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ORANGE COUNTY LANDFILL
ROUTE 17M, GOSHEN, NEW YORK
(NYSDEC SITE NO. 336007)

SEEP MITIGATION PLAN & ENGINEERING REPORT

Prepared for:

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"Serving our clients and the environment since 1993"

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CERTIFICATION

I, Mark P. Millspaugh, P.E., certify that I am currently a New York State registered professional engineer and that this Seep Mitigation Plan & Engineering Report was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the Division of Environmental Remediation (DER) Technical Guidance for Site Investigation and Remediation (DER-10).

Mark P. Millspaugh, P.E.

10/31/14
Date

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1.0 INTRODUCTION

The Orange County Landfill (Landfill), located in the Town of Goshen, Orange County, New York (the County) is registered as a Class 2 Inactive Hazardous Waste Disposal Site, Registry No. 336007 by the New York State Department of Environmental Conservation (NYSDEC). The Landfill was previously remediated subject to the NYSDEC's oversight and approval. A Site Location Map is provided as Figure 1.

The monitoring and maintenance program for the Landfill is described in the NYSDEC approved Site Management Plan (SMP), dated June 6, 2014. The County is entering into a Consent Order with the NYSDEC to mitigate landfill impacted seeps observed offsite along the banks of the Cheechunk Canal downgradient from the Landfill on land owned by New York State. This Seep Mitigation Plan & Engineering Report is prepared as required by the anticipated Consent Order and the approved SMP.

1.1 Background Information

The Landfill footprint totals approximately 75-acres within a 300-acre parcel approximately three (3) miles west of the Village of Goshen, west of NYS Route 17M. The property is bounded by the Cheechunk Canal to the southeast and by the old channel of the Wallkill River to the northwest and southwest. The New Hampton Transfer Station is located on the northeast portion of the 300-acre parcel. Property features are present on the aerial photograph presented as Figure 2.

The Orange County Department of Public Works operated the Landfill between 1974 and January 1992. In March 1992, the Landfill was classified by the NYSDEC as a "Class 2" Inactive Hazardous Waste Disposal Site, indicating "a site which the disposal of hazardous waste constitutes a threat to human health or environment". The "threat" was the possibility of the contamination of a principal aquifer underlying the site. The Record of Decision (ROD) dated January 28, 1994 addressed the immediate capping of the wastemass, Operable Unit No. 2, as a means of source control. A perimeter leachate collection system and surface water runoff collection system were installed in November 1995, prior to the capping of the Landfill. Construction of the Landfill cap was completed in November 1995. The final cap directed surface water runoff to onsite recharge/settling basins, eventually discharging into the Wallkill River and Cheechunk Canal. Leachate collected by the perimeter leachate collection system is pumped into leachate tanks and transported offsite for treatment and disposal at permitted wastewater treatment plant (WWTP) facilities.

The March 26, 1998 ROD was issued from the results of the Remedial Investigation/Feasibility Study in 1996 and called for the continued operation and monitoring of the leachate collection system, leachate disposal and continued environmental monitoring of the site, Operable Unit 01, as a whole.

1.2 Cheechunk Canal

The Cheechunk Canal is prone to significant seasonal flooding. The Orange County Soil and Water Conservation District is undertaking a study entitled "Wallkill River Flood Mitigation Implementation Plan Black Dirt Region Orange County, NY". The study area includes the Cheechunk Canal proximate to the Orange County Landfill. The August 16, 2013 "Summary of Further Investigations Regarding Flood Mitigation Study Areas" (provided in Appendix A) includes important observations regarding the Landfill and its relationship to the canal. The study is also evaluating the merits of dredging the canal to aid in flood mitigation.

Flooding at the Landfill site often extends above the tree line at the toe of the mowed slope to the south and east of the wastemass. The flooding condition shown below occurred in September 2011 followed heavy precipitation due to Hurricane Storm Irene.

The summary further notes that with respect to the relationship of the Landfill to the canal, there is "no evidence or data that would support the theory that the current configuration impedes flow". The Landfill limit of waste and the limit of the final cover system are no closer than 125 feet from the normal waterline of the canal.

1.3 Landfill Conceptual Model

The physical characterization, nature and extent of contamination, and contaminant fate and transport have been extensively studied at the unlined landfill since the early 1980's. The distribution and character of geologic materials, occurrence of groundwater, and overall water quality has been well documented since 1987. The conceptual model is as follows:

- Six (6) discrete overburden units exist in the vicinity of the landfill and consist of recent alluvial deposits, highly permeable glaciofluvial deposits, moderate to lowly permeable glaciolacustrine units, moderately permeable glaciolacustrine fine sand deposits, and low to moderately permeable glacial till (Wehran, 1984).
- The Wappinger Group dolostone and Martinsburg Formation shale underlie the glacial deposits at the site (Wehran, 1984).
- Groundwater on the site is unconfined and/or confined conditions.
- Three hydrostratigraphic units have been identified: glaciolacustrine silt and clay, glaciofluvial sand and gravel or glaciolacustrine fine sand, and bedrock. The refuse mass lies over the low permeability glaciolacustrine silt and clay deposits at the site. In areas where the glaciolacustrine

silt and clay is significantly thick it acts as a confining layer for the underlying glaciofluvial sand and gravel aquifer and where this glacial unit is thin or non-existent the sand and gravel aquifer is under unconfined conditions. The bedrock hydrogeologic unit is considered a confined aquifer system.

- The shallow overburden groundwater moves generally in a west-to-east flow direction.

- Groundwater analytical results, collected from post-closure monitoring over two (2) decades have consistently documented that the groundwater near the landfill is characterized by elevated concentrations of Total Dissolved Solids (TDS), iron and manganese and occasional exceedances of drinking water standards for magnesium, ammonia, chloride, phenolics, arsenic, chromium, lead, selenium, and sodium.

- Historical surface water quality data has documented that local surface waters are not significantly influenced by the Orange County Landfill.

- Leachate, collected by the perimeter leachate collection system, has reported detectable to elevated concentrations of typical landfill leachate constituents including Total Organic Carbon (TOC), alkalinity, ammonia, Biochemical Oxygen Demand (BOD), chloride, chemical oxygen demand (COD), nitrate, hardness, Total Kjeldahl Nitrogen (TKN), TDS, phenolics, sulfate, arsenic, barium, boron, calcium, chromium, copper, iron, magnesium, manganese, nickel, potassium, sodium, and zinc during post-closure monitoring events.

- Monthly post-closure landfill site inspections have documented that the integrity of the landfill cap, drainage structures, leachate collection system, gas venting system and monitoring well network to be in good condition.

1.4 Groundwater Seeps

Offsite groundwater seeps have been observed at various locations along the northern and southern banks of the Cheechunk Canal. Seeps are formed when the groundwater table intersects the ground surface. The Cheechunk Canal was reportedly originally constructed in 1824 to drain the upstream portion of the Wallkill River, because valley farmers wanted to create a landscape more suitable for agriculture from the unproductive, swampy area known as the "drowned lands" and to address flooding of the Wallkill River. More recently, the Cheechunk Canal has been dredged by the United States Army Corps of Engineers (USACE) with dredge spoils sidecast onto the canal banks. Some portions of the canal bank were previously armored with rip-rap. Other areas lack any protection from erosion and flooding. In some areas that lack armoring, seeps are evident. Many of the seeps on both sides of the canal are red stained due to naturally occurring oxidized iron. In fact, the prevalent soils of Orange County are derived from glacial till or glaciolacustrine deposits, which are known to contain iron, and red stained groundwater seeps are commonplace.

In 2012, NYSDEC received citizen complaints that seeps were observed immediately downstream of the Landfill. It should be noted that the canal is reportedly owned by New York State. Due to the canal's proximity to the Landfill, the NYSDEC notified Orange County that the seeps may indicate the Landfill perimeter leachate collection system is not functioning properly. The County immediately responded, and has continued to respond, as follows:

- July 16, 2012 - NYSDEC notifies County to prepare a work plan for the sampling, analysis, and assessment of the seeps.

- August 16, 2012 - Orange County met with the NYSDEC at the Landfill to inspect the seeps and select sampling locations.

- August 22, 2012 - Orange County met with the NYSDEC at the Landfill to inspect the seeps. The inspection included canoeing the stretch of the canal along the entire length of the canal adjacent to the Landfill. Samples of seeps were collected for laboratory analysis. Notes, photographs, and data generated by this inspection were submitted to the NYSDEC on September 20, 2012 (Appendix B). A NYSDEC Solid Waste Management Facility Site Visit Report, dated August 24, 2012 is provided in Appendix C.

- October 19, 2012 - Orange County provides a Work Plan for investigation of the perimeter leachate collection system (Appendix D).

- April 11, 2013 and August 19, 2013 - Orange County proceeded with investigation of the leachate collection system (LCS) including cleaning and internal video inspection by Closed Circuit Television (CCTV). Mr. Carl Hoffman of the NYSDEC observed the field investigation on April 11, 2013. The findings are described in Section 3.2 below.

- August 21, 2013 - Samples of seeps were collected for laboratory analysis. Laboratory analytical results are provided in Appendix E.

- December 13, 2013 - Orange County submits a Draft Site Management Plan to NYSDEC.

- December 18, 2013 –Orange County provides a Work Plan to install piezometers between the Landfill and Canal to understand the subsurface conditions and piezometry immediately upgradient of the seeps exhibiting elevated ammonia. A copy of the Work Plan is provided as Appendix F. The Work Plan was approved by the NYSDEC on December 31, 2013.

- February 19 and 20, 2014 - Following NYSDEC approval of the Work Plan, six (6) overburden piezometers were installed. A comprehensive letter report summarizing the findings of the piezometer installations is provided as Appendix G.

- June 12, 2014 - Orange County collected samples of the seeps and surface water for laboratory analysis.

- October 6 and 8, 2014 - Orange County conducted sampling of the overburden groundwater, seeps in accordance with the approved Work Plan. The purpose of monitoring was to understand seasonal fluctuations in groundwater elevation and water quality as the foundation to developing a seep mitigation plan.

- October 20, 2014 - Based upon agreements reached at the September 22, 2014 meeting with NYSDEC, Orange County proceeded with steps to immediately address the seeps (see correspondence provided in Appendix H) and a Pre-Construction Notification was submitted to the USACOE.

1.5 Site Management Plan (SMP)

The approved Site Management Plan (SMP) provides the recommended scope of work to continuously monitor the major components of the selected remedy for the Landfill as provided in the NYSDEC Division of Remediation RODs dated January 28, 1994 for Operable Unit No. 2 and March 26, 1998 for Operable Unit 01 as outlined below:

- Landfill cap;
- Groundwater monitoring wells;
- Leachate collection system;
- Surface water drainage channels;
- Air quality;
- Property deed restrictions;
- Post-closure monitoring and maintenance; and
- Contingency plans to protect nearby residents.

The SMP sets forth contingency measures for potential problems associated with groundwater and surface water contamination. If conditions indicative of leachate outbreaks, such as wet spots, dead vegetation, surface sloughing or discoloration are observed during the inspection, the SMP requires further investigation to evaluate the condition and determine the appropriate corrective action.

The condition must be reported to the NYSDEC and an investigation plan must be developed to determine the cause and extent of the observed condition. The investigation plan may include, but is not necessarily limited to, test pit excavations or other appropriate subsurface investigation methods. A remedial action plan must then be developed to address the condition.

If significant offsite migration of surface or groundwater contamination is determined to be occurring, then the potential threat to human health or the environment must be assessed. Factors contributing to this assessment include, but are not limited to:

- Proximity of downgradient groundwater users.
- Distance to environmentally sensitive surface waters or wetlands.
- Evidence of environmental damage, including stressed vegetation, abnormal algal growth, and abnormally high number of fish deaths.
- Deterioration of surface or groundwater quality.

This Seep Mitigation Plan & Engineering Report is prepared as a contingency response, as required by the SMP.

2.0 LANDFILL ENVIRONMENTAL MONITORING PROGRAM

The Landfill and surroundings have been extensively investigated. There are a total of thirty three (33) monitoring wells, which have been monitored regularly since 1990, based on the Long Term Post-Closure Monitoring Program. The NYSDEC approved Closure Plan as modified by the December 23, 2003 post-closure monitoring variance request established the monitoring well network (twenty one (21) monitoring wells and three (3) piezometers), four (4) surface water monitoring locations, and two (2) leachate manhole collections for the Landfill. This Variance Request, approved by the NYSDEC in December 2002, reduced the frequency of monitoring at the landfill to every fifth quarter for 6 NYCRR Part 360 Baseline Parameters.

The data collected from these wells and other monitoring points provide the foundation for the conceptual model and understanding of the Landfill's relationship to the underlying groundwater systems. Environmental monitoring data generated over the last two (2) decades provide a clear understanding of the Landfill's impact upon groundwater quality. The data shows that Landfill related chemistry, such as ammonia, TDS, phenolics, arsenic, iron, etc., are stable with little fluctuation in reported parameter concentrations. Further, the reported horizontal and vertical distribution of the Landfill constituents in groundwater have remained consistent over time. Recent (2013) results from upgradient monitoring wells (MW-230S and MW-230D), downgradient monitoring wells (PZ-4, MW-3B, MW-220, MW-245S and MW-245D), seeps (2012 through 2014), and the downstream surface water sampling location (SW-8) show a completely different geochemical profile compared to the leachate results, as depicted below:

Parameter	Leachate	Upgradient GW	Downgradient GW	Seep	Downstream SW
Ammonia	47 to 560	0.079 to 0.08	0.039 to 9.0	6.3 to 40	non-detect to 0.221
TDS	800 to 3,900	162 to 330	590 to 820	660 to 830	190 to 428
Phenolics	non-detect to 0.024	non-detect	non-detect to 0.0087	non-detect to 0.0054 J	non-detect to 0.0115
Arsenic	0.022 to 0.26	non-detect to 0.0093	non-detect to 0.056	0.029 to 0.12	non-detect to 0.014
Iron	15 to 1,100	0.5 to 1.1	1.0 to 6.3	3.2 to 13	0.34 to 3.13
Manganese	0.031 to 0.089	0.13 to 0.47	0.45 to 1.9	0.28 to 1.8	0.052 to 0.28

Source: Cornerstone, 2013 and Sterling, 2012/2013/2014.
All results are expressed in mg/L.

Based on this understanding, Orange County recommended a modification to the currently approved long term monitoring program on December 13, 2013 as considerable data had been generated for decades and the environmental conditions at the site are well understood. In recognition of this, the modified long term monitoring program was approved by the NYSDEC in 2014.

As set forth in the approved SMP, dated June 6, 2014, the approved post-closure environmental monitoring program at the Landfill consists of the collection and analysis of groundwater, surface water and leachate samples and the performance of explosive gas monitoring. Post-closure monitoring has been conducted since 1998. In addition, the monitoring program includes inspections of the Landfill to observe general conditions, oversee and inspect operation and maintenance activities, and to handle non-routine site issues, such as damage to the Landfill cover system.

Groundwater, surface water and leachate monitoring currently consists of annual sampling of seven (7) groundwater monitoring wells, three (3) surface water locations, and two (2) leachate manholes for 6 NYCRR Part 360-2.11 (effective date December 31, 1988) Baseline Parameters. The monitoring wells consist of an upgradient well pair (two hydrogeologic units: overburden sand and gravel and upper bedrock) and five downgradient monitoring wells located south of the Landfill and north of the Cheechunk Canal. The three surface water sample locations are collected from the Cheechunk Canal south of the Landfill while Leachate samples will continue to be collected from two (2) manholes along the perimeter of the Landfill. In addition, groundwater elevations from twenty-eight (28) monitoring wells are recorded during each monitoring event. Figure 3 shows the post-closure monitoring locations.

In addition, the Institutional and Engineering Control (IC/EC) Plan also outlines steps necessary to manage and implement the controls for the Landfill property and to evaluate such controls for annual certification consistent with the requirements of the ROD, dated March 1998, and NYSDEC DER-10.

The ECs for the Landfill to control the source of contamination and the generation of contaminated leachate include:

- Maintenance of the Landfill cover system that includes layers of fill material, gas venting system and an impermeable membrane.

- Maintenance of groundwater monitoring wells. The groundwater monitoring wells are regularly sampled to observe groundwater quality at the Landfill. The groundwater monitoring wells are located upgradient, downgradient, and cross-gradient of the Landfill. The monitoring wells range between 10 and 88 feet deep and are installed in sand and gravel or bedrock (see Figure 3 for locations).

- Operation and maintenance of ongoing leachate collection of leachate for offsite treatment. Leachate collected by the perimeter trench system flows by gravity to sumps. From these manhole sumps, leachate is pumped into aboveground storage tanks (ASTs) for subsequent removal and transportation to an offsite permitted wastewater treatment plant.

- Maintenance of surface water drainage swales and erosion control features to collect and divert surface water runoff downgradient of sections of the impermeable membrane installed on the Landfill slopes. Terraces and downchutes have been established on both the Landfill footprint and the immediate land surrounding the Landfill for the prevention of standing water on the Landfill footprint and any damage to the Landfill cover system. These surface water features divert excess surface waters away from the Landfill wastemass.

- Site inspections of the final cover system, including inspections for leachate outbreaks, settlement, erosion and insufficient vegetation continue to be completed monthly by Orange County personnel.

2.1 General Landfill Seep Characteristics

The phenomena of groundwater seeps at old, unlined municipal waste landfills have been studied and much has been learned regarding the fate and transport of principal landfill parameters of concern namely iron, manganese, arsenic and ammonia. Research by the NYSDEC staff is at the forefront of the understanding of unlined landfills and their impact on the environment.

It is important to appreciate that red-stained groundwater seeps are commonplace in Orange County. Dissolved iron in groundwater rapidly forms an iron oxide precipitate when groundwater daylights. Iron seeps are common at landfill sites throughout New York due to the release of iron from waste decomposition and the reducing environment of the groundwater impacted by landfill releases. A reducing environment causes more naturally occurring iron and other metals, such as arsenic, to be dissolved from the soils underlying old landfills.

Readers of this landfill Seep Mitigation Plan are strongly encouraged to review the various studies and research into how unlined landfills behave and the typical makeup of groundwater influenced by unlined landfills.[1,2]

One published study of environmental monitoring data from 42 unlined landfills in New York provides a statistical analysis of groundwater impacts by typical landfill indicator constituents.

At the most affected seep the concentrations of key indicator parameters are as follows:

Parameter of Interest	Reported Range
Ammonia	6.3 - 40 mg/L
Arsenic	0.048 - 0.12 mg/L
Iron	3.2 - 13 mg/L
Manganese	0.28 - 1.8 mg/L

For these same parameters the evaluation of 42 unlined landfills indicates the following:

Parameter of Interest	Reported Range
Ammonia	ND - 200 mg/L
Arsenic	ND – 15.5 mg/L
Iron	ND - 1,330 mg/L
Manganese	ND - 81 mg/L

Clearly, in comparison with the 42 unlined landfills subject to the study, the Orange County Landfill seeps show an impact within the range typically encountered and well below the maximum range experiences within the State.

Further, the seep data shows no presence of volatile organic compounds (VOCs), petroleum constituents or heavy metals that can be present in landfill leachates. The exceedances experienced at the seep represent minor exceedances of the NYSDEC promulgated drinking water standards.

[1] "An Assessment of Groundwater Quality Monitoring Data Collected at Unlined Municipal Solid Waste Landfills." Presented by Steven Parisio of NYSDEC Region 3, Bolton Landing, NY. May 8, 2007.

[2] "Historic Fill & Old Landfills: Tools for Delineation.", Presented by Steven Parisio of NYSDEC Region 3, May 20, 2014.

3.0 SEEP INVESTIGATION AND RESPONSE

3.1 Initial Response

A joint inspection of the Canal was conducted on August 22, 2012 with NYSDEC, Orange County, and STERLING. The inspection included canoeing the entire stretch of Canal along the Landfill site. The on water inspection included Mr. Steven Parisio and Mr. Carl Hoffman from the NYSDEC. Based on observed conditions several seeps were selected for sampling. It was noted that some seeps were present on the opposite side of the Canal from the Landfill and at locations removed from the Landfill. The entire stretch of Canal along Orange County's property has been extensively disturbed in the past by dredging the Canal. Excavated material has been sidecast and has not been graded. As a result, the canal banks are poorly drained and in some areas precipitation runoff is trapped upslope contributing to the existence of the observed seeps.

Results from the August 22, 2012 and August 21, 2013 inspections and sampling are provided in Appendices B and E.

3.2 Leachate Collection System Investigation

On April 11, 2013 and August 19, 2013, attempts were made to inspect the perimeter leachate collection system immediately upgradient from the groundwater seeps. Self-propelled robotic camera units were unable to fully access the leachate collection pipe at the connection to the manhole.

Subsequently, push-style video cameras were manually advanced into the leachate collection pipe as far as possible (approximately 140 feet in April 2013, and approximately 175 feet in August 2013). Overall, the perforated leachate collection pipe that was able to be inspected appeared to be in good condition, with no apparent blockages. In August 2013, a jet-vac hose (with no camera) was successfully advanced approximately 190 feet.

Based upon the information obtained and the design of the collection system, the perimeter leachate collection system was determined to be functioning as the installed leachate collection pipe is surrounded by permeable stone. Accordingly, leachate and groundwater is collected and conveyed through the system to the leachate manhole even if the perforated pipe were damaged or blocked. As a result, further efforts to conduct internal video inspection were suspended.

3.3 Overburden Piezometer

On February 19 and 20, 2014, six (6) temporary shallow overburden piezometers (PZ-14-1 through PZ-14-6) were installed between the Landfill's perimeter access road and the seeps near the Cheechunk Canal bank to better understand the subsurface hydrology between the limit of waste and the seeps northwest of the Cheechunk Canal and southeast of the perimeter access road (Figure 2). The Cheechunk Canal/Seep Evaluation Letter Report was submitted to the NYSDEC on April 4, 2014 (Appendix G).

Upon completion of sampling, each borehole was either converted into a 1¼-inch (PZ-14-1, PZ-14-2, PZ-14-4, and PZ-14-6) or a 2-inch inside diameter (I.D.) temporary piezometer (PZ-14-3 and PZ-14-5) with a five (5) foot long section of 0.01-inch (10 slot) machine slotted PVC well. As detailed in Table 1, the total depths ranged from 28.91 feet below ground surface (bgs) at PZ-14-4 to 39.5 feet bgs at PZ-14-1. The screened intervals were set in the uppermost portion of the overburden hydrogeologic unit (glaciolacustrine fine sand) to obtain basic aquifer data (groundwater flow direction, gradients, horizontal hydraulic conductivity, aquifer transmissivity, and aquifer yield) and define the hydrogeologic relationship between the Landfill and the seeps identified on the northern bank of the Cheechunk Canal.

The elevation for the top of the piezometer casings (measuring points) were measured with an engineer's level from the measuring point of nearby monitoring well MW-3B to allow for direct comparison of groundwater level measurements routinely collected at the Landfill. The apparent elevations of the Canal bank seeps downgradient from the piezometers, as well as the water level of the Canal, were also determined in the same manner. It should be noted that the slope in this portion of the site ranged from 24% to 28%.

Following installation, three (3) synoptic rounds of groundwater elevation measurements were collected on February 20, March 18, and March 27, 2014 to gain a complete understanding of the local hydrostratigraphy, define groundwater flow direction and gradients, and build a conceptual profile between the Landfill and the Cheechunk Canal.

In addition, field hydraulic conductivity testing was performed on two (2) of the temporary overburden piezometers (PZ-14-3 and PZ-14-5) to characterize the horizontal hydraulic conductivity of the aquifer and a short-term two (2) hour constant rate pumping test was performed at temporary piezometer PZ-14-3 to further define aquifer characteristics, such as yield and transmissivity (Appendix G).

Groundwater in each temporary piezometer between the Landfill and the seeps were also sampled for 6 NYCRR Part 360 field parameters (specific conductivity, temperature, pH, and Eh). Due to weather conditions, the subject seep area could not be evaluated as the Canal water level was higher than the seep elevation.

3.3.1 Installation

The temporary overburden piezometers were installed using a track-mounted Geoprobe® to a depth sufficient to encounter the upper overburden aquifer (glaciolacustrine fine sand), which underlies the Cheechunk Canal (Figure 2). At each location, soil samples were collected on a continuous basis from ground surface to termination depth using the Macro-core® MC5 soil sampler. Each borehole was logged to define the local model of the critical site stratigraphy as it relates to the Landfill and the Cheechunk Canal (Appendix G).

Upon completion of sampling, each borehole was either converted into a 1¼-inch (PZ-14-1, PZ-14-2, PZ-14-4, and PZ-14-6) or a 2-inch inside diameter (I.D.) temporary piezometer (PZ-14-3 and PZ-14-5) with a five (5) foot long section of 0.01-inch (10 slot) machine slotted PVC well. As detailed in Table 1, the total depths ranged from 28.91 feet below ground surface (bgs) at PZ-14-4 to 39.5 feet bgs at PZ-14-1. The screened intervals were set in the uppermost portion of the overburden hydrogeologic unit (glaciolacustrine fine sand) to obtain basic aquifer data (groundwater flow direction, gradients, horizontal hydraulic conductivity, aquifer transmissivity, and aquifer yield) and define the hydrogeologic relationship between the Landfill and the seeps identified on the northern bank of the Cheechunk Canal.

3.3.2 Site Stratigraphy

The field investigation, performed between February and March 2014, was used to define the local geologic conditions, hydrogeologic setting, and environmental parameters as well as serve as the core of understanding to remediate the subject seeps). Findings are detailed below.

The critical site stratigraphy between the Landfill and the canal has been defined as follows:

Glaciolacustrine Silt and Clay: Moist grayish brown clayey silt to silty clay; stiff to moderately stiff; occasionally to frequently varved; lowly permeable; and, moderately plastic. As presented in Table 1, this unit was encountered at surface to depths ranging from 24.4 to 34.1 feet bgs, which is consistent with historical data collected near this portion of the Landfill and the Cheechunk Canal. Stearns & Wheler reported that this silt and clay layer thins toward the northeast from approximately 60 feet to 20 feet. The base of the glaciolacustrine silt and clay unit is approximately three (3) to five (5) feet above the subject seep(s).

Glaciolacustrine Sand: Wet fine sand; medium dense; moderately permeable; and, laminated. The top of this water-bearing unit is between 355.52 (PZ-14-1) and 357.43 (PZ-14-3) and feet in elevation and slightly tilts to the north away from the Cheechunk Canal (Table 1 and Figure 4). Again, this field data is consistent with historic geoenvironmental data collected from historical investigations/remedial investigation which reports this unit as being 25 to 35 feet in thickness. The base of the glaciolacustrine sand unit was not encountered during the course of this investigation.

Glacial Till: Basal lodgement till is a dense, unstratified diamict of poorly sorted sediment emplaced on bedrock by the base of the glacier during ice advance. It often has large erratics oriented in the direction of the ice movement. The glacial till unit, which was not encountered during this investigation, is lowly permeable and is not considered a water bearing zone.

3.3.3 Aquifer Characterization

The hydrogeologic nature of the piezometer installations was interpreted using historic well logs, slug tests, groundwater elevation data, geologic cross sections, and publications. The hydrogeologic setting was further refined from information obtained from the recent drilling, surveying, overburden groundwater measurements, hydraulic conductivity testing, and the short-term pumping test.

Complex vertical and horizontal stratigraphic relationships exist between the glacial deposits on the site. As shown in Figure 4, the Cheechunk Canal dissects the glacially-derived overburden often cutting down through the glaciolacustrine silt and clay deposits, creating a hydraulic connection between the overburden groundwater unit (glaciolacustrine fine sand) and the Cheechunk Canal (Wallkill River). In general, the low hydraulic conductivity of the glaciolacustrine silt and clay, which underlies a large portion of the Landfill, limits recharge to underlying hydrogeologic units such as the glaciolacustrine fine sand (encountered). The glaciolacustrine silt and clay unit is not a water-bearing zone.

Hydraulic conductivity estimates in the overburden hydrogeologic unit (glaciolacustrine fine sand) were determined using slug tests. The data obtained were analyzed using the Bouwer and Rice method (1989). This method consists of quickly lowering or raising water levels in a well and measuring its rate of recovery. Although originally designed for use in unconfined aquifers, the authors (Bouwer and Rice) determined that most of the head difference "y" between the static water table and water level in the piezometer is dissipated in the vicinity of the piezometer around the screen and slotted section, the method is also applicable to confined or semi-confined conditions. Hydraulic conductivity of the overburden hydrogeologic unit ranged from 9.29×10^{-6} feet/min (4.72×10^{-6} cm/sec) to 2.35×10^{-5} feet/min (1.19×10^{-5} cm/sec).

Groundwater flow in the overburden hydrogeologic unit was determined using depth to groundwater measurements collected from the temporary overburden piezometers between February 20, 2014 and October 6, 2014 (Table 2 and Figures 5A, 5B, and 5C). This data, in conjunction with historical well log data and plots of changes in groundwater elevation over time, suggest that the glaciolacustrine fine sand unit is currently in semi-confined to confined conditions. Therefore, the directions of groundwater flow are based on the potentiometric surface of the glaciolacustrine fine sand, not strictly elevations of the water table surface.

Groundwater flow in the overburden west or north of the Canal is to the east-southeast (Figures 5A, 5B, and 5C), discharging to the Canal that acts as a discharge zone and a groundwater flow boundary separating flow regimes on either side of the Canal. Overburden piezometers PZ-14-2, PZ-14-3, and PZ-14-4 are located immediately upgradient of the subject seep(s); the water level at the subject seep is variable but is approximately nine (9) to eleven (11) feet below the potentiometric surface observed at the lowermost piezometers (PZ-14-2, PZ-14-3 and PZ-14-4). The actual location of the piezometer array was successful at locating the groundwater that is likely causing the subject seeps (Figure 6). There is little potential for contamination to flow between the Canal and to areas east or south of the Canal based on previous investigations conducted at the Landfill. The direction of groundwater movement can be understood in the fact that groundwater always flows in the direction of decreasing head. The rate of movement, on the other hand, is dependent on the hydraulic gradient, which is the change in head per unit distance. The change in head measurement is ideally in the direction where the maximum difference of head decrease occurs. The hydraulic gradient (the change in head divided by the change in distance) on the Orange County property is seasonally variable and ranged from 0.0077 ft./ft. to 0.0133 ft./ft. based on data collected in late winter (March 18, 2014, Figure 5A) and was significantly greater in early September 2014, ranging from 0.0398 ft./ft. to 0.0557 ft./ft. when the subject seep(s) were evident (September 9, 2014, Figure 5B). The moderately steep-sloped lands between the Orange County property line and the Cheechunk Canal exhibits a consistently steeper hydraulic gradient and is less seasonally variable and is best represented by the data collected in early October 2014, ranging from 0.1216 ft./ft. to 0.0.1538 ft./ft. (October 6, 2014, Figure 5C).

An aquifer overlain by a bed of material that has a significantly lower hydraulic conductivity is termed as confined. As was observed during the field investigation, the potentiometric surface of the confined aquifer was 3.5 to 8.5 feet above the base of the overlying confining layer (Tables 1 and 2 and Figure 4). The least seasonal variability was observed in the three (3) uppermost overburden piezometers (PZ-14-1, PZ-14-5, and PZ-14-6). Water levels in confined aquifers are typically slow to respond to storm events or droughts and therefore typically exhibit minor fluctuations. A semi-confined or "leaky" confined aquifer is characterized by a low permeability layer (i.e., glaciolacustrine silt and clay) that permits water to slowly flow through it. Groundwater in these aquifers respond more quickly to changes in precipitation.

Review of site groundwater measurement data, collected between February and October 2014, indicates that the upper portion of the site is in confined conditions while the lowermost plateau, where seeps have been reported, is likely under unconfined conditions (Figures 4 and 6). The similarity between the potentiometric surface elevation and the subject seep(s) elevation suggests that there is seasonal hydraulic connection between the Cheechunk Canal and site groundwater. If groundwater was totally confined, no hydraulic connection would exist between the Canal and local overburden groundwater. The semi-confinement can be the result of leakage through the saturated overlying low permeability layer (glaciolacustrine silt and clay) or through fractures/varved planes in the silt and clay.

Seepage velocities were also calculated in this overburden hydrogeologic unit using the following equation:

$$V = \frac{KI}{n}$$

Where "V" is the seepage velocity in distance per unit time; "K" is the hydraulic conductivity at the borehole (in distance per unit time); "I" is the hydraulic gradient (dimensionless); and, "n" is the estimated effective porosity. The lowest possible values for "n" were used to estimate highest seepage velocities. Seepage velocities indicate a range from $2.57x10^{-4}$ feet/day (0.094 feet/year) to $1.2x10^{-3}$ feet/day (0.438 feet/year).

On March 18, 2014, a two (2) hour constant flow rate pumping test was conducted on PZ-14-3 (Figure 6). Initial pumping at 2 gallons per minute (gpm) resulted in complete drawdown at piezometer PZ-14-3; the pumping rate was reduced to provide further evaluation of the overburden aquifer characteristics. Pump flow rate (0.38 to 0.4 gpm) and overburden piezometer water levels were monitored every 15 minutes throughout the two (2) hour test. A drawdown of 7.8 feet was observed during the pumping period, dropping 7.33 feet in the first five (5) minutes and steadily dropped 0.46 foot over the remainder of the pumping test period (Appendix G). Based on this information, the specific capacity was calculated as being 0.05 gpm/ft with a transmissivity of 75 ft^2/day. The adjacent piezometers were lowered by 0.19 foot (PZ-14-6) to 0.29 foot (PZ-14-2), demonstrating good connection to the localized low rate pumping activity (Appendix G).

3.3.4 Sampling

Results from the August 22, 2012 and August 21, 2013 inspections and sampling are provided in Appendices B and E, respectively.

Following the inspection, the County provided a Work Plan to conduct a subsurface investigation downgradient of the Landfill and immediately upslope of the observed seep closest to the Landfill. The Work Plan was approved by NYSDEC on December 31, 2013. The investigation proceeded on February 19 and 20, 2014 consisted of installing six (6) piezometers to define the groundwater elevations and to allow for sample collection. Results of the NYSDEC approved investigation were provided to the NYSDEC by letter dated April 4, 2014.

Synoptic rounds of water levels from overburden piezometers and Cheechunk Canal have been collected since February 20, 2014 (Table 2). Recent inspections conducted by STERLING on August 21, 2014, September 4, 2014, September 9, 2014, and October 6, 2014 identified five (5) seeps; no flowing seeps were observed.

Additional seep and surface water sampling was performed on June 12, 2014 and October 6 - 8, 2014 (Figure 7). The June 12, 2014 sampling event consisted of the collection of five (5) seep samples (Upstream: GW-B and GW-1; at seep area (GW-2); and, Downstream: (GW-3)) and two surface water samples (Upstream: SW-01 and Downstream: SW-02). These samples were analyzed for NYSDEC Baseline parameters and results are provided on Appendix I, Figures 6 and 8, and Tables 5 and 6. The October 6, 2014 sampling event consisted of the collection of two overburden groundwater samples, collected from PZ-14-3 and PZ-14-5, one seep sample (Seep Monitoring Point) in the vicinity of the most persistent seep, and three (3) surface water samples (Upstream: SW-5; slightly downstream of the seep area (SW-Seep-DS; and, Downstream: (SW-8)). These samples were analyzed for NYSDEC Baseline parameters and results are provided in Appendix J, Figures 6 and 8, and Tables 4, 5, and 6. Sampling results for field parameters, overburden groundwater, seeps, and surface water are summarized below.

Field Parameters

On March 27, 2014 and October 6, 2014, overburden groundwater in each temporary overburden piezometer, between the Landfill and the seeps, were sampled for 6 NYCRR Part 360 field parameters, including specific conductivity, temperature, pH, and Eh (Table 3). Due to weather conditions, the subject seep area could not be evaluated in February and March 2014 as it was covered with ice or submerged during this period.

As detailed in Appendix G, the specific conductance from overburden groundwater ranged from 0.607 millisiemens per centimeter (mS/cm) at PZ-14-4 to 1.230 mS/cm at PZ-14-5. The specific conductance of the water sample is the measure of its ability to carry an electrical current under specific conditions and is typically an indication of the concentration of TDS in the groundwater. A specific conductance value that is markedly different from those obtained in nearby piezometers may indicate a different source of the groundwater or leakage from a formation that contains water of a different quality. Specific conductance values from 2012 and 2014 seep sampling ranged from 0.695 mS/cm at Seep GW-03 on August 22, 2012 to 1.339 mS/cm at GW-D on August 21, 2013 (Tables 4, 5, and 6).

As detailed in Table 3 of Appendix G, the redox potential in the overburden aquifer is sensitive to organic matter associated with landfill leachate and of concentrations of redox-active components such as the mineralization of the groundwater. Oxidizing-reducing reactions result in a change of the charge of an ion as it gains or loses an electron. These reactions are almost always facilitated by bacteria that are able to gain energy from the reactions. The most common cause of reducing reactions is organic matter, either in solid form or as dissolved organic carbon. Water in contact with air will have an Eh in the range of 350 milliVolts (mV) to 500mV. Microbially mediated redox processes may decrease the redox potential to values as low as -300mV. The redox potential from overburden groundwater ranged from -90.2 mV at PZ-14-1 to 214.8 mV at PZ-14-5. Oxidation-Reduction Potential (ORP) values from 2012 and 2014 seep sampling ranged from -90.6 mV at Seep GW-01 on August 22, 2012 to 31 mV at GW-3 on June 12, 2014 (Table 5). The redox potential at PZ-14-5 is considered the most irregular.

At any given temperature, there is a specific concentration of a dissolved mineral's constituents in the groundwater that is in contact with that mineral. Even minor changes in groundwater temperature can cause detectable changes in TDS. It should be noted that the temperature of the upper piezometers (PZ-14-1, PZ-14-5, and PZ-14-6) were consistently higher than the lower piezometers (PZ-14-2, PZ-14-3, and PZ-14-4). The temperature at PZ-14-5 is notably higher than others collected on March 27, 2014 and October 6, 2014.

The pH is actually a measure of the hydrogen ion (H+) availability (activity). The hydrogen ion is very small and is able to enter and disrupt mineral structures so that they can contribute dissolved constituents to groundwater. Consequently, the greater the hydrogen ion availability the lower the pH and the higher the TDS in groundwater. The pH readings collected from overburden groundwater ranged from 7.00 standard units (s.u.) at PZ-14-1 to 7.75 s.u. at PZ-14-2. In comparison, 2012 and 2014 seep sampling reported pH readings that ranged from 6.77 s.u. (Seep GW-3) on June 12, 2014 to 7.15 s.u. (GW-D) on August 21, 2013. No direct conclusions can be made based on comparison of pH readings obtained from the piezometers.

Two (2) one (1) liter samples were collected for comparison of water quality field parameters at the start and end of the short-term pumping test, which was performed at PZ-14-3. No significant changes or fluctuations were observed in the field parameters.

Field parameter and leachate indicator analytical results for 2013 from nearby environmental monitoring points (four (4) overburden groundwater monitoring wells (MW-3B, PZ-4, MW-220, MW-222), two (2) surface water locations (SW-5 and SW-8), and one (1) leachate location (MH-7)) were reviewed to further evaluate the potential presence of leachate impacted groundwater. Only total dissolved solids (TDS) exceeded the class GA standard (500 mg/L) at these select monitoring wells, ranging from 730 mg/L (MW-3B) to 860 mg/L (MW-222). Ammonia was only detected above the NYSDEC GA standard (2 mg/L) at monitoring wells MW-3B (4.4 mg/L) and MW-222 (12 mg/L). In comparison, 2013 results for TDS and ammonia from nearby leachate (MH-7) was 3,900 mg/L and 560 mg/L, respectively.

Overburden Groundwater

As shown in Figure 8 and Table 4, groundwater from overburden piezometers PZ-14-3 and PZ-14-5 showed no presence of volatile organic compounds (VOCs) and exceedances of select leachate indicator parameters such as ammonia (ranging from 5.3 to 9.1 mg/L), total cyanide (0.23 mg/L) and phenolics (0.026 mg/L) at PZ-14-5, TDS (680 to 780 mg/L), and turbidity (240 to 450 mg/L). The higher levels of ammonia and TDS at PZ-14-5 correlate to the analysis of field parameter results summarized above. Inorganic analytes that slightly exceeded NYSDEC groundwater standards include arsenic (0.057 - 0.094 mg/L), iron (4.8 - 18 mg/L), magnesium (54 - 56 mg/L), manganese (1.0 - 2.0 mg/L), and sodium (60 - 87 mg/L).

Seeps

Review of historical and recent seep analytical results (water quality parameters) for upstream seep sample locations (GW-B and GW-01 or GW-1), seep samples in the vicinity of the piezometer array (GW-03, GW-D, GW-2 and Seep Monitoring Point (10/6/2014), and downstream seep samples (GW-3 and GW-A) are provided in Figure 8 and Table 5. Results showed no presence of VOCs, petroleum constituents or heavy metals frequently observed in landfill leachates. Further, as the seeps ultimately discharge into the Cheechunk Canal, a Class C surface water, the promulgated surface water standards are exceeded for ammonia, TDS, iron, occasionally dissolved oxygen. Several slight exceedance of phenols have also been observed.

Surface Water

Review of historical surface water analytical results (water quality parameters) for upstream surface water sample locations (SW-13, SW-5, and SW-01), nearby surface water samples (SW-Seep DS), and downstream surface water samples (SW-02 and SW-8) revealed no exceedances of T.O.G.S. 1.1.1 Ambient Water Quality Standards for Class C Surface Water Quality standards, except for iron (ranging from 0.22 mg/L to 9.17 mg/L (Figure 8 and Table 6), three isolated historical field pH exceedances (ranging from 9.02 to 9.33 s.u. upstream of the site (SW-05) and 8.81 s.u. at the downstreammost location (SW-8)), and one phenol exceedance (0.0072 mg/L) at SW-5 in 2000 and at SW-8 (0.0115 mg/L) in September 2002 (Figure 8 and Table 6).

3.4 Investigation Findings and Results

The piezometer installations confirm a lowly permeable glaciolacustrine silt and clay unit exists at surface to depths ranging from 24.4 to 34.1 feet bgs. The base of this geologic unit tilts to the north away from the Cheechunk Canal. Underlying the silt and clay unit is moderately permeable glaciolacustrine fine sand, which is typically 25 to 35 feet in thickness.

The overlying glaciolacustrine silt and clay unit is not a water-bearing zone and limits recharge to underlying hydrogeologic units while the overburden hydrogeologic unit discharges into and is hydraulically connected to the Cheechunk Canal. Groundwater in the glaciolacustrine fine sand unit reveals semi-confined conditions with groundwater flow being to the east-southeast with a moderate hydraulic gradient between the Landfill and the canal. Two (2) hours of constant rate pumping (0.38 to 0.4 gpm) at PZ-14-3 revealed the following: 1). A drawdown of 7.8 feet at the wellhead; 2). Lowering of the potentiometric surface between 0.19 foot (PZ-14-6) to 0.29 foot (PZ-14-2) within the piezometer array, demonstrating a good connection within the overburden hydrogeologic unit and the Cheechunk Canal (at low pumping rates); 3). The specific capacity and transmissivity values are low for the overburden hydrogeologic unit between the Landfill and the canal; and, 4). The actual location of the piezometer array was successful at locating the groundwater that is connected to the subject seep(s).

Results from leachate, upgradient monitoring wells (MW-230S and MW-230D), downgradient monitoring wells (PZ-4, MW-3B, MW-220, MW-245S and MW-245D), seeps (2012 through 2014), and the downstream surface water sampling location (SW-8) indicate a completely different geochemical profile compared to the leachate results, as depicted below:

Parameter	Leachate	Upgradient GW	Downgradient GW	Seep	Downstream SW
Ammonia	47 to 560	0.079 to 0.08	0.039 to 9.0	6.3 to 40	non-detect to 0.221
TDS	800 to 3,900	162 to 330	590 to 820	660 to 830	190 to 428
Phenolics	non-detect to 0.024	non-detect	non-detect to 0.0087	non-detect to 0.0054 J	non-detect to 0.0115
Arsenic	0.022 to 0.26	non-detect to 0.0093	non-detect to 0.056	0.029 to 0.12	non-detect to 0.014
Iron	15 to 1,100	0.5 to 1.1	1.0 to 6.3	3.2 to 13	0.34 to 3.13
Manganese	0.031 to 0.089	0.13 to 0.47	0.45 to 1.9	0.28 to 1.8	0.052 to 0.28

Source: Cornerstone, 2013 and Sterling, 2012/2013/2014.
All results are expressed in mg/L.

4.0 MITIGATION ALTERNATIVES

Various remedial technologies exist to eliminate or reduce impacts from the seeps to the environment and canal. The following alternatives are evaluated.

4.1 Canal Bank Erosion Control

This option provides for controlling erosion of canal bank at the location of the seeps. Obvious seep areas will be armored to control erosion. Existing, active seeps on the northern bank of the canal will be properly armored by overlaying with a medium to heavy duty (depending on the geomechanical properties of the underlying soils) woven geotextile filter fabric and covered by at least twenty-four (24) inches of NYSDOT medium stone fill rip-rap.

4.2 Focused Groundwater Collection and Treatment

4.2.1 Groundwater Extraction

Groundwater collection will consist of groundwater removal immediately upgradient of the seeps by depressing the water table to flatten the groundwater gradient. This would effectively halt the migration of groundwater toward the seeps. One or more recovery wells will be installed upgradient of the seeps outside of the flood zone of the canal, and continually pumped to maintain a specific drawdown in the well(s). Creating a zone of influence around the recovery well(s) will remove the gradient and eliminate groundwater flow towards the seeps.

Based on the aquifer characteristics at the proposed groundwater collection well, initial pumping rates of 6 to 10 gpm are projected (approximately 9,000 to 14,000 gpd). Upon facilitating the desired drawdown conditions, lower pumping rates are anticipated to maintain the drawdown condition.

4.2.2 Groundwater Treatment

The County is pursuing two (2) options to treat the collected groundwater. It is not feasible to collect and truck all collected groundwater to distant offsite permitted wastewater treatment plants (WWTPs). Accordingly, Orange County is proposing to simultaneously pursue the following options to treat the collected groundwater:

1. <u>Constructed Wetland Treatment System</u>

   Constructed wetlands and biofilters have been demonstrated as very effective in treating landfill impacted groundwater. Two (2) locations have been identified on the Landfill property as suitable for construction of lined wetlands. One totals 1.7 acres in area, the other 1.9 acres.

   Initially, collected groundwater will be trucked to a constructed wetland at one or more of the locations indicated on Figure 11. Groundwater will be discharged to a lined forebay which will be sized to initially receive groundwater delivery by tank truck in 6,000 gallon batch deliveries (later to be hard-piped once pumping rates and daily treatment volumes are known).

   The constructed wetland will be developed by stripping existing vegetation and grading the footprint to prevent runon of stormwater. The wetlands will be configured as presented on Figure 11. The wetland will be underlined with a 20 mil flexible membrane liner. Above the liner, a suitable wetland substrate will be installed to an average depth of 12 to 24 inches, depending on the chosen wetland vegetation. The substrate will provide the media for growth of wetland vegetation.

The collected groundwater will be slowly unloaded onto the forebay of the wetland biofilter. Influent to the wetland will flow from the forebay via wetland treatment cell via perforated pipe. The water will flow to the treatment cell where the ammonia will be removed through nitrification. Hardy wetland vegetation will be employed, namely phragmites (common reed) and typhya (cattails).

2. Mid-Hudson Psychiatric Center Wastewater Treatment Plant

The existing WWTP is located between Training Center Lane and Mid-Hudson Psychiatric Center Road on the south side of NYS Route 17M, approximately 4,600 feet from the Landfill. The existing WWTP is reportedly permitted for 80,000 gallons per day (gpd) of sanitary wastewater and an additional 20,000 gpd of "other" wastewater for a total of 100,000 gpd. Reportedly, the plant is reportedly currently operating at 45,000 gpd average daily flow. Accordingly, there is surplus capacity to treat up to 55,000 gpd of groundwater from the seep mitigation.

Discussions have initiated between Orange County and New York State Office of Mental Health with respect to utilizing this surplus wastewater treatment capacity to treat the collected groundwater. If the Mid-Hudson Psychiatric Center WWTP is agreeable, initial treatment of groundwater could commence upon NYSDEC Division of Water concurrence that the groundwater may be accepted for treatment.

In such case, groundwater will be initially trucked and unloaded into the plant headworks utilizing Orange County's 6,000 gallon tanker (potentially to be hard-piped in the future).

As described above, 9,000 to 14,000 gpd are initially expected to be collected for treatment, reducing to lower rates once the desired drawdown is achieved. Therefore, there may initially be two (2) tanker loads per day on average, later reducing to one (1) load per day.

The tanker will slowly unload into the headworks of the WWTP so as to minimally impact the treatment process. Unloading over a six (6) hour period amounts to an incremental flow of approximately 16 gpm (25% of permitted average daily flow).

Batch delivery to the treatment works can be timed such that a delivery at the start of the work day can be allowed to slowly unload until mid-afternoon. The afternoon delivery can be timed to unload overnight. Operating in this manner will provide for equalization of the flow into the WWTP minimizing potential impacts on the plant and treatment process.

4.2.3 Treatability Evaluation

The groundwater to be collected upgradient of the seeps is minimally impacted with Ammonia as the most significant parameter requiring treatment. Landfill leachate treatability studies conducted on low strength leachates and groundwater demonstrate treatment system operations are most challenging where the strength and volume of water to be treated vary significantly. Neither appears to be the case at the Orange County Landfill. As reported in Sections 2.0 and 3.0, the groundwater elevation upgradient of the seeps are relatively stable. Based on historical data, the concentration range of dissolved iron and ammonia in groundwater south of the Landfill have also remained relatively stable. Heavy metals have not been reported in the groundwater to be treated. For this reason, a site specific treatability study is not envisioned.

4.3 Seep Source Collection

This option involves collection of groundwater directly from the various seep locations. Shallow collection trenches (one to two feet deep) will be excavated at the seep locations, and plumbed to drain by gravity flow to a sump equipped with a pump.

The installation will require disturbance of the stream bank, excavation of previously dredged material and the installed collection system will be at a location regularly subjected to significant flooding. Accordingly, the design must provide for protection from flooding and the system operation will be designed to terminate operations when the flood stage of the canal exceeds the elevation of the collection trench. Such is necessary as the pumping system cannot be sized to operate when surcharged by flood waters.

The groundwater will be collected and treated as discussed in Section 4.2.

4.4 Containment

This option involves construction of a low permeable slurry wall or installation of sheet piles to impede the groundwater flow path to the seeps to the canal. Recovery wells or a collection trench will be installed upgradient of the barrier to remove groundwater behind the barrier.

Upgradient groundwater of the containment will be collected and treated as discussed in Section 4.2.2.

4.5 In-Situ Groundwater Treatment

Several technologies are available to provide in-situ treatment of the groundwater before it discharges along the banks of the canal.

4.5.1 Chemical Injection

This option involves the installation of groundwater injection wells to inject substances into the groundwater for subsurface treatment before the seeps discharge along the banks of the canal.

Proprietary products such as Metals Remediation Compound (MRC©) by Regenesis can be used to reduce metals contamination through precipitation and/or sorption to soil particles.

Ammonia in groundwater is typically treated by groundwater extraction and injection of treated water back to the subsurface. Accordingly, this option would require additional installation of groundwater extraction wells along with the injection wells.

4.5.2 Permeable Reactive Zone

This option involves the construction of a permeable reactive zone or trench upgradient of the groundwater seeps, which would passively treat groundwater and remove or break down contaminants, releasing treated water downgradient of the treatment zone.

A trench would be installed uphill from the seeps along the canal, and the trench would be backfilled with reactive media. Proprietary reactive media are available such as Nitrex™ (a mixture of wood chips and lime) for treatment of nitrate, ammonia, and dissolved organic nitrogen through denitrification, and Phosphex™ (a mixture of by-product of the steel industry and limestone) for metals removal via precipitation and adsorption.

4.6 Evaluation of Alternatives

In accordance with DER-10, the mitigation alternatives are evaluated primarily on the basis of implementability, effectiveness, permanence and cost for construction, operation and maintenance. An evaluation summary of the seep mitigation alternatives is provided as Table 7.

A common element of all alternatives is the armoring of the unprotected banks of the Cheechunk Canal where the seeps and erosion are occurring. The Orange County Department of Public Works can proceed with this work immediately upon approval of this Seep Mitigation Plan & Engineering Report.

4.6.1 Implementability

All technologies evaluated for the purposes of selecting a mitigation approach are implementable. It is generally preferred to avoid excavation and infrastructure installation within the flood zones. Annual flood elevations of the canal along the Landfill site results in as much as 20 feet of water over the seep elevation. Additionally, the degree of difficulty associated with implementing containment systems, seep source collection systems, or permeable reactive barriers is generally greater when compared to other treatment technologies.

As previously noted, the observed seeps indicating Landfill derived chemistry are located on the northern bank of the Cheechunk Canal. Containment structures, collection trenches, and reactive trenches installed in close proximity to the canal would be difficult to install due to the steep slope of the bank and composition of the previously dredged canal sediments on the banks and composition of the underlying soils. Similarly, containment structures and reactive trenches installed upgradient of groundwater flow will need to be installed outside the flood zone of the canal at a much greater depth, thus increasing the effort and cost of installation. Lastly, trenching across sensitive soils such as those observed at the project site may cause instability of the canal banks.

4.6.2 Effectiveness

The assessment of the effectiveness of various technologies focused upon the reduction/elimination of groundwater seeps into the canal as well as the feasibility to treat potentially impacted seep groundwater.

Containment systems will effectively reduce and, under ideal conditions, prevent seep groundwater from reaching the canal.

In-situ treatment of seep groundwater effectively treats potentially impacted groundwater. Notwithstanding, regular fluctuations of the canal flood stage would limit the effective operation of a seep source collection system as surface water from the canal would inevitably be collected by a collection trench installed near the location of the observed seeps. Ineffective collection of seep groundwater is not expected with a focused groundwater collection system as described in Section 4.2.

Chemical injection involves bench and pilot scale testing to determine an acceptable treatment formula and dosing rate in consideration of in-situ treatment of seep groundwater utilizing chemical injection technology.

The use of permeable reactive barriers is a well-documented technology with proven effectiveness, although the effectiveness of permeable reactive barriers is highly dependent on the proper delineation of site geology as well as bench and pilot scale evaluation prior to full implementation.

4.6.3 Permanence

Treatment technologies installed at or near the canal bank would be subject to significant flooding and potential damage. As such, concerns regarding long term maintenance and permanence are associated with the implementation of containment systems, seep source collection systems, and/or permeable reactive barriers.

In-situ treatment of groundwater, chemical injection technologies, and focused groundwater collection could be installed outside the flood zone but will require a continuous and long term operational effort.

4.6.4 Cost

The life-cycle costs of the remedial technologies considered for this evaluation are comparable. Although the capital costs for the installation of containment systems or permeable reactive barriers is generally greater than those for pump and treat systems and chemical injection technologies, the lower operational costs for such systems would result in a comparable, and potentially lower, life-cycle cost.

However, containment systems, seep source collection systems, or permeable reactive barriers installed near the bank of the canal are subject to flooding and fluctuations in canal stage. Unexpected costs associated with maintenance and repair from damaging flood events should be avoided by implementing design modifications, or an alternative technology altogether. As previously noted, trenches installed at a distance from the canal bank and upgradient of groundwater flow will have to be installed at a much greater depth, vastly increasing the effort and cost of installation.

4.6.5 Preferred Alternative

As canal bank erosion control armoring is readily implementable, effective and provides significant cost benefit, this protective measure will be included in the selected remedy. Based on an evaluation of various seep mitigation technologies, a focused groundwater collection and treatment, as described in Section 4.2, is the preferred approach. This technology is readily implementable with a comparable life-cycle cost to other technologies. The collection and treatment of groundwater effectively reduces/eliminates the discharge of groundwater seeps into the canal. It is favored over a seep source point collection system as all necessary mitigation groundwater collection infrastructure can be installed without disturbance of the canal banks and outside of the flood zone. Seep groundwater will be treated at a permitted wastewater treatment plant or constructed wetland system after collection from recovery well(s).

5.0 SEEP MITIGATION PLAN

5.1 Selected Mitigation Alternatives

The selected mitigation alternative consists of canal bank erosion control, focused groundwater collection and treatment, described as follows.

5.2 Canal Bank Erosion Control

Canal banks will be protected from erosion by riprap armoring as shown on Figure 9. The active seeps on the northern bank of the canal with demonstrated Landfill related chemistry will be overlain with geotextile filter fabric and covered by at least twenty-four (24) inches of riprap. Approximately 120 cubic yards of riprap will be required. Details of the canal bank erosion control measures are shown on Figure 10. The placement of rip-rap as indicated on Figure 10 will be subject to an USACOE Nationwide Permit and Pre-Construction Notice is required. This remedial work is expected to qualify for a Nationwide Permit No. 38 as the work will proceed as part of the remedy approved by the NYSDEC.

5.3 Groundwater Collection System

The groundwater collection system will consist of one (1) or more six (6) inch diameter recovery wells with submersible pumps to depress the water table upgradient from the seeps, preventing the seeps from discharging along the canal banks.

A recovery well will be installed at the location shown on Figure 9. Prior to system startup, pump tests will be performed with measurements made at the nearby piezometers to further evaluate the hydraulic conductivity of the groundwater aquifer, as well as to verify the radius of influence.

The pump test results will then be used to optimize pumping and system operation and to assess the need for additional recovery wells to produce the desired cone of depression at the established drawdown level, as well as to correctly size the permanent pump installation(s). If deemed necessary, additional recovery wells will be installed cross-gradient from the pilot recovery well as shown on Figure 9.

The recovery well(s) will be equipped with a submersible pump, water level pressure transducer, and pump controller. The pump controller will be capable of adjusting the target drawdown level in the well, and will automatically control the pump to maintain the set level. Groundwater discharged from the recovery well(s) will be conveyed to the temporary holding tank via forcemain as shown on Figure 9.

The forcemain will be sized following the initial pump test and aquifer characterization based upon the anticipated groundwater pumping rates.

The County will provide an existing aboveground 20,000 gallon steel tank to be utilized to collect and hold groundwater pending treatment at a permitted facility or the proposed onsite constructed wetland system. The tank will be equipped with a high level alarm that will automatically shut off the recovery well pump(s) and notify site personnel that the tank is full.

Proposed details of the proposed recovery well(s), forcemain, and storage tank are provided on Figure 10.

5.4 Groundwater Treatment

As discussed in Section 4.2, groundwater treatment will be by an onsite constructed wetland or by discharge to the Mid-Hudson Psychiatric Center WWTP. Discussions with NYS Office of Mental Health have initiated to explore the feasibility of utilizing existing surplus treatment capacity. The County will continue to pursue this option as it represents the most direct, immediately implementable option for treatment of impacted groundwater.

Under this scenario, minor headwork modifications will be made to the WWTP to allow for direct unloading of water from the hauling vehicle. The County will continue delivering the water by truck over initial operations until the need for additional recovery wells and final pumping rates have been established. At that time, the County will consider hard piping the collected water from the wellhead(s) to the WWTP.

Simultaneous with the discussions with New York State Office of Mental Health regarding the use of the WWTP, Orange County will proceed with conducting field percolation tests at the proposed wetland treatment location and will complete the Construction Plans, Specifications and Contract Documents for the treatment system.

5.5 Groundwater Conveyance System / Performance Effectiveness Monitoring

The Landfill inspections and environmental monitoring will continue as set forth in the approved Site Management Plan (SMP). The groundwater collection and treatment works will be monitored on a daily basis during the initial phases of operation as trucking of collected groundwater is proposed. Later, when groundwater is to be pumped to the treatment works, the inspection and monitoring frequency will be adjusted.

5.5.1 Ongoing Environmental Monitoring Program

The Landfill Environmental Monitoring Program (EMP) will continue as currently approved by the NYSDEC. Additional seep monitoring will be conducted as part of the routine monitoring of the groundwater extraction system. During all regular inspections of the Landfill, the installed erosion control measures at the seeps will be inspected. Additionally, following high water conditions in the canal, the seep locations will be inspected after the canal recedes.

6.0 CONSTRUCTION PLAN

Upon NYSDEC approval of the Seep Mitigation Plan & Engineering Report, the County will proceed with production of Construction Plans, Specifications and Contract Documents for the elements of the work that must be subject of competitive bidding under the County's procurement policies. These Construction Documents will consist of the following.

6.1 Construction Documents

INSTRUCTIONS TO BIDDERS

1. Invitation
2. Delivery of Proposals
3. Preparation and Submission
4. Interpretation of Bidding Documents

5. Inspection of Site
6. Addenda
7. Resultant Contract
8. Proposed Subcontractors and Suppliers
9. Alternates
10. Project Schedule
11. Bidding Documents
12. Health and Safety Plan (HASP)
13. Community Air Monitoring Plan (CAMP)
14. Storm Water Pollution Prevention Plan (SWPPP)
15. Dust Control Plan (DCP)

VENDOR AGREEMENT / CONSTRUCTION CONTRACT

STANDARD GENERAL CONDITIONS

Article 1	Definitions and Terminology
Article 2	Preliminary Matters
Article 3	Contract Documents: Intent, Amending, Reuse
Article 4	Availability of Lands; Subsurface and Physical Conditions; Hazardous Environmental Conditions; Reference Points
Article 5	Bonds and Insurance
Article 6	Contractor's Responsibilities
Article 7	Other Work at the Site
Article 8	Owner's Responsibilities
Article 9	Engineer's Status During Construction
Article 10	Changes in the Work; Claims
Article 11	Cost of the Work; Allowances; Unit Price Work
Article 12	Change of Contract Price; Change of Contract Times
Article 13	Tests and Inspections; Correction, Removal or Acceptance of Defective Work
Article 14	Payments to Contractor and Completion
Article 15	Suspension of Work and Termination
Article 16	Dispute Resolution
Article 17	Miscellaneous

SUPPLEMENTARY CONDITIONS

Article 1	Definitions and Terminology
Article 4	Availability of Lands; Subsurface and Physical Conditions; Hazardous Environmental Conditions; Reference Points
Article 5	Bonds and Insurance
Article 6	Contractor's Responsibilities
Article 17	Miscellaneous - Statutory Requirements

EXHIBITS

Exhibit A	Specifications

Contract No. 1 – Division 1 - General Requirements

01010	Summary of Work
01030	Progress Meetings
01041	Coordination
01050	Field Engineering
01150	Measurement and Payment
01210	Preconstruction Conference
01310	Construction Schedules
01340	Shop Drawings, Product Data and Samples
01370	Schedule of Values
01410	Testing Laboratory Services
01501	Contractor's Field Office
01540	Security
01560	Temporary Controls
01570	Maintenance and Protection of Traffic
01600	Transportation and Handling of Materials and Equipment
01620	Storage and Protection
01720	Project Record Documents

Contract No. 1 – Division 2 – Site Work

02110	Site Preparation/Clearing and Grubbing
02222	Rough Grading, Excavation and Backfill
02290	Storm Water Drainage
02936	Seed and Mulch
02949	Erosion Control
03000	Mobilization/Demobilization
04000	Dust Control
05000	Health and Safety

Contract No. 1 – Division 3 – Mechanical

03110	Recovery Well Drilling and Construction
03222	Pumps and Controls

Contract No. 1 – Division 4 – Electrical

Exhibit B	Bid Form

1. Bid Form – Contract No. 1
2. Statement of Contractor's Qualifications
3. Certificate of Insurance

Exhibit C	Insurance Requirements

DRAWINGS

Plate 1	Existing Conditions
Plate 2	Site Preparation
Plate 3	Groundwater Recovery Well, Pumps and Controls
Plate 4	Wetland Treatment System
Plate 5	Details
Plate 6	Details

SUPPORTING DOCUMENTS

Site Management Plan (SMP) inclusive of:

- Storm Water Pollution Prevention Plan (SWPPP)
- Community Air Monitoring Plan (CAMP)
- Health and Safety Plan (HASP)

6.2 Construction Procurement

The project is a municipal prevailing rate wage project requiring coordination with New York State Department of Labor. Additionally, the bid process and procurement of a qualified construction contractor must follow Orange County's established procurement policies and procedures.

6.3 Construction Sequence

The following construction sequence is anticipated.

Work Element	Construction Completion
Receipt of NYSDEC Approval of Mitigation Plan	November 15, 2014
Apply Erosion Control to Canal Banks	December 15, 2014*
Submit Construction Plans, Specifications and Contract Documents	December 31, 2014
NYSDEC Approval	February 1, 2015
Orange County Issue Notice to Bidders	February 15, 2015
Pre-Construction Meeting	March 1, 2015
Receipt of Bids	April 1, 2015
Evaluate Bids / Award Contract	May 1, 2015
Contractor Mobilization	May 15, 2015
Construction Phase (estimated at 8 weeks)	June 10, 2015
Submission of As-Built and Construction Certification	June 30, 2015
System Startup and Shakedown	June 10 – June 30, 2015
Performance Evaluation and Determination of Additional Groundwater Collection	August 1, 2015

*To be performed by Orange County Department of Public Works.

6.4 Startup

Prior to final acceptance of the work, the contractor will perform a startup operation at the pumping rate indicated by the pump test during drilling and installation of the recovery well.

The pumps, controls and system operation will be monitored over the course of a week to verify the drawdown conditions is being maintained and that the pump is cycling properly. Orange County personnel will remove groundwater from the groundwater recovery tank for delivery to the treatment system using Orange County's site tank truck.

Similarly, in the same timeframe the treatment works will be started, in the case of the constructed wetland, initial loads will be slowly unloaded into the forebay. Startup will be monitored to verify water flows freely from the forebay to the constructed wetland cell. Once discharge is noted into the recharge cell, effluent sampling will be performed to verify that the system is effectively removing ammonia and iron.

Following successful startup, the facility will be placed into routine operational mode and will be monitored on a daily basis in conjunction with transport of the groundwater to treatment.

7.0 OPERATION AND MAINTENANCE PLAN

7.1 Operation

The groundwater collection and conveyance system is designed to fully operate in a fully automatic mode. The recovery well system(s) will be equipped with a pressure transducer and pump controller to automatically maintain a set drawdown in the well(s). The groundwater drawdown level will be able to be controlled by the operator at the control panel located near the road.

In the event of a high water condition of the groundwater storage tank, a high-level alarm will activate and the recovery well(s) will shut down automatically.

7.2 Maintenance

Maintenance will be performed regularly and repairs made when necessary so that proper function is not interrupted. The area around the groundwater collection system will be regularly mowed as part of routine Landfill maintenance. Fragile structures (recovery well risers, control panels, electrical conduits, etc.) will be protected by bollards, concrete blocks or other means.

Landfill access roads will be maintained, including plowing during winter.

7.2.1 Canal Banks

The canal banks and riprap erosion control areas shall be inspected during regular monthly landfill inspections as set forth in the Site Management Plan (SMP) for signs of erosion, slope instability and occurrence of new seeps.

7.2.2 Pumps

Pump maintenance shall be performed in accordance with the manufacturer's recommendations, to be provided upon installation of the pump(s). Such will be determined based upon the specific pumping units selected and installed in accordance with the engineer's approvals.

7.2.3 Recovery Wells

The recovery well(s) should be inspected semi-annually. The wells should be checked for damage by frost or landscaping equipment, and should be cleared of surrounding vegetation.

7.2.4 Forcemain

Any exposed portions of the forcemain will be inspected monthly for signs of damage or leaks. The ground above the buried forcemain will be inspected for erosion and wet spots that may indicate a leak.

Manually operated valves should be operated semi-annually. Pipes will be inspected by video camera equipment if deemed necessary.

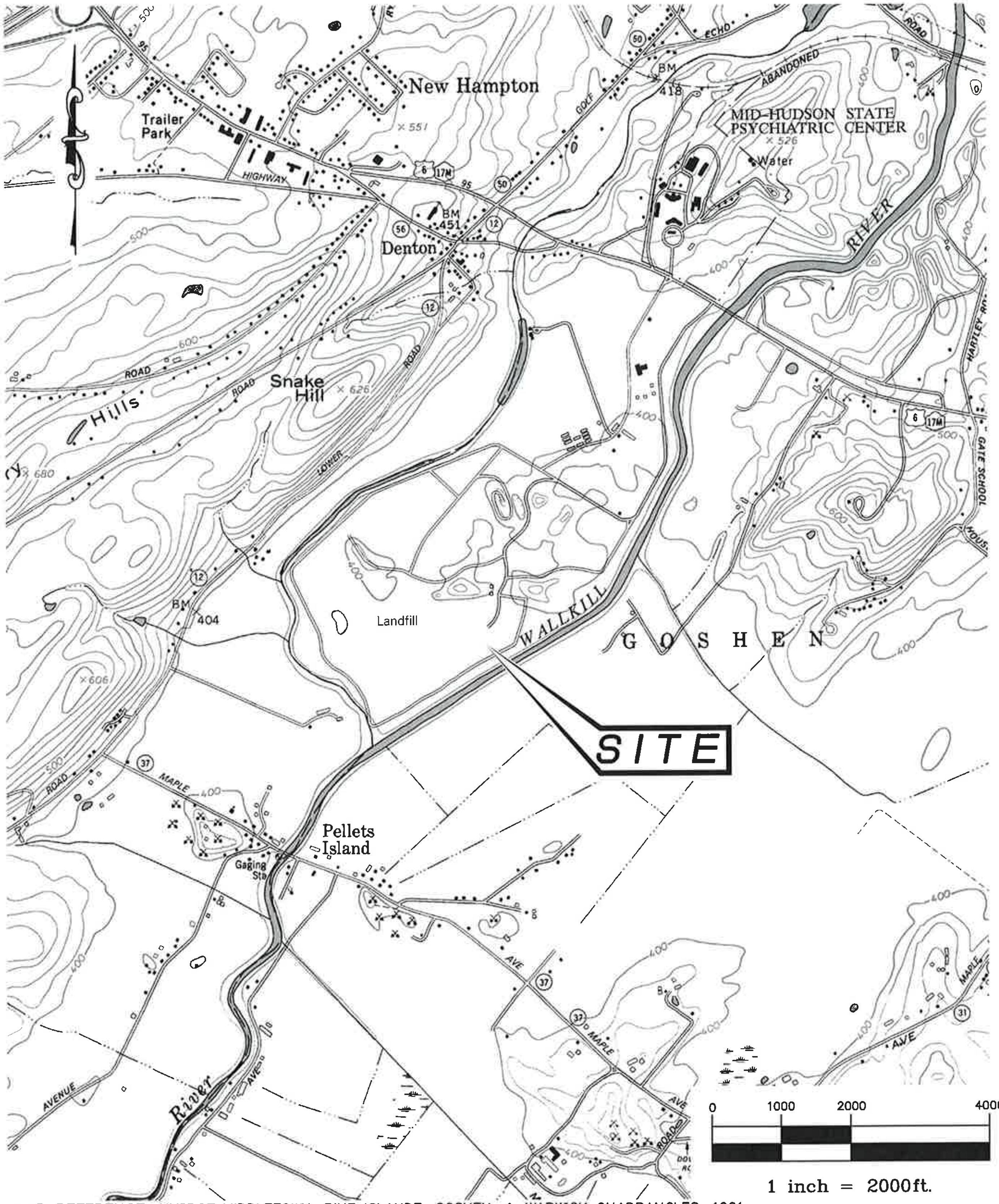
7.2.5 Storage Tank

The storage tank shall be inspected quarterly for signs of damage or leaks. Manually operated valves should be operated semi-annually. The discharge connection coupler shall be inspected for wear, damage or leaks during each transfer operation.

7.2.6 Treatment System

The treatment system operations will include influent and effluent monitoring for ammonia and iron. The monitoring program can be modified if additional Landfill parameters of concern are identified.

FIGURES



MAP REFERENCE: NYSDOT MIDDLETOWN, PINE ISLANDE, GOSHEN, & WARWICK QUADRANGLES, 1991.

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SITE LOCATION MAP

ORANGE CO. DEPT. OF PUBLIC WORKS

ORANGE COUNTY LANDFILL

TOWN OF GOSHEN — ORANGE CO., N.Y.

PROJ. No.: 2013-29	DATE: 10/31/14	SCALE: 1" = 2000'	DWG. NO. 2010-15026	FIGURE 1

LEGEND:

APPROXIMATE PROPERTY BOUNDARY

APPROXIMATE LIMIT OF WASTE

MAP REFERENCES:

1. PROPERTY BOUNDARY AND LIMIT OF WASTE FROM DRAWINGS ENTITLED "OVERALL PLAN AND RESTRICTED PARCEL," BY THOMAS J. BARRY, DATED FEBRUARY 14, 2013.
2. AERIAL PHOTOGRAPH FROM GOOGLE EARTH IMAGERY, DATED 2013.

0 1000 2000 4000

1 inch = 2000ft.

S:\Drawings\2010-15 - Orange County\2010-15027 SiteVicinity.dwg 10/31/2014 3:11 PM

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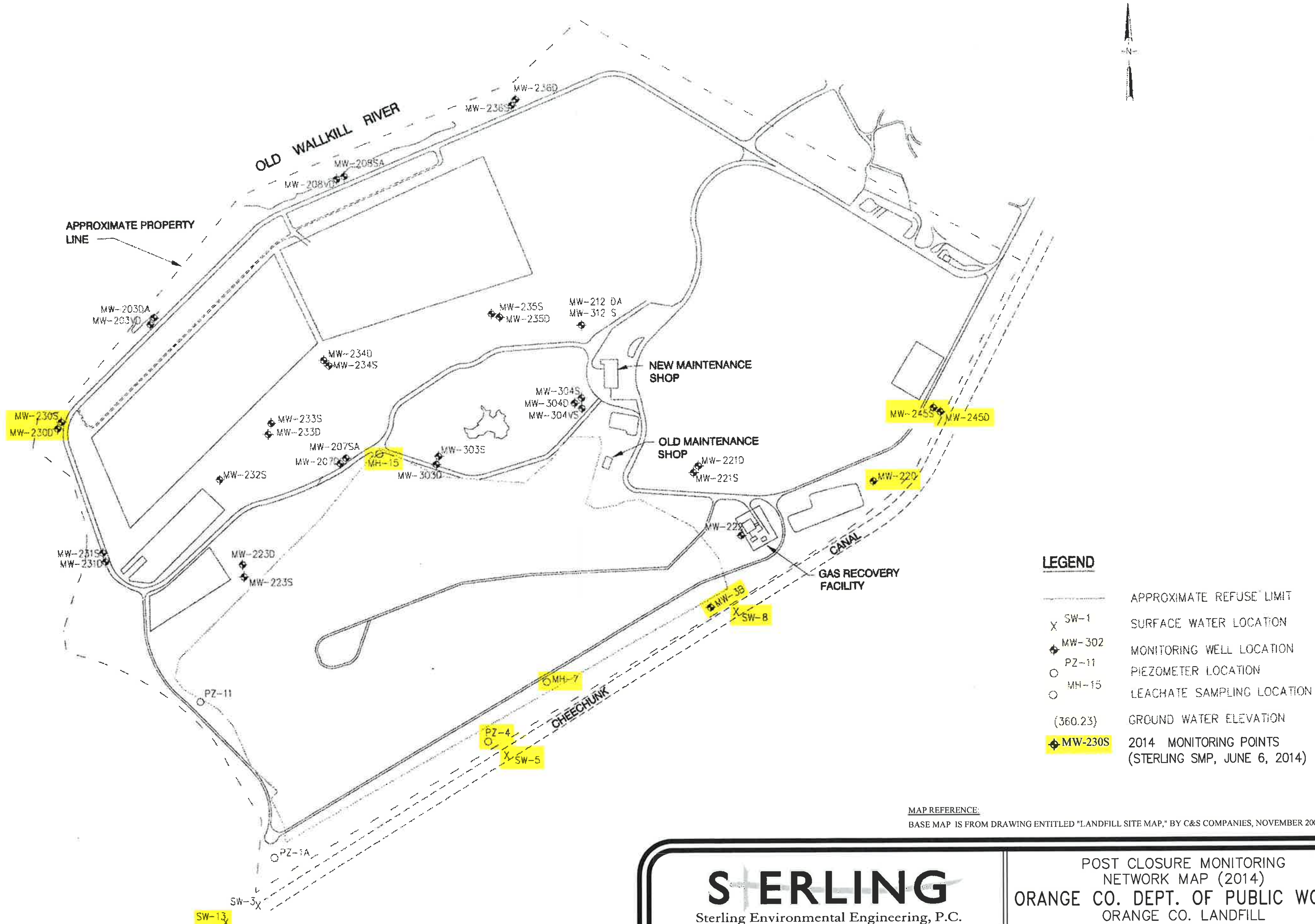
SITE VICINITY MAP
ORANGE CO. DEPT. OF PUBLIC WORKS
ORANGE COUNTY LANDFILL

TOWN OF GOSHEN ORANGE CO., N.Y.

PROJ. No.: 2010-15	DATE: 10/31/14	SCALE: 1" = 1000'	DWG. NO. 2010-15027	FIGURE 2



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POST CLOSURE MONITORING NETWORK MAP (2014)
ORANGE CO. DEPT. OF PUBLIC WORKS
ORANGE CO. LANDFILL

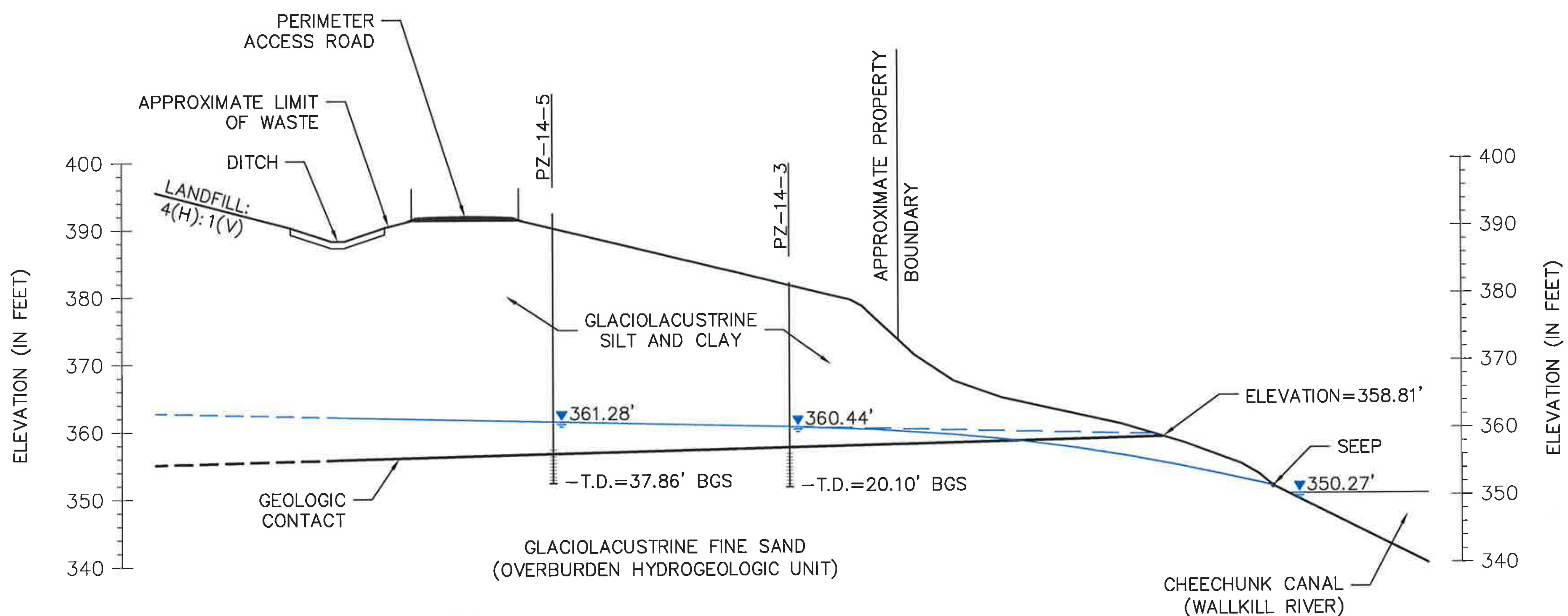
TOWN OF GOSHEN | ORANGE CO., N.Y.

PROJ. No.: 2010-15	DATE: 10/31/14	SCALE: 1" = 500'	DWG. NO. 2010-15028	FIGURE 3

S:\Drawings\2010-15 - Orange County\2010-15028 PostClosureMonitoringMap.dwg 10/31/2014 3:10 PM

GEOLOGIC CROSS SECTION A-A'

HORIZONTAL SCALE: 1"=20'
VERTICAL SCALE: 1"=20'



POTENTIOMETRIC SURFACE (OCTOBER 6, 2014)

LINE OF SECTION A-A'

SCALE: 1" =100'

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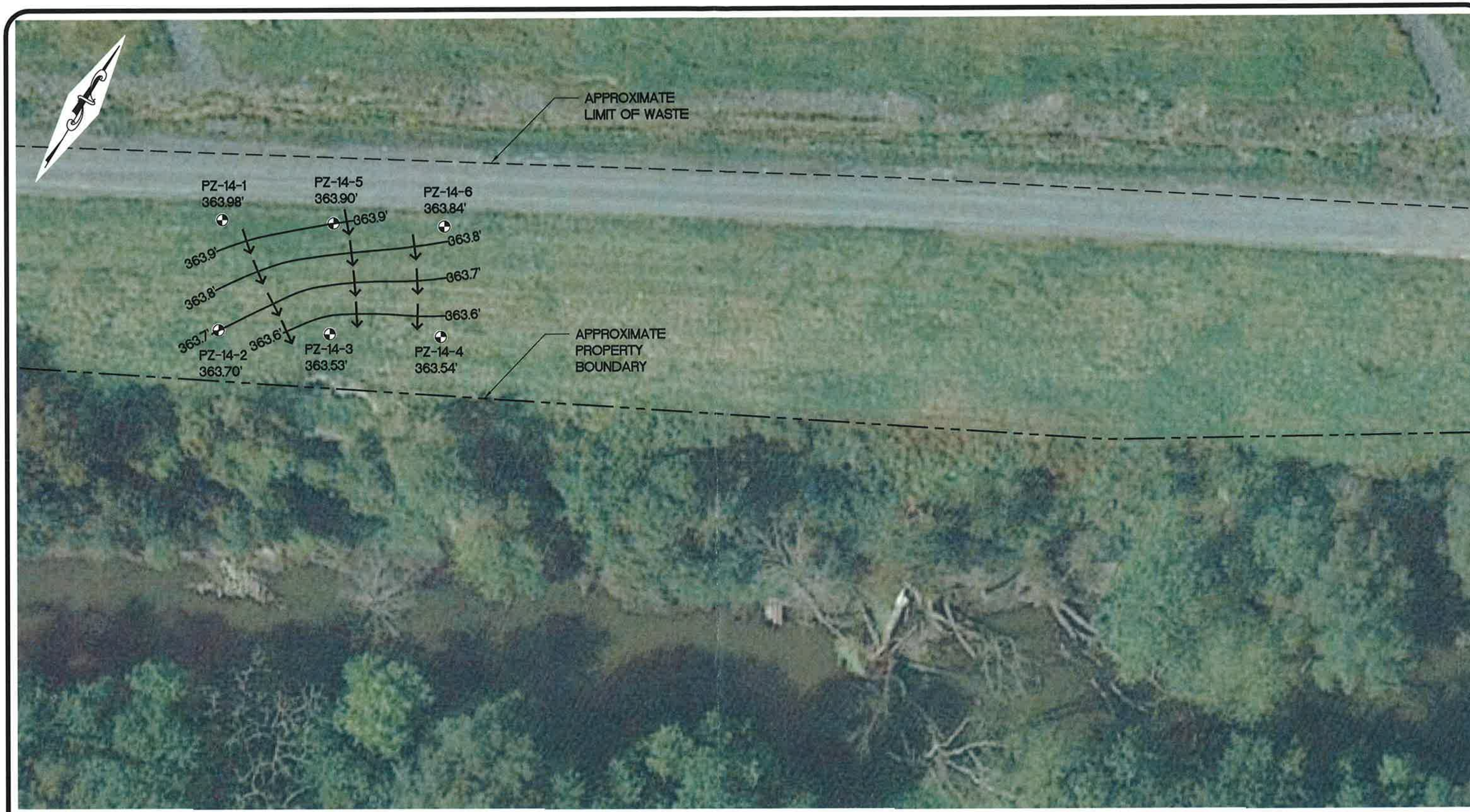
GEOLOGIC CROSS SECTION A-A'
ORANGE CO. DEPT. OF PUBLIC WORKS
ORANGE COUNTY LANDFILL

TOWN OF GOSHEN			ORANGE CO., N.Y.		
PROJ. No.: 2010-15	DATE: 10/31/14	SCALE: AS NOTED	DWG. NO. 2010-15029	FIGURE	4



LEGEND:

PZ-14-1 361.21'	PIEZOMETER LOCATION WITH GROUNDWATER ELEVATION
352'	GROUNDWATER ELEVATION CONTOURS
→ →	GROUNDWATER FLOW DIRECTION
— — — — —	LIMIT OF WASTE
—— - - ——	PROPERTY BOUNDARY

0 15 30 60

(IN FEET)
1 inch = 30 ft.

MAP REFERENCES:
1. PROPERTY BOUNDARY AND LIMIT OF WASTE FROM DRAWINGS ENTITLED "OVERALL PLAN AND RESTRICTED PARCEL," BY THOMAS J. BARRY, DATED FEBRUARY 14, 2013.
2. AERIAL PHOTOGRAPH FROM GOOGLE EARTH IMAGERY, DATED 2013.

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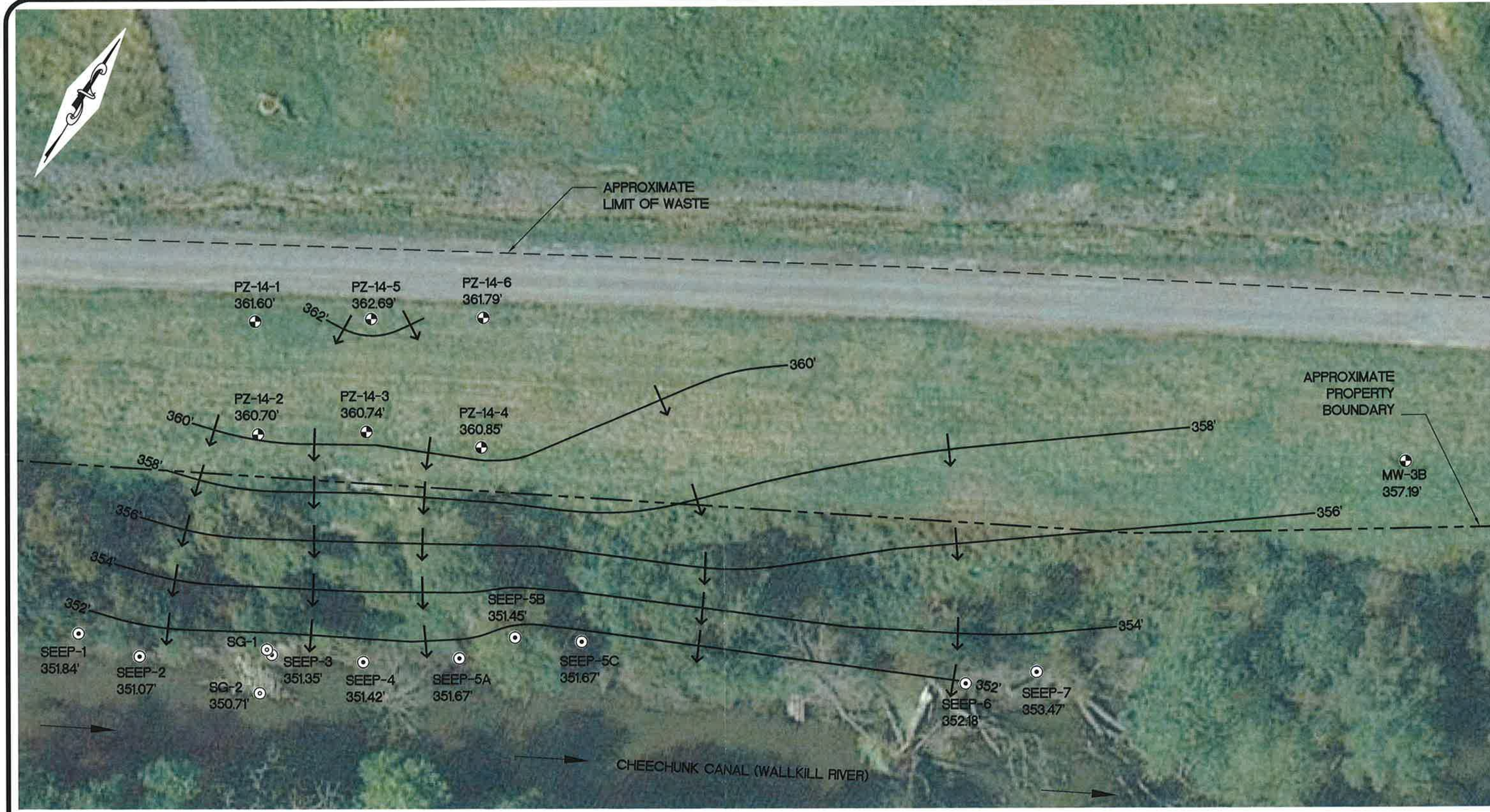
OVERBURDEN GROUNDWATER CONTOUR MAP
(MARCH 18, 2014)
ORANGE CO. DEPT. OF PUBLIC WORKS
ORANGE COUNTY LANDFILL
TOWN OF GOSHEN ORANGE CO., N.Y.

PROJ. No.: 2010-15	DATE: 10/31/14	SCALE: 1" = 30'	DWG. NO. 2010-15030A	FIGURE 5A

S:\Drawings\2010-15 - Orange County\2010-15030A GWContoursMap3-18-14.dwg10/31/2014 3:08 PM



LEGEND:

PZ-14-1 361.21'	PIEZOMETER LOCATION WITH GROUNDWATER ELEVATION
⊙	SEEP MONITORING POINT
SG-2 350.27'	STAFF GAUGE ELEVATION
352'	GROUNDWATER ELEVATION CONTOURS
→	GROUNDWATER FLOW DIRECTION
— — —	LIMIT OF WASTE
—— — — ——	PROPERTY BOUNDARY

0 15 30 60

(IN FEET)
1 inch = 30 ft.

MAP REFERENCES:
1. PROPERTY BOUNDARY AND LIMIT OF WASTE FROM DRAWINGS ENTITLED "OVERALL PLAN AND RESTRICTED PARCEL," BY THOMAS J. BARRY, DATED FEBRUARY 14, 2013.
2. AERIAL PHOTOGRAPH FROM GOOGLE EARTH IMAGERY, DATED 2013.

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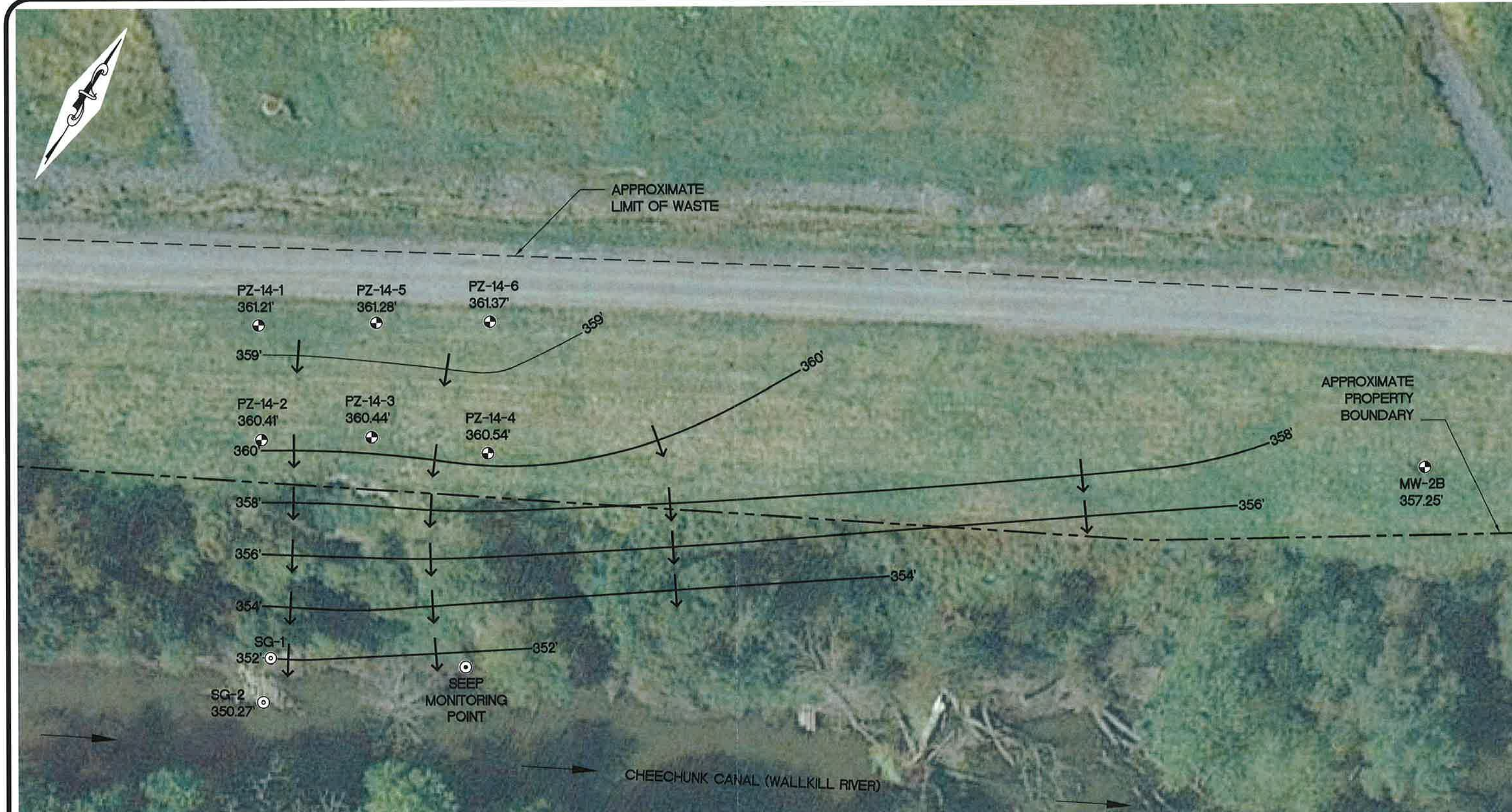
OVERBURDEN GROUNDWATER CONTOUR MAP
(SEPTEMBER 9, 2014)
ORANGE CO. DEPT. OF PUBLIC WORKS
ORANGE COUNTY LANDFILL
TOWN OF GOSHEN ORANGE CO., N.Y.

PROJ. No.: 2010-15	DATE: 10/31/14	SCALE: 1" = 30'	DWG. NO. 2010-15030B	FIGURE 5B



LEGEND:

PZ-14-1 361.21'	PIEZOMETER LOCATION WITH GROUNDWATER ELEVATION
⊙	SEEP MONITORING POINT
SG-2 350.27'	STAFF GAUGE ELEVATION
——352'	GROUNDWATER ELEVATION CONTOURS
→	GROUNDWATER FLOW DIRECTION
— — — —	LIMIT OF WASTE
—— - - ——	PROPERTY BOUNDARY

0 15 30 60

(IN FEET)
1 inch = 30 ft.

MAP REFERENCES:
1. PROPERTY BOUNDARY AND LIMIT OF WASTE FROM DRAWINGS ENTITLED "OVERALL PLAN AND RESTRICTED PARCEL," BY THOMAS J. BARRY, DATED FEBRUARY 14, 2013.
2. AERIAL PHOTOGRAPH FROM GOOGLE EARTH IMAGERY, DATED 2013.

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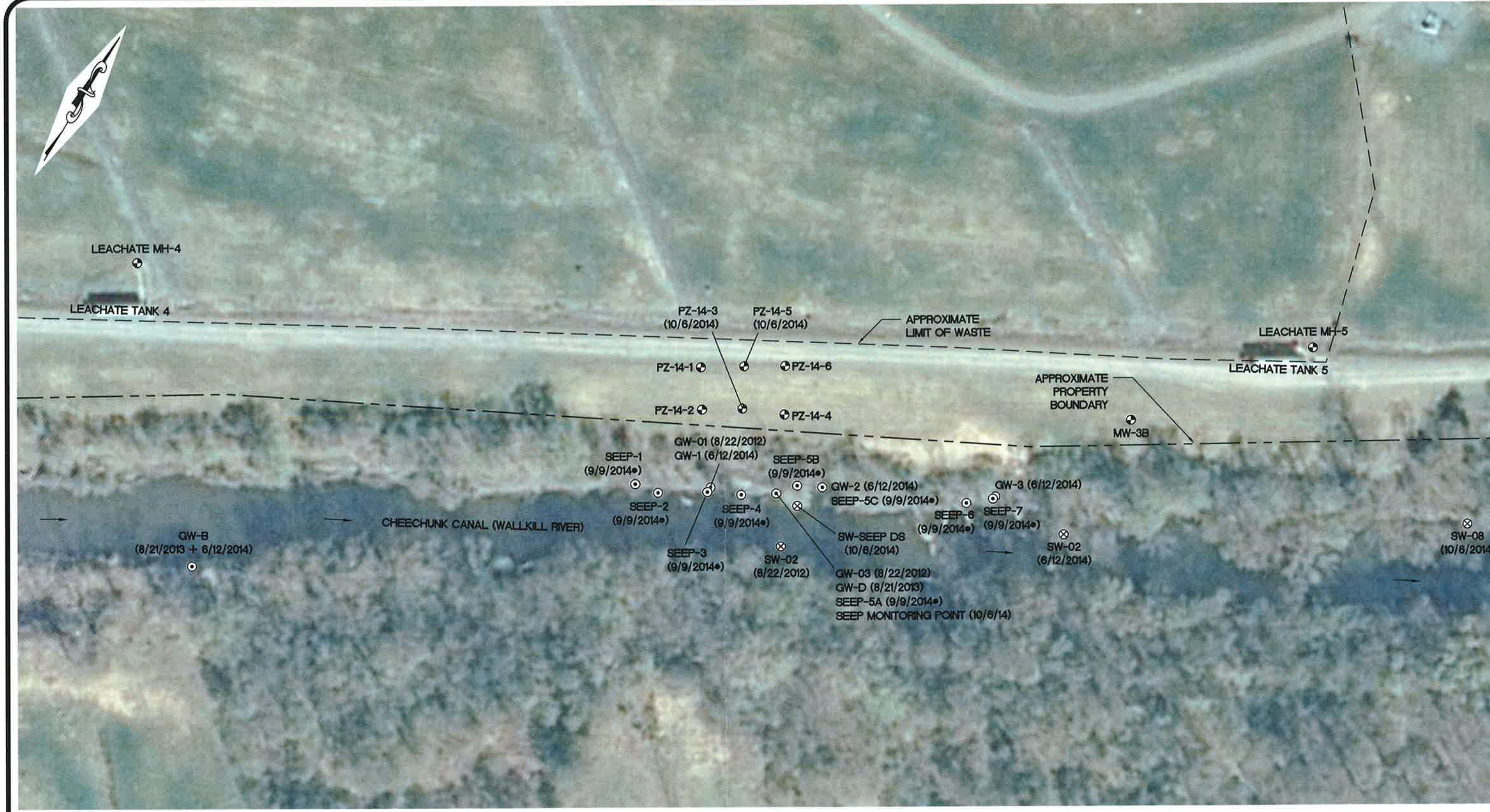
OVERBURDEN GROUNDWATER CONTOUR MAP
(OCTOBER 6, 2014)
ORANGE CO. DEPT. OF PUBLIC WORKS
ORANGE COUNTY LANDFILL
TOWN OF GOSHEN ORANGE CO., .N.Y.

PROJ. No.: 2010-15	DATE: 10/31/14	SCALE: 1" = 30'	DWG. NO. 2010-15030C	FIGURE 5C

S:\Drawings\2010-15 - Orange County\2010-15030C-GWContourMap_10-6-14 dwg10/31/2014 2:54 PM



LEGEND:

PZ-14-1 (6/12/14)	PIEZOMETER/MONITORING WELL LOCATION (DATE SAMPLE WAS TAKEN)
GW-01 (8/22/12) SEEP-1 (9/9/14•)	SEEP LOCATION (DATE SAMPLE WAS TAKEN) SEEP LOCATION (DATE OBSERVED)
SW-02 (8/22/12)	SURFACE WATER LOCATION (DATE SAMPLE WAS TAKEN)
— — — — —	LIMIT OF WASTE
—— — — ——	PROPERTY BOUNDARY

0 40 80 160

(IN FEET)
1 inch = 80 ft.

MAP REFERENCES:
1. PROPERTY BOUNDARY AND LIMIT OF WASTE FROM DRAWINGS ENTITLED "OVERALL PLAN AND RESTRICTED PARCEL," BY THOMAS J. BARRY, DATED FEBRUARY 14, 2013.
2. AERIAL PHOTOGRAPHY FROM NEW YORK STATWIDE DIGITAL ORTHOIMAGERY PROGRAM, PHOTOGRAPHY CIRCA 2013.

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SAMPLE & SEEP LOCATION MAP
ORANGE CO. DEPT. OF PUBLIC WORKS
ORANGE COUNTY LANDFILL

TOWN OF GOSHEN ORANGE CO., .N.Y.

PROJ. No.: 2010-15 | DATE: 10/31/14 | SCALE: 1" = 80' | DWG. NO. 2010-15031 | FIGURE 6

S:\Drawings\2010-15 - Orange County\2010-15031 SampleLocMap.dwg10/31/2014 2:53 PM

LEGEND:

MW-3B	GROUNDWATER AND LEACHATE SAMPLE LOCATIONS
⊙	SEEP MONITORING POINT
⊗ SW-5	SURFACE WATER SAMPLE LOCATION
— — — — —	LIMIT OF WASTE
—— – – ——	PROPERTY BOUNDARY

0 150 300 600

(IN FEET)
1 inch = 300 ft.

MAP REFERENCES:
1. PROPERTY BOUNDARY AND LIMIT OF WASTE FROM DRAWINGS ENTITLED "OVERALL PLAN AND RESTRICTED PARCEL," BY THOMAS J. BARRY, DATED FEBRUARY 14, 2013.
2. AERIAL PHOTOGRAPHY FROM NEW YORK STATWIDE DIGITAL ORTHOIMAGERY PROGRAM, PHOTOGRAPHY CIRCA 2013.

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OCTOBER 2014 SAMPLE LOCATION MAP
ORANGE CO. DEPT. OF PUBLIC WORKS
ORANGE COUNTY LANDFILL
TOWN OF GOSHEN ORANGE CO., N.Y.

PROJ. No.: 2010-15	DATE: 10/31/14	SCALE: 1"=300'	DWG. NO. 2010-15032	FIGURE 7

SURFACE WATER SAMPLE I.D.	ANALYTICAL RESULTS		
	AMMONIA	TDS	IRON
SW-01 (8/22/12)	0.049	300	**1.4**

All results expressed in mg/L

SEEP SAMPLE I.D.	ANALYTICAL RESULTS			
	AMMONIA	PHENOLS	TDS	IRON
GW-B (8/21/2013)	0.075	**0.0069 J**	430	**1.5**
GW-B (6/12/2014)	0.14	0.005 U	420	**8.0**

All results expressed in mg/L

SURFACE WATER SAMPLE I.D.	ANALYTICAL RESULTS		
	AMMONIA	TDS	IRON
SW-02 (8/22/12)	0.21	300	**1.4**

All results expressed in mg/L

SURFACE WATER SAMPLE I.D.	ANALYTICAL RESULTS		
	AMMONIA	TDS	IRON
SW-01 (6/12/14)	0.053	310	**0.81**

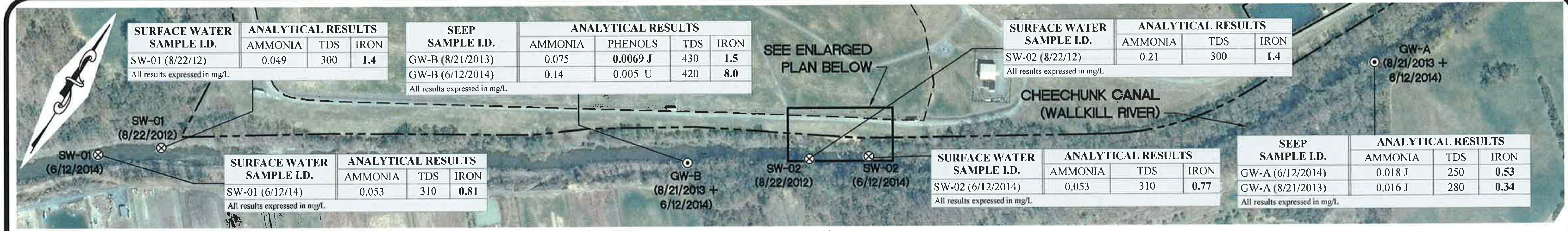
All results expressed in mg/L

SURFACE WATER SAMPLE I.D.	ANALYTICAL RESULTS		
	AMMONIA	TDS	IRON
SW-02 (6/12/2014)	0.053	310	**0.77**

All results expressed in mg/L

SEEP SAMPLE I.D.	ANALYTICAL RESULTS		
	AMMONIA	TDS	IRON
GW-A (6/12/2014)	0.018 J	250	**0.53**
GW-A (8/21/2013)	0.016 J	280	**0.34**

All results expressed in mg/L



SITE PLAN
SCALE: 1" = 400'

GROUNDWATER SAMPLE I.D.	ANALYTICAL RESULTS				
	AMMONIA	PHENOLS	ARSENIC	TDS	IRON
PZ-14-5 (10/6/2014)	**9.1 B**	0.005 U	**0.057**	**780**	**4.8 B**

All results expressed in mg/L

GROUNDWATER SAMPLE I.D.	ANALYTICAL RESULTS				
	AMMONIA	PHENOLS	ARSENIC	TDS	IRON
PZ-14-3 (10/6/2014)	**5.3**	**0.026**	**0.094**	**680**	**18 B**

All results expressed in mg/L

SEEP SAMPLE I.D.	ANALYTICAL RESULTS			
	AMMONIA	PHENOLS	TDS	IRON
GW-3 (6/12/2014)	**6.3**	0.005 U	**780**	**13**

All results expressed in mg/L

SEEP SAMPLE I.D.	ANALYTICAL RESULTS			
	AMMONIA	PHENOLS	TDS	IRON
GW-2 (6/12/2014)	**8.8**	0.005 U	**660**	**5.3**

All results expressed in mg/L

SEEP SAMPLE I.D.	ANALYTICAL RESULTS			
	AMMONIA	PHENOLS	TDS	IRON
GW-01 (8/22/2012)	**40**	**0.0054 J**	**680**	**6.5**
GW-1 (6/12/2014)	**18**	0.005 U	**690**	**11**

All results expressed in mg/L

SEEP SAMPLE I.D.	ANALYTICAL RESULTS			
	AMMONIA	PHENOLS	TDS	IRON
GW-03 (8/22/2012)	**13**	0.005 U	**780**	**3.2**
GW-D (8/21/2013)	**8**	**0.005 J H**	**830**	**12**
SEEP MONITORING POINT (10/6/2014)	**6.9**	0.01 U	**720**	**8.6**

All results expressed in mg/L

NOTE:
U = Not detected at or above laboratory method detection limit

ENLARGED SITE PLAN
SCALE: 1" = 40'

LEGEND:

- PZ-14-1 (6/12/14) — PIEZOMETER/MONITORING WELL LOCATION (DATE SAMPLE WAS TAKEN)
- GW-01 (8/22/12) — SEEP LOCATION (DATE SAMPLE WAS TAKEN)
- SW-01 (8/22/12) — SURFACE WATER LOCATION (DATE SAMPLE WAS TAKEN)
- — — — — — LIMIT OF WASTE
- ——— – – ——— PROPERTY BOUNDARY

0 20 40 80

(IN FEET)
1 inch = 40 ft.

MAP REFERENCES:
1. PROPERTY BOUNDARY AND LIMIT OF WASTE FROM DRAWINGS ENTITLED "OVERALL PLAN AND RESTRICTED PARCEL," BY THOMAS J. BARRY, DATED FEBRUARY 14, 2013.
2. AERIAL PHOTOGRAPHY FROM NEW YORK STATWIDE DIGITAL ORTHOIMAGERY PROGRAM, PHOTOGRAPHY CIRCA 2013.

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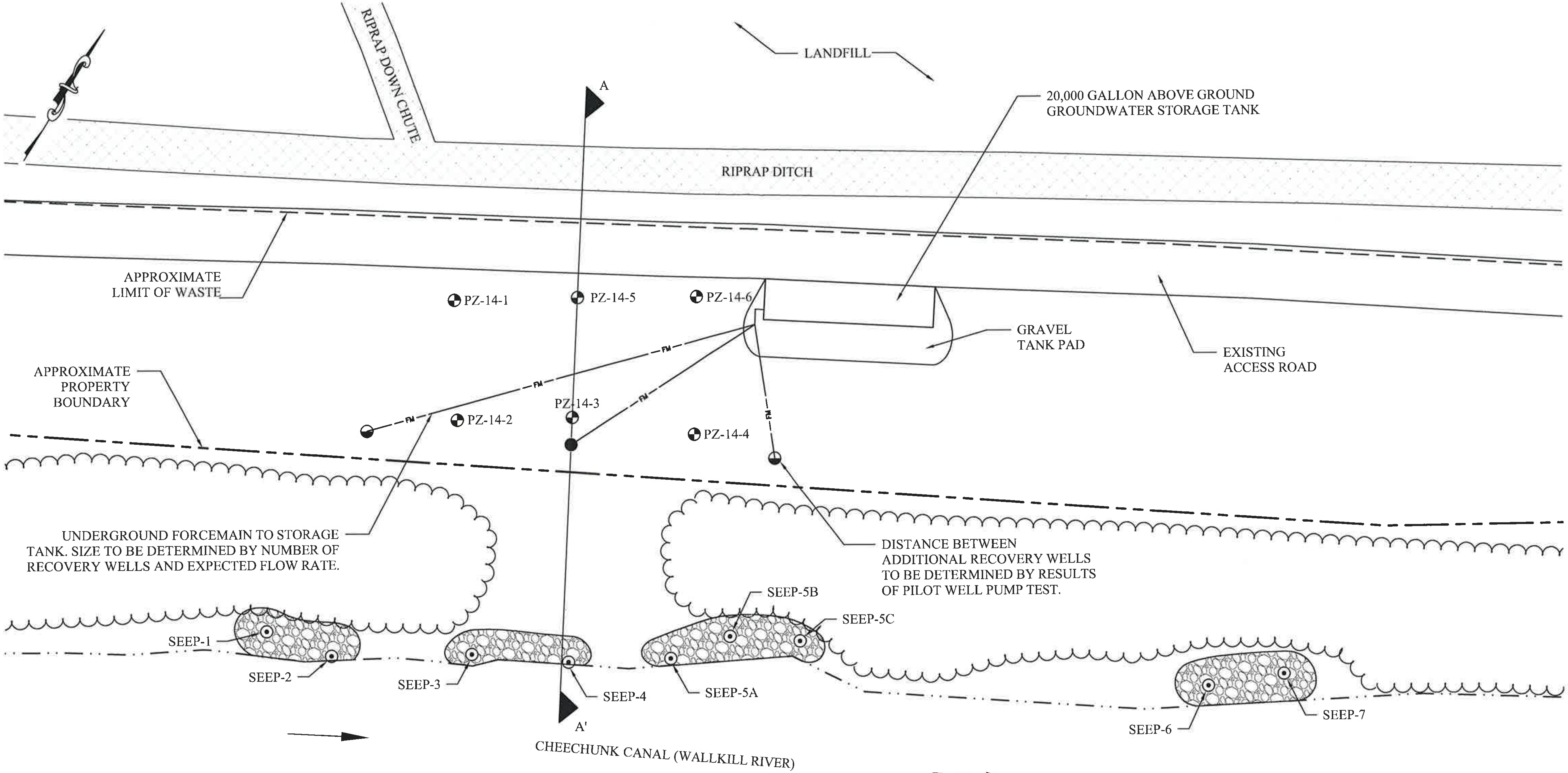
2012, 2013, & 2014 GROUNDWATER / SEEP / SURFACE WATER EXCEEDANCES MAP
ORANGE CO. DEPT. OF PUBLIC WORKS
ORANGE COUNTY LANDFILL
TOWN OF GOSHEN ORANGE CO., N.Y.

PROJ. No.: 2010-15	DATE: 10/31/14	SCALE: AS NOTED	DWG. NO. 2010-15033	FIGURE 8

S:\Drawings\2010-15 - Orange County\2010-15033 ExceedancesMap.dwg 10/31/2014 2:50 PM



LEGEND:

●	PROPOSED PILOT RECOVERY WELL
◒	ADDITIONAL RECOVERY WELLS (IF NECESSARY)
(riprap symbol)	PROPOSED CANAL BANK EROSION CONTROL RIPRAP ARMORING
PZ-14-1	EXISTING PIEZOMETER LOCATIONS
SEEP-1	SEEP/SURFACE WATER LOCATIONS
— — —	PROPERTY BOUNDARY
— — — —	LIMIT OF WASTE
— · · — · ·	EDGE OF STREAM
⌒⌒⌒	TREE LINE

0 15 30 60

(IN FEET)
1 inch = 30 ft.

MAP REFERENCES:
1. PROPERTY BOUNDARY AND LIMIT OF WASTE FROM DRAWINGS ENTITLED "OVERALL PLAN AND RESTRICTED PARCEL," BY THOMAS J. BARRY, DATED FEBRUARY 14, 2013.

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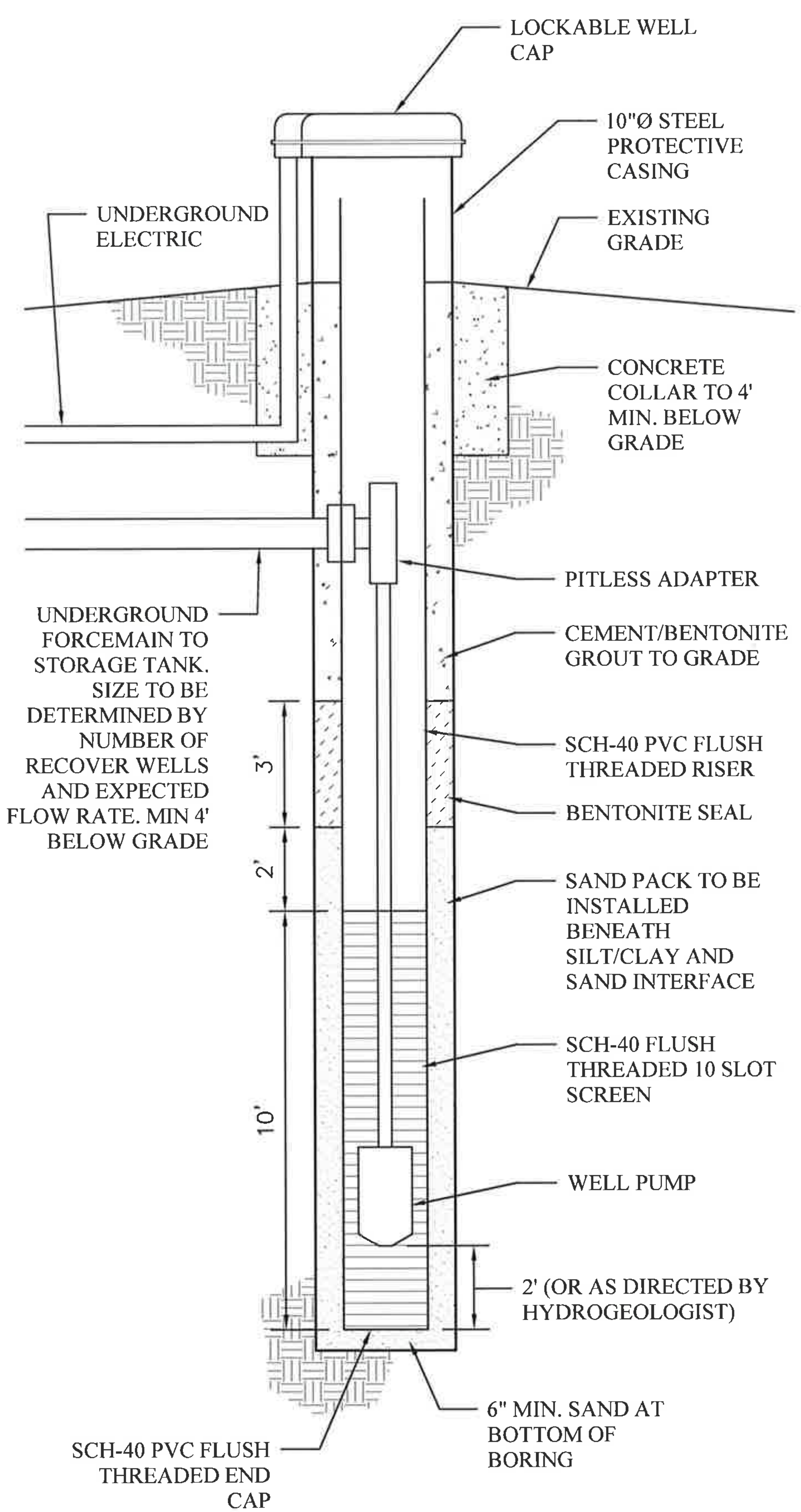
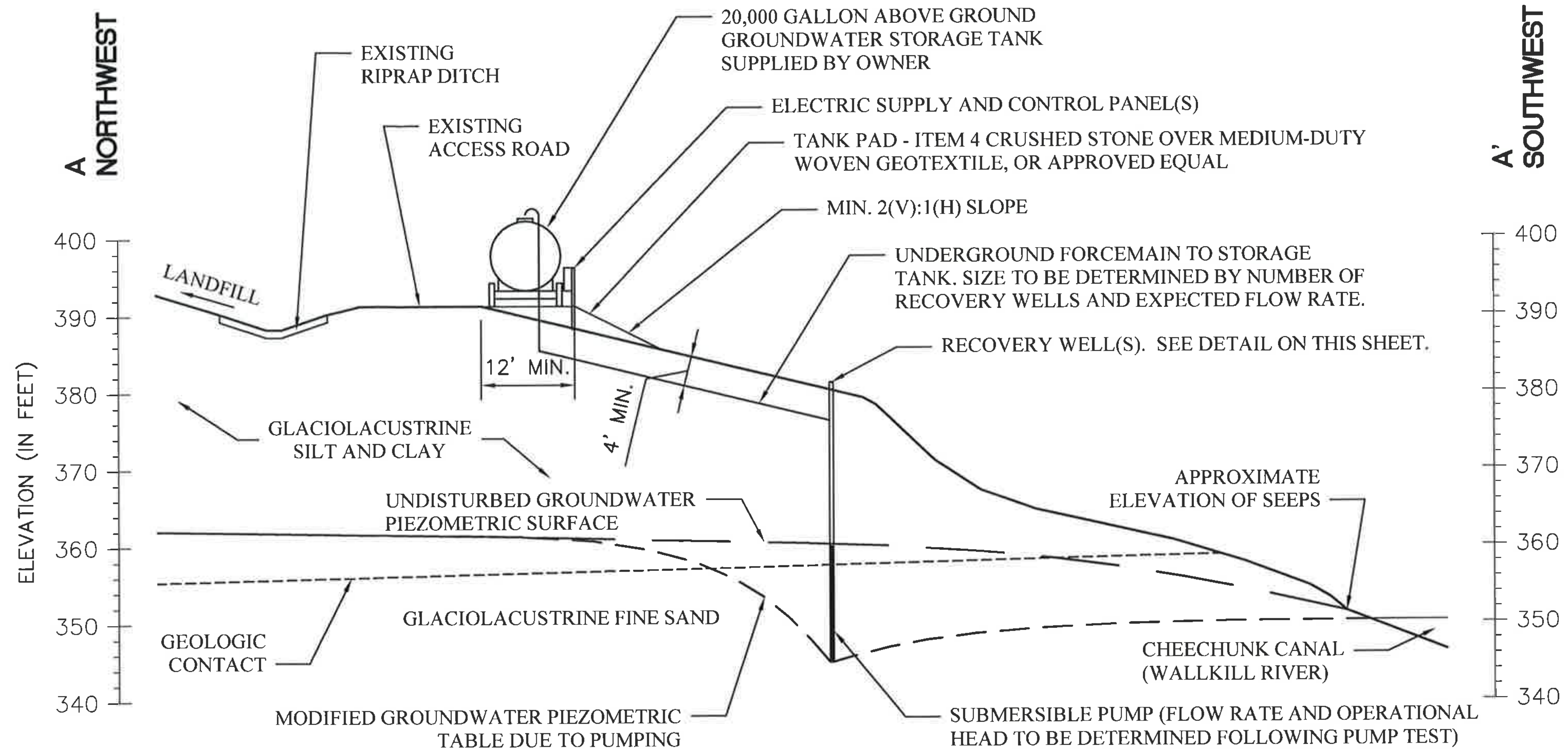
SEEP MITIGATION PLAN
ORANGE CO. DEPT. OF PUBLIC WORKS
ORANGE COUNTY LANDFILL
TOWN OF GOSHEN ORANGE CO., N.Y.

PROJ. No.: 2010-15	DATE: 10/31/14	SCALE: 1" = 30'	DWG. NO. 2010-15034	FIGURE 9

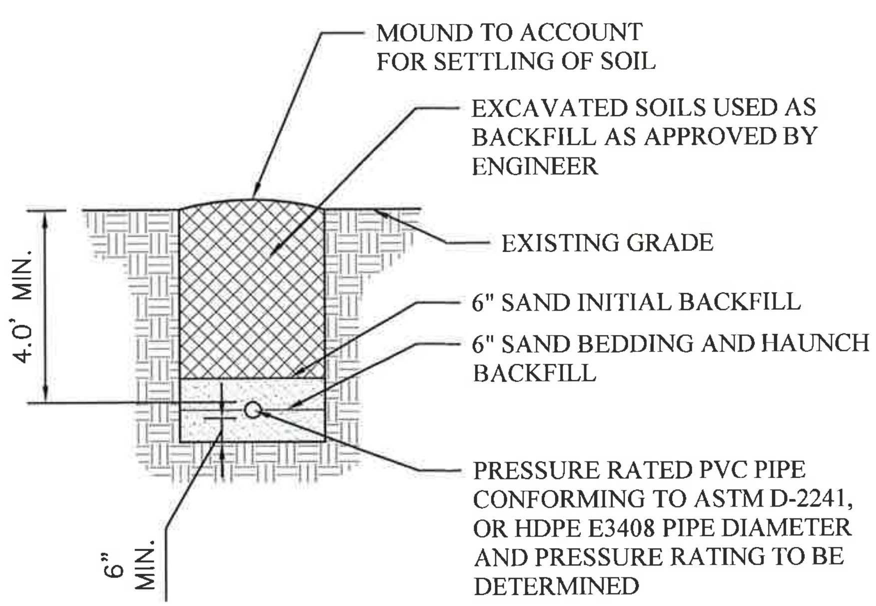
S:\Drawings\2010-15 - Orange County\2010-15034-35 SeepMitigationPlan.dwg10/31/2014 2:49 PM



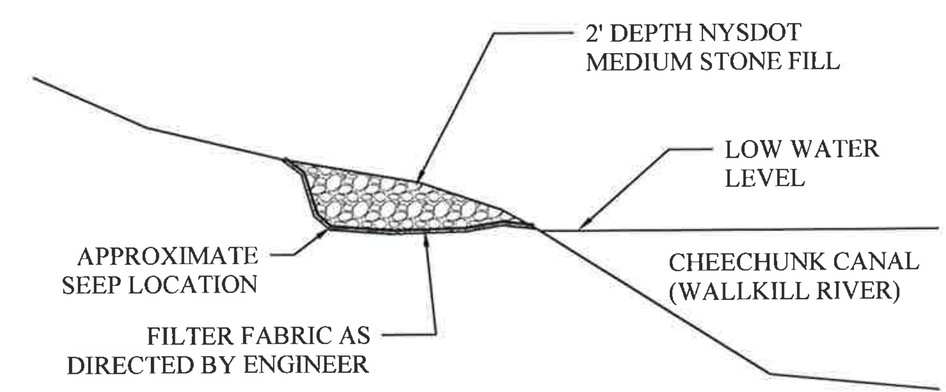
RECOVERY WELL DETAIL
NOT TO SCALE



CROSS SECTION A–A'
SCALE: 1" = 20'



FORCEMAIN TRENCH DETAIL
NOT TO SCALE



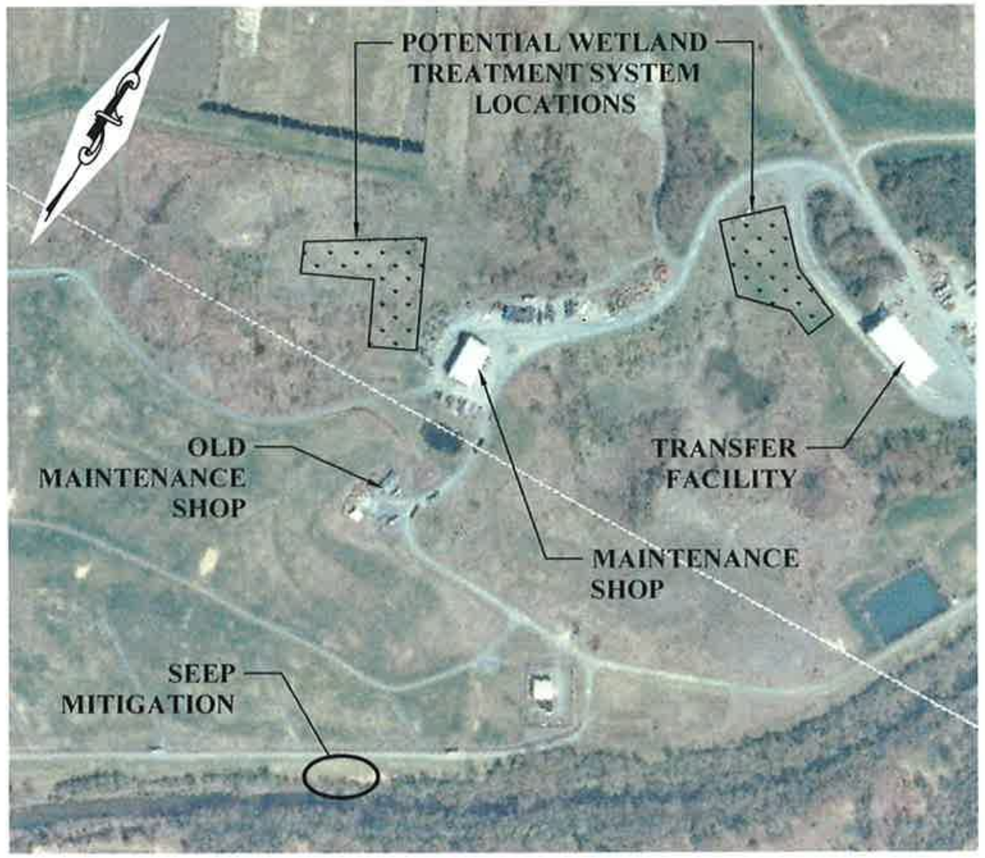
CANAL BANK EROSION CONTROL
NOT TO SCALE

STERLING
Sterling Environmental Engineering, P.C.
24 Wade Road • Latham, New York 12110

SEEP MITIGATION DETAILS
ORANGE CO. DEPT. OF PUBLIC WORKS
ORANGE COUNTY LANDFILL
TOWN OF GOSHEN — ORANGE CO., N.Y.

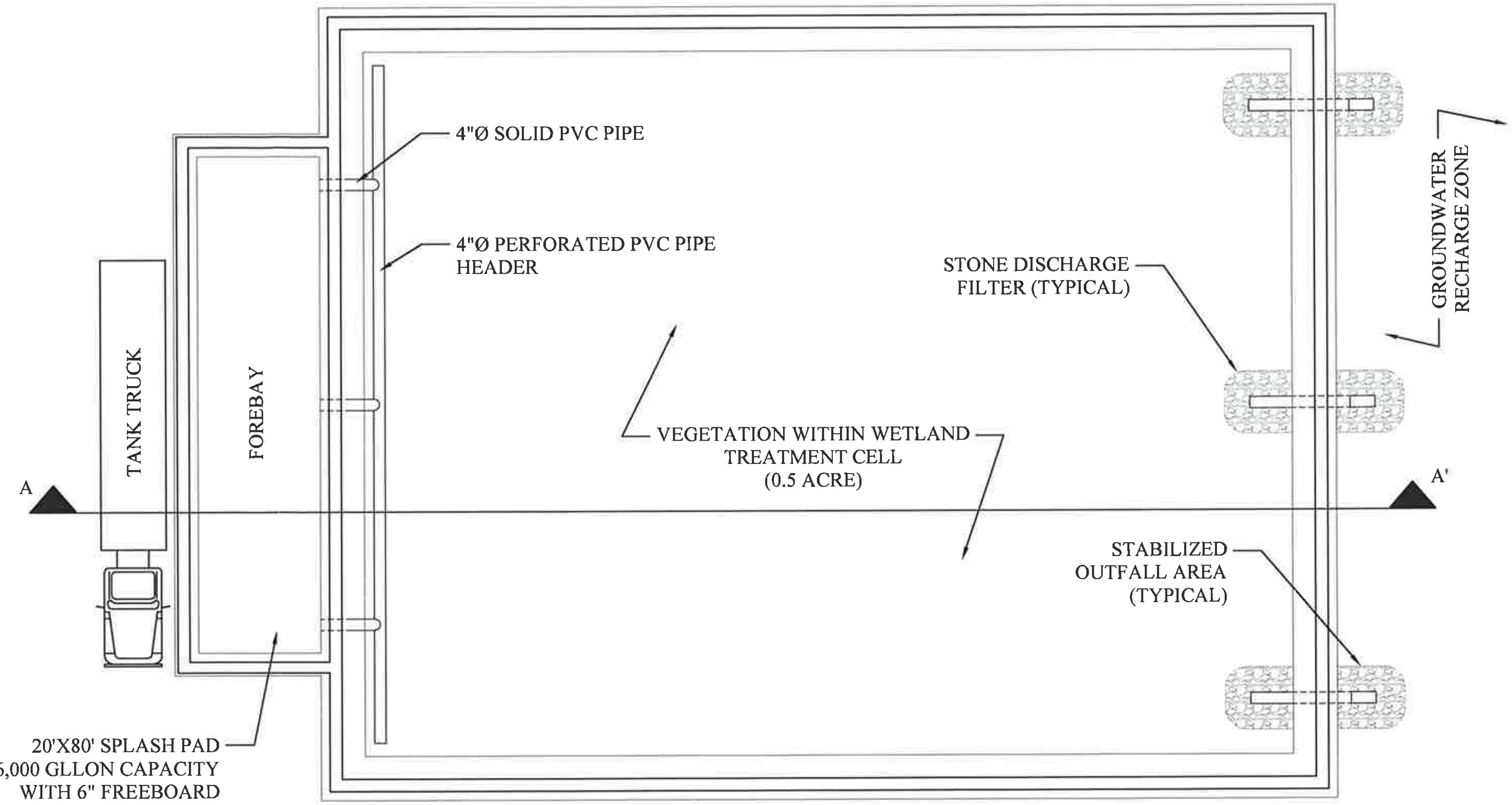
PROJ. No.: 2010–15	DATE: 10/31/14	SCALE: AS NOTED	DWG. NO. 2010–15035	FIGURE 10

S:\Drawings\2010-15 - Orange County\2010-15034-35 SeepMitigationPlan.dwg 10/31/2014 2:48 PM



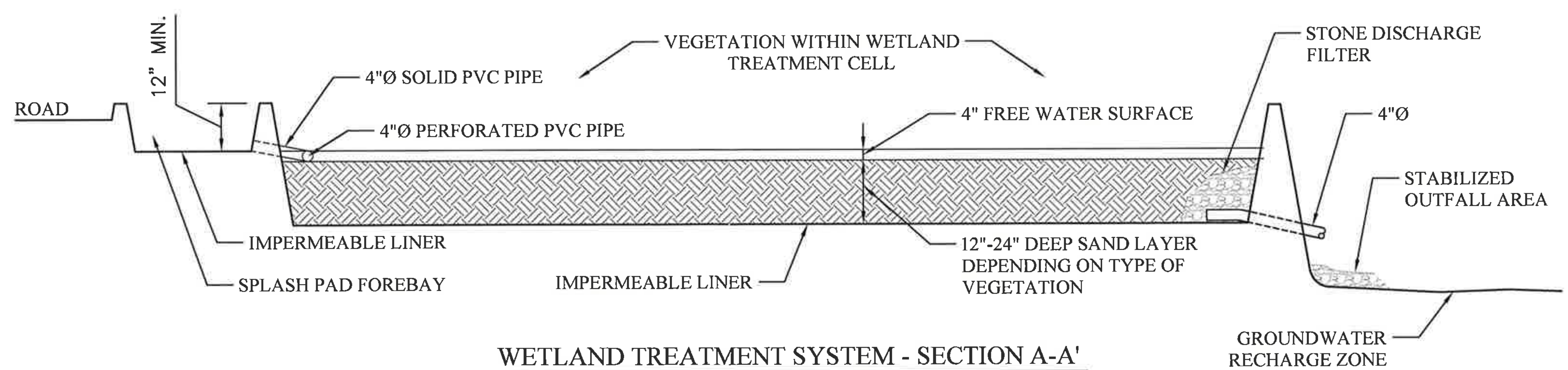
POTENTIAL WETLAND TREATMENT LOCATIONS

SCALE: 1" = 1000'



WETLAND TREATMENT SYSTEM - PLAN

NOT TO SCALE



WETLAND TREATMENT SYSTEM - SECTION A-A'

NOT TO SCALE

STERLING

Sterling Environmental Engineering, P.C.

24 Wade Road ♦ Latham, New York 12110

WETLAND TREATMENT SYSTEM

ORANGE CO. DEPT. OF PUBLIC WORKS

ORANGE COUNTY LANDFILL

TOWN OF GOSHEN | ORANGE CO., .N.Y.

PROJ. No.: 2010–15	DATE: 10/31/14	SCALE: NOT TO SCALE	DWG. NO. 2010–15036	FIGURE 11

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TABLES

Table 1

Summary of Site Stratigraphy
Orange County Landfill, Goshen, New York

Piezometer I.D.	Measuring Point (MP) Elevation (Site Datum)	Piezometer Stickup (feet)	Ground Surface Elevation (Site Datum)	Glaciolacustrine Silt and Clay/Glaciolacustrine Fine Sand Interface (feet BGS)/[Geologic Contact Elevation]	Screened Interval (feet BGS) / [Screened Elevation]	Total Depth (Feet BGS) / [Bottom Elevation]
PZ-14-1	390.27	0.65	389.62	34.1 / [355.52]	34.5-39.5 / [355.12 - 350.12]	39.50 / [350.12]
PZ-14-2	381.94	0.80	381.14	24.6 / [356.54]	24.5-29.5 / [356.64 - 351.64]	30.26 / [350.88]
PZ-14-3	381.83	0.35	381.48	24.4 / [357.43]	24.92 -29.92 / [356.56 - 351.56]	29.92 / [351.56]
PZ-14-4	381.77	1.35	380.42	23.9 / [356.52]	23.91-28.91 / [356.51 - 351.51]	28.91 / [351.51]
PZ-14-5	392.22	2.17	390.05	33.5/ [356.55]	32.9-37.9 / [357.15 - 352.15]	37.86 / [352.19]
PZ-14-6	391.11	0.88	390.23	33.85 / [356.38]	34.2-39.2 / [356.03 - 351.03]	39.20 / [351.03]

Table 2

Summary of Surveyed Elevations and Select Water Level Measurements
Orange County Landfill, Goshen, New York

Piezometer I.D.	Northing	Easting	Ground Surface Elevation (Site Datum)	Measuring Point (MP) Elevation (Site Datum)	February 20, 2014 Depth to Groundwater (feet BMP {Top of PVC}) / [Groundwater Elevation]	March 18, 2014 Depth to Groundwater (feet BMP {Top of PVC}) / [Groundwater Elevation]	September 9, 2014 Depth to Groundwater (feet BMP {Top of PVC}) / [Groundwater Elevation]	October 6, 2014 Depth to Groundwater (feet BMP {Top of PVC}) / [Groundwater Elevation]
PZ-14-1	N 41° 23' 19.50"	W 74° 24' 4.85"	389.62	390.27	27.69 / [362.58]	26.29 / [363.98]	28.67 / [361.60]	29.06 / [361.21]
PZ-14-2	N 41° 23' 19.21"	W 74° 24' 4.60"	381.14	381.94	20.21 / [361.73]	18.24 / [363.70]	21.24 / [360.70]	21.53 / [360.41]
PZ-14-3	N 41° 23' 19.39"	W 74° 24' 4.22"	381.48	381.83	20.10 / [361.73]	18.30 / [363.53]	21.09 / [360.74]	21.39 / [360.44]
PZ-14-4	N 41° 23' 19.54"	W 74° 24' 3.79"	380.42	381.77	19.88 / [361.89]	18.23 / [363.54]	20.92 / [360.85]	21.23 / [360.54]
PZ-14-5	N 41° 23' 19.70"	W 74° 24' 4.45"	390.05	392.22	29.58 / [362.64]	28.32 / [363.90]	29.53 / [362.69]	30.94 / [361.28]
PZ-14-6	N 41° 23' 19.88"	W 74° 24' 4.06"	390.23	391.11	28.61 / [362.50]	27.27 / [363.41]	29.32 / [361.79]	29.74 / [361.37]
SG-1	N 41° 23' 18.66"	W 74° 24' 4.11"	---	357.49				
SG-2	N 41° 23' 18.54"	W 74° 24' 4.04"	---	354.99			4.28 / [350.71]	4.72 / [350.27]

Notes:
Northing and Easting coordinates are in New York State Plane.

TABLE 3

Summary of Field Parameter Measurements (October 6, 2014)
Orange County Landfill, Goshen, New York

Parameter	Title 6 Part 703.5 Standards	Units	Groundwater Locations						Seep Location	Surface Water Locations				Leachate
			PZ-14-1[3]	PZ-14-2[3]	PZ-14-3	PZ-14-4[3]	PZ-14-5	PZ-14-6[3]	Seep Monitoring Point	SW-13 (Upstream)	SW-5 (Upstream)	SW-Seep DS	SW-8 (Dwonstream)	MH-5
Static Water Level [1]	---	feet	29.06	21.53	21.39	21.23	31.93	29.74	---	---	---	---	---	---
Specific Conductance	---	mS/cm^c	1.094 (1.113)	1.022 (0.698)	1.041 (0.859)	1.014 (0.607)	1.223 (1.230)	1.006 (1.001)	1.246	0.790	0.806	0.787	0.788	1.775
Temperature	---	°C	16.02 (13.56)	15.15 (12.68)	18.00 (12.96)	15.27 (12.36)	19.80 (14.15)	16.07 (13.66)	16.09	15.79	16.00	15.39	15.47	17.11
Turbidity		NTU	899	235	77.6	291	75.0	165	---	---	---	---	---	---
pH	6.5<pH< 8.5	S.U.	7.22 (7.00)	7.31 (7.41)	7.65 (7.03)	7.10 (7.21)	7.75 (7.03)	7.14 (7.12)	6.95	7.46	7.36	7.56	7.61	7.50
ORP	---	mV	-82.7 (-90.2)	-84.5 (3.10)	-40.4 (38.2)	-55.7 (47.5)	17.8 (214.8)	-64.9 (-15.9)	-58.8	516.9	-138.6	490.1	495.8	204.4
Dissolved Oxygen	> 3.0 [2]	mg/L	1.50 (1.76)	1.89 (2.77)	1.69 (1.19)	1.40 (1.44)	0.69 (1.29)	1.80 (1.72)	2.85	5.71	4.51	3.74	4.83	0.79

NOTES :
[1] Measured from the top of the PVC casing to water surface.
[2] Standard only applies to surface water samples.
[3] Only field measurements were taken at these locations, no sample.
Values in parentheses reflect field parameter measurements collected on March 18, 2014.
Values in **BOLD** indicate an exceedance of applicable water quality standard or guidance value.
--- No standard or not measured.

Table 4

Summary of Analytical Results (October 2014)
Orange County Landfill, Goshen, New York

Analyte and Method	Units	Groundwater Standard and Guidance Values[(A)]	Groundwater Samples		Surface Water Standard and Guidance Values[(B)]	Seep Sample Location		Surface Water Sample Locations				Leachate
			PZ-14-3	PZ14-5		Seep Monitoring Point	DUP-1	SW-13 (Upstream)	SW-5 (Upstream)	SW-Seep DS	SW-8 (Downstream)	MH-5
Volatile Organic Compounds												
1,1,1-Trichloroethane	µg/L	5.0	0.39 U	0.39 U	---	0.39 U	0.39 U	0.39 U	0.39 U	0.39 U	0.39 U	3.9 U
1,1,2,2-Tetrachloroethane	µg/L	5.0	0.26 U	0.26 U	---	0.26 U	0.26 U	0.26 U	0.26 U	0.26 U	0.26 U	2.6 U
1,1,2-Trichloroethane	µg/L	1.0	0.48 U	0.48 U	---	0.48 U	0.48 U	0.48 U	0.48 U	0.48 U	0.48 U	4.8 U
1,1-Dichloroethane	µg/L	5.0	0.59 U	0.59 U	---	0.59 U	0.59 U	0.59 U	0.59 U	0.59 U	0.59 U	5.9 U
1,1-Dichloroethene	µg/L	5.0	0.85 U	0.85 U	---	0.85 U	0.85 U	0.85 U	0.85 U	0.85 U	0.85 U	8.5 U
1,2-Dichlorobenzene	µg/L	3.0	0.44 U	0.44 U	5 [(2)]	0.44 U	0.44 U	0.44 U	0.44 U	0.44 U	0.44 U	4.4 U
1,2-Dichloroethane	µg/L	0.6[(1)]	0.60 U	0.60 U	---	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	6.0 U
1,2-Dichloropropane	µg/L	1.0	0.61 U	0.61 U	---	0.61 U	0.61 U	0.61 U	0.61 U	0.61 U	0.61 U	6.1 U
1,3-Dichlorobenzene	µg/L	3.0	0.54 U	0.54 U	5 [(2)]	0.54 U	0.54 U	0.54 U	0.54 U	0.54 U	0.54 U	5.4 U
1,4-Dichlorobenzene	µg/L	3.0	0.51 U	0.51 U	5 [(2)]	0.51 U	0.51 U	0.51 U	0.51 U	0.51 U	0.51 U	5.1 U
2-Chloroethyl vinyl ether	µg/L	---	1.9 U	1.9 U	---	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U	19 U
Benzene	µg/L	1.0	0.60 U	0.60 U	10	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	6.0 U
Bromodichloromethane	µg/L	50	0.54 U	0.54 U	---	0.54 U	0.54 U	0.54 U	0.54 U	0.54 U	0.54 U	5.4 U
Bromoform	µg/L	50	0.47 U	0.47 U	---	0.47 U	0.47 U	0.47 U	0.47 U	0.47 U	0.47 U	4.7 U
Bromomethane	µg/L	5.0	1.2 U	1.2 U	---	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U	12 U
Carbon tetrachloride	µg/L	5.0	0.51 U	0.51 U	---	0.51 U	0.51 U	0.51 U	0.51 U	0.51 U	0.51 U	5.1 U
Chlorobenzene	µg/L	5.0	0.48 U	0.48 U	5	0.48 U	0.48 U	0.48 U	0.48 U	0.48 U	0.48 U	4.8 U
Chloroethane	µg/L	5.0	0.87 U	0.87 U	---	0.87 U	0.87 U	0.87 U	0.87 U	0.87 U	0.87 U	20 J
Chloroform	µg/L	7.0	0.54 U	0.54 U	---	0.54 U	0.54 U	0.54 U	0.54 U	0.54 U	0.54 U	5.4 U
Chloromethane	µg/L	5.0	0.64 U	0.64 U	---	0.64 U	0.64 U	0.64 U	0.64 U	0.64 U	0.64 U	6.4 U
cis-1,2-Dichloroethene	µg/L	5.0	0.57 U	0.57 U	---	0.57 U	0.57 U	0.57 U	0.57 U	0.57 U	0.57 U	5.7 U
cis-1,3-Dichloropropene	µg/L	0.4	0.33 U	0.33 U	---	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	3.3 U
Dibromochloromethane	µg/L	50	0.41 U	0.41 U	---	0.41 U	0.41 U	0.41 U	0.41 U	0.41 U	0.41 U	4.1 U
Dichlorodifluoromethane	µg/L	5.0	0.28 U	0.28 U	---	0.28 U	0.28 U	0.28 U	0.28 U	0.28 U	0.28 U	2.8 U
Ethylbenzene	µg/L	5.0	0.46 U	0.46 U	17	0.46 U	0.46 U	0.46 U	0.46 U	0.46 U	0.46 U	4.6 U
Methylene Chloride	µg/L	5.0	0.81 U	0.81 U	200	0.81 U	0.81 U	0.81 U	0.81 U	0.81 U	0.81 U	8.1 U
m-Xylene & p-Xylene	µg/L	5.0 [(2)]	1.1 U	1.1 U	65 [(2)]	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	11 U
o-Xylene	µg/L	5.0	0.43 U	0.43 U	65 [(2)]	0.43 U	0.43 U	0.43 U	0.43 U	0.43 U	0.43 U	4.3 U
Tetrachloroethene	µg/L	5.0	0.34 U	0.34 U	1.0	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	3.4 U
Toluene	µg/L	5.0	0.45 U	0.45 U	6,000	0.45 U	0.45 U	0.45 U	0.45 U	0.45 U	0.45 U	4.5 U
trans-1,2-Dichloroethene	µg/L	5.0	0.59 U	0.59 U	---	0.59 U	0.59 U	0.59 U	0.59 U	0.59 U	0.59 U	5.9 U
trans-1,3-Dichloropropene	µg/L	0.4[(1)(2)]	0.44 U	0.44 U	---	0.44 U	0.44 U	0.44 U	0.44 U	0.44 U	0.44 U	4.4 U
Trichloroethene	µg/L	5.0	0.60 U	0.60 U	40	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	6.0 U
Trichlorofluoromethane	µg/L	5.0	0.45 U	0.45 U	---	0.45 U	0.45 U	0.45 U	0.45 U	0.45 U	0.45 U	4.5 U
Vinyl chloride	µg/L	2.0	0.75 U	0.75 U	---	0.75 U	0.75 U	0.75 U	0.75 U	0.75 U	0.75 U	7.5 U
Xylenes, Total	µg/L	5.0	1.1 U	1.1 U	65	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	11 U

Table 4

Summary of Analytical Results (October 2014)
Orange County Landfill, Goshen, New York

Analyte and Method	Units	Groundwater Standard and Guidance Values(A)	Groundwater Samples		Surface Water Standard and Guidance Values(B)	Seep Sample Location		Surface Water Sample Locations				Leachate
			PZ-14-3	PZ-14-5		Seep Monitoring Point	DUP-1	SW-13 (Upstream)	SW-5 (Upstream)	SW-Seep DS	SW-8 (Downstream)	MH-5
Leachate Indicator Parameters												
Alkalinity, Total	mg/L	---	570 B	600 B	---	590	620	210 B	230	230 B	220 B	1300 B
Ammonia	mg/L	2.0	**5.3**	**9.1 B**	(3)	**6.9**	**7.0**	0.009 U	0.009 U	0.058 B	0.014 JB	130 B
Biochemical Oxygen Demand	mg/L	---	2.0 U	7.1 b	---	6.1	5.2	2.0 H	2.0 U	2.0 Hb	2.0 U	16 b
Chemical Oxygen Demand	mg/L	---	23 B	32 B	---	21	15	6.4 JB^	21 B	23 B	21 B	250 B
Chloride	mg/L	250	61	79	---	81	84	100	100	100	100	520
Color	Color Units	15	5.0 U	5.0 U	---	**60**	**50**	25	25	25	25	40
Cyanide, Total	mg/L	0.2	0.005 U	**0.23**	0.0052	0.01 U	0.12	0.005 ^	0.005 ^	0.005 U	0.005 ^	0.0083 J
Hardness	mg/L	---	610	580	---	490	500	240	230	240	240	760
Nitrate as N	mg/L	10	0.69	0.090	---	0.02 U	0.02 U	2.1	2.1	2.1	2.1	0.24
Phenolics, Total Recoverable	mg/L	0.001(1)	0.005 U	**0.026**	0.001(1)	0.01 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.0075 J
Sulfate	mg/L	250	34	30	---	4.7	5.9	33	33	34	34	4.6
Total Dissolved Solids	mg/L	500	**680**	**780**	---	**720**	**740**	390	420	410	400	1000
Total Kjeldahl Nitrogen	mg/L	---	5.9	9.2	---	8.5 B	8.2 B	0.94	0.75	0.8	0.41	140
Total Organic Carbon	mg/L	---	3.2	8.9	---	4.4	4.4	4.1	4.1	4.1	4.1	57
Turbidity	NTU	5.0	**450**	**240**	---	**76**	**73**	28	29	23	22	440
Total Metals												
Aluminum, Total Recoverable	mg/L	---	6.3	0.73	---	0.19 J	0.06 U	0.54	0.4	0.16 J	0.47	0.16 J
Antimony, Total Recoverable	mg/L	0.003(1)	0.0068 U	0.0068 U	---	0.0068 U	0.0064 U	0.0068 U	0.0068 U	0.0068 U	0.0068 U	0.0068 U
Arsenic, Total Recoverable	mg/L	0.025	**0.094**	**0.057**	0.15(5)	0.11	0.12	0.0056 U	0.0056 U	0.0062 J	0.0098 J	0.031
Barium, Total Recoverable	mg/L	1.0	0.63	0.51	---	0.86	0.93	0.041	0.04	0.043	0.041	1.9
Beryllium, Total Recoverable	mg/L	0.003(1)	0.00047 J	0.0003 U	(4)	0.0003 U	0.0003 U	0.0003 U	0.0003 U	0.0003 U	0.0003 U	0.0003 U
Boron, Total Recoverable	mg/L	1.0	0.18	0.21	10	0.24	0.24	0.046	0.045	0.048	0.045	1.0
Cadmium, Total Recoverable	mg/L	0.005	0.0005 U	0.0005 U	(4)	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U
Calcium, Total Recoverable	mg/L	---	180	140	---	130	130	59	58	61	61	180
Chromium, Total Recoverable	mg/L	0.05	0.028	0.0076	(4)	0.0018 J	0.0017 J	0.0015 J	0.001 U	0.0015 J	0.001 J	0.0054
Chromium, hexavalent	mg/L	0.05	0.005 U	0.005 U	0.011(5)	0.005 U	0.005 H	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Copper, Total Recoverable	mg/L	0.2	0.091	0.0072 J	(4)	0.0026 J	0.0018 J	0.0054 J	0.0051 J	0.0052 J	0.005 J	0.0038 J
Iron, Total Recoverable	mg/L	0.3	**18 B**	**4.8 B**	0.3	**8.6**	**9.1**	**0.54 B**	**0.4 B**	0.22 B	**0.46 B**	47 B
Lead, Total Recoverable	mg/L	0.025	0.017	0.003 U	(4)	0.0032 J	0.003 U	0.003 U	0.003 U	0.003 U	0.0031 J	0.003 U
Magnesium, Total Recoverable	mg/L	35(1)	**56**	**54**	---	**63**	**63**	23	23	23	23	53
Manganese, Total Recoverable	mg/L	0.3	**2.0**	**1.0**	---	**0.76 B**	**0.76 B**	0.13	0.13	0.13	0.12	2.2
Mercury, Total Recoverable	mg/L	0.0007	0.00012 U	0.00012 U	0.7	0.00012 U	0.0001 U	0.00012 U	0.00012 U	0.00012 U	0.00012 U	0.00012 U
Nickel, Total Recoverable	mg/L	0.1	0.025	0.028	(4)	0.0094 J	0.0099 J	0.0016 J	0.0018 J	0.0018 J	0.002 J	0.028
Potassium, Total Recoverable	mg/L	---	9.3	9.8	---	16	16	3.8	3.7	3.7	3.8	67
Selenium, Total Recoverable	mg/L	0.01	0.0087 U	0.0087 U	---	0.0087 U	0.0087 U	0.0087 U	0.0087 U	0.0087 U	0.0087 U	0.0087 U
Silver, Total Recoverable	mg/L	0.05	0.0017 U	0.0017 U	---	0.0017 U	0.0017 U	0.0017 U	0.0017 U	0.0017 U	0.0017 U	0.0017 U
Sodium, Total Recoverable	mg/L	20	**60**	**87**	---	**64**	**66**	52	52	52	52	370
Thallium, Total Recoverable	mg/L	0.0005(1)	0.01 U	0.01 U	0.008(1)	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Zinc, Total Recoverable	mg/L	2.0(1)	0.087 B	0.026 B	(4)	0.0094 JB	0.0071 JB	0.0071 JB	0.023 B	0.041 B	0.012 B	0.014 B

Table 4

Summary of Analytical Results (October 2014)
Orange County Landfill, Goshen, New York

Analyte and Method	Units	Groundwater Standard and Guidance Values[A]	Groundwater Samples		Surface Water Standard and Guidance Values[B]	Seep Sample Location		Surface Water Sample Locations				Leachate
			PZ-14-3	PZ-14-5		Seep Monitoring Point	DUP-1	SW-13 (Upstream)	SW-5 (Upstream)	SW-Seep DS	SW-8 (Downstream)	MH-5
Dissolved Metals												
Aluminum, Dissolved	mg/L	---	8.7	2.7	---	---	---	---	---	---	---	---
Antimony, Dissolved	mg/L	---	0.0068 U	0.0068 U	---	---	---	---	---	---	---	---
Arsenic, Dissolved	mg/L	---	0.092	0.055	---	---	---	---	---	---	---	---
Barium, Dissolved	mg/L	---	0.59	0.47	---	---	---	---	---	---	---	---
Beryllium, Dissolved	mg/L	---	0.00048 J	0.0003 U	---	---	---	---	---	---	---	---
Boron, Dissolved	mg/L	---	0.17 B	0.20 B	---	---	---	---	---	---	---	---
Cadmium, Dissolved	mg/L	---	0.0005 U	0.0005 U	---	---	---	---	---	---	---	---
Calcium, Dissolved	mg/L	---	150	130	---	---	---	---	---	---	---	---
Chromium, Dissolved	mg/L	---	0.032	0.016	---	---	---	---	---	---	---	---
Copper, Dissolved	mg/L	---	0.083 B	0.011 B	---	---	---	---	---	---	---	---
Iron, Dissolved	mg/L	---	22	7.7	---	---	---	---	---	---	---	---
Lead, Dissolved	mg/L	---	0.015	0.0051 J	---	---	---	---	---	---	---	---
Magnesium, Dissolved	mg/L	---	54	52	---	---	---	---	---	---	---	---
Manganese, Dissolved	mg/L	---	1.7	1.1	---	---	---	---	---	---	---	---
Mercury, Dissolved	mg/L	---	0.00012 U	0.00012 U	---	---	---	---	---	---	---	---
Nickel, Dissolved	mg/L	---	0.030	0.032	---	---	---	---	---	---	---	---
Potassium, Dissolved	mg/L	---	9.1	9.7	---	---	---	---	---	---	---	---
Selenium, Dissolved	mg/L	---	0.0087 U	0.0087 U	---	---	---	---	---	---	---	---
Silver, Dissolved	mg/L	---	0.0017 U	0.0017 U	---	---	---	---	---	---	---	---
Sodium, Dissolved	mg/L	---	58	85	---	---	---	---	---	---	---	---
Thallium, Dissolved	mg/L	---	0.010 U	0.01 U	---	---	---	---	---	---	---	---
Zinc, Dissolved	mg/L	---	0.087 B	0.036 B	---	---	---	---	---	---	---	---

Values in **BOLD** indicate exceedance of applicable groundwater and surface water quality standard.

--- = Not analyzed or no applicable standard.

(A) = T.O.G.S. 1.1.1 Ambient Water Quality Standards for Class GA Groundwater

(B) = T.O.G.S. 1.1.1 Ambient Water Quality Standards for Class C Surface Water

(1) = Laboratory Method Detection Limit is greater than or equal to the applicable water quality standard.

(2) = Applies to the sum of 1,2-1,3-1,4-Dichlorobenzene, or Applies to each individual isomer, or applies to the sum of m-, o-, and p-xylenes, or applies to the sum of cis-trans 1,3-Dichloropropene.

(3) = Surface water standard for ammonia (mg/L) is interpolated using the temperatures and pH of the individual samples. SW-13 = 2.18; SW-5 = 2.19; SW SEEP DS = 2.14; and SW-8 = 2.10

(4) = Surface Water Standard for Berylium, Cadmium, Chromium, Copper, Lead, Nickel, and Zinc are based on the individual sample's hardness.

Berylium (mg/L): SW-13 = 1.1; SW-5 = 1.1; SW SEEP DS = 1.1; and SW-8 = 1.1
Cadmium (mg/L): SW-13 = 0.01; SW-5 = 0.01; SW SEEP DS = 0.01; and SW-8 = 0.01
Chromium: (mg/L): SW-13 = 1.17; SW-5 = 1.13; SW SEEP DS = 1.17; and SW-8 = 1.7
Copper (mg/L): SW-13 = 0.03; SW-5 = 0.03; SW SEEP DS = 0.03; and SW-8 = 0.03
Lead (mg/L): SW-13 = 0.25; SW-5 = 0.24; SW SEEP DS = 0.25; and SW-8 = 0.25
Nickel (mg/L): SW-13 = 0.98; SW-5 = 0.95; SW SEEP DS = 0.98; and SW-8 = 0.98
Zinc (mg/L): SW-13 = 0.25; SW-5 = 0.24; SW SEEP DS = 0.25; and SW-8 = 0.25

(5) = Standard applies to the dissolved form, not total recoverable.

U = Compound is not detected at or above laboratory method detection limit.

J = Result is less than the laboratory reporting limit but greater than or equal to the method detection limit and the concentration is an approximate value.

B = Compound was found in the blank and the sample.

b = Result detected in the unseeded control blank (USB).

H = Sample was prepped or analyzed beyond specified holding time.

^ = Instrument related QC exceeds the control limits.

DUP-1 was collected at the Seep Monitoring Point location.

Table 5

Summary of Historical Analytical Results - Seeps (2012 - 2014)
Orange County Landfill, Goshen, New York

Analyte	Units	Surface Water Standard and Guidance Values[A]	GW-B (South Side of Canal)		GW-01/GW-1 (North Side of Canal)		Seep Monitoring Point (North Side of Canal)				GW-3 (North Side of Canal)	GW-A (South Side of Canal)	
			8/21/2013	6/12/2014	8/22/2012	6/12/2014	8/22/2012 (GW-03)	8/21/2013 (GW-D)	6/12/2014 (GW-2)	10/6/2014	6/12/2014	8/21/2013	6/12/2014
Field Measurements													
Temperature	°C	---	21.75	16.83	20.77	13.81	23.88	19.01	14.47	16.09	15.66	20.57	15.12
Dissolved Oxygen	mg/L	< 4	---	8.1	9.3	**1.98**	8.17	6.54	**2.39**	**2.85**	9.18	5.68	9.08
Oxidation Reduction Potential	mV	---	-7.0	232	-90.6	-15.0	-77	-55	14.1	-58.8	31	9.6	252.3
pH	S.U.	6.5-8.5	7.46	7.7	7.03	6.85	---	7.15	6.83	6.95	6.77	7.48	6.92
Specific Conductivity	mS/cm[c]	---	0.426	0.438	0.7772	1.265	0.695	1.339	1.162	1.246	1.247	0.420	0.426
Water Quality Parameters													
Alkalinity	mg/L	---	130 B	260	640	560	850	640	610	590	630	170 B	130
Ammonia	mg/L	(2)	0.075	0.14	**40**	**18**	**13**	**8.0**	**8.8**	**6.9**	**6.3**	0.018 J	0.016 J
Biochemical Oxygen Demand	mg/L	---	2.0 b	2.2 b	2.0 U	2.0 U	5.8 b	13	2.0 U	6.1	14 b	2.0 U	<2.0
Bromide	mg/L	---	0.073 U^	---	0.65	---	0.75	1.0 ^	---	---	---	0.073	---
Chemical Oxygen Demand	mg/L	---	210	110	21	31	22	18 B	5.0 U	21	21	18	24
Chloride	mg/L	---	3.0	0.82	82	73	63	73	58	81	54	23	44
Color	Color Units	---	400	140	150	25	35	100	15	60	5.0	50	60
Cyanide	mg/L	0.0052	0.012 B	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	**0.0053 J**	0.01 U	0.005 U	0.005 U	0.005 U
Nitrate	mg/L	---	0.28	0.31	0.011 U	0.076	0.26	0.075 U	0.57	0.02 U	0.02 U	0.33	0.45
Phenols	mg/L	0.001[1]	**0.0069 J**	0.005 U	**0.0054 J**	0.005 U	0.005 U	**0.005 JH**	0.005 U	0.01 U	0.005 U	0.005 U	0.005 U
Sulfate	mg/L	---	86	23	19	4.7	7.7	10	11	4.7	67	27	17
Total Dissolved Solids	mg/L	500	430	420	**680**	**690**	**780**	**830**	**660**	**720**	**780**	250	280
Total Hardness	mg/L	---	240	250	530	490	540	760	500	490	600	180	160
Total Kjeldahl Nitrogen	mg/L	---	4.1 B	2.7	38	16	12	8.2	8.6	8.5 B	6.8	0.50	0.41
Total Organic Carbon	mg/L	---	67	46	6.1	6.0	6.0	5.5 b	5.9	4.4	5.5	5.6	6.9
Turbidity	NTU	---	7.6	160	66	320	1.0 U	7100	120	76	150	7.6	12
Metal Parameters													
Aluminum	mg/L	---	0.67	6.3	0.22	0.60	0.80	4.4	1.4	0.19 J	0.21	0.23	0.37
Antimony	mg/L	---	0.0068 U	0.0068 U	0.0068 U	0.0068 U	0.0068 U	0.0068 U	0.0068 U	0.0068 U	0.0068 U	0.0068 U	0.0068 U
Arsenic	mg/L	0.15[3]	0.0056 U	0.0058 J	0.094	0.12	0.048	0.11	0.086	0.11	0.029	0.0056 U	0.0056 U
Barium	mg/L	---	0.032	0.074	0.44	1.2	0.33	0.90	0.38	0.86	0.49	0.022	0.021
Berylium	mg/L	1.1	0.0003 U	0.00045 J	0.0003 U	0.0003 U	0.0003 U	0.0003 U	0.0003 U	0.0003 U	0.0003 U	0.0003 U	0.0003
Boron	mg/L	10	0.080	0.027 B	0.37 B	0.27 B	0.23 B	0.25	0.17 B	0.24	0.17 B	0.092	0.023 B
Cadmium	mg/L	*	0.0005 U	0.0005 U	0.0005 U	0.00094 J	0.0005 U	0.0014	0.00062 J	0.0005 U	0.0005 U	0.0005 U	0.0005
Calcium	mg/L	---	72	76	100	92	130	140	120	130	150	56	49
Chromium	mg/L	*	0.0018 J	0.0078	0.001 U	0.0010 U	0.0011 J	0.0058	0.0020 J	0.0018 J	0.0010	0.001 U	0.001 U
Chromium, Hexavalent	mg/L	0.011	0.005 UH	0.005 U	0.005 U	0.005 U	0.005 U	0.0079 JH	0.005 U	0.005 U	0.005 U	0.0087 JH	0.005 U
Cobalt	mg/L	0.005	**0.0065**	0.0014 J	0.00063 U	0.00063 J	0.0034 J	**0.0051**	0.0019 J	---	0.0024 J	0.00063 U	0.00063 U
Copper	mg/L	*	**0.04**	0.012	0.0016 U	0.0016 U	0.0038 J	0.013	0.0027 J	0.0026 J	0.0016 U	0.0044 J	0.0016 U
Iron	mg/L	0.3	**1.5**	**8.0**	**6.5**	**11**	**3.2**	**12**	**5.3**	**8.6**	**13**	**0.34**	**0.53**
Lead	mg/L	*	0.003 U	0.007 J	0.003 U	0.003 U	0.003 U	0.0075	0.0042 J	0.0032 J	0.0030 U	0.003	0.003 U
Magnesium	mg/L	---	12	16	41	57	51	57	44	63	48	9.3	8.8
Manganese	mg/L	---	0.93	1.0	0.54	0.28	1.7	1.1	1.8	0.76 B	1.4	0.047	0.063
Mercury	mg/L	0.0007	0.00012 U	0.00012 U	0.00012 U	0.00012 U	0.00012 U	0.00012 U	0.00012 U	0.00012 U	0.00012 U	0.00012 U	0.00012 U
Nickel	mg/L	*	0.027	0.018	0.0093 J	0.013	0.009 J	0.015	0.0091 J	0.0094 J	0.0073	0.0013 U	0.0013 U
Potassium	mg/L	---	3.3 B	4.4	23	19	15	13 B	12	16	8.0	2.2 B	1.8
Selenium	mg/L	0.0046[1]	0.0087 U	0.0087 U	0.0087 U	0.0087 U	0.0087 U	0.0087 U	0.0087 U	0.0087 U	0.0087 U	0.0087 U	0.0087 U
Silver	mg/L	0.0001	0.0017 U	0.0017 U	0.0017 U	0.0017 U	0.0017 U	0.0017 U	0.0017 U	0.0017 U	0.0017 U	0.0017 U	0.0017 U
Sodium	mg/L	---	2.0	3.2	81	65	59	64	45	64	45	16	24
Thallium	mg/L	0.008	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Vanadium	mg/L	0.014	0.0015 U	0.0015 U	0.0017 J	0.0015 U	0.0074	0.0067	0.0015 U	---	0.0015 U	0.0015 U	0.0015 U
Zinc	mg/L	*	0.011	0.028	0.0096 JB	0.012	0.010 B	0.033	0.020	0.0094 JB	0.0054 J	0.0017 J	0.0029 J

Values in **BOLD** indicate exceedance of applicable groundwater and surface water quality standard.

--- = Not analyzed or no applicable standard.

[A] = T.O.G.S. 1.1.1 Ambient Water Quality Standards for Class C Surface Water. Part 703.3 for pH, D.O., TDS, Color, and Trubidity.

[1] = Laboratory Method Detection Limit is greater than or equal to the applicable water quality standard.

[2] Surface Water Standard for ammonia, in mg/L, is interpolated from the samples pH and temperature. GW-B (8/21/2013) = 1.5, GW-B (6/12/2014) = 2.04, GW-1/GW-01 (8/22/2012) = 1.5, GW-1/GW-01 (6/12/2014) = 2.2,

[3] = Standard applies to the dissolved form, not total recoverable.

Seep Monitoring Point (8/22/2012) = No pH value, can't interpolate standard; Seep Monitoring Point (8/21/2013) = 1.5; Seep Monitoring Point (6/12/2014) = 2.2; Seep Monitoring Point (10/6/2014) = 2.2; GW-3 (6/12/2014) = 2.2; GW-A (8/21/2013) = 1.5; and, GW-A (6/12/2014) = 2.2

* = Surface water standards for Cadmium, Chromium, Copper, Lead, Nickel, and Zinc are based on the samples hardness for Class C streams.

Cadmium (mg/L): GW-B(8/21/2013) = 0.01, GW-B(6/12/2014) = 0.01, GW-1/GW-01(8/22/2012) = 0.03, GW-1/GW-01(6/12/2014) = 0.02, Seep Monitoring Point(8/22/2012) = 0.03, Seep Monitoring Point(8/21/2013) = 0.04, Seep Monitoring Point(6/12/2014) = 0.02, Seep Monitoring Point(10/6/2014) = 0.02, GW-3(6/12/2014) = 0.03, GW-A(8/21/2013) = 0.01, GW-A(6/12/2014) = 0.01

Chromium: (mg/L): GW-B(8/21/2013) = 1.17, GW-B(6/12/2014) = 1.12, GW-1/GW-01(8/22/2012) = 2.23, GW-1/GW-01(6/12/2014) = 2.09, Seep Monitoring Point(8/22/2012) = 2.27, Seep Monitoring Point(8/21/2013) = 3.00, Seep Monitoring Point(6/12/2014) = 2.13, Seep Monitoring Point(10/6/2014) = 2.09, GW-3(6/12/2014) = 2.47, GW-A(8/21/2013) = 0.92, GW-A(6/12/2014) = 0.84

Copper (mg/L): GW-B(8/21/2013) = 0.03, GW-B(6/12/2014) = 0.03, GW-1/GW-01(8/22/2012) = 0.06, GW-1/GW-01(6/12/2014) = 0.06, Seep Monitoring Point(8/22/2012) = 0.07, Seep Monitoring Point(8/21/2013) = 0.09, Seep Monitoring Point(6/12/2014) = 0.06, Seep Monitoring Point(10/6/2014) = 0.06, GW-3(6/12/2014) = 2.47, GW-A(8/21/2013) = 0.07, GW-A(6/12/2014) = 0.02

Lead (mg/L): GW-B(8/21/2013) = 0.25, GW-B(6/12/2014) = 0.26, GW-1/GW-01(8/22/2012) = 0.56, GW-1/GW-01(6/12/2014) = 0.52, Seep Monitoring Point(8/22/2012) = 0.57, Seep Monitoring Point(8/21/2013) = 0.80, Seep Monitoring Point(6/12/2014) = 0.53, Seep Monitoring Point(10/6/2014) = 0.52, GW-3(6/12/2014) = 0.64, GW-A(8/21/2013) = 0.18, GW-A(6/12/2014) = 0.16

Nickel (mg/L): GW-B(8/21/2013) = 0.98, GW-B(6/12/2014) = 1.02, GW-1/GW-01(8/22/2012) = 1.92, GW-1/GW-01(6/12/2014) = 1.80, Seep Monitoring Point(8/22/2012) = 1.95, Seep Monitoring Point(8/21/2013) = 2.60, Seep Monitoring Point(6/12/2014) = 1.83, Seep Monitoring Point(10/6/2014) = 1.80, GW-3(6/12/2014) = 2.13, GW-A(8/21/2013) = 0.77, GW-A(6/12/2014) = 0.70

Zinc (mg/L): GW-B(8/21/2013) = 0.25, GW-B(6/12/2014) = 0.25, GW-1/GW-01(8/22/2012) = 0.48, GW-1/GW-01(6/12/2014) = 0.45, Seep Monitoring Point(8/22/2012) = 0.49, Seep Monitoring Point(8/21/2013) = 0.65, Seep Monitoring Point(6/12/2014) = 0.46, Seep Monitoring Point(10/6/2014) = 0.45, GW-3(6/12/2014) = 0.53, GW-A(8/21/2013) = 0.19, GW-A(6/12/2014) = 0.17

U = Compound is not detected at or above laboratory method detection limit.

J = Result is less than the laboratory reporting limit but greater than or equal to the method detection limit and the concentration is an approximate value.

B = Compound was found in the blank and the sample.

b = Result detected in the unseeded control blank (USB).

H = Sample was prepped or analyzed beyond specified holding time.

^ = Instrument related QC exceeds the control limits.

TABLE 6

Summary of Historical Analytical Results - Surface Water (2012 - 2014)
Orange County Landfill, Goshen, New York

Analyte	Units	Surface Water Standard and Guidance Values[(A)]	SW-13 (Upstream)		SW-5 (Upstream)		SW-01 (Upstream)		SW-Seep DS (Downstream)	SW-02** (Downstream)		SW-8 (Downstream)	
			10/6/2014	Historical Range	10/6/2014	Historical Range	8/22/2012	6/12/2014	10/6/2014	8/22/2012	6/12/2014	10/6/2014	Historical Range
Field Measurements													
Temperature	°C	---	15.79	0.3-25.3	16	0.1-25.4	22.17	18.63	15.39	23.25	18.67	15.47	0.2-25.91
Dissolved Oxygen	mg/L	< 4	5.71	6.79-12.68	4.51	5.2-10.8	6.78	8.13	3.74	6.68	8.04	4.83	6-11.28
Oxidation Reduction Potential	mV	---	516.9	-137-380	-138.6	-162-370	43.9	235.3	490.1	-20.6	235.1	495.8	-186-395
pH	S.U.	6.5-8.5	7.46	7.18-**9.02**	7.36	7.01-**9.33**	7.78	7.85	7.56	7.80	7.72	7.61	7.0-**8.81**
Specific Conductivity	mS/cm[c]	---	0.79	285-576	0.806	290-684	0.479	0.492	0.787	0.488	0.492	0.788	300-4940
Water Quality Parameters													
Alkalinity	mg/L	---	210 B	44-187	230	62.9-160	130 B	130	230 B	140 B	140	220 B	65.2-189
Ammonia	mg/L	(2)	0.009 U	0.03-0.51 U	0.009 U	0.03-0.155 U	0.049	0.053	0.058 B	0.21	0.053	0.014 JB	0.03 U-0.221
Biochemical Oxygen Demand	mg/L	---	2.0 H	2.0-7.0 U	2.0 U	2.0 U-8.0	3.3 b	2.0 U	2.0 Hb	2.0 U	2.0 U	2.0 U	2.0 U-14
Bromide	mg/L	---	---	0.1 U-1.0 U	---	0.1 U-1.0 U	0.1 U	---	---	0.1 U	---	---	0.1 U-1.0 U
Chemical Oxygen Demand	mg/L	--	6.4 JB^	10 U-50	21	10 U-105	14	10	23 B	14	9.0 J	21 B	6.0-34
Chloride	mg/L	---	100	23-82	100	28.9-79	46	61	100	47	61	100	30-80
Chromium, Hexavalent	mg/L	0.011	0.005 U	0.004 U-0.01 U	0.005 U	0.004 U-0.01 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	<0.005	0.004 U-0.01
Color	Color Units	---	25	5.0 U-750	25	5.0 U-750	40	35	25	50	40	25	5.0 U-500
Cyanide	mg/L	0.0052	0.005^	0.005 U-0.01 U	0.005^	0.005 U-0.01 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005^	0.005 U-0.01 U
Hardness	mg/L	---	240	96.7-260	230	99.8-242	18 J	180	240	180	180	240	102-238
Nitrate	mg/L	---	2.1	0.4-1.82	2.1	0.1 U-1.72	0.77	0.91	2.1	0.83	0.93	2.1	0.1 U-3.3
Phenols	mg/L	0.005	0.005 U	0.002 U-0.0045 U	0.005 U	0.002 U-**0.0072**	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	<0.005	0.002 U-**0.0115**
Sulfate	mg/L	---	33	11-91	33	7.5-100	19	14	34	19	14	34	8.5-100
Total Dissolved Solids	mg/L	500	390	172-404	420	156-446	300	310	410	300	310	400	190-428
Total Kjeldahl Nitrogen	mg/L	---	0.94	0.58-1.45	0.75	0.5-7.52	2.4	0.41	0.8	0.97	0.44	0.41	0.58-1.76
Total Organic Carbon	mg/L	---	4.1	4.5-18	4.1	4.2-11	5.8	4.4	4.1	5.5	4.4	4.1	4.4-18
Turbidity	NTU	---	28	5.6-130	29	8.7-95	37	16	23	29	17	22	5.8-112
Metal Parameters													
Aluminum	mg/L	---	0.54	0.08-0.991	0.4	0.13-0.941	1.5	0.57	0.16 J	1.6	0.55	0.47	0.12-1
Antimony	mg/L	---	0.0068 U	0.0068 U-0.06 U	0.0068 U	0.0044 U-0.0068 U	0.0068 U	0.0068 U	0.0068 U	0.0068 U	0.0068 U	0.0068 U	0.05 U-0.12
Arsenic	mg/L	0.15[(3)]	0.0056 U	0.002 U-0.02 U	0.0056 U	0.001-0.014	0.0056 U	0.0056 U	0.0062 J	0.0056 U	0.0056 U	0.0098 J	0.002 U-0.014
Barium	mg/L	---	0.041	0.017-0.2 U	0.04	0.016-0.2	0.033	0.024	0.043	0.039	0.024	0.041	0.2 U-0.037
Beryllium	mg/L	*	0.0003 U	0.0003 U-0.02 U	0.0003 U	0.0003 U-0.02 U	0.0003 U	0.0003 U	0.0003 U	0.0003 U	0.0003 U	0.0003 U	0.0003 U-0.02 U
Boron	mg/L	10	0.046	0.026-0.5 U	0.045	0.048 U-0.066	0.035 B	0.022 B	0.048	0.036 B	0.023 B	0.045	0.025 U-0.053
Cadmium	mg/L	*	0.0005 U	0.0005 U-0.02 U	0.0005 U	0.0005 U-0.02 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U-0.02 U
Calcium	mg/L	---	59	28.1-67	58	27.5-61.4	45	43	61	46	44	61	26.8-60.6
Chromium	mg/L	*	0.0015 J	0.001 U-0.02 U	0.001 U	0.0009 U-0.02 U	0.0016 J	0.001 U	0.0015 U	0.0022 J	0.001 U	0.001 J	0.001 U-0.02 U
Cobalt	mg/L	0.005	---	0.0019 U-0.05 U	---	0.0019 U-0.05 U	0.00067 J	0.00063 U	---	0.0019 U	0.00063 U	---	0.0019 U-0.05 U
Copper	mg/L	*	0.0054 J	0.0053-0.017 U	0.0051	0.003 U-0.025 U	**0.0034 J**	0.0016 U	0.0052 J	0.0031 J	0.0017 J	0.005 J	0.0021-0.025 U
Iron	mg/L	0.3	**0.54 B**	**0.36-8.2**	**0.4**	0.285-**9.17**	**1.4**	**0.81**	0.22 B	**1.4**	**0.77**	**0.46**	**0.34-3.13**
Lead	mg/L	*	0.003 U	0.001 U-0.014	0.003 U	0.0019 U-0.013	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.0031 J	0.001 U-0.02 U
Magnesium	mg/L	---	23	6.44-22.7	23	7.55-22.2	15	15	23	16	15	23	7.57-21.2
Manganese	mg/L	---	0.13	0.048-1.0	0.13	0.055-0.22	0.14	0.11	0.13	0.15	0.11	0.12	0.052-0.28
Mercury	mg/L	0.0007	0.00012 U	0.00012 U-0.001 U	0.00012 U	0.00012 U-0.001 U	0.00012 U	0.00012 U	0.00012 U	0.00012 U	0.00012 U	0.00012 U	0.00012 U-0.001 U
Nickel	mg/L	*	0.0016	0.0013 U-0.04 U	0.0018	0.0013 U-0.02 U	0.0015 J	0.0015 J	0.0018 J	0.0016 J	0.0013 U	0.002 J	0.0013 U-0.04 U
Potassium	mg/L	---	3.8	1.4-5.22	3.7	1.6-4.98	3.2	1.8	3.7	3.3	1.8	3.8	1.2-4.92
Selenium	mg/L	0.00046	0.0087 U	0.001 U-0.059	0.0087 U	0.001 U-0.077 U	0.0087 U	0.0087 U	0.0087 U	0.0087 U	0.0087 U	0.0087 U	0.001 U-0.079
Silver	mg/L	0.0001[(1)]	0.0017 U	0.0012-0.01 U	0.0017 U	0.0017 U-0.01	0.0017 U	0.0017 U	0.0017 U	0.0017 U	0.0017 U	0.0017 U	0.0015-0.01 U
Sodium	mg/L	---	52	14.9-41	52	15-38.6	29	32	52	30	32	52	15-40
Thallium	mg/L	0.008[(1)]	0.01 U	0.001 U-0.022	0.01 U	0.001 U-0.023	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.001 U-0.02 U
Vanadium	mg/L	0.014	---	0.002 U-0.274	---	0.002 U-0.01 U	0.0043 J	0.0015 U	---	0.0033 J	0.0015 U	---	0.002 U-0.02 U
Zinc	mg/L	*	0.0071 JB	0.0043-0.149	0.023 B	0.028 U-0.0023	0.0069 JB	0.006 J	0.041 B	0.0095 JB	0.0055 J	0.012 B	0.004-0.0345

Values in **BOLD** indicate exceedance of applicable groundwater and surface water quality standard.

--- = Not analyzed or no applicable standard.

(A) = T.O.G.S. 1.1.1 Ambient Water Quality Standards for Class C Surface Water

(1) = Laboratory Method Detection Limit is greater than or equal to the applicable water quality standard.

(2) = Surface water standard for ammonia (mg/L) is interpolated using the temperatures and pH of the individual samples. SW-13 = 2.18; SW-01(8/22/2012) = 1.34, SW-01(6/12/2014) = 1.21; SW-5 = 2.19; SW SEEP DS = 2.14; SW-02(8/22/2012) = 1.31; SW-02(6/12/2014) = 1.41; and SW-8 = 2.10

(3) = Standard applies to the dissolved form.

* = Surface Water Standard for Berylium, Cadmium, Chromium, Copper, Lead, Nickel, and Zinc are based on the individual sample's hardness

Beryllium (mg/L): SW-13 = 1.1; SW-01(8/22/2012) = 0.011; SW-01(6/12/2014) = 1.1; SW-5 = 1.1; SW SEEP DS = 1.1; SW-02(8/22/2012) = 1.1; SW-02(6/12/2014) = 1.1; and SW-8 = 1.1

Cadmium (mg/L): SW-13 = 0.01; SW-01(8/22/2012) = 0.0006; SW-01(6/12/2014) = 0.007; SW-5 = 0.01; SW SEEP DS = 0.01; SW-02(8/22/2012) = 0.007; SW-02(6/12/2014) = 0.007; and SW-8 = 0.01

Chromium: (mg/L): SW-13 = 0.03; SW-01(8/22/2012) = 0.14; SW-01(6/12/2014) = 0.92; SW-5 = 1.13; SW SEEP DS = 1.17; SW-02(8/22/2012) = 0.92; SW-02(6/12/2014) = 0.92; and SW-8 = 0.03

Copper (mg/L): SW-13 = 0.03; SW-01(8/22/2012) = 0.003; SW-01(6/12/2014) = 0.02; SW-5 = 0.03; SW SEEP DS = 0.03; SW-02(8/22/2012) = 0.02; SW-02(6/12/2014) = 0.02; and SW-8 = 0.03

Lead (mg/L): SW-13 = 0.25; SW-01(8/22/2012) = 0.01; SW-01(6/12/2014) = 0.18; SW-5 = 0.24; SW SEEP DS = 0.25; SW-02(8/22/2012) = 0.18; SW-02(6/12/2014) = 0.18; and SW-8 = 0.25

Nickel (mg/L): SW-13 = 0.25; SW-01(8/22/2012) = 0.11; SW-01(6/12/2014) = 0.77; SW-5 = 0.95; SW SEEP DS = 0.98; SW-02(8/22/2012) = 0.77; SW-02(6/12/2014) = 0.77; and SW-8 = 0.98

Zinc (mg/L): SW-13 = 0.25; SW-01(8/22/2012) = 0.03; SW-01(6/12/2014) = 0.19; SW-5 = 0.24; SW SEEP DS = 0.25; SW-02(8/22/2012) = 0.19; SW-02(6/12/2014) = 0.19; and SW-8 = 0.25

** = Sampling Location SW-02 at distinct locations (see Figure 4).

U = Compound is not detected at or above laboratory method detection limit.

J = Result is less than the laboratory reporting limit but greater than or equal to the method detection limit and the concentration is an approximate value.

B = Compound was found in the blank and the sample.

b = Result detected in the unseeded control blank (USB).

H = Sample was prepped or analyzed beyond specified holding time.

^ = Instrument related QC exceeds the control limits.

Table 7

Evaluation of Mitigation Alternatives
Orange County Landfill, Goshen, New York

Response Action	Technology	Implementability	Effectiveness and Permanence	Cost Remarks
Containment	Geotextile filter fabric or Geomembrane w/ Riprap	Moderately difficult to install and maintain due to location and slope.	Effectively controls seep from reaching canal, no associated treatment of seep, potential negative ecological impacts, and will likely require maintenance.	Likely maintenance costs.
Containment	Slurry Wall	Moderately difficult to install and maintain due to location and slope.	Effectively prevents seep from reaching canal. Will likely require maintenance. Effectiveness could be reduced due to movement of Canal bank.	Likely maintenance costs. Recurring operational costs.
Groundwater Collection	Focused Groundwater Collection Treatment	Readily implementable.	Effectively prevents seep from reaching canal and treats groundwater contamination. Continuous operation of pump required.	Recurring operational costs.
Seep Source Collection	Seep Source Point Collection	Moderately difficult to maintain due to fluctuations of the canal stage.	Effectively prevents seep from reaching canal and treats present contamination. Continuous operation of pump required. Potentially ineffective operation due to frequent flooding of the canal stage.	Recurring operational costs.
In-situ Treatment	Chemical Injection	Readily implementable.	Effectiveness of technology currently unknown. Continuous operation of pump required.	Bench / pilot scale testing costs. Recurring operational costs.
In-situ Treatment	Reactive Trench	Moderately difficult to install and maintain due to location, slope, and is prone to site flooding.	Effectively prevents seep from reaching canal. Will likely require maintenance.	Likely maintenance costs.