there will be reduced erosion of stream banks, providing the opportunity to beneficially improve water quality.

Other opportunities for wetland creation and enhancement include the creation of bogs on the disturbed sands located to the west of the mobile home park. Bogs were once a part of the Pine Bush ecosystem but most, if not all, are gone.

In total, it is estimated that approximately 10-15 acres of wetland communities can be created with an additional 25 acres of wetland enhancement. An important point is that all this mitigation is tied into a restoration and enhancement plan addressing the larger issue of large

scale habitat connectivity within the Pine Bush Preserve. At the end of 6-7 years, when the landfill is closed, there will be a total of approximately 250 acres of restoration, mitigation and enhancement, all of which will be permanently protected.

7.6 Implementation

The Habitat Plan requires a significant effort and commitment of money and resources to implement and is contemplated by the City only as a component of the landfill expansion project as currently proposed. It is anticipated that implementation of the plan will be a permit condition of the landfill expansion. The expansion will provide the financial capability to undertake this massive effort over time. Since a portion of the landfill would remain active for 6-7 years as a result of the proposed expansion, the restoration will occur in phases over this time period. Detailed cost estimates will be prepared as the plan becomes refined towards construction drawings. Much of the cost will depend on the availability and location of suitable sand.

The first phase will occur in Year 1 and will be concurrent with construction of the first landfill cell that will include overfill and expansion onto other currently disturbed lands. Wetland impact will be avoided or minimal in this phase and therefore wetland mitigation will not be the primary focus. However, this phase will provide the opportunity to prepare for wetland mitigation and the rescue of desirable species from the Expansion Area. During this phase, ecologists will begin the process of identifying and preparing species for transfer. A nursery will be established on the mobile home park site where some species will be transferred.

Restoration during Phase 1 will focus on the establishment of pine barrens test plots on portions of the closed landfill with the intent of demonstrating the viability of these natural communities on a capped landfill.

Phase 2 is identified as years 2 and 3 and will provide some very substantive results by restoring the mobile home park to pine barrens and riparian wetland, reconnecting streams, restoring wetland hydrology, enhancing degraded wetlands, and improving water quality. Most of the wetland and stream mitigation work will occur in this phase.

Phase 3 (years 3 and 4) will again take on some significant restoration and enhancement efforts, particularly on the landfill, creating the pitch pine buffer along the Thruway, addressing stormwater and invasive species issues on the western edge of the landfill, and completing the

east-west habitat connection with the restoration of pine barrens in the northeast portion of the project area.

Phases 4 & 5 (years 5-6 and 7-10) will focus on the landfill cap, restoring pine barrens to currently closed portions in Phase 4. Phase 5 will be part of the final closure of the landfill.

Actual phasing will be dictated by the availability of suitable sand. In order to support the unique ecological communities of the Pine Bush, the sands should come from the Pine Bush or possibly from other areas within the region with similar soils. The results of the detailed soils analysis performed as part of this SDEIS may also allow for the chemical modification of sands taken from other sources should there be no other options. Sands will be stockpiled and used as needed.

The success of this undertaking will depend partly on continued cooperation between the City and various stakeholders such as the APBPC, The Nature Conservancy, and regulatory agencies.

8.0 DISCUSSION

Part 360, and specifically 6 NYCRR 360-1.7(c), provides that an applicant may request that DEC grant a variance from a specific provision of Part 360. Pursuant to the Part 360 Regulations, every application for a variance must:

(i) identify the specific provisions of this Part from which a variance is sought;

(ii) demonstrate that compliance with the identified provisions would, on the basis of conditions unique to the person's particular situation, tend to impose an unreasonable economic, technological or safety burden on the person or the public; and

(iii) demonstrate that the proposed activity will have no significant adverse impact on the public health, safety or welfare, the environment or natural resources and will be consistent with the provisions of the ECL and the performance expected from application of this Part.

This section is intended to demonstrate that the City is entitled to the requested variance, as more fully set forth below.

8.1 Part 360 Provisions from which a Variance is Sought

The City specifically requests a variance from the provisions of 6 NYCRR 360-2.12(c)(1)(i), which prohibits, siting a landfill over a primary water supply aquifer or principal aquifer.

8.2 Conditions Justifying the Variance

This report, together with the Fourth Draft Supplemental Environmental Impact Statement and the Part 360 application as a whole, thoroughly demonstrates that there are circumstances unique to the City of Albany and the ANSWERS Wasteshed which justify granting a variance from the provisions of 6 NYCRR 360-2.12(c)(1)(i). These circumstances generally include the City's pursuit of alternative landfill sites, the significant economic impact to the City and the members

of the ANSWERS wasteshed community will incur if the landfill permit and all requested variances are not approved, the lack of any adverse impact to the aquifer associated with the landfill expansion, the potential impacts to the Pine Bush habitat that would result from the development of a public water supply within the Pine Bush Formation, and the environmental benefit of the City's proposed Habitat Plan that would not be undertaken if the requested variance is not approved.

At this time, the only valid short term solution to meet public need is the expansion of the existing landfill, specifically the proposed Eastern Expansion, which is the preferred alternative as presented in the SDEIS. At current rates of disposal, this will provide 6-7 years of landfill life. However, unlike previous expansion efforts, the option for an additional future expansion will be foreclosed by virtue of both the fact that all surrounding lands are dedicated to the APBPC and the proposed Habitat Plan that will be phased in during construction and operation of this expansion, with the last phase of the Habitat Plan encompassing the Eastern Expansion after closure. The result would be a landfill transformed into Pine Bush habitat with some remaining landfill infrastructure such as landfill offices, a possible future transfer station, and gas to energy facilities. Therefore, the majority of the landfill, as well as the surrounding lands, will be committed to habitat, leaving no room for further expansion.

From an economic standpoint, as demonstrated in Section 5.0, if the landfill expansion is not approved, then there will be severe economic consequences, not only for the City of Albany, but for the ANSWERS Wasteshed as a whole. As noted above, revenues from the operation of the landfill currently pay for the City's solid waste and recyclables related services ($3,069,000) and annual debt services on bonds issued for solid waste related projects ($2,376,100), for a total of $5,445,100. To the extent that revenues from the operation of the landfill exceed this amount, those revenues are paid into the general fund, to reduce the total tax burden on the residents of the City of Albany. In addition, if the Eastern Expansion were not approved with the requested variance, the City would not only have to find an alternative source of revenues for these costs, it would incur an additional $2,890,000 per year in transfer/haul costs, including the operation of a transfer station. The members of the ANSWERS Wasteshed would incur significant additional costs to dispose of its waste should the Eastern Expansion not be approved. Therefore, the failure to grant the requested variance would impose an unreasonable economic burden on the City of Albany, the members of the ANSWERS Wasteshed, and the Capital Region as a whole.

8.3 Absence of Potential Significant Impacts

In addition to the above conditions, granting the requested variance will not have any significant adverse impact on the public health, safety or welfare, the environment or natural resources as demonstrated from the lack of impacts associated with the operation of the existing AIL. The proposed double liner system that will be used in the construction of the proposed Eastern Expansion will be consistent with the liner system used for the existing AIL. Based on more than ten years of environmental monitoring data for the AIL, there are no adverse impacts to groundwater that are attributable to the landfill liner system. A detailed assessment of the groundwater quality at the Rapp Road site including the necessary data that demonstrate the lack of adverse impacts from the existing AIL is presented in the Hydrogeologic Report, which has been submitted as part of the Eastern Expansion permit documents.

Sections 3.0 and 4.0 of this report demonstrate that the Pine Bush Formation has limited utility as a potential source of groundwater, and the municipalities in the Pine Bush area developed public water supplies in more highly productive aquifers or surface waters outside the Pine Bush Formation. The City of Albany utilizes the Alcove and Basic reservoirs, located in the Helderberg Mountains; the Town of Guilderland utilizes a deep well array located approximately 3 miles west (and upgradient) of the landfill, and the Town and Village of Colonie (Latham Water District) utilize the Mohawk River, Stony Creek Reservoir, and wells located adjacent to the Mohawk River, located approximately 7 miles northeast of the landfill. Although the Latham Water District reportedly owns land on Morris Road which had been developed for wells to be used as a groundwater supply, these wells were abandoned in the 1960's due to their low yield, poor water quality, and need for treatment to remove fine particulates. These existing public water supply systems currently have adequate capacity to handle expected growth in the area, and none of the municipalities involved have plans to develop any additional groundwater capacity within the Pine Bush Formation. Finally, the existing water quality of the Pine Bush Formation Rapp Road facility and to some extent regionally, is of poor quality and therefore, the Pine Bush Formation will not likely be used as a public water supply. As a result, any impacts to the existing aquifer would not result in any significant adverse impact on the public health, safety or welfare, or critical environment or natural resources.

Furthermore, as demonstrated in Section 5.0, any development of a public water supply within the Pine Bush Formation could potentially have a significant effect on the Pine Bush ecosystem. As demonstrated therein, development of a public water supply of sufficient quantity (approximately 200 to 400 gpm) would require 8 to 16 individual pumping wells, resulting in the lowering of static water levels across an area in excess of 11 acres by up to 30 feet. Such a lowering of the water table could have significant adverse impacts such as dewatering of wetlands, streams running seasonally dry, and diminishing the duration and frequency of vernal pools. Since there are many rare and endangered species which rely on these characteristics of the Pine Bush habitat, any development of a public water supply within the Pine Bush Formation could result in negative impacts to these species.

Finally, the City has worked with the APBPC to develop a Habitat Restoration and Enhancement Plan that will be implemented following approval of the Eastern Expansion. The Habitat Plan and the Eastern Expansion are intertwined in terms of construction phasing, financing, and landfill closure. Restoration, mitigation, and enhancement projects will begin during the first year of the landfill expansion and will be phased over the anticipated 6.6-year life of the project, with the final phase a component of the closure plan. The end result converts the entire Rapp Road Landfill complex and surrounding lands, with the exception of landfill operations structures that will be needed to continue to address gas and leachate collection, odor abatement, and possible transfer station operations, into Pine Bush habitat. This expansion project provides the financial means to restore and enhance approximately 250 acres of land. With limited State and local funding sources, the ability of the Pine Bush Preserve Commission to achieve the goals of the Habitat Plan is significantly diminished if not impossible.

In summary, the City has amply demonstrated that the granting of a variance from the provisions of 6 NYCRR 360-2.12(c)(1)(i) meets the requirements of 6 NYCRR 360-1.7(c), due to the unique economic burdens it would impose on the City of Albany and the members of the ANSWERS Wasteshed, and the lack of any significant impact from the proposed variance request.

9.0 CONCLUSIONS

Under the unique circumstances presented here, a variance from the provisions of 6 NYCRR 360-2.12(c)(1) is warranted. The Pine Bush Formation is not presently, and most likely will never be, used as a public water supply. In addition, any potential development of the aquifer may cause irreparable harm to the Pine Bush habitat. Furthermore, the delays which the City has encountered in siting a long term landfill have been unforeseeable, and the City has an obligation to provide disposal capacity to the member municipalities in the ANSWERS Wasteshed. Providing this variance will ensure that the City continues to provide that critical disposal capacity to the members of the ANSWERS Wasteshed, while not causing any environmental impact to the Pine Bush Formation.

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MW-15D
MW-15I
MW-15S

MW-14D
MW-14I
MW-14S

EE-B-1

EE-B-2

PROPOSED EXPANSION AREA

MW-2D
MW-2I
MW-2S

MW-7D
MW-7I
MW-7S

MW-1D
MW-1I
MW-1S

MW-3D
MW-3I
MW-3S

CELL 1

CELL 2

CELL 3

CELL 4

CELL 5

CELL 6

CELL 7

CELL 8

CELL 9

CELL 10

CELL 11

MW-11D
MW-11I
MW-11S

MW-10D
MW-10I
MW-10S

MW-12D
MW-12I
MW-12S

MW-9D
MW-9I
MW-9S

MW3

GW2D

MW-4D
MW-4I
MW-4S

MW-8D
MW-8I
MW-8S

MW-6D
MW-6I
MW-6S

MW-5D
MW-5I
MW-5S

GW5D
GW5S

MW2

LEGEND

MW-1D
MW-1I
MW-1S — EXISTING ALBANY INTERIM LANDFILL MONITORING WELL CLUSTER

GW1D — GREATER ALBANY/RAPP ROAD LANDFILL MONITORING WELL CLUSTER

EE-B-2 — EXPANSION AREA SOIL BORING LOCATION

MW-1D
MW-1I
MW-1S — ABANDONED MONITORING WELL CLUSTER

MW-1D
MW-1I
MW-1S — NEWLY INSTALLED EASTERN EXPANSION MONITORING WELLS

SCALE: 1" = 200'

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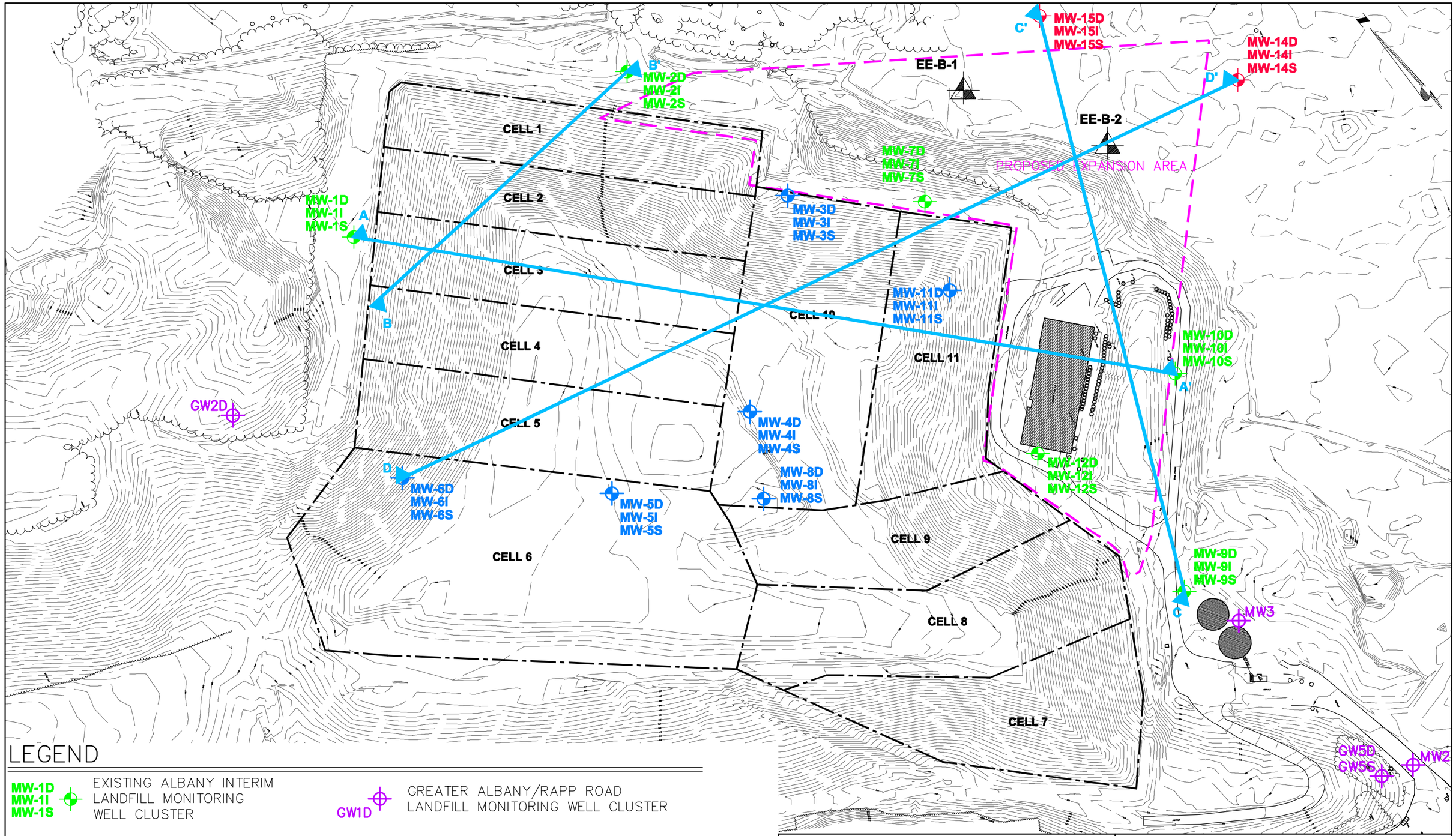
FIGURE 1
SITE PLAN
RAPP ROAD SOLID WASTE MANAGEMENT FACILITY
CITY OF ALBANY
STATE OF NEW YORK



LEGEND

- MW-1D / MW-1I / MW-1S — EXISTING ALBANY INTERIM LANDFILL MONITORING WELL CLUSTER
- GW1D — GREATER ALBANY/RAPP ROAD LANDFILL MONITORING WELL CLUSTER
- MW-1D / MW-1I / MW-1S — ABANDONED MONITORING WELL CLUSTER
- MW-1D / MW-1I / MW-1S — NEWLY INSTALLED EASTERN EXPANSION MONITORING WELLS
- EE-B-2 — DEEP SOIL BORING LOCATION EASTERN EXPANSION AREA
- A — A' — CROSS SECTION LOCATION

SCALE: 1" = 200'

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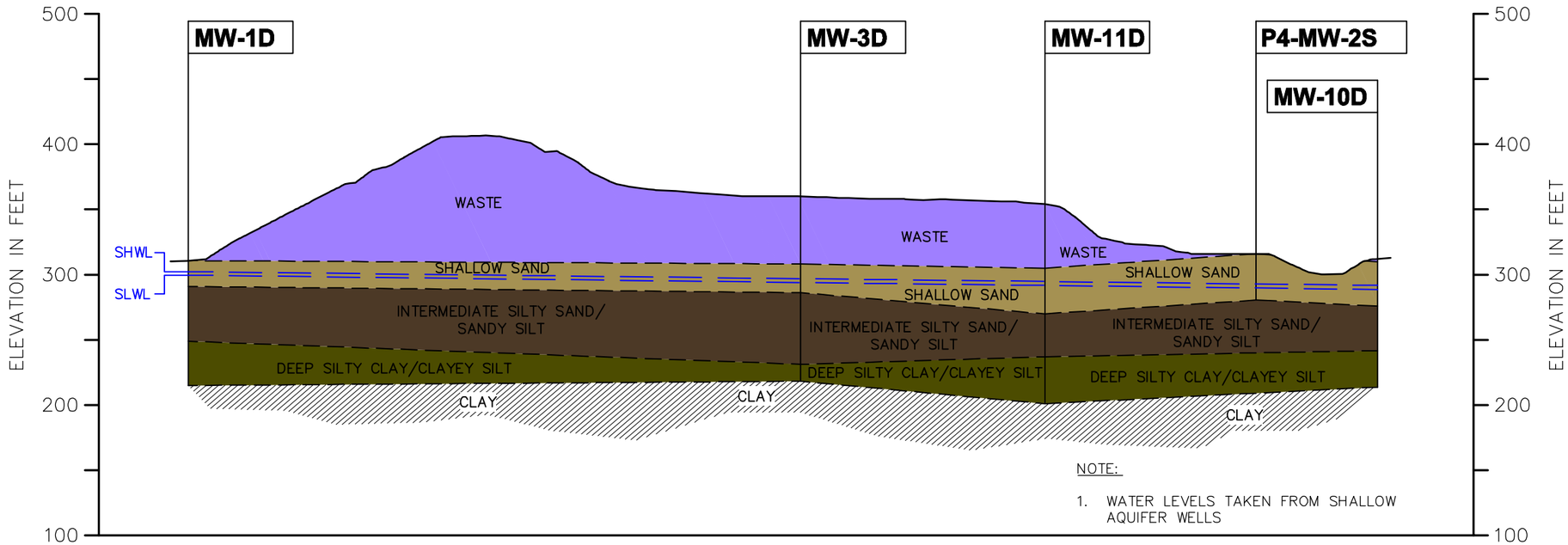
FIGURE 2

CROSS SECTION LOCATION PLAN

AQUIFER VARIANCE REPORT
RAPP ROAD SOLID WASTE MANAGEMENT FACILITY
CITY OF ALBANY
STATE OF NEW YORK



SECTION A–A'

HORIZONTAL SCALE: 1" = 200'
VERTICAL SCALE: 1" = 100'

LEGEND:

SHWL – SEASONAL HIGH WATER LEVEL

SLWL – SEASONAL LOW WATER LEVEL

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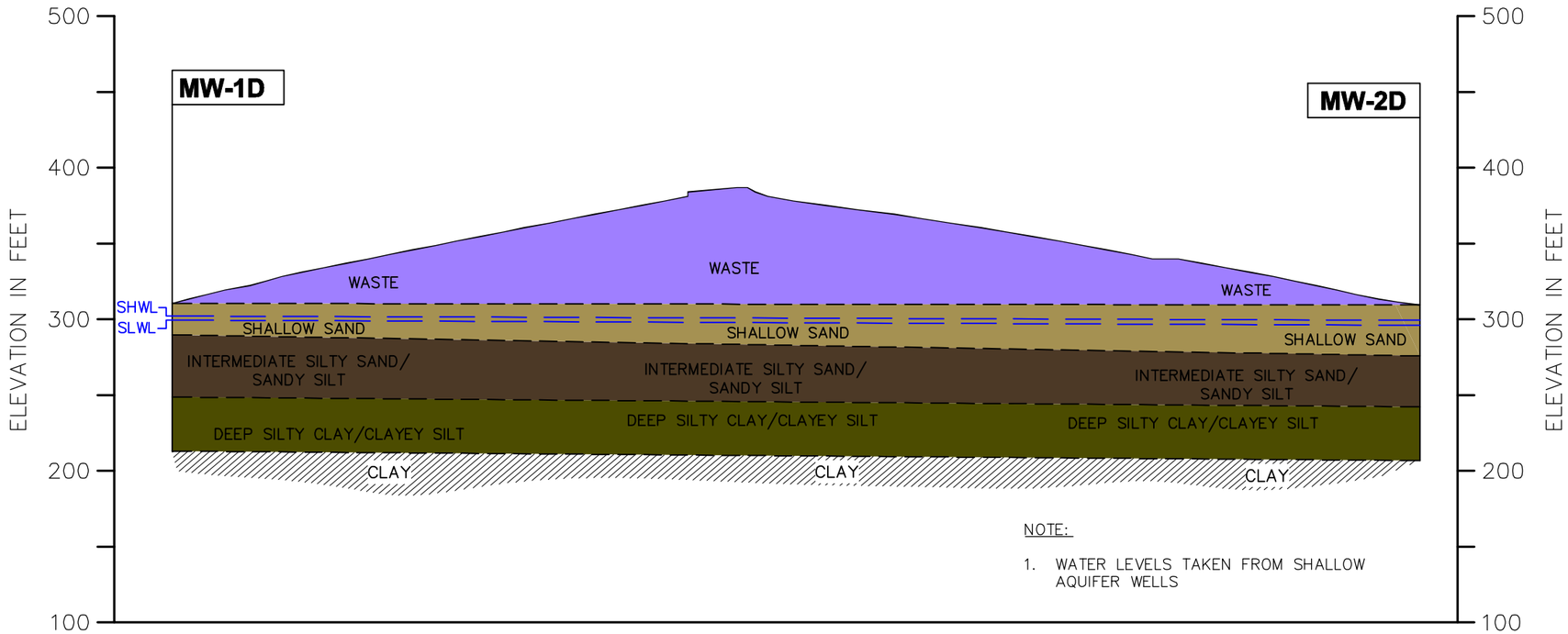
FIGURE 3

GEOLOGIC SECTION A–A'
AQUIFER VARIANCE REPORT
RAPP ROAD SOLID WASTE MANAGEMENT FACILITY
CITY OF ALBANY
STATE OF NEW YORK



SECTION B–B'

HORIZONTAL SCALE: 1" = 100'
VERTICAL SCALE: 1" = 100'

LEGEND:

SHWL – SEASONAL HIGH WATER LEVEL

SLWL – SEASONAL LOW WATER LEVEL

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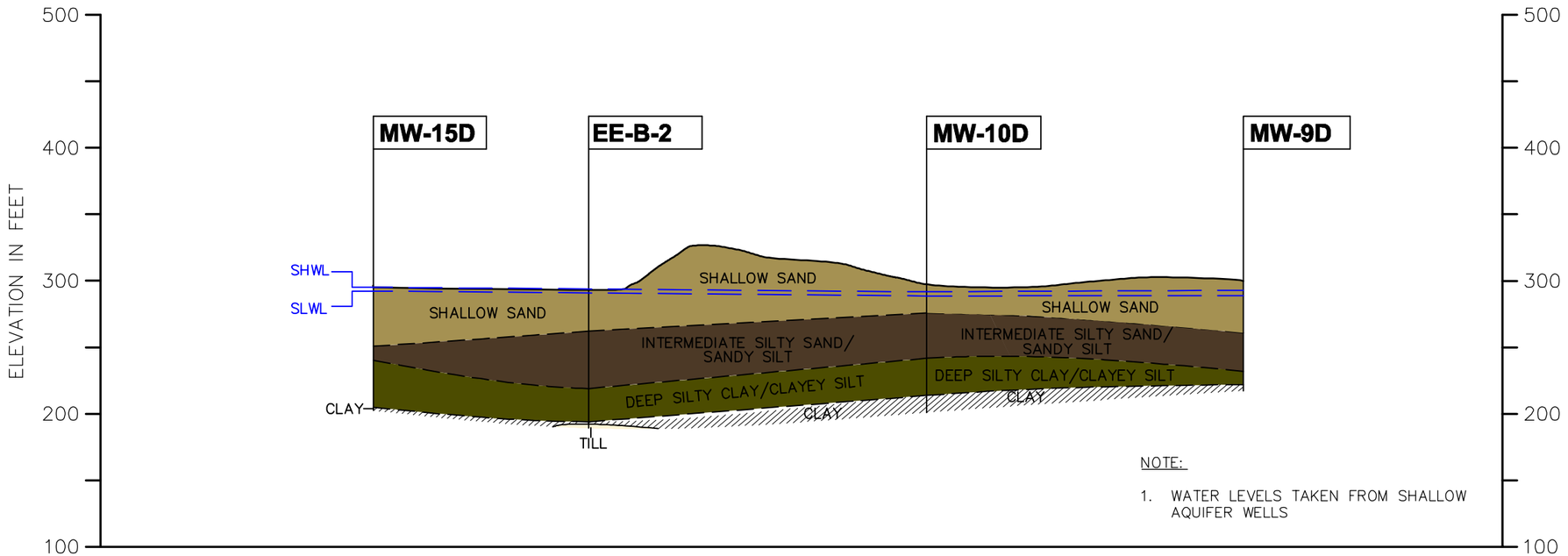
FIGURE 4

GEOLOGIC SECTION B–B'
AQUIFER VARIANCE REPORT
RAPP ROAD SOLID WASTE MANAGEMENT FACILITY
CITY OF ALBANY
STATE OF NEW YORK



SECTION C–C'

HORIZONTAL SCALE: 1" = 200'
VERTICAL SCALE: 1" = 100'

LEGEND:

SHWL – SEASONAL HIGH WATER LEVEL

SLWL – SEASONAL LOW WATER LEVEL

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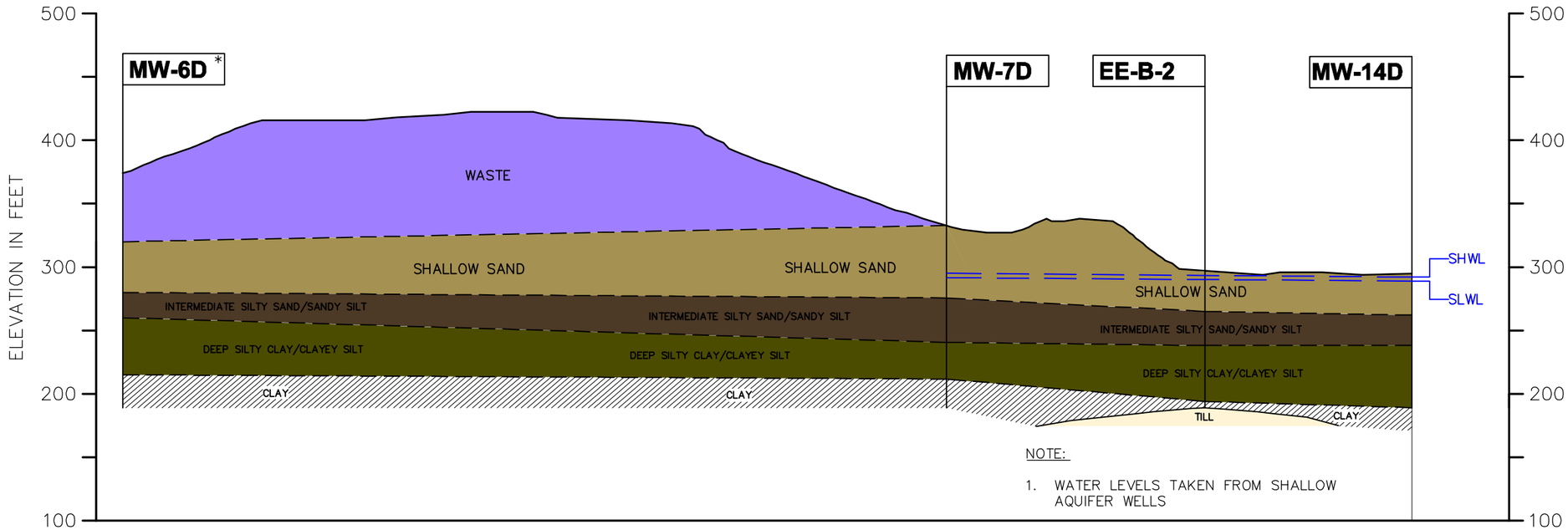
FIGURE 5

GEOLOGIC SECTION C–C'
AQUIFER VARIANCE REPORT
RAPP ROAD SOLID WASTE MANAGEMENT FACILITY
CITY OF ALBANY
STATE OF NEW YORK



SECTION D–D'

* ORIGINAL SURFACE ELEVATION FOR "6D" ESTIMATED BY CLOSEST ORIGINAL TOPOLOGICAL FEATURE

HORIZONTAL SCALE: 1" = 200'
VERTICAL SCALE: 1" = 100'

LEGEND:

SHWL – SEASONAL HIGH WATER LEVEL

SLWL – SEASONAL LOW WATER LEVEL

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FIGURE 6

GEOLOGIC SECTION D–D'
AQUIFER VARIANCE REPORT
RAPP ROAD SOLID WASTE MANAGEMENT FACILITY
CITY OF ALBANY
STATE OF NEW YORK

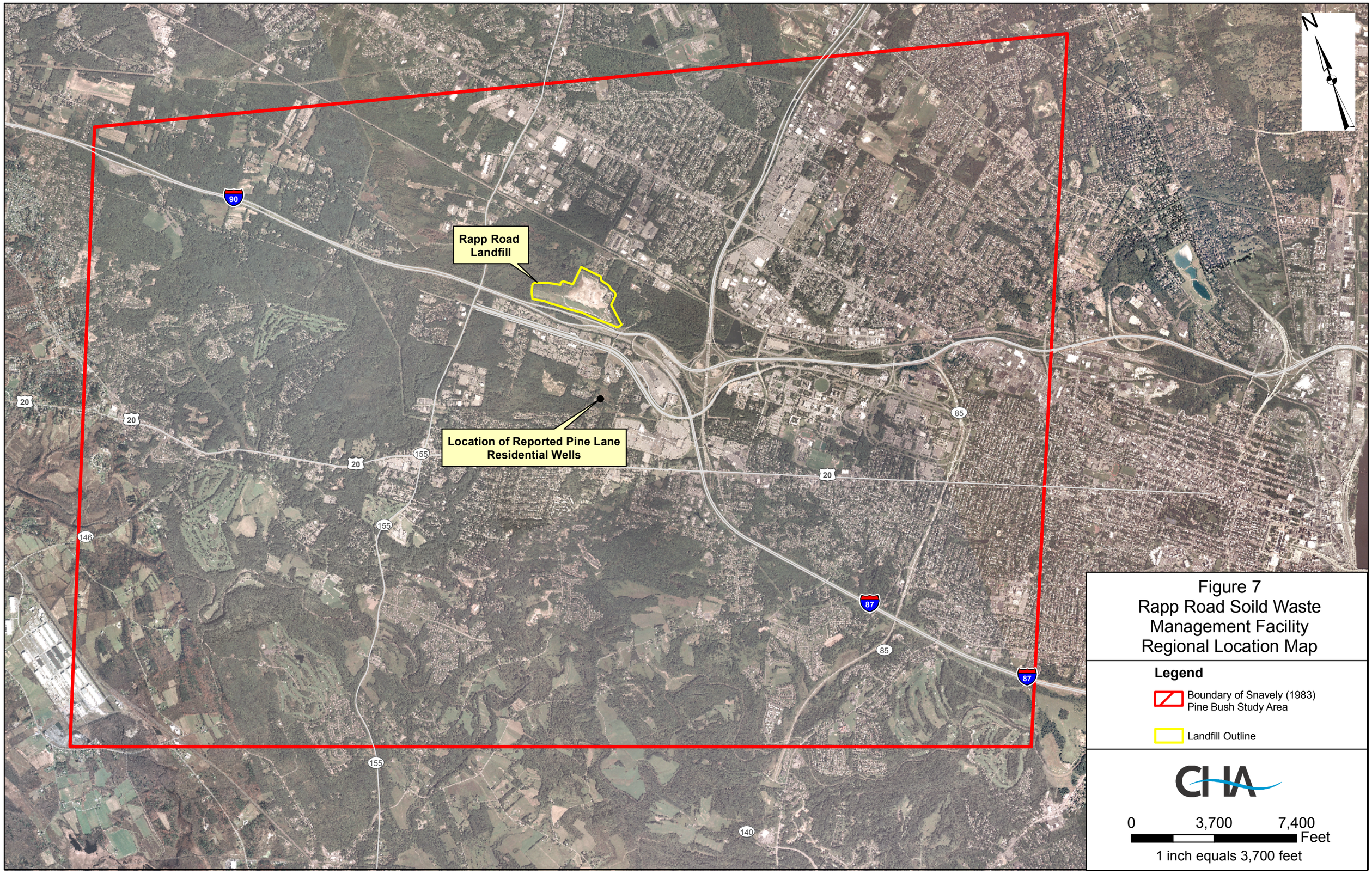


Figure 7
Rapp Road Soild Waste
Management Facility
Regional Location Map

Legend

Boundary of Snavely (1983)
Pine Bush Study Area

Landfill Outline

CHA

0 3,700 7,400 Feet

1 inch equals 3,700 feet

TOWN OF GUILDERLAND
CITY OF ALBANY

TOWN OF GUILDERLAND
CITY OF ALBANY

APPROXIMATE LIMITS OF PROPOSED EXPANSION AREA

PROPOSED EXPANSION AREA

ALBANY INTERIM LANDFILL
(ACTIVE)

P-4 LANDFILL EXPANSION AREA

ALBANY INTERIM LANDFILL EXPANSION WEDGE

GREATER ALBANY LANDFILL
(INACTIVE – CAPPED)

GREATER ALBANY LANDFILL
(INACTIVE – CAPPED)

GREATER ALBANY LANDFILL
(INACTIVE – CAPPED)

PW-2

PW-1

LEGEND

APPROXIMATE LIMITS OF PROPOSED EASTERN LANDFILL EXPANSION

PW-1 TEST WELL LOCATION

SCALE: 1" = 300'

CLOUGH HARBOUR & ASSOCIATES LLP
III Winners Circle, PO Box 5269, Albany, NY 12205
Main: (518) 453-4500 · www.cloughharbour.com

12206.4008.1102

DATE: 1/23/09

FIGURE 8
FEASIBILITY STUDY
TEST WELL LOCATION MAP
RAPP ROAD SOLID WASTE MANAGEMENT FACILITY
CITY OF ALBANY
STATE OF NEW YORK

APPENDIX A

CLOUGH HARBOUR & ASSOCIATES LLP

PROJECT NUMBER: 12206-4008-1102 7/9/2007

Rapp Road Eastern Expansion
SUBSURFACE LOG
HOLE NUMBER EE-B-1

LOCATION: Albany, New York

CLIENT: City of Albany DGS

CONTRACTOR: New England Boring Contractors

DRILLER: T. Carpenter INSPECTOR: K. Defayette

START DATE and TIME: 12/11/2006 1:00:00 PM

FINISH DATE and TIME: 12/13/2006 2:00:00 PM

SURFACE ELEV: 296.00 (ft; Estimated) CHECKED BY: W. Harris

DRILL FLUID: Water @ 8' DRILLING METHOD: 4" FJC

WATER LEVEL OBSERVATIONS DURING DRILLING	DATE	TIME	READING TYPE	WATER DEPTH (ft)	CASING BOTTOM (ft)	HOLE BOTTOM (ft)
	12-11-06	1:00 PM	During Drilling	0.8	None	2

SAMP./CORE NUMBER	SAMP. ADV. (ft) LEN. CORE (ft)	RECOVERY (ft)	Blows Per 6" on Split Spoon Sampler	"N" Value or RQD%	SAMPLE	DEPTH (Feet)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEVATION (Feet)	Remarks on Character of Drilling, Water Return, etc.	WATER LEVELS AND/OR WELL DATA
								TOPSOIL		Advances boring with 2.25" SSA to 8' then advances 4" FJC to boring termination.	▽
S-1	2	1	1-WH-2-4					**f. SAND**, Some Silt, trace roots, brownish gray, v. loose, saturated **(SM)**			
						2		**f.m. SAND**, trace silt, brown, loose, saturated **(SP)**	294		
S-2	2	2	4-4-2-2	6							
						4		**f.m. SAND**, little silt, trace roots, grayish black, v. loose, saturated **(SM)**	292		
S-3	2	1.4	1-1-1-3	2							
						6		**f.m. SAND**, trace silt, brownish black, loose, saturated **(SP)**	290		
S-4	2	2	2-2-3-3	5							
						8		becomes dark gray, v. loose **(SP)**	288		
S-5	2	2	2-2-2-3	4							
						10		**f.m. SAND**, trace silt, dark gray, loose, saturated **(SP)**	286		
S-6	2	1.3	4-2-3-4	5							
						12		**Similar Soil (SP)**	284		
S-7	2	1.7	2-4-4-7	8							
						14		No Recovery	282	Tried to recover split spoon sample S-8 twice.	
S-8	2	0	2-2-3-2	5							
						16		**f.m. SAND**, trace silt, gray, v. loose, saturated **(SP)**	280		
S-9	2	1.8	2-2-2-2	4							
						18		becomes m. compact **(SP)**	278		
S-10	2	1.7	4-8-8-9	16							

CLOUGH HARBOUR & ASSOCIATES LLP

PROJECT NUMBER: 12206-4008-1102 7/9/2007

Rapp Road Eastern Expansion
SUBSURFACE LOG
HOLE NUMBER EE-B-1

SAMP./CORE NUMBER	SAMP. ADV. (ft) LEN. CORE (ft)	RECOVERY (ft)	Blows Per 6" on Split Spoon Sampler	"N" Value or RQD%	SAMPLE	DEPTH (Feet)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEVATION (Feet)	Remarks on Character of Drilling, Water Return, etc.	WATER LEVELS AND/OR WELL DATA
								f.m. SAND, trace silt, gray, m. compact, saturated **(SP)**			
S-11	2	1.3	4-6-7-8	13							
						22		**Similar Soil (SP)**	274		
S-12	2	2	5-5-7-8	12							
						24		becomes loose **(SP)**	272		
S-13	2	2	4-4-5-6	9							
						26		becomes m. compact **(SP)**	270		
S-14	2	1.1	2-4-7-7	11							
						28		**Similar Soil (SP)**	268		
S-15	2	1.8	3-7-14-21	21							
						30		**Similar Soil (SP)**	266		
S-16	2	2	6-9-10-12	19							
						32		**Similar Soil (SP)**	264		
S-17	2	2	5-9-11-17	20							
						34		**Similar Soil (SP)**	262		
S-18	2	1.5	7-7-9-12	16							
						36		becomes loose **(SP)**	260		
S-19	2	2	2-5-5-7	10							
						38		becomes m. compact **(SP)**	258		
S-20	2	2	2-5-9-13	14							
						40		**Similar Soil (SP)**	256		
S-21	2	2	5-6-8-10	14							
						42		**Similar Soil (SP)**	254		
S-22	2	2	4-6-9-10	15							
						44			252		

CLOUGH HARBOUR & ASSOCIATES LLP

PROJECT NUMBER: 12206-4008-1102 7/9/2007

Rapp Road Eastern Expansion
SUBSURFACE LOG
HOLE NUMBER EE-B-1

SAMP./CORE NUMBER	SAMP. ADV. (ft) LEN. CORE (ft)	RECOVERY (ft)	Blows Per 6" on Split Spoon Sampler	"N" Value or RQD%	SAMPLE	DEPTH (Feet)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEVATION (Feet)	Remarks on Character of Drilling, Water Return, etc.	WATER LEVELS AND/OR WELL DATA
								becomes loose **(SP)** *(continued)*			
S-23	2	2	4-4-6-8	10							
						46		**f. SAND**, little silt, gray, loose, saturated **(SM)**	250		
								f. SAND, trace silt, gray, loose, saturated **(SP)**			
S-24	2	1.6	2-3-3-5	6							
						48		becomes m. compact **(SP)**	248		
S-25	2	2	3-5-7-8	12							
						50		**f. SAND**, little silt, gray, loose, saturated **(SM)**	246		
S-26	2	2	3-4-5-8	9							
						52		**f.m. SAND**, trace silt, gray, loose, saturated **(SP)**	244		
S-27	2	2	4-4-6-8	10							
						54		becomes m. compact **(SP)**	242		
S-28	2	2	6-5-7-7	12							
						56		**Clayey SILT**, Some f. Sand, gray, stiff, saturated **(ML)**	240	f. Sand seams through out clayey silt layer.	
S-29	2	2	3-5-8-12	13							
						58		becomes hard **(ML)**	238		
S-30	2	2	12-16-17-21	33				**f.m. SAND**, Some Silt, gray, m. compact, saturated **(SM)**			
						60		**f. SAND**, little silt, gray, m. compact, saturated **(SM)**	236		
S-31	2	2	1-5-7-9	12							
						62		**Similar Soil (SM)**	234		
S-32	2	2	6-8-13-17	21				**f.m. SAND**, trace silt, gray, m. compact, saturated **(SP)**			
						64		**Similar Soil (SP)**	232		
S-33	2	2	11-11-11-11	22				**f. SAND**, Some Silt, gray, m. compact, saturated **(SM)**			
						66		**Similar Soil (SM)**	230		
S-34	2	2	10-9-11-12	20							
						68			228		

CLOUGH HARBOUR & ASSOCIATES LLP

PROJECT NUMBER: 12206-4008-1102 7/9/2007

Rapp Road Eastern Expansion
SUBSURFACE LOG
HOLE NUMBER EE-B-1

SAMP./CORE NUMBER	SAMP. ADV. (ft) LEN. CORE (ft)	RECOVERY (ft)	Blows Per 6" on Split Spoon Sampler	"N" Value or RQD%	SAMPLE	DEPTH (Feet)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEVATION (Feet)	Remarks on Character of Drilling, Water Return, etc.	WATER LEVELS AND/OR WELL DATA
S-35	2	2	7-8-10-14	18				**f. SAND**, Some Silt, gray, m. compact, saturated **(SM)** *(continued)*			
						70		becomes compact **(SM)**	226		
S-36	2	1.6	13-18-15-18	33							
						72		becomes m. compact **(SM)**	224		
S-37	2	2	10-10-10-11	20							
						74		**Clayey SILT**, Some f. Sand, gray, m. compact, saturated **(ML)**	222	f. Sand seams through out clayey silt layer.	
S-38	2	1.2	6-6-6-6	12				**f. SAND**, Some Silt, gray, m. compact, saturated **(SM)**			
						76		becomes v. loose **(SM)**	220		
S-39	2	2	3-2-1-2	3				**Silty CLAY**, Some f.Sand, gray, soft, saturated **(CL)**			
						78		becomes m. stiff **(CL)**	218	f. Sand seams through out silty clay layer.	
S-40	2	2	3-3-5-7	8							
						80		**Similar Soil (CL)**	216		
S-41	2	2	3-4-6-7	10							
						82		**Similar Soil (CL)**	214		
S-42	2	2	3-4-5-6	9							
						84		becomes m. stiff **(CL)**	212		
S-43	2	2	WH-WH-5-5								
						86		becomes stiff **(CL)**	210		
S-44	2	2	5-5-5-5	10							
						88		**Similar Soil (CL)**	208		
S-45	2	2	5-6-6-6	12							
						90		becomes m. stiff **(CL)**	206		
S-46	2	2	1-1-4-9	5							
						92		**Silty CLAY**, Some f. Sand, gray, m. stiff, saturated **(CL)**	204		

CLOUGH HARBOUR & ASSOCIATES LLP

PROJECT NUMBER: 12206-4008-1102 7/9/2007

Rapp Road Eastern Expansion
SUBSURFACE LOG
HOLE NUMBER EE-B-1

SAMP./CORE NUMBER	SAMP. ADV. (ft) LEN. CORE (ft)	RECOVERY (ft)	Blows Per 6" on Split Spoon Sampler	"N" Value or RQD%	SAMPLE	DEPTH (Feet)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEVATION (Feet)	Remarks on Character of Drilling, Water Return, etc.	WATER LEVELS AND/OR WELL DATA
S-47	2	2	4-4-4-4	8		94		**Silty CLAY**, Some f. Sand, gray, m. stiff, saturated **(CL)** *(continued)* becomes stiff **(CL)**	202		
S-48	2	2	1-1-10-12	11		96		**f.m. SAND**, trace silt, gray, m. compact, saturated **(SP)** **Similar Soil (SP)**	200		
S-49	2	2	14-12-13-14	25		98		**Silty CLAY**, Some f. Sand, gray, m. compact, saturated **(CL)** becomes stiff **(CL)**	198		
S-50	2	2	6-6-6-7	12		100		becomes v. stiff **(CL)**	196		
S-51	2	2	6-12-13-33	25		102		**Clayey SILT**, Some f.m.c Sand, little f.c gravel, gray, m. compact, wet **(ML-TILL)**	194		
S-52	2	1.3	30-62-40-45	R		104		becomes v. compact **(ML-TILL)** End of Boring at 104 ft	192		
						106			190		
						108			188		
						110			186		
						112			184		
						114			182		
						116			180		

CLOUGH HARBOUR & ASSOCIATES LLP

PROJECT NUMBER: 12206-4008-1102 7/9/2007

Rapp Road Eastern Expansion
SUBSURFACE LOG
HOLE NUMBER EE-B-2

LOCATION: Albany, New York

CLIENT: City of Albany DGS

CONTRACTOR: New England Boring Contractors

DRILLER: T. Carpenter INSPECTOR: K. Defayette

START DATE and TIME: 12/13/2006 2:40:00 PM

FINISH DATE and TIME: 12/15/2006 4:30:00 PM

SURFACE ELEV: 293.00 (ft; Estimated) CHECKED BY: W. Harris

DRILL FLUID: Water @ 10' DRILLING METHOD: 4" FJC

WATER LEVEL OBSERVATIONS DURING DRILLING	DATE	TIME	READING TYPE	WATER DEPTH (ft)	CASING BOTTOM (ft)	HOLE BOTTOM (ft)
	12-13-06	2:50 PM	During Drilling	1	None	2

SAMP./CORE NUMBER	SAMP. ADV. (ft) LEN. CORE (ft)	RECOVERY (ft)	Blows Per 6" on Split Spoon Sampler	"N" Value or RQD%	SAMPLE	DEPTH (Feet)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEVATION (Feet)	Remarks on Character of Drilling, Water Return, etc.	WATER LEVELS AND/OR WELL DATA
								TOPSOIL		Advances boring with 2.25" SSA to 10' then advances 4" FJC to boring termination.	▽
S-1	2	1.1	1-1-2-2	3				**f.m. SAND**, Some Silt, some roots, trace wood, brown/gray, v. loose, saturated **(SM)**	292		
						2		**f.m. SAND**, Some Silt, trace roots, brownish gray, loose, saturated **(SM)**			
S-2	2	2	2-3-2-5	5					290		
						4		**f.m. SAND**, trace silt, trace roots, gray, loose, saturated **(SP)**			
S-3	2	1.8	2-3-3-3	6					288		
						6		**f.m. SAND**, trace silt, gray, loose, saturated **(SP)**			
S-4	2	2	2-3-4-5	7					286		
						8		becomes m. compact **(SP)**			
S-5	2	2	8-8-11-10	19					284		
						10		becomes loose **(SP)**			
S-6	2	1.3	3-4-4-5	8					282		
						12		becomes m. compact **(SP)**			
S-7	2	2	5-7-7-8	14					280		
						14		becomes loose **(SP)**			
S-8	2	1.2	3-4-5-5	9					278		
						16		**Similar Soil (SP)**			
S-9	2	1.3	2-3-6-9	9					276		
						18		becomes m. compact **(SP)**			
S-10	2	2	5-7-9-10	16					274		

CLOUGH HARBOUR & ASSOCIATES LLP

PROJECT NUMBER: 12206-4008-1102 7/9/2007

Rapp Road Eastern Expansion
SUBSURFACE LOG
HOLE NUMBER EE-B-2

SAMP./CORE NUMBER	SAMP. ADV. (ft) LEN. CORE (ft)	RECOVERY (ft)	Blows Per 6" on Split Spoon Sampler	"N" Value or RQD%	SAMPLE	DEPTH (Feet)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEVATION (Feet)	Remarks on Character of Drilling, Water Return, etc.	WATER LEVELS AND/OR WELL DATA
								f.m. SAND, trace silt, gray, loose, saturated **(SP)**			
S-11	2	2	4-5-4-6	9					272		
						22		**Similar Soil (SP)**			
S-12	2	2	4-3-4-4	7					270		
						24		becomes trace clay **(SP)**			
S-13	2	1.5	4-5-4-6	9					268		
						26		**f. SAND and SILT**, gray, m. compact, saturated **(SM)**			
S-14	2	2	4-6-6-6	12					266		
						28		**f. SAND**, Some silt, gray, m. compact, saturated **(SM)**			
S-15	2	2	4-6-8-20	14					264		
						30		becomes compact **(SM)**			
S-16	2	2	10-15-17-18	32					262		
						32		becomes m. compact **(SM)**			
S-17	2	2	5-7-7-10	14					260		
						34		**f.m. SAND**, trace silt, gray, loose, saturated **(SP)**			
S-18	2	1.5	3-3-3-4	6					258		
						36		**Similar Soil (SP)**			
S-19	2	1.5	2-3-3-5	6					256		
						38		**Similar Soil (SP)**			
S-20	2	2	3-4-5-6	9					254		
						40		**Similar Soil (SP)**			
S-21	2	1.6	3-4-3-4	7					252		
						42		becomes m. compact **(SP)**			
S-22	2	2	4-7-9-9	16					250		
						44					

CLOUGH HARBOUR & ASSOCIATES LLP

PROJECT NUMBER: 12206-4008-1102 7/9/2007

Rapp Road Eastern Expansion
SUBSURFACE LOG
HOLE NUMBER EE-B-2

SAMP./CORE NUMBER	SAMP. ADV. (ft) LEN. CORE (ft)	RECOVERY (ft)	Blows Per 6" on Split Spoon Sampler	"N" Value or RQD%	SAMPLE	DEPTH (Feet)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEVATION (Feet)	Remarks on Character of Drilling, Water Return, etc.	WATER LEVELS AND/OR WELL DATA
S-23	2	1.7	5-6-5-6	11				**f. SAND**, little silt, gray, m. compact, saturated **(SM)** *(continued)*	248		
						46		**f. SAND**, Some Silt, gray, m. compact, saturated **(SM)**			
S-24	2	2	4-7-7-7	14					246		
						48		becomes loose **(SM)**			
S-25	2	2	2-5-5-6	10					244		
						50		**Similar Soil (SM)**			
S-26	2	2	3-4-6-8	10					242		
								f. SAND, trace silt, gray, loose, saturated **(SP)**			
						52		**Similar Soil (SP)**			
S-27	2	2	5-5-5-8	10				**f. SAND**, Some SIlt, gray, loose, wet **(SM)**	240		
						54		becomes v. loose **(SM)**			
S-28	2	1.3	6-1-2-2	3				**Silty CLAY**, Some f. Sand, gray, soft, wet **(CL)**	238		
						56		becomes m. stiff **(CL)**			
S-29	2	2	2-2-3-3	5					236		
						58		becomes stiff **(CL)**			
S-30	2	2	3-3-6-7	9					234		
						60		becomes m. stiff **(CL)**			
S-31	2	2	2-2-3-5	5					232		
						62		becomes stiff **(CL)**			
S-32	2	2	3-5-5-7	10					230		
						64		**Similar Soil (CL)**			
S-33	2	2	3-4-6-6	10					228		
						66		**Similar Soil (CL)**			
S-34	2	2	WH-WH-3-3						226		
						68		becomes m. stiff **(CL)**			

CLOUGH HARBOUR & ASSOCIATES LLP

PROJECT NUMBER: 12206-4008-1102 7/9/2007

Rapp Road Eastern Expansion
SUBSURFACE LOG
HOLE NUMBER EE-B-2

SAMP./CORE NUMBER	SAMP. ADV. (ft) LEN. CORE (ft)	RECOVERY (ft)	Blows Per 6" on Split Spoon Sampler	"N" Value or RQD%	SAMPLE	DEPTH (Feet)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEVATION (Feet)	Remarks on Character of Drilling, Water Return, etc.	WATER LEVELS AND/OR WELL DATA
S-35	2	2	WH-2-3-3	5				becomes m. stiff **(CL)** *(continued)*	224		
						70		becomes stiff **(CL)**			
S-36	2	2	5-6-5-9	11					222		
						72		becomes v. stiff **(CL)**			
S-37	2	2	6-8-8-6	16					220		
						74		becomes m. stiff **(CL)**			
S-38	2	2	4-4-4-5	8					218		
						76		becomes v. soft **(CL)**			
S-39	2	0.4	WH-WH-1-WH						216		
						78		**Clayey SILT**, Some f. Sand, stiff, gray, wet **(ML)**			
S-40	2	2	8-6-5-5	11					214		
						80		**f. SAND**, Some Silt, gray, compact, wet **(SM)**			
S-41	2	1.5	8-15-17-20	32					212		
						82		**Similar Soil (SM)**			
S-42	2	1.5	11-18-21-27	39					210		
						84		**f. SAND**, trace silt, gray, v. compact, wet **(SP)**			
S-43	2	1	24-31-46-50	77					208		
						86		**f. SAND**, little clayey silt, gray, v. compact, wet **(SM)**			
S-44	2	1	10-23-37-41	60					206		
						88		**f. SAND**, Some Silt, gray, v. compact, wet **(SM)**			
S-45	2	2	27-41-49-62	90					204		
						90		**f. SAND and SILT**, gray, v. compact, wet **(SM)**			
S-46	2	2	26-40-41-50	81					202		
						92		**SILT**, Some f. sand, gray, v. compact, wet **(ML)**			
			18-47-81/0.5								

CLOUGH HARBOUR & ASSOCIATES LLP

PROJECT NUMBER: 12206-4008-1102 7/9/2007

Rapp Road Eastern Expansion
SUBSURFACE LOG
HOLE NUMBER EE-B-2

SAMP./CORE NUMBER	SAMP. ADV. (ft) LEN. CORE (ft)	RECOVERY (ft)	Blows Per 6" on Split Spoon Sampler	"N" Value or RQD%	SAMPLE	DEPTH (Feet)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEVATION (Feet)	Remarks on Character of Drilling, Water Return, etc.	WATER LEVELS AND/OR WELL DATA
S-47	1.5	1.5		R		94		**SILT**, Some f. sand, gray, v. compact, wet **(ML)** *(continued)* **Similar Soil (ML)**	200		
S-48	2	2	38-47-55-61	R		96		**Similar Soil (ML)**	198		
S-49	2	2	24-24-33-29	57		98		**Similar Soil (ML)**	196		
S-50	2	2	25-32-35-38	67		100		**Silty CLAY**, Some f. Sand, gray, hard, wet **(CL)** becomes stiff **(CL)**	194		
S-51	2	2	5-5-7-7	12		102		becomes v. stiff **(CL)**	192		
S-52	2	2	6-10-9-18	19		104		**Clayey SILT**, Some f.m.c Sand, little f.c gravel, gray, v. stiff, wet **(ML-TILL)** End of Boring at 104 ft	190		
						106			188		
						108			186		
						110			184		
						112			182		
						114			180		
						116			178		
									176		

CLOUGH HARBOUR & ASSOCIATES LLP

PROJECT NUMBER: 12206-4008-1102 7/9/2007

Rapp Road Eastern Expansion
SUBSURFACE LOG
HOLE NUMBER MW-14S

LOCATION: Albany, New York

CLIENT: City of Albany DGS

CONTRACTOR: New England Boring Contractors

DRILLER: T. Carpenter INSPECTOR: K. Defayette

START DATE and TIME: 1/4/2007 9:00:00 AM

FINISH DATE and TIME: 1/4/2007 11:45:00 AM

SURFACE ELEV: 292.10 (ft; Estimated) CHECKED BY: W. Harris

DRILL FLUID: Water @ 8' DRILLING METHOD: 4" FJC

WATER LEVEL OBSERVATIONS DURING DRILLING	DATE	TIME	READING TYPE	WATER DEPTH (ft)	CASING BOTTOM (ft)	HOLE BOTTOM (ft)

SAMP./CORE NUMBER	SAMP. ADV. (ft) LEN. CORE (ft)	RECOVERY (ft)	Blows Per 6" on Split Spoon Sampler	"N" Value or RQD%	SAMPLE	DEPTH (Feet)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEVATION (Feet)	Remarks on Character of Drilling, Water Return, etc.	WATER LEVELS AND/OR WELL DATA
								TOPSOIL			
S-1	2	2	2-3-3-4	6		2		**f. SAND and SILT**, trace clay, brown, loose, wet **(SM)**	290		
								becomes gray **(SM)**			
						4			288		
S-2	2	2	1-1-2-2	3		6		**f. SAND**, trace silt, trace roots, gray, v. loose, saturated **(SP)**	286		
						8			284		
S-3	2	0.8	1-WH-2-2			10		**f. SAND**, trace silt, gray, v. loose, saturated **(SP)**	282		
						12			280		
								End of Boring at 13 ft			
						14			278		
						16			276		
						18			274		

SUBSURFACE LOG LOGS (12206.4008).GPJ UPDATEDCHA.GDT 7/31/07

CLOUGH HARBOUR & ASSOCIATES LLP

PROJECT NUMBER: 12206-4008-1102 7/9/2007

Rapp Road Eastern Expansion
SUBSURFACE LOG
HOLE NUMBER MW-14I

LOCATION: Albany, New York

CLIENT: City of Albany DGS

CONTRACTOR: New England Boring Contractors

DRILLER: T. Carpenter INSPECTOR: K. Defayette

START DATE and TIME: 1/3/2007 9:30:00 AM

FINISH DATE and TIME: 1/4/2007 8:00:00 AM

SURFACE ELEV: 292.10 (ft; Estimated) CHECKED BY: W. Harris

DRILL FLUID: Water @ 8' DRILLING METHOD: 4" FJC

WATER LEVEL OBSERVATIONS DURING DRILLING	DATE	TIME	READING TYPE	WATER DEPTH (ft)	CASING BOTTOM (ft)	HOLE BOTTOM (ft)

SAMP./CORE NUMBER	SAMP. ADV. (ft) LEN. CORE (ft)	RECOVERY (ft)	Blows Per 6" on Split Spoon Sampler	"N" Value or RQD%	SAMPLE	DEPTH (Feet)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEVATION (Feet)	Remarks on Character of Drilling, Water Return, etc.	WATER LEVELS AND/OR WELL DATA
								TOPSOIL			
S-1	2	2	2-2-2-4	4		2		**f. SAND**, Some Silt, gray, v. loose, wet **(SM)**	290		
						4			288		
S-2	2	2	2-2-2-2	4		6		**f. SAND**, little silt, trace roots, gray, v. loose, saturated **(SM)**	286		
						8			284		
S-3	2	1.8	3-5-5-6	10		10		**f. SAND**, Some Silt, gray, loose, saturated **(SM)**	282		
						12			280		
						14			278		
S-4	2	1.2	4-4-5-6	9		16		**f. SAND**, trace silt, gray, loose, saturated **(SP)**	276		
						18			274		

SUBSURFACE LOG LOGS (12206.4008).GPJ UPDATEDCHA.GDT 7/31/07

CLOUGH HARBOUR & ASSOCIATES LLP

PROJECT NUMBER: 12206-4008-1102 7/9/2007

Rapp Road Eastern Expansion
SUBSURFACE LOG
HOLE NUMBER MW-14I

SAMP./CORE NUMBER	SAMP. ADV. (ft) LEN. CORE (ft)	RECOVERY (ft)	Blows Per 6" on Split Spoon Sampler	"N" Value or RQD%	SAMPLE	DEPTH (Feet)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEVATION (Feet)	Remarks on Character of Drilling, Water Return, etc.	WATER LEVELS AND/OR WELL DATA
								f. SAND, trace silt, gray, loose, saturated **(SP)**			
S-5	2	1.5	3-6-4-6	10		22			270		
						24			268		
								Similar Soil (SP)			
S-6	2	1.5	3-2-3-3	5		26			266		
						28			264		
						30		**f. SAND**, Some Silt, gray, m. compact, saturated **(SM)**	262		
S-7	2	1.6	4-6-6-6	12		32			260		
						34			258		
								f. SAND, trace silt, gray, loose, saturated **(SP)**			
S-8	2	1.6	5-6-4-6	10		36			256		
						38			254		
						40		becomes m. compact **(SP)**	252		
S-9	2	2	7-10-15-13	25		42			250		
						44			248		

CLOUGH HARBOUR & ASSOCIATES LLP

PROJECT NUMBER: 12206-4008-1102 7/9/2007

Rapp Road Eastern Expansion
SUBSURFACE LOG
HOLE NUMBER MW-14I

SAMP./CORE NUMBER	SAMP. ADV. (ft) LEN. CORE (ft)	RECOVERY (ft)	Blows Per 6" on Split Spoon Sampler	"N" Value or RQD%	SAMPLE	DEPTH (Feet)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEVATION (Feet)	Remarks on Character of Drilling, Water Return, etc.	WATER LEVELS AND/OR WELL DATA
						46		**f. SAND**, Some Silt, gray, loose, saturated **(SM)**	246		
S-10	2	1.7	4-4-4-4	8							
						48			244		
						50		**f. SAND and SILT**, gray, loose, saturated **(SM)**	242		
S-11	2	1.5	3-4-3-5	7							
						52			240		
						54			238		
								Silty CLAY, Some f. Sand, gray, m. stiff, wet **(CL)**			
S-12	2	2	2-2-3-3	5		56			236		
								End of Boring at 57 ft			
						58			234		
						60			232		
						62			230		
						64			228		
						66			226		
						68			224		

CLOUGH HARBOUR & ASSOCIATES LLP

Rapp Road Eastern Expansion
SUBSURFACE LOG
HOLE NUMBER MW-14D

PROJECT NUMBER: 12206-4008-1102 7/9/2007

LOCATION: Albany, New York

CLIENT: City of Albany DGS

CONTRACTOR: New England Boring Contractors

DRILLER: T. Carpenter INSPECTOR: K. Defayette

START DATE and TIME: 12/28/2006 7:30:00 AM

FINISH DATE and TIME: 1/2/2007 9:00:00 AM

SURFACE ELEV: 292.10 (ft; Estimated) CHECKED BY: W. Harris

DRILL FLUID: Water @ 10' DRILLING METHOD: 4" FJC

WATER LEVEL OBSERVATIONS DURING DRILLING	DATE	TIME	READING TYPE	WATER DEPTH (ft)	CASING BOTTOM (ft)	HOLE BOTTOM (ft)

SAMP./CORE NUMBER	SAMP. ADV. (ft) LEN. CORE (ft)	RECOVERY (ft)	Blows Per 6" on Split Spoon Sampler	"N" Value or RQD%	DEPTH (Feet)	DESCRIPTION AND CLASSIFICATION	ELEVATION (Feet)	Remarks on Character of Drilling, Water Return, etc.	WATER LEVELS AND/OR WELL DATA
						TOPSOIL			
S-1	2	1.7	1-1-1-1	2		**f. SAND and SILT**, trace clay, trace roots, trace wood, brown, v. loose, saturated **(SM)**			
					2		290		
						f.m. SAND, little silt, gray, loose, saturated **(SM)**			
S-2	2	2	3-5-3-5	8					
					4		288		
						f. SAND, trace silt, trace roots, brownish gray, loose, saturated **(SP)**			
S-3	2	2	4-3-3-4	6					
					6		286		
						f. SAND, trace silt, gray, v. loose, saturated **(SP)**			
S-4	2	2	1-2-1-2	3					
					8		284		
						becomes loose **(SP)**			
S-5	2	2	2-2-3-3	5					
					10		282		
						f. SAND, little silt, gray, loose, saturated **(SM)**			
S-6	2	1	1-1-3-5	4					
					12		280		
						becomes m. compact **(SM)**			
S-7	2	2	11-11-15-19	26					
					14		278		
						f. SAND, trace silt, gray, m. compact, saturated **(SP)**			
S-8	2	2	5-6-5-6	11					
					16		276		
						becomes v. loose **(SP)**			
S-9	2	1.3	1-2-2-3	4					
					18		274		
						becomes m. compact **(SP)**			
S-10	2	2	4-8-12-14	20					

SUBSURFACE LOG LOGS (12206.4008).GPJ UPDATEDCHA.GDT 7/31/07

CLOUGH HARBOUR & ASSOCIATES LLP

PROJECT NUMBER: 12206-4008-1102 7/9/2007

Rapp Road Eastern Expansion
SUBSURFACE LOG
HOLE NUMBER MW-14D

SAMP./CORE NUMBER	SAMP. ADV. (ft) LEN. CORE (ft)	RECOVERY (ft)	Blows Per 6" on Split Spoon Sampler	"N" Value or RQD%	SAMPLE	DEPTH (Feet)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEVATION (Feet)	Remarks on Character of Drilling, Water Return, etc.	WATER LEVELS AND/OR WELL DATA
								Similar Soil (SP)			
S-11	2	2	3-8-12-10	20							
						22		**Similar Soil (SP)**	270		
S-12	2	2	6-6-7-9	13							
						24		becomes loose **(SP)**	268		
S-13	2	1.4	1-2-3-4	5							
						26		becomes v. loose **(SP)**	266		
S-14	2	0.8	2-1-2-2	3							
						28		becomes loose **(SP)**	264		
S-15	2	2	2-3-4-5	7							
						30		**f. SAND**, little silt, gray, m. compact, saturated **(SM)**	262	1" Silt seam in sample S-16.	
S-16	2	2	5-5-7-7	12							
						32		becomes loose **(SM)**	260	1" Silt seam in sample S-17.	
S-17	2	2	3-5-5-8	10							
						34		**Similar Soil (SM)**	258		
S-18	2	2	4-6-6-6	12							
						36		**f. SAND**, trace silt, gray, m. compact, saturated **(SP)**	256		
S-19	2	2	3-4-7-8	11							
						38		**Similar Soil (SP)**	254		
S-20	2	2	3-6-9-15	15							
						40		**Similar Soil (SP)**	252		
S-21	2	2	3-9-12-14	21							
						42		**Similar Soil (SP)**	250		
S-22	2	2	5-6-10-12	16							
						44			248		

CLOUGH HARBOUR & ASSOCIATES LLP

PROJECT NUMBER: 12206-4008-1102 7/9/2007

Rapp Road Eastern Expansion
SUBSURFACE LOG
HOLE NUMBER MW-14D

SAMP./CORE NUMBER	SAMP. ADV. (ft) LEN. CORE (ft)	RECOVERY (ft)	Blows Per 6" on Split Spoon Sampler	"N" Value or RQD%	SAMPLE	DEPTH (Feet)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEVATION (Feet)	Remarks on Character of Drilling, Water Return, etc.	WATER LEVELS AND/OR WELL DATA
S-23	2	2	4-6-7-6	13				**f. SAND and SILT**, gray, m. compact, saturated **(SM)** *(continued)*			
						46		**f. SAND and SILT**, gray, loose, saturated **(SM)**	246		
S-24	2	2	5-3-5-5	8							
						48		becomes m. compact **(SM)**	244		
S-25	2	2	3-5-6-5	11							
						50		becomes loose **(SM)**	242		
S-26	2	2	6-5-3-9	8							
						52		**Similar Soil (SM)**	240		
S-27	2	2	5-5-5-7	10							
						54		**Silty CLAY**, Some f. Sand, gray, soft, wet **(CL)**	238		
S-28	2	2	2-1-2-3	3							
						56		becomes m. stiff **(CL)**	236		
S-29	2	2	2-3-5-5	8							
						58		becomes stiff **(CL)**	234		
S-30	2	2	4-4-5-5	9							
						60		becomes m. stiff **(CL)**	232		
S-31	2	2	2-3-5-5	8							
						62		becomes stiff **(CL)**	230		
S-32	2	2	5-5-6-7	11							
						64		becomes m. stiff **(CL)**	228		
S-33	2	2	2-3-5-7	8							
						66		becomes stiff **(CL)**	226		
S-34	2	2	4-5-4-5	9							
						68		**Similar Soil (CL)**	224		

CLOUGH HARBOUR & ASSOCIATES LLP

PROJECT NUMBER: 12206-4008-1102 7/9/2007

Rapp Road Eastern Expansion
SUBSURFACE LOG
HOLE NUMBER MW-14D

SAMP./CORE NUMBER	SAMP. ADV. (ft) LEN. CORE (ft)	RECOVERY (ft)	Blows Per 6" on Split Spoon Sampler	"N" Value or RQD%	SAMPLE	DEPTH (Feet)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEVATION (Feet)	Remarks on Character of Drilling, Water Return, etc.	WATER LEVELS AND/OR WELL DATA
S-35	2	2	4-5-5-6	10				**Similar Soil (CL)** *(continued)*			
						70		**Similar Soil (CL)**	222		
S-36	2	2	5-5-5-6	10							
						72		**Similar Soil (CL)**	220		
S-37	2	2	3-5-6-6	11							
						74		becomes v. stiff **(CL)**	218		
S-38	2	2	10-14-15-24	29				**f. SAND and SILT**, gray, m. compact, saturated **(SM)**			
						76		**Similar Soil (SM)**	216		
S-39	2	1.5	8-9-13-16	22							
						78		becomes compact **(SM)**	214		
S-40	2	2	6-12-20-24	32							
						80		becomes hard **(SM)**	212		
S-41	2	1.5	12-20-24-31	44							
						82		**Similar Soil (SM)**	210		
S-42	2	2	19-17-31-34	48							
						84		**Similar Soil (SM)**	208		
S-43	2	2	18-18-22-29	40							
						86		becomes m. compact **(SM)**	206		
S-44	2	2	8-11-16-24	27							
						88		becomes v. compact **(SM)**	204		
S-45	2	2	11-25-33-41	58							
						90		becomes compact **(SM)**	202		
S-46	2	2	15-26-23-33	49							
						92		becomes v. compact **(SM)**	200		

CLOUGH HARBOUR & ASSOCIATES LLP

PROJECT NUMBER: 12206-4008-1102 7/9/2007

Rapp Road Eastern Expansion
SUBSURFACE LOG
HOLE NUMBER MW-14D

SAMP./CORE NUMBER	SAMP. ADV. (ft) LEN. CORE (ft)	RECOVERY (ft)	Blows Per 6" on Split Spoon Sampler	"N" Value or RQD%	SAMPLE	DEPTH (Feet)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEVATION (Feet)	Remarks on Character of Drilling, Water Return, etc.	WATER LEVELS AND/OR WELL DATA
S-47	2	2	14-25-34-46	59				becomes v. compact **(SM)** *(continued)*			
						94		becomes compact **(SM)**	198		
S-48	2	2	17-19-28-33	47							
						96		**Similar Soil (SM)**	196		
S-49	2	2	6-18-31-49	49							
						98			194	Driller advanced casing to far by accident from 98' to 100'.	
						100		**f. SAND and SILT**, little m. sand, gray, v. compact, saturated **(SM)**	192	m. Sand seams in sample S-50.	
S-50	2	2	29-34-0.5	34.5							
						102		**f.m. SAND**, trace silt, gray, m. compact, saturated **(SP)**	190		
S-51	2	2	5-10-16-15	26				**Silty CLAY**, Some f. Sand, gray, v. stiff, wet **(CL)**			
						104		End of Boring at 104 ft	188		
						106			186		
						108			184		
						110			182		
						112			180		
						114			178		
						116			176		

CLOUGH HARBOUR & ASSOCIATES LLP

PROJECT NUMBER: 12206-4008-1102 7/9/2007

Rapp Road Eastern Expansion
SUBSURFACE LOG
HOLE NUMBER MW-15S

LOCATION: Albany, New York

CLIENT: City of Albany DGS

CONTRACTOR: New England Boring Contractors

DRILLER: T. Carpenter INSPECTOR: K. Defayette

START DATE and TIME: 12/26/2006 8:30:00 AM

FINISH DATE and TIME: 12/16/2006 3:00:00 PM

SURFACE ELEV: 294.80 (ft; Estimated) CHECKED BY: W. Harris

DRILL FLUID: Water @ 8' DRILLING METHOD: 4" FJC

WATER LEVEL OBSERVATIONS DURING DRILLING	DATE	TIME	READING TYPE	WATER DEPTH (ft)	CASING BOTTOM (ft)	HOLE BOTTOM (ft)

SAMP./CORE NUMBER	SAMP. ADV. (ft) LEN. CORE (ft)	RECOVERY (ft)	Blows Per 6" on Split Spoon Sampler	"N" Value or RQD%	SAMPLE	DEPTH (Feet)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEVATION (Feet)	Remarks on Character of Drilling, Water Return, etc.	WATER LEVELS AND/OR WELL DATA
S-1	2	0.5	1-0-0-1	0		2		**TOPSOIL** **f. SAND and SILT**, trace clay, little c. sand, little roots, brownish gray, v. loose, saturated **(SM)**	294		
						4			292		
S-2	2	0.6	2-2-2-2	4		6		**f. SAND and SILT**, gray, v. loose, saturated **(SM)**	290		
						8			288		
S-3	2	2	2-1-2-2	3		10		**f. SAND**, trace silt, gray, v. loose, saturated **(SP)**	286		
						12			284		
						14		End of Boring at 13 ft	282		
						16			280		
						18			278		
									276		

SUBSURFACE LOG LOGS (12206.4008).GPJ UPDATEDCHA.GDT 7/31/07

CLOUGH HARBOUR & ASSOCIATES LLP

PROJECT NUMBER: 12206-4008-1102 7/9/2007

Rapp Road Eastern Expansion
SUBSURFACE LOG
HOLE NUMBER MW-15I

LOCATION: Albany, New York

CLIENT: City of Albany DGS

CONTRACTOR: New England Boring Contractors

DRILLER: T. Carpenter INSPECTOR: K. Defayette

START DATE and TIME: 12/21/2006 9:00:00 AM

FINISH DATE and TIME: 12/26/2006 8:00:00 AM

SURFACE ELEV: 294.80 (ft; Estimated) CHECKED BY: W. Harris

DRILL FLUID: Water @ 8' DRILLING METHOD: 4" FJC

WATER LEVEL OBSERVATIONS DURING DRILLING	DATE	TIME	READING TYPE	WATER DEPTH (ft)	CASING BOTTOM (ft)	HOLE BOTTOM (ft)

SAMP./CORE NUMBER	SAMP. ADV. (ft) LEN. CORE (ft)	RECOVERY (ft)	Blows Per 6" on Split Spoon Sampler	"N" Value or RQD%	SAMPLE	DEPTH (Feet)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEVATION (Feet)	Remarks on Character of Drilling, Water Return, etc.	WATER LEVELS AND/OR WELL DATA
								TOPSOIL			
S-1	2	0.4	1-1-WH-1			2		**f. SAND and SILT**, little roots, little c. sand, brown, v. loose, saturated **(SM)**	294		
						4			292		
S-2	2	2	1-2-3-4	5		6		**f.m. SAND**, trace silt, brownish gray, loose, saturated **(SP)**	290		
						8			288		
S-3	2	1	1-1-4-4	5		10		**Similar Soil (SP)**	286		
						12			284		
						14			282		
S-4	2	0.7	1-2-1-3	3		16		becomes v. loose **(SP)**	280		
						18			278		
									276		

CLOUGH HARBOUR & ASSOCIATES LLP

PROJECT NUMBER: 12206-4008-1102 7/9/2007

Rapp Road Eastern Expansion
SUBSURFACE LOG
HOLE NUMBER MW-15I

SAMP./CORE NUMBER	SAMP. ADV. (ft) LEN. CORE (ft)	RECOVERY (ft)	Blows Per 6" on Split Spoon Sampler	"N" Value or RQD%	SAMPLE	DEPTH (Feet)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEVATION (Feet)	Remarks on Character of Drilling, Water Return, etc.	WATER LEVELS AND/OR WELL DATA
								f.m. SAND, trace silt, gray, loose, saturated **(SP)**			
S-5	2	1.4	3-3-4-4	7		22			274		
						24			272		
								Similar Soil (SP)	270		
S-6	2	1.6	2-3-4-4	7		26			268		
						28			266		
						30		**f. SAND**, trace silt, gray, m. compact, saturated **(SP)**	264		
S-7	2	1.6	6-7-8-12	15		32			262		
						34			260		
								becomes v. loose **(SP)**			
S-8	2	2	WH-1-3-3	4		36			258		
						38			256		
						40		becomes m. compact **(SP)**	254		
S-9	2	2	6-6-5-7	11		42			252		
						44					

SUBSURFACE LOG LOGS (12206.4008).GPJ UPDATEDCHA.GDT 7/31/07

CLOUGH HARBOUR & ASSOCIATES LLP

PROJECT NUMBER: 12206-4008-1102 7/9/2007

Rapp Road Eastern Expansion
SUBSURFACE LOG
HOLE NUMBER MW-15I

SAMP./CORE NUMBER	SAMP. ADV. (ft) LEN. CORE (ft)	RECOVERY (ft)	Blows Per 6" on Split Spoon Sampler	"N" Value or RQD%	SAMPLE	DEPTH (Feet)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEVATION (Feet)	Remarks on Character of Drilling, Water Return, etc.	WATER LEVELS AND/OR WELL DATA
						46		**f. SAND and SILT**, gray, loose, saturated **(SM)**	250		
S-10	2	1.8	5-4-5-6	9					248		
						48					
									246		
						50		**Similar Soil (SM)**			
S-11	2	2	4-4-4-4	8					244		
						52					
									242		
						54					
								Silty CLAY, Some f. Sand, gray, m. stiff, wet **(CL)**	240		
S-12	2	2	1-3-3-5	6		56					
									238		
								End of Boring at 57 ft			
						58					
									236		
						60					
									234		
						62					
									232		
						64					
									230		
						66					
									228		
						68					

CLOUGH HARBOUR & ASSOCIATES LLP

PROJECT NUMBER: 12206-4008-1102 7/9/2007

Rapp Road Eastern Expansion
SUBSURFACE LOG
HOLE NUMBER MW-15D

LOCATION: Albany, New York

CLIENT: City of Albany DGS

CONTRACTOR: New England Boring Contractors

DRILLER: T. Carpenter INSPECTOR: K. Defayette

START DATE and TIME: 12/18/2006 12:35:00 PM

FINISH DATE and TIME: 12/21/2006 8:00:00 AM

SURFACE ELEV: 294.80 (ft; Estimated) CHECKED BY: W. Harris

DRILL FLUID: Water @ 10' DRILLING METHOD: 4" FJC

WATER LEVEL OBSERVATIONS DURING DRILLING	DATE	TIME	READING TYPE	WATER DEPTH (ft)	CASING BOTTOM (ft)	HOLE BOTTOM (ft)

SAMP./CORE NUMBER	SAMP. ADV. (ft) LEN. CORE (ft)	RECOVERY (ft)	Blows Per 6" on Split Spoon Sampler	"N" Value or RQD%	DEPTH (Feet)	DESCRIPTION AND CLASSIFICATION	ELEVATION (Feet)	Remarks on Character of Drilling, Water Return, etc.
					0	**TOPSOIL**		
S-1	2	0.5	2-2-2-3	4		**f. SAND and SILT**, little roots, little c. sand, brown, v. loose, saturated **(SM)**	294	
					2			
S-2	2	2	2-6-4-5	10		**f. SAND and SILT**, little roots, brownish gray, loose, wet **(SM)**	292	
					4			
S-3	2	0.9	2-2-1-1	3		**f. SAND**, little silt, trace roots, brownish gray, v. loose, saturated **(SM)**	290	
					6			
S-4	2	2	1-1-2-3	3		**f. SAND**, trace silt, gray, v. loose, saturated **(SP)**	288	
					8			
S-5	2	2	1-2-4-7	6		becomes loose **(SP)**	286	
					10			
S-6	2	1	4-2-4-4	6		**Similar Soil (SP)**	284	
					12			
S-7	2	2	3-3-4-4	7		**Similar Soil (SP)**	282	
					14			
S-8	2	1.4	2-1-1-3	2		**f. SAND**, trace silt, trace c. sand, gray, v. loose, saturated **(SP)**	280	Vanes of brown c. sand in sample S-8
					16			
S-9	2	1.3	2-4-5-7	9		**f. SAND**, trace silt, gray, loose, saturated **(SP)**	278	
					18			
S-10	2	1.3	6-6-8-12	14		becomes m. compact **(SP)**	276	

WATER LEVELS AND/OR WELL DATA

CLOUGH HARBOUR & ASSOCIATES LLP

PROJECT NUMBER: 12206-4008-1102 7/9/2007

Rapp Road Eastern Expansion
SUBSURFACE LOG
HOLE NUMBER MW-15D

SAMP./CORE NUMBER	SAMP. ADV. (ft) LEN. CORE (ft)	RECOVERY (ft)	Blows Per 6" on Split Spoon Sampler	"N" Value or RQD%	SAMPLE	DEPTH (Feet)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEVATION (Feet)	Remarks on Character of Drilling, Water Return, etc.	WATER LEVELS AND/OR WELL DATA
								f. SAND, trace silt, gray, m. compact, saturated **(SP)**			
S-11	2	1.2	4-5-6-7	11					274		
						22		**Similar Soil (SP)**			
S-12	2	1.4	6-7-7-8	14					272		
						24		becomes v. loose **(SP)**			
S-13	2	1.3	2-2-2-2	4					270		
						26		**Similar Soil (SP)**			
S-14	2	1.2	2-1-2-4	3					268		
						28		becomes loose **(SP)**			
S-15	2	2	3-3-5-7	8					266		
						30		becomes m. compact **(SP)**			
S-16	2	2	6-7-8-8	15					264		
						32		becomes loose **(SP)**			
S-17	2	2	4-4-5-7	9					262		
						34		becomes v. loose **(SP)**			
S-18	2	1.4	1-1-1-5	2					260		
						36		becomes loose **(SP)**			
S-19	2	2	1-3-5-7	8					258		
						38		becomes m. compact **(SP)**			
S-20	2	2	3-6-7-7	13					256		
						40		becomes loose **(SP)**			
S-21	2	2	4-3-6-6	9					254		
						42		becomes m. compact **(SP)**			
S-22	2	2	6-6-7-9	13					252		
						44					

CLOUGH HARBOUR & ASSOCIATES LLP

PROJECT NUMBER: 12206-4008-1102 7/9/2007

Rapp Road Eastern Expansion
SUBSURFACE LOG
HOLE NUMBER MW-15D

SAMP./CORE NUMBER	SAMP. ADV. (ft) LEN. CORE (ft)	RECOVERY (ft)	Blows Per 6" on Split Spoon Sampler	"N" Value or RQD%	SAMPLE	DEPTH (Feet)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEVATION (Feet)	Remarks on Character of Drilling, Water Return, etc.	WATER LEVELS AND/OR WELL DATA
S-23	2	2	3-5-4-6	9		46		**f. SAND and SILT**, gray, loose, saturated **(SM)** *(continued)*	250		
								Similar Soil (SM)			
S-24	2	2	2-3-6-6	9		48		becomes m. compact **(SM)**	248		
S-25	2	2	3-6-9-8	15		50		**f. SAND**, little silt, gray, m. compact, saturated **(SM)**	246		
S-26	2	1.7	6-6-5-5	11		52		**f. SAND and SILT**, gray, m. compact, saturated **(SM)**	244		
								Similar Soil (SM)			
S-27	2	2	3-6-7-8	13		54		becomes loose **(SM)**	242		
S-28	2	1.2	2-3-2-4	5		56		**Silty CLAY**, Some f. Sand, gray, soft, wet **(CL)**	240	f. Sand seams throughout silty clay layer.	
								becomes stiff **(CL)**			
S-29	2	2	3-5-6-6	11		58		becomes m. stiff **(CL)**	238		
S-30	2	2	4-4-4-6	8		60		**Similar Soil (CL)**	236		
S-31	2	2	2-3-4-4	7		62		becomes stiff **(CL)**	234		
S-32	2	2	5-4-7-7	11		64		becomes m. stiff **(CL)**	232		
S-33	2	2	1-1-5-7	6		66		**Similar Soil (CL)**	230		
S-34	2	2	3-3-4-4	7		68		becomes stiff **(CL)**	228		

CLOUGH HARBOUR & ASSOCIATES LLP

PROJECT NUMBER: 12206-4008-1102 7/9/2007

Rapp Road Eastern Expansion
SUBSURFACE LOG
HOLE NUMBER MW-15D

SAMP./CORE NUMBER	SAMP. ADV. (ft) LEN. CORE (ft)	RECOVERY (ft)	Blows Per 6" on Split Spoon Sampler	"N" Value or RQD%	SAMPLE	DEPTH (Feet)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEVATION (Feet)	Remarks on Character of Drilling, Water Return, etc.	WATER LEVELS AND/OR WELL DATA
S-35	2	2	4-5-8-7	13		70		becomes stiff **(CL)** *(continued)*	226		
								Similar Soil (CL)			
S-36	2	2	3-4-5-17	9				**f. SAND and SILT**, gray, loose, saturated **(SM)**	224		
						72		becomes m. compact **(SM)**			
S-37	2	2	8-10-12-16	22					222		
						74		**Similar Soil (SM)**			
S-38	2	1.4	5-11-18-20	29					220		
						76		**Similar Soil (SM)**			
S-39	2	2	6-15-14-18	29					218		
						78		**Similar Soil (SM)**			
S-40	2	2	8-13-14-17	27					216		
						80		becomes compact **(SM)**			
S-41	2	2	12-17-17-22	34					214		
						82		becomes v. compact **(SM)**			
S-42	2	2	13-34-25-21	59					212		
						84		becomes m. compact **(SM)**			
S-43	2	2	6-9-11-11	20					210		
						86		**Similar Soil (SM)**			
S-44	2	2	4-7-12-14	19					208		
						88		**SILT and f. SAND**, gray, compact, saturated **(ML)**			
S-45	2	2	8-18-25-25	43					206		
						90		**Silty CLAY**, Some f. Sand, gray, m. stiff, wet **(CL)**			
S-46	2	2	4-3-3-5	6					204		
						92		**Silty CLAY**, Some f. Sand, gray, v. soft, wet **(CL)**			

CLOUGH HARBOUR & ASSOCIATES LLP

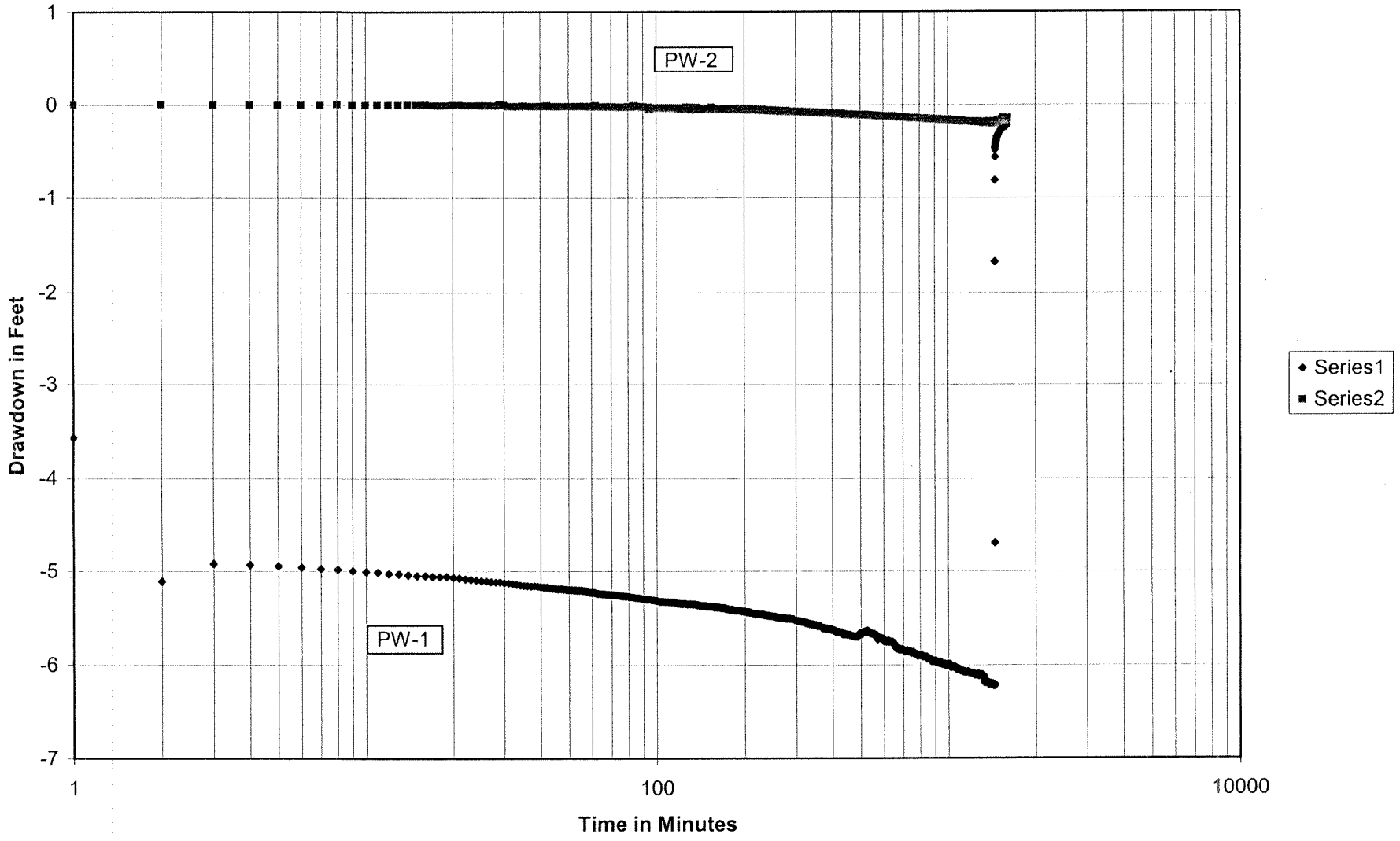
PROJECT NUMBER: 12206-4008-1102 7/9/2007

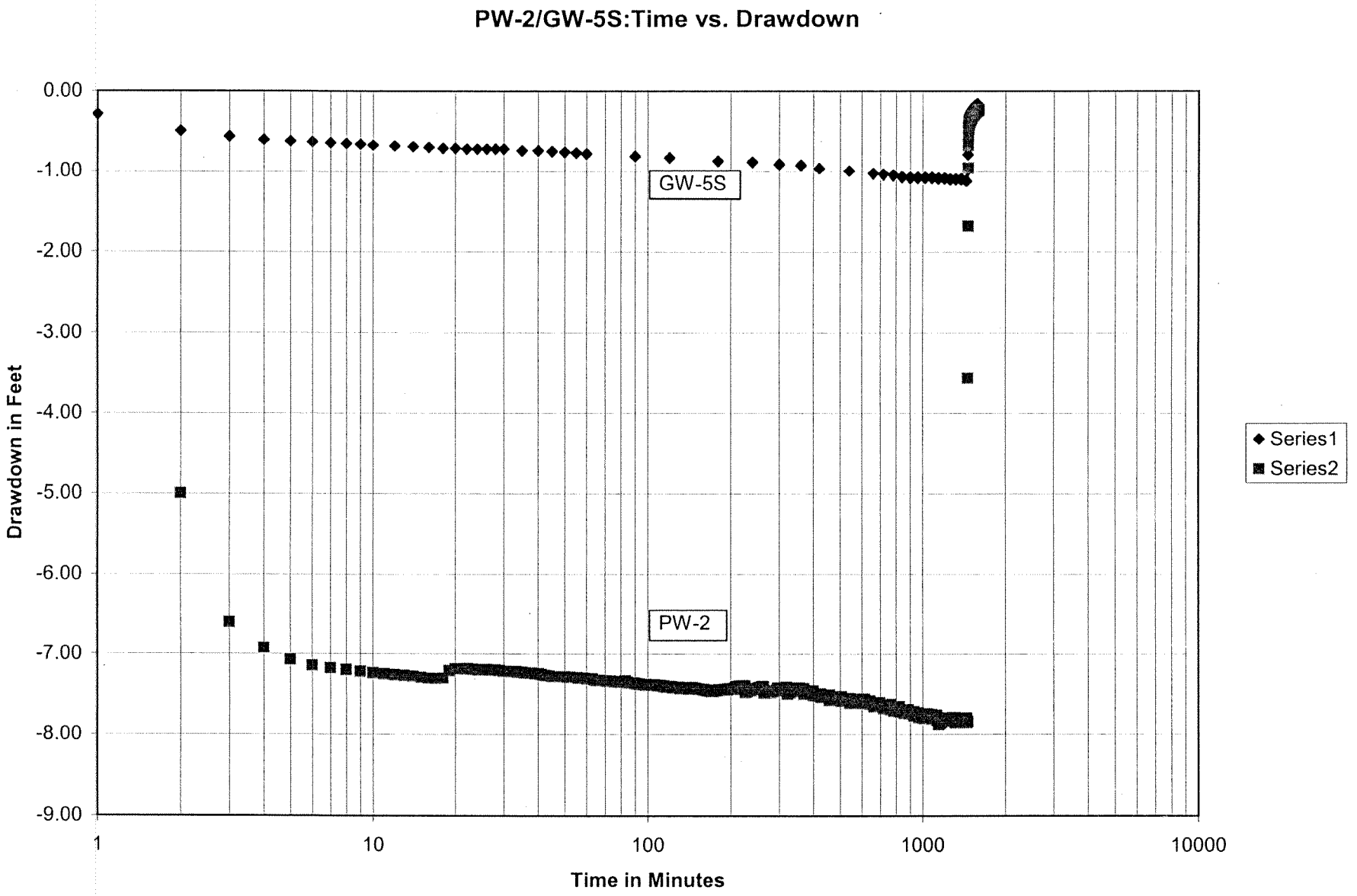
Rapp Road Eastern Expansion
SUBSURFACE LOG
HOLE NUMBER MW-15D

SAMP./CORE NUMBER	SAMP. ADV. (ft) LEN. CORE (ft)	RECOVERY (ft)	Blows Per 6" on Split Spoon Sampler	"N" Value or RQD%	SAMPLE	DEPTH (Feet)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEVATION (Feet)	Remarks on Character of Drilling, Water Return, etc.	WATER LEVELS AND/OR WELL DATA
S-47	2	1	WH-1-WH-1			94		**Silty CLAY**, Some f. Sand, gray, v. soft, wet **(CL)** *(continued)*			
								Silty CLAY, Some f.m Sand, gray, m. stiff, wet **(CL)**	200		
S-48	2	2	WH-3-3-3	6		96		End of Boring at 96 ft			
						98			198		
						100			196		
						102			194		
						104			192		
						106			190		
						108			188		
						110			186		
						112			184		
						114			182		
						116			180		
									178		

APPENDIX B

PW-1/PW-2:Time vs. Drawdown




PW-2/GW-5S:Time vs. Drawdown
0.00
-1.00
-2.00
-3.00
-4.00
-5.00
-6.00
-7.00
-8.00
-9.00
Drawdown in Feet
GW-5S
PW-2
1
10
100
1000
10000
Time in Minutes
Series1
Series2

APPENDIX C

CHA COMPUTATION PAD

COMPLETED BY:	K. Cowan
CHECKED BY:	
PROJECT NAME:	City of Albany LF Expansion
PROJECT LOCATION:	Albany Landfill-Rapp Rd.

PROJECT	PHASE	ORG
12206	4008	1102

SHEET #: 1 OF 2

DATE: 1-13-09

SUBJECT: Potential Yield Calculation

Test Well Location PW-1

Yield = 10.3 gpm
Total drawdown = 6.22 ft.
Total Well Depth = 25.0 ft. bgs (Based on NYSDEC well Comp. Report)
Static Water Level = 11.25 ft. bgs (Assumes 18" Casing Stick-up)
Stabilized Wat. Level = 11.25 ft bgs + 6.22 ft. = 17.47
Specific Capacity = 1.66 gpm/ft.

Total Available Drawdown = Total Well Depth − Static Water Level
= 25.0 ft. bgs − 11.25 bgs
= 13.75 ft

Observed Drawdown = 45.2% of Total Available (6.22ft/13.75ft.)

According to Driscol pg. 217: 45.2% of total Drawdown equals ±70% of max. yield.

Max Yield = (100%/70%) × 10.3

= 14.7 gpm

Theoretical Expansion Area Well

Yield = 10.3 gpm
Total drawdown = 6.22 ft
Total Well Depth = 44 ft. bgs (max pumping Level = 33 ft. bgs)
Static Water Level = 2.0 ft. bgs (based on expansion area monitoring wells)
Theoretical Stabilized Drawdown = 8.22 ft. bgs

Total Available Drawdown = 33.0 ft − 2.0 ft
= 31 ft.

CHA COMPUTATION PAD

COMPLETED BY:	K. Cowan
CHECKED BY:	
PROJECT NAME:	Albany LF Eastern Expansion
PROJECT LOCATION:	Albany Landfill - Rapp Rd.

PROJECT	PHASE	ORG
12206	4008	1102

SHEET #: 2 OF 2

DATE: 1-13-09

SUBJECT: Potential Yield Calculations

From Discol:

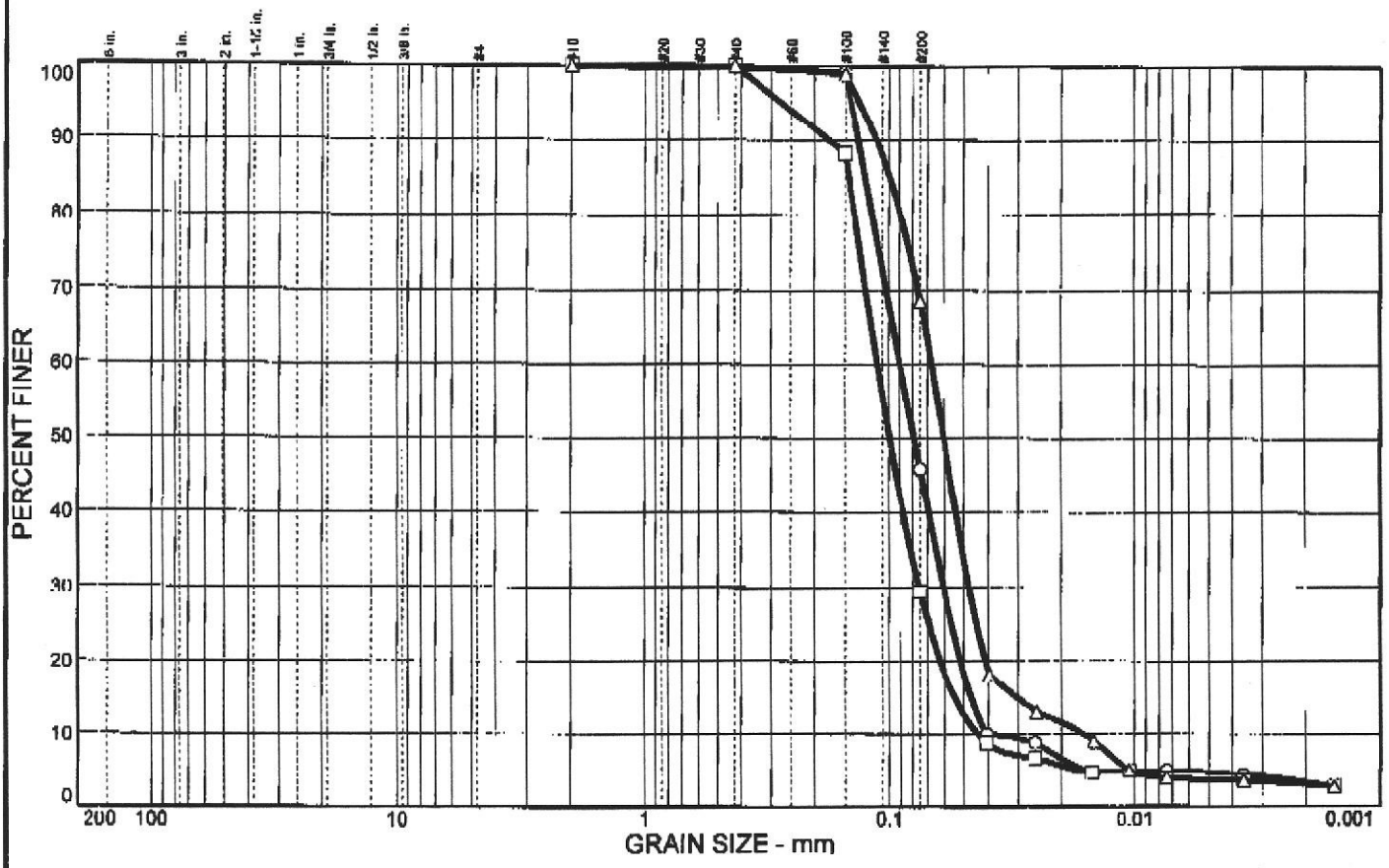
Total Theoretical drawdown of 6.22 ft. = 20.1% of total available Drawdown

20.1% of Total Available Drawdown = ±36% of Total Potential Yield

$\therefore \frac{100\%}{36\%} \times 10.3\text{gpm} = 28.6\text{ gpm}.$

APPENDIX D

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○			54.1	41.2	4.7	SM	A-4(0)	NP	NP
□			70.6	25.8	3.6	SM	A-2-4(0)	NP	NP
△			31.4	64.9	3.7	ML	A-4(0)	NP	NP

SIEVE inches size	PERCENT FINER ○	□	△
	GRAIN SIZE		
D_{60}	0.0902	0.111	0.0674
D_{30}	0.0605	0.0757	0.0478
D_{10}	0.0406	0.0442	0.0163
	COEFFICIENTS		
C_c	1.00	1.17	2.08
C_u	2.22	2.52	4.15

SIEVE number size	PERCENT FINER ○	□	△
#10	100.0	100.0	100.0
#40	99.8	100.0	100.0
#100	99.2	88.3	99.0
#200	45.9	29.4	68.6

SOIL DESCRIPTION

○ fine SAND and SILT

□ fine SAND, some Silt

△ SILT some, fine Sand

REMARKS:

○ Tested By: MM Checked By: GB Per ASTM D422 Washed

□ Tested By: MM Checked By: GB Per ASTM D422 Washed

△ Tested By: MM Checked By: GB Per ASTM D422 Washed

○ Source: Landfill Soils - Albany Sample No.: 403: EE-B-2 Elev./Depth: S-14

□ Source: Landfill Soils - Albany Sample No.: 404: EE-B-2 Elev./Depth: S-15

△ Source: Landfill Soils - Albany Sample No.: 405: EE-B-2 Elev./Depth: S-47

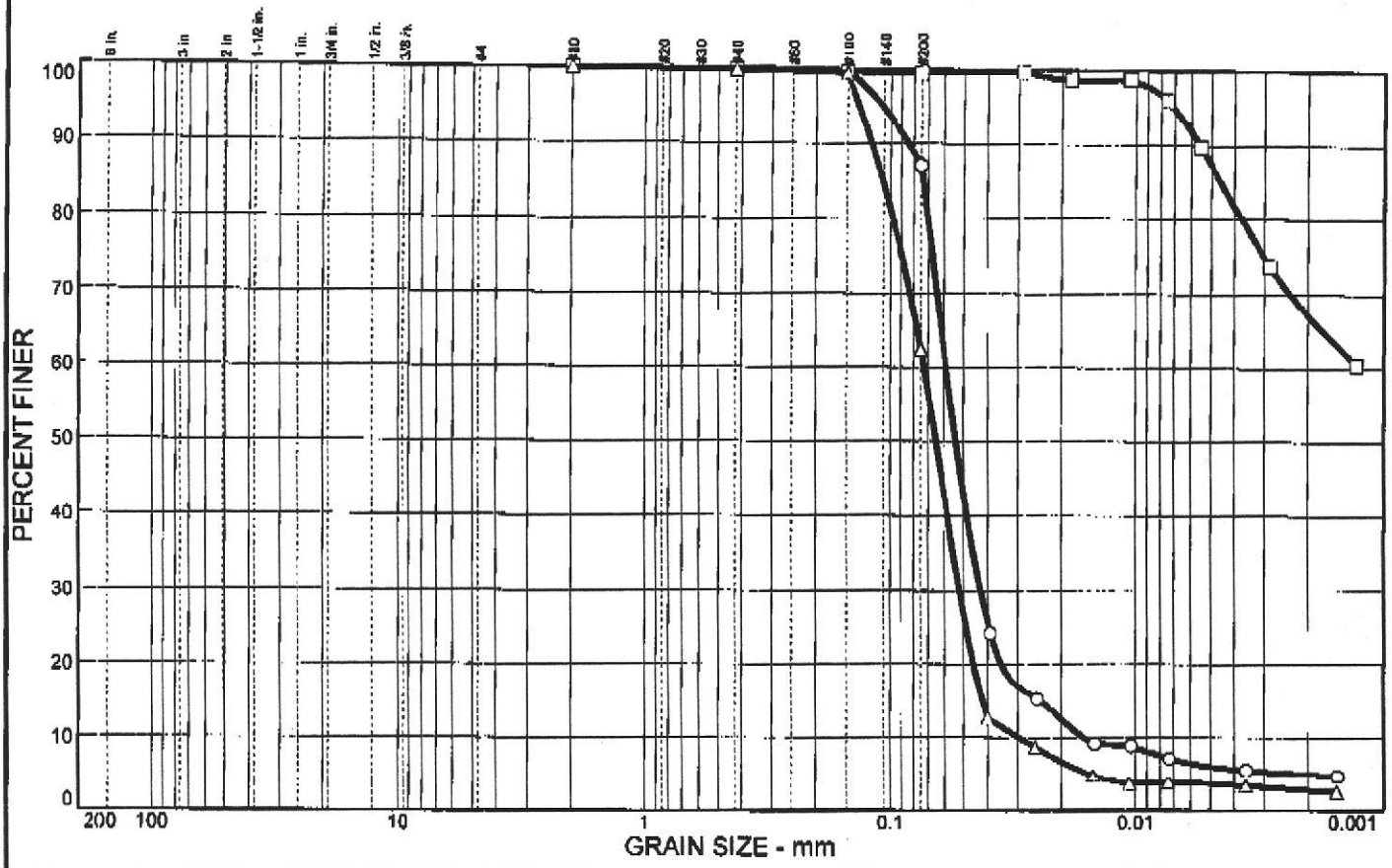
EVERGREEN TESTING, INC.
Watervliet, NY

Client: Clough Harbour Associates

Project: Various Projects

Project No.: ETE 07 13 Figure 403-405

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○			12.9	81.0	6.1	ML	A-4(0)	NP	NP
□			0.4	12.2	87.4	CL	A-4(0)		
△			37.7	58.6	3.7	ML	A-4(0)	NP	NP

SIEVE inches size	PERCENT FINER ○	□	△
	GRAIN SIZE		
D_{60}	0.0592		0.0729
D_{30}	0.0429		0.0521
D_{10}	0.0163		0.0299
	COEFFICIENTS		
C_c	1.91		1.25
C_u	3.63		2.44

SIEVE number size	PERCENT FINER ○	□	△
#10	100.0	100.0	100.0
#40	100.0	99.9	99.9
#100	99.8	99.6	99.5
#200	87.1	99.6	62.3

SOIL DESCRIPTION

○ SILT, little fine Sand

□ CLAYEY SILT

△ SILT and fine SAND

REMARKS:

○ Tested By: MM Checked By: GB
Per ASTM D422 Washed

□ Tested By: MM Checked By: GB
Per ASTM D422 Washed

△ Tested By: MM Checked By: GB
Per ASTM D422 Washed

○ Source: Landfill Soils - Albany	Sample No.: 406: EE-B-2	Elev./Depth: S-26
□ Source: Landfill Soils - Albany	Sample No.: 407: EE-B-2	Elev./Depth: S-51
△ Source: Landfill Soils - Albany	Sample No.: 408: MW-15D	Elev./Depth: S-45

EVERGREEN TESTING, INC.
Watervliet, NY

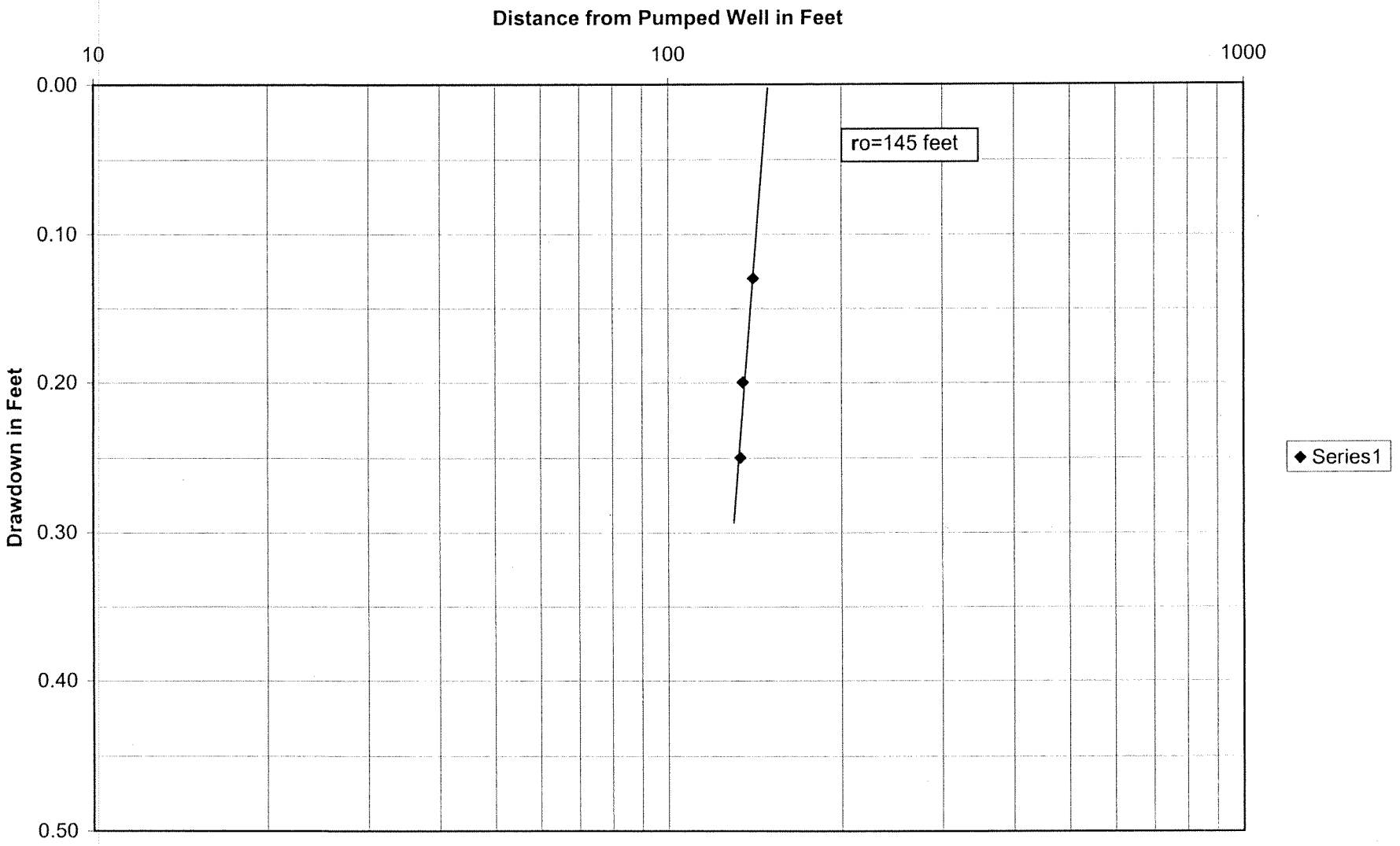
Client: Clough Harbour Associates

Project: Various Projects

Project No.: ETE-07-13 Figure 406-408

APPENDIX E

PW-1:Drawdown Graph



PW-2:Drawdown Graph (Q=10.5 gpm)