PROPOSED REMEDIAL ACTION PLAN
CARROLL TOWN LANDFILL SITE
Town of Carroll, Chautauqua County, New York
Site No. 9-07-017

November 2008

Prepared by:

Division of Environmental Remediation
New York State Department of Environmental Conservation

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SECTION 1: <u>SUMMARY AND PURPOSE OF THE PROPOSED PLAN</u>

The New York State Department of Environmental Conservation (the Department), in consultation with the New York State Department of Health (NYSDOH), is proposing a remedy for the Carroll Town Landfill Site. The presence of hazardous waste has created significant threats to human health and/or the environment that are addressed by this proposed remedy. As more fully described in Sections 3 and 5 of this document, landfilling of municipal and industrial waste and construction debris at the site have resulted in the disposal of hazardous wastes, including volatile organics (VOCs), semi-volatile organics (SVOCs), and inorganics. These wastes have contaminated the groundwater and landfill waste at the site, and have resulted in:

- a significant threat to human health associated with current and potential exposure to groundwater and landfill waste.

- a significant environmental threat associated with the current and potential impacts of contaminants to groundwater.

To eliminate or mitigate these threats, the Department proposes to consolidate waste into a smaller area and place a soil cap on the landfill to improve drainage and to reduce surface water infiltration. This would reduce the amount of water entering the landfill mass and eliminate direct exposure to landfill waste. The groundwater migrating towards the municipal water supply would be treated to remove contaminants from the groundwater.

The proposed remedy, discussed in detail in Section 8, is intended to attain the remediation goals identified for this site in Section 6. The remedy must conform to officially promulgated standards and criteria that are directly applicable, or that are relevant and appropriate requirements (ARARs). The selection of a remedy must also take into consideration guidance, as appropriate. Standards, criteria, and guidance are hereafter called SCGs.

This Proposed Remedial Action Plan (PRAP) identifies the preferred remedy, summarizes the other alternatives considered, and discusses the reasons for this preference. The Department will select a final remedy for the site only after careful consideration of all comments received during the public comment period.

The Department has issued this PRAP as a component of the Citizen Participation Plan developed pursuant to the New York State Environmental Conservation Law and Title 6 of the Official Compilation of Codes, Rules and Regulations of the State of New York (6 NYCRR) Part 375. This document is a summary of the information that can be found in greater detail in the January 2006 Remedial Investigation (RI) Report, *Remedial Investigation Report/Feasibility Study – Town of Carroll Landfill and* the April 2006 *Town of Carroll Landfill Site Feasibility Study Report*, and other relevant documents. The public is encouraged to review the project documents, which are available at the following repositories:

Myers Memorial Library
23 Ivory Street
Frewsburg, New York
Phone: (716) 569-5515

William Murray
NYSDEC
270 Michigan Avenue
Buffalo, NY 14203
Phone: (716) 851-7220
****BY APPOINTMENT ONLY****

Vivek Nattanmai, P.E.
NYSDEC
625 Broadway
Albany, NY 12233-7013
Phone: (518)402-9814
****BY APPOINTMENT ONLY****

The Department seeks input from the community on all PRAPs. A public comment period has been set from December 17, 2008 to January 22, 2009 to provide an opportunity for public participation in the remedy selection process. A public meeting is scheduled for January 7, 2009 at the Harry J. Murray auditorium located at the Frewsburg Central School beginning at 7:00 PM.

At the meeting, the results of the RI/FS will be presented along with a summary of the proposed remedy. After the presentation, a question-and-answer period will be held, during which verbal or written comments may be submitted on the PRAP. Written comments may also be sent to Mr. Vivek Nattanmai, P.E. at the above address through January 22, 2009.

The Department may modify the proposed remedy or select another of the alternatives presented in this PRAP, based on new information or public comments. Therefore, the public is encouraged to review and comment on all of the alternatives identified here.

Comments will be summarized and addressed in the responsiveness summary section of the Record of Decision (ROD). The ROD is the Department's final selection of the remedy for this site.

SECTION 2: <u>SITE LOCATION AND DESCRIPTION</u>

The Town of Carroll Landfill is a former municipal and construction and demolition (C&D) debris landfill and solid waste transfer station in the Village of Frewsburg, Town of Carroll, Chautauqua County (Figure 1). The landfill is located at the end of an unnamed gravel road, approximately 1,700 feet north of NYS Route 62 (also known as Ivory Road). The landfill is approximately 25 acres. The surrounding area includes farmland, wooded areas, wetlands, and private homes. Conewango Creek lies to the north, northwest, and west of the Site within a broad floodplain.

The Site is located in the Allegany Plateau physiographic province of New York State and is composed of fill, lacustrine sandy silt and silty clay, glacial outwash sand and gravel, till, and bedrock. The total depth of fill within the landfill ranged from approximately 2-ft to10-ft. The top of the fill material was encountered between approximately 1 and 5-ft within each test pit. The sandy silt unit varies in thickness from 5 ft (southwest) to 10 ft (northeast) and the silty clay unit varies in thickness from about 3 ft to 10 ft. The total depth of these units ranges from 7 ft to 20 ft below ground surface. An outwash of sand and gravel, at a total approximate depth of 45-ft, underlies the sandy silt and silty clay units. The till layer beneath the outwash sand and gravel unit is about 15-ft deep. The weathered shale bedrock was encountered at 76 to 81 ft below ground surface.

Groundwater was observed between 3 ft and 9 ft below grade. The natural flow of groundwater is generally northerly toward Conewango Creek. Shallow groundwater was observed to have a flow component to the west-northwest and to the west-southwest. Groundwater in the intermediate zone flows to the southwest. It is likely that groundwater flow direction is being influenced to the southwest by pumping activities of the Frewsburg Water District Supply Well No. 5 beginning in April 2000. The well No. 5 is installed at a depth of approximately 80 feet with a10 foot screen at the bottom.

SECTION 3: SITE HISTORY

3.1: Operational/Disposal History

The Site operated as a former municipal landfill from the early 1960's to 1979. A Part 360 Permit for landfill operation expired in 1976. In June 1979, the Town of Carroll filed a permit application to operate a transfer station at the site. Following the issuance of a Consent Order on October 2, 1979, to address several solid waste violations including failure to provide a complete application for the landfill operation, the Town operated the site as a C&D debris landfill and transfer station. The western disposal area was closed in 1980.

During a public meeting for the remedial investigation of the Vac Air Alloys site (Site No. 907016), citizens attending the meeting alleged that Vac Air Alloys disposed industrial waste at the Town of Carroll Landfill. Allegations included citizen's reports of having witnessed drums of waste labeled as "trichloroethene" being disposed at the landfill. NYSDEC records indicated that industrial waste was allegedly disposed in the landfill during its operation. These records indicated that Vac Air Alloys allegedly disposed drums containing metal debris and metal turnings. Inspections by NYSDEC indicated the presence of partially buried 55-gallon drums in April 1992.

3.2: Remedial History

In May 1998, the Department listed the site as a Class 2 site in the Registry of Inactive Hazardous Waste Disposal Sites in New York. A Class 2 site is a site where hazardous waste presents a significant threat to the public health or the environment and action is required.

Between December 1992 and March 1993, Moody and Associates, Inc. performed a hydrogeologic investigation for the Frewsburg Water District to locate a water supply well. After identifying the Town of Carroll Public Works site, which is adjacent to the landfill, as the probable site for the new water supply well, water quality testing was performed to characterize the aquifer. Groundwater samples were analyzed for VOCs, semivolatile organic compounds (SVOCs), iron, manganese, dissolved solids, hardness, and chloride. At that time, test parameters indicated the water quality was good, except for chloride, which was attributed to runoff from the road salt storage pile and brine storage tank at the Public Works Garage.

Subsequent sampling results indicated that volatile organic compounds (VOCs) in leachate may have been migrating from the Site. This led to making the Site a potential hazardous waste disposal site on June 9, 1992. A Preliminary Site Assessment (PSA) was completed in February 1997. The resulting determinations of a significant threat lead to the listing of the site as Class 2 site on the Registry of Inactive Hazardous Waste Disposal Sites in May 1998.

SECTION 4: ENFORCEMENT STATUS

Potentially Responsible Parties (PRPs) are those who may be legally liable for contamination at a site. This may include past or present owners and operators, waste generators, and haulers.

The PRPs for the site, documented to date, include: the Town of Carroll, the current owner of the site and Keywell, L.L.C. the successor corporation to Vac Air Alloys Corporation.

The PRPs declined to implement the RI/FS at the site when requested by the Department. After the remedy is selected, the PRPs will again be contacted to assume responsibility for the remedial program. If an agreement cannot be reached with the PRPs, the Department will evaluate the site for further action under the State Superfund. The PRPs are subject to legal actions by the state for recovery of all response costs the state has incurred.

SECTION 5: SITE CONTAMINATION

A remedial investigation/feasibility study (RI/FS) has been conducted to evaluate the alternatives for addressing the significant threats to human health and the environment.

5.1: Summary of the Remedial Investigation

The purpose of the RI was to define the nature and extent of any contamination resulting from previous activities at the site. The RI was conducted between August 2004 and November 2004. The field activities and findings of the investigation are described in detail in the RI report.

The RI included the following activities:

- Environmental samples were collected from the following media: soil vapor, surface soil, surface water, sediment, landfill waste, leachate seep liquid, and groundwater.
- Groundwater wells were installed.
- Landfill waste was sampled from test pits excavated at locations along the boundary of the western cell.

- Surface water and sediment samples were collected from a drainage swale (intermittent stream) north of the landfill cells, the wetland area west of the western landfill cell, and the drainage swale between the eastern and western landfill.

Figure 2 shows the locations of all the samples collected at the site.

5.1.1: <u>Standards, Criteria, and Guidance (SCGs)</u>

To determine whether the landfill waste and groundwater contains contamination at levels of concern, data from the investigation were compared to the following SCGs:

- Groundwater, drinking water, and surface water SCGs are based on the Department's 'Ambient Water Quality Standards and Guidance Values' and Part 5 of the New York State Sanitary Code.

- Soil SCGs are based on 6 NYCRR Subpart 375-6 – Remedial Program Soil Cleanup Objectives.

- Sediment SCGs are based on the Department's " Technical Guidance for Screening Contaminated Sediments".

- Soil vapor SCGs are based on the NYSDOH "Guidance for Evaluating Soil Vapor Intrusion in the State of New York" dated October 2006.

Based on the RI results, in comparison to the SCGs and potential public health and environmental exposure routes, certain media and areas of the site require remediation. These are summarized in Section 5.1.2. More complete information can be found in the RI report.

5.1.2: <u>Nature and Extent of Contamination</u>

This section describes the findings of the investigation for all environmental media that were investigated.

As described in the RI report, many soil, groundwater, surface water, and sediment samples were collected to characterize the nature and extent of contamination. As summarized in Table 1, the main categories of contaminants that exceed their SCGs are volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and inorganics (metals). For comparison purposes, where applicable, SCGs are provided for each medium in parentheses next to the compound.

Chemical concentrations are reported in parts per billion (ppb) for water, microgram per liter (ug/l) for leachate and parts per million (ppm) for waste, soil, and sediment. Air samples are reported in micrograms per cubic meter ($\mu g/m^3$).

Table 1 summarizes the degree of contamination for the contaminants of concern in the groundwater, soils, soil vapor, leachate, sediment and surface water and compares the data with the SCGs for the site. The following are the media which were investigated and a summary of the findings of the investigation.

Leachate

The only VOC detected was trichloroethene at a concentration of 21 ug/l (guidance value is 40 ug/l) which is less than the established NYS Class C water quality criteria. Twelve inorganic constituents were detected at concentrations that exceeded NYS Class C water quality criteria. Review of the data indicates that the highest concentrations of these constituents were detected at the LT-03 location to the northwest of the western landfill cell. Some of the inorganics detected above the water quality standards are cadmium at 24.9 ug/l (SCG is 4) and zinc at 4150 ug/l (SCG is 152). Lead was detected at a concentration of 302 ug/l (SCG is 300) which is marginally greater than the SCG. No SVOCs, pesticides or PCBs were detected in the samples.

Surface Soil (0-2 inches)

Surface soil concentrations of inorganic constituents that appear to be related to the landfill due to their elevated concentrations include cadmium, lead and zinc at the SS-09 location as well as lead and zinc at the SS-10 location. The highest concentration detected was cadmium at 2.9 ppm (SCG is 2.5), barium at 448 ppm (SCG 350), zinc at 381 (SCG 109), nickel at 52.4 (SCG 30) and lead at 98 ppm (SCG is 63). These surface soil samples were collected within the eastern landfill cell. Although lead concentrations at SS-09 may be related to landfill operations, the concentration is within the range for Eastern United States background soils. The analytical results for pesticides and PCBs indicate that concentrations are below SCG for unrestricted future use.

Subsurface Soil

Fifteen VOCs including 1,4-dichlorobenzene, cis-1,2-dichloroethene and trichloroethene were detected in the subsurface soil samples but none of them exceeded the SCG for unrestricted future use.

Inorganic constituents within subsurface soil that appear to be related to the landfill due to their elevated concentrations include arsenic, cadmium, chromium, copper, mercury, nickel, and zinc. These subsurface soil samples were from test pits installed at the northern, eastern, and southern limits of the western landfill cell. Concentrations of cadmium, chromium, copper and nickel exceeded the cleanup level for unrestricted future use. Chromium and nickel are the only inorganic compounds of concern that was detected at significant concentration at two locations. At TP-07, chromium was detected at a concentration of 8870 ppm (SCG is 30) and nickel was detected at 30,700 ppm (SCG 30). At TP-10 chromium was detected at 5900 ppm and nickel at 4300 ppm.

Groundwater

Groundwater samples were collected from eighteen wells installed at the site and one water sample collected from each of three test pits. One round of groundwater samples were collected in October 2004 and another round of samples were collected in January 2005. A recent groundwater sampling event was conducted in August 2008 to obtain current groundwater quality after the pumping at well#5 was discontinued in early 2007. Figure 3 shows the groundwater samples from the wells installed at the site and the concentration of contaminants detected at each location.

Based on the results from 2004 and 2005 sampling, only two monitoring wells had VOC concentration exceeding the groundwater standard. The highest concentration of VOCs was detected at MW-107S with

600 ppb of vinyl chloride (SCG is 2 ppb) and 69 ppb of cis-1,2-dichloroethene (SCG is 5 ppb). The wells installed around this location detected very low levels of these compound which indicate that this could be a localized impact from past disposal activities and is not a widespread area of contamination. Soil samples collected from test pits installed adjacent to this location did not detect these compounds. The same two compounds were detected at MW-102I but at low concentrations and marginally exceeding the groundwater standard.

The detection of VOCs in the shallow, intermediate and deep monitoring wells suggests that VOCs have migrated from the landfill. However, based on the groundwater analytical data, VOC concentrations appear to decrease with depth. This may suggest that the limited detection and low concentration of VOCs in the intermediate and deep sand and gravel unit are the result of biodegradation/natural attenuation of VOCs along the migration pathways.

Based on the analytical data, vinyl chloride and cis-1, 2-dichloroethene have migrated from the landfill to public water supply well No. 5. The supply well was installed west of the landfill and pumping was initiated in 2000. The Town has installed a sentinel monitoring well (MW-13) approximately 600 feet from the west of the landfill and 185 feet east of the supply well. The well is being sampled periodically to monitor contaminant migration from the landfill towards the public water supply well, prior to the contaminated groundwater reaching the water supply. While well No. 5 was operational in June 2005 the groundwater samples were collected from MW-13 and well No. 5. The concentrations of vinyl chloride and cis-1, 2-dichloroethene were detected at 10 ppb and 15 ppb respectively in MW-13. Vinyl chloride and cis-1, 2-dichloroethene were detected at 0.8 ppb and 2.4 ppb respectively in well No. 5. Although the concentration was less than the drinking water standards, pumping of supply well No. 5 was discontinued in early 2007 to insure that groundwater standards were not exceeded. The May 2007 sampling detected vinyl chloride and cis-1,2-dichloroethene at 0.6 ppb and 9.3 ppb respectively at MW-13 and non-detect at supply well No. 5. This indicates that when pumping at well No. 5 is operational contamination is migrating from the landfill to the supply well. Conversely, the recent groundwater sampling conducted in August 2008 indicate that the contaminated plume is no longer migrating toward the water supply, as evidenced from the decreasing contaminant concentration in MW-13, because of the termination of pumping at well No. 5.

Three SVOCs (4-methylphenol, 4-chloro-3-methylphenol, and 4-nitrophenol) were detected in the temporary well water sample collected from TW-TP-02 at concentrations exceeding NYS Class GA groundwater standards. The water collected from the TW-TP-02 location was in contact with the fill materials. SVOCs were not detected in the groundwater samples collected from the monitoring wells suggesting that the migration of SVOCs present within the fill materials to groundwater is limited.

Arsenic, barium, chromium, iron, lead and manganese were detected within groundwater at concentrations exceeding groundwater standards. Of these contaminants, iron was the only contaminant that was detected consistently (30 of 31 samples) exceeding groundwater standards in the groundwater samples. Inorganic concentrations above the groundwater standards were detected sporadically, both spatially and temporally, with the exception of iron. Review of the iron concentrations, combined with the frequency of detection suggests that the detected concentrations are likely representative of naturally occurring background groundwater quality conditions.

Surface Water

Phenol was detected in surface water sample SW1 at a concentration of 11 ppb, which is slightly exceeds the NYS Class C water quality criteria of 5 ppb. No other SVOCs were detected in the surface water samples at concentrations exceeding NYS Class C water quality criteria.

Inorganic contaminants in surface water at concentrations exceeding NYS Class C water quality criteria included cobalt, lead, vanadium, and zinc. The concentration of these compounds range from 0.99 – 11.2 ppb (SCG is 5 ppb) for cobalt, 8.4 – 22.5 ppb (SCG is 5 ppb) for lead, 1.1 – 16.6 ppb (SCG is 14 ppb) for vanadium and 8.8 – 210 ppb (SCG is 152 ppb) for zinc. The inorganic contaminants detected in the surface water samples are likely attributable to the migration of leachate from the landfill to drainage swales between the two landfill cells, which ultimately drain to the drainage swale to the north of the cells. Similar inorganic contaminants were detected in the surface water samples as in the leachate samples. The potential for these contaminants to impact the Conewengo Creek is minimal because the creek is located approximately 4000 feet to the west of the site.

Drainage Swale Soils

No VOCs or SVOCs were detected above the sediment cleanup guidance.

Drainage swale soil samples were co-located with the surface water samples. In general, similar inorganic contaminants were detected in the drainage swale soil samples as in the surface water samples. However, in almost all cases, contaminant concentrations in the drainage swale soil were higher than those detected in surface water. Inorganic drainage swale soil concentrations were collected in locations where surface water is not present throughout the year, the concentrations were compared to soil cleanup levels. The concentrations of inorganics in drainage swale soil samples were below cleanup levels when compared to soil cleanup objectives.

Soil Vapor

Thirty-seven soil vapor points were installed within the landfill area for VOC and methane screening purposes. VOCs were detected in soil vapor within the boundaries of the landfill cells at four locations. The soil vapor data were screened according to NYSDOH guidance to evaluate potential vapor impacts relative to potential future uses of the landfill property. However, occupied structures are not currently present in the immediate vicinity of the landfill, therefore the potential for vapor impacts are considered minimal.

Methane was detected at three locations ranging from 2.4% - 14.0%. These concentrations range above the Lower Explosive Level of 5% and are less than the Upper Explosive Level of 15%. During the design of the proposed remedy, evaluation would be done to include a venting system in the soil cover to be placed on the landfill.

Review of the soil vapor VOC data indicates that detected VOCs consist mainly of petroleum hydrocarbons and other compounds such as benzene, toluene, ethylbenzene, xylene. Other chlorinated compounds such as tirchloroethene, and tetrachloroethene were also present in soil vapor. The highest concentrations of VOCs were generally detected in the soil vapor sample collected at SV-16. The magnitudes of detected concentrations in the soil vapor samples are relatively low and do not appear indicative of the presence of a significant source at the soil vapor sample locations. Soil vapor samples were collected within the waste limits.

5.2: Interim Remedial Measures

An interim remedial measure (IRM) is conducted at a site when a source of contamination or exposure pathway can be effectively addressed before completion of the RI/FS and a direct threat to humans or environment exist.

An IRM was initiated by the Department in early 2006 to evaluate the existing problems with the treatment system at well No. 2A and repair the system as necessary. The IRM was initiated because the sentinel well MW-13 located upgradient of well No. 5 detected vinyl chloride above drinking water standards and well No. 5 detected vinyl chloride but below drinking water standards. In order for the Frewsburg Water District to meet water supply demand, the treatment on well No. 2A needed to be repaired.

The evaluation of the treatment system on well No. 2A was completed in September 2006. During the evaluation, it was identified that the influent pipe which extends above the roof freezes during winter and shuts down the air stripper tower, hammering occurs along the supply line and the service pumps are subject to frequent cycling. These issues were evaluated and several alternatives were proposed during the evaluation. Final alternatives were selected and equipment was purchased to implement the selected alternatives.

Equipment installation began on October 5, 2006 and completed on October 10, 2006. Based on trial runs, all the equipment installed to resolve the problems is functioning properly. The Department provided assistance to the Town by helping them to train the Town staff to operate the new equipment.

5.3: Summary of Human Exposure Pathways:

This section describes the types of human exposures that may present added health risks to persons at or around the site. A more detailed discussion of the human exposure pathways can be found in Section 7.0 (Appendix I) of the RI report. An exposure pathway describes the means by which an individual may be exposed to contaminants originating from a site. An exposure pathway has five elements: [1] a contaminant source, [2] contaminant release and transport mechanisms, [3] a point of exposure, [4] a route of exposure, and [5] a receptor population.

The source of contamination is the location where contaminants were released to the environment (any waste disposal area or point of discharge). Contaminant release and transport mechanisms carry contaminants from the source to a point where people may be exposed. The exposure point is a location where actual or potential human contact with a contaminated medium may occur. The route of exposure is the manner in which a contaminant actually enters or contacts the body (e.g., ingestion, inhalation, or direct contact). The receptor population is the people who are, or may be, exposed to contaminants at a point of exposure.

An exposure pathway is complete when all five elements of an exposure pathway exist. An exposure pathway is considered a potential pathway when one or more of the elements currently does not exist, but could in the future.

Under current and future use scenario's, there exists the potential for exposure to metals via incidental ingestion or dermal contact with on-site contaminated surface soils, subsurface soils and leachate. There could also be exposure to volatile organic compounds via soil vapor intrusion should structures be build on or in the vicinity of the site.

Groundwater in the vicinity of the site is utilized for drinking water for the Village of Frewsburg. The groundwater on site is contaminated with volatile organic compounds. This contamination represents a threat to this public water supply source.

5.4: <u>Summary of Environmental Assessment</u>

This section summarizes the assessment of existing and potential future environmental impacts presented by the site. Environmental impacts include existing and potential future exposure pathways to fish and wildlife receptors, as well as damage to natural resources such as aquifers and wetlands.

The Fish and Wildlife Impact Analysis, which is included in Section 6.0 of the RI report, presents a detailed discussion of the existing and potential impacts from the site to fish and wildlife receptors.

The following environmental exposure pathways and ecological risks have been identified:

- Aquatic areas existing on-site include a portion of the unnamed tributary of Conewango Creek, emergent and scrub-shrub wetlands and several drainage ways. The wetlands provide habitat for a variety of terrestrial and aquatic receptors. The unnamed tributary likely provides some habitat for a variety of fish and other wildlife species that frequent aquatic habitats. However, the relatively small size of the tributary limits the value of this habitat to some wildlife, particularly fish.
- The terrestrial areas surrounding the site and within the study area consists of a mixture of natural communities and areas exhibiting rural (predominantly agricultural and residential) land use. Approximately 45 percent of the aerial extent of the study area consist of agricultural and residential land uses that may somewhat limit use by transient or residential wildlife species.
- Approximately 55 percent of the aerial extent of the study area consists of natural cover types such as coniferous and hardwood forest; freshwater wooded, scrub-shrub and emergent wetlands; and streams that provide appropriate habitat for a variety of fish and wildlife species.
- Due to the presence of chemical constituents in surface soil, surface water and sediment associated with the site, complete exposure pathways to terrestrial and aquatic receptors likely exist at and down-gradient of the site.

Site contamination has impacted the groundwater to the southwest of the landfill, which in turn was migrating towards the Frewsburg Water District Supply Well No. 5 when the well was in use. Based on available data from the Chautauqua County Department of Health, vinyl chloride and cis-1, 2-DCE have been detected but have not exceeded the drinking water standard in the supply well since 2003.

The proposed remedy would minimize the impacts from contaminants found at the site to wetlands and other surface water bodies. In addition, the impacted groundwater would be addressed in the proposed remedy.

SECTION 6: SUMMARY OF THE REMEDIATION GOALS

Goals for the remedial program have been established through the remedy selection process stated in 6 NYCRR Part 375. At a minimum, the remedy selected must eliminate or mitigate all significant threats to public health and/or the environment presented by the hazardous waste disposed at the site through the proper application of scientific and engineering principles.

The remediation goals for this site are to eliminate or reduce to the extent practicable:

- Exposures of persons at or around the site to landfill waste;

- Exposures to contaminated groundwater via the Frewsburg Water District drinking water well located adjacent to the Site;

- Environmental exposures of flora or fauna to inorganics in leachate and surface water;

- The release of contaminants from soil into groundwater that may create exceedances of groundwater quality standards; and

- The potential for vapor intrusion into structures on or nearby the landfill.

Further, the remediation goals for the site include attaining to the extent practicable:

- Ambient groundwater quality standards.

SECTION 7: SUMMARY OF THE EVALUATION OF ALTERNATIVES

The selected remedy must be protective of human health and the environment, be cost-effective, comply with other statutory requirements, and utilize permanent solutions, alternative technologies or resource recovery technologies to the maximum extent practicable. Potential remedial alternatives for the Carroll Town Landfill Site were identified, screened and evaluated in the FS report which is available at the document repositories established for this site. However, in some instances, the alternatives presented in the FS have been modified as determined appropriate for the site related to current activities associated with the public drinking water wells, as well as, following currently accepted presumptive remedies as established by the EPA.

The use of a part 360 low permeable landfill cap was evaluated as one of the alternatives in the FS report but is not included in the PRAP as an alternative. The soil cover considered in the PRAP would minimize infiltration, provides proper drainage, promote natural attenuation and would offer flexibility for future beneficial use. The soil cover would be as effective as the low permeable cover in eliminating the direct exposure to humans and wildlife. The consolidation of the landfill material would result in a landfill with roughly 50% less area which in turn would reduce infiltration of precipitation by 50%. Additionally, the soil cover would be contoured to promote surface water runoff thereby reducing water infiltration further. The combination of these measures would effectively reduce infiltration of water into the landfill waste and minimize the migration of contamination from the waste. An impermeable part 360 cap would eliminate infiltration into the waste but at an increased cost of $2.5 million in capital costs. It is our proposal that the measures taken to reduce the infiltration through consolidation and contouring a soil cover would result in a landfill that will effectively minimize contamination migrating from the landfill.

A summary of the remedial alternatives that were considered for this site is discussed below. The present worth represents the amount of money invested in the current year that would be sufficient to cover all present and future costs associated with the alternative. This enables the costs of remedial alternatives to be compared on a common basis. As a convention, a time frame of 30 years is used to evaluate present worth costs for alternatives with an indefinite duration. This does not imply that operation, maintenance, or monitoring would cease after 30 years if remediation goals are not achieved.

7.1: Description of Remedial Alternatives

The following potential remedies were considered to address the contaminated groundwater, leachate, and landfill waste at the site.

Alternative 1: No Action

The No Action Alternative is evaluated as a procedural requirement and as a basis for comparison. It requires continued monitoring only, allowing the site to remain in an unremediated state. This alternative would leave the site in its present condition and would not provide any additional protection to human health or the environment. It also would not achieve the remedial goals and would not satisfy the ARARs established for the site.

Present Worth: *$221,500*
Capital Cost: *$0*
O&M Present Cost: *$221,500*
Annual O&M Costs: *$11,300*
Time to Implement: .... *NA*

Alternative 2: Landfill Cover with Monitored Natural Attenuation

Alternative 2 includes a landfill cover with continued monitoring. Based on the RI data, the soil or the waste samples collected from the landfill detected contamination but the contamination was below the SCGs. Groundwater contamination can be attributed to the migration of surface water through the landfill carrying contaminants to the groundwater. Also, leachate can generally be attributed to surface water entering the landfill at a higher elevation and migrating to seeps at lower elevations and to surrounding surface waterways. A soil cap would be placed on the landfill to improve surface drainage thereby reducing the infiltration of surface water; and would eliminate direct exposure to landfill waste.

The landfill is made up of two separate cells, an east cell and a west cell. Since the depth of landfill waste is an average of 2-feet, it is proposed to consolidate material from one cell to the other to minimize the landfill footprint and therefore, the amount of soil cover. If the consolidation of cells is not found to be cost effective or practical, the landfill would be covered as it exists now. Soil cover would consist of 6 inches of topsoil and18 inches of soil material. During the design of the remedy, the soils to be used would be further evaluated to determine the availability of low permeability soils and their impact on infiltration of water into the landfill. The surface would be sloped so that drainage was directed away from the landfill towards the swale that flows towards the north. Control of the surface water should also minimize concerns associated with leachate. Covering the landfill waste would minimize potential exposure to humans in and around the landfill.

During the excavation and consolidation of waste material, verification samples would be taken from the unconsolidated soil to insure that soils meet the restricted commercial objective for the site. This clean up objective is consistent with the intended future use of the site which is for commercial purposes.

It is evident from the groundwater sampling results that subsurface biological activity is occurring at the site and therefore, under this alternative, groundwater would continue to naturally attenuate. Groundwater would be monitored for increases in contaminant levels and any direct threats to humans, particularly if the public water system Well No. 5 was to be used for potable water. However, institutional controls such as an environmental easement would be required to restrict the use of groundwater for potable purposes.

Costs are based on construction of a landfill cover followed by continued monitoring over a 30 year period.

Present Worth: *$2,941,500*
Capital Cost: *$2,720,000*
O&M Present Cost: *$221,500*
Annual O&M Costs: *$11,300*
Time to Implement: .... *8 months*

Alternative 3: Landfill Cover with In Situ Treatment

Similar to Alternative 2, a landfill cover would be constructed under Alternative 3 in a similar manner. In addition, in situ treatment would be performed to address the groundwater contamination. In order to accelerate the current subsurface biological activity, an in-situ treatment product capable of reducing contaminant levels would be installed/injected, or an air sparging system would be installed. Since the groundwater plume has been identified between the landfill and the sentry well, this area and extending north to intercept the natural groundwater flow direction northwest of the landfill would be the focus for in situ treatment.

A pilot study would be conducted to determine the number of injection points and the biological compound or the air sparging compound that will be applicable for the site conditions. In addition, institutional controls preventing the use of public supply Well No. 5 should be implemented during the implementation of this technology because the pumping at Well No. 5 would draw the injected compound towards the direction of pumping and could compromise the effectiveness of this technology.

Groundwater would be monitored for changes in contaminant levels, particularly increases. Institutional controls such as an environmental easement would be required to restrict the use of groundwater for potable purposes.

Costs are based on construction of a landfill cover and a one time injection of an in situ bioremediation product followed by continued monitoring over a 30 year period.

Present Worth: *$4,066,500*
Capital Cost: *$3,845,000*
O&M Present Cost: *$221,500*
Annual O&M Costs: *$11,300*
Time to Implement: .... *8 months*

Alternative 4: Landfill Cover with Ex Situ Treatment

Similar to Alternative 2, a landfill cover would also be constructed under Alternative 4 in a similar manner. In addition, ex situ treatment would be performed to address the groundwater contamination. An appropriate treatment system would be installed at well No. 5 to treat the groundwater. The treatment system would be installed and operated for a period of one year following the Department's approval of the final engineering report and then the responsibility of operating the system would be transferred to the Town. During this time, training to operate the system would be provided to the Town staff.

Groundwater would be monitored for changes in contaminant levels.

Costs are based on construction of a landfill cover and installation of a treatment system such as an air stripper for VOC removal within the pump house at Well No. 5. Operation and maintenance of the treatment system is assumed for a period of 1 year and the maintenance and monitoring of the landfill is assumed for a period of 30 years.

Present Worth: *$3,291,700*
Capital Cost: *$3,032,000*
O&M Present Cost: *$259,700*
Annual O&M Costs: .... *$ 49,500*
Time to Implement: .... *8 months*

7.2 <u>Evaluation of Remedial Alternatives</u>

The criteria to which potential remedial alternatives are compared are defined in 6 NYCRR Part 375, which governs the remediation of inactive hazardous waste disposal sites in New York A detailed discussion of the evaluation criteria and comparative analysis is included in the FS report.

The first two evaluation criteria are termed "threshold criteria" and must be satisfied in order for an alternative to be considered for selection.

1. <u>Protection of Human Health and the Environment</u>. This criterion is an overall evaluation of each alternative's ability to protect public health and the environment.

2. <u>Compliance with New York State Standards, Criteria, and Guidance (SCGs)</u>. Compliance with SCGs addresses whether a remedy will meet environmental laws, regulations, and other standards and criteria. In addition, this criterion includes the consideration of guidance which the Department has determined to be applicable on a case-specific basis.

The major SCGs applicable for this site include groundwater and drinking water standards in the Department's Technical and Operational Guidance Series 1.1.1 (TOGS 1.1.1) – Class C Surface Water Criteria. The discharge of treated groundwater to surface water would also have to meet state pollution discharge elimination system requirements.

The next five "primary balancing criteria" are used to compare the positive and negative aspects of each of the remedial strategies.

3. Short-term Effectiveness. The potential short-term adverse impacts of the remedial action upon the community, the workers, and the environment during the construction and/or implementation are evaluated. The length of time needed to achieve the remedial objectives is also estimated and compared against the other alternatives.

4. Long-term Effectiveness and Permanence. This criterion evaluates the long-term effectiveness of the remedial alternatives after implementation. If wastes or treated residuals remain on-site after the selected remedy has been implemented, the following items are evaluated: 1) the magnitude of the remaining risks, 2) the adequacy of the engineering and/or institutional controls intended to limit the risk, and 3) the reliability of these controls.

5. Reduction of Toxicity, Mobility or Volume. Preference is given to alternatives that permanently and significantly reduce the toxicity, mobility or volume of the wastes at the site.

6. Implementability. The technical and administrative feasibility of implementing each alternative are evaluated. Technical feasibility includes the difficulties associated with the construction of the remedy and the ability to monitor its effectiveness. For administrative feasibility, the availability of the necessary personnel and materials is evaluated along with potential difficulties in obtaining specific operating approvals, access for construction, institutional controls, and so forth.

7. Cost-Effectiveness. Capital costs and annual operation, maintenance, and monitoring costs are estimated for each alternative and compared on a present worth basis. Although cost-effectiveness is the last balancing criterion evaluated, where two or more alternatives have met the requirements of the other criteria, it can be used as the basis for the final decision.

This final criterion, community acceptance, is considered a "modifying criterion" and is taken into account after evaluating those above. It is evaluated after public comments on the Proposed Remedial Action Plan have been received.

8. Community Acceptance - Concerns of the community regarding the RI/FS reports and the PRAP are evaluated. A responsiveness summary will be prepared that describes public comments received and the manner in which the Department will address the concerns raised. If the selected remedy differs significantly from the proposed remedy, notices to the public will be issued describing the differences and reasons for the changes.

SECTION 8: SUMMARY OF THE PROPOSED REMEDY

The Department is proposing Alternative 4, Landfill Cover with Ex Situ Treatment, as the remedy for this site. The proposed remedy is based on the results of the RI and the evaluation of alternatives presented in this document and the FS.

The components of the remedy include consolidation of the two landfill cells, if possible, followed by construction of a landfill cover to minimize infiltration of surface water and subsequent migration of contamination from the landfill waste. The cover would promote water runoff thereby minimizing migration of leachate from the landfill waste to the surface drainage ditches. A treatment system would be installed at Well No. 5 and be used as an ex situ treatment system of the groundwater. This would provide the Frewsburg Water district with an effective spply well which could be used under current conditions. Refer to Figure 4 for the layout of the proposed remedy.

Alternative 4 is being selected based on the evaluation of the four alternatives developed for this site. With the exception of the No Action alternative, each of the alternatives would comply with the threshold criteria, although Alternative 2 may take a longer period due to natural attenuation. In addition, alternatives 2, 3 and 4 would comply with the balancing criteria but the level of compliance varies for each alternative. The major differences between the three alternatives are overall effectiveness and cost. Essentially, Alternative 4 provides the greatest certainty of achieving the remediation goals for the site and is effective.

Alternative 2 (Landfill Cover with Monitored Natural Attenuation) is the lowest cost compared to Alternatives 3 and 4, but the groundwater cleanup goals may take a significant time for natural attenuation to achieve clean up goals. The soil cover under Alternative 2 would improve surface drainage thereby reducing the infiltration of surface water; and would eliminate direct exposure to landfill waste but the groundwater contamination plume would continue to pose exposures to public heath and the environment.

Alternative 3 (Landfill Cover with In Situ Treatment) would rely on effective design and implementation of an in situ remediation compound or air sparging system to treat the contaminated groundwater. Alternative 3 would require a pilot study prior to the implementation of this treatment technology on a full-scale level at the site. The long-term effectiveness of Alternative 3 would depend on its implementability and availability of experienced contractors. Also groundwater flow would need to be better defined in order to properly design a treatment system. Alternative 4 would be readily implementable.

Compared to other alternatives, Alternative 4 would be effective in removing the contaminants from the groundwater and would eliminate the threat of potential ingestion of contaminated groundwater.

The cost of the alternatives varies. Alternative 4 is less expensive than Alternative 3. The costs for Alternatives 2 and 4 are approximately the same. Alternative 3 costs significantly more and its implementability and effectiveness are uncertain. Designing the remedy, mobilizing the equipments, preparing the site, and construction management are substantial costs associated with each of these remedies.
The estimated present worth cost to implement the remedy is $3,198,200. The cost to construct the remedy is estimated to be $3,032,000 and the estimated average annual O & M cost is $38,200.

The elements of the proposed remedy are as follows:

1. A remedial design program would be implemented to provide the details necessary for the construction, operation, maintenance, and monitoring of the remedial program.

2. Landfill consolidation, if possible, would excavate waste from the east cell to the west cell resulting in a smaller landfill footprint and restoring the east cell area to usable land. The consolidated soils

would be regraded to provide drainage away from the landfill.

3. A treatment system would be designed and installed at Well No.5 to insure that drinking water standards are not contravened. The Frewsburg Water district could use the treated water for public water supply.

4. A soil cover would be constructed over the landfill to prevent exposure to contaminated soils and provide contouring to promote runoff of surface water. The cover materials would be further evaluated during design but nominally would consists of 6 inches topsoil and18 inches soil material underlain by an indicator such as orange plastic snow fence to demarcate the cover soil from the subsurface soil. Clean soil would constitute soil that meets the Division of Environmental Remediation's criteria for backfill or local site background. Non-vegetated areas such as roadways are not anticipated at this site but if they are required, these areas would be covered by a paving system at least 6 inches thick.

5. Imposition of an institutional control in the form of an environmental easement that would require (a) limiting the use and development of the property to permit commercial or industrial uses; (b) compliance with the approved site management plan; (c) restricting the use of groundwater as a source of potable or process water, without necessary water quality treatment as determined by NYSDOH; and (d) the property owner to complete and submit to the Department a periodic certification of institutional and engineering controls.

6. Development of a site management plan which would include the following institutional and engineering controls: (a) management of the final cover system to restrict excavation below the soil cover's demarcation layer. Excavated soil would be tested, properly handled to protect the health and safety of workers and the nearby community, and would be properly managed in a manner acceptable to the Department; (b) continued evaluation of the potential for vapor intrusion for any buildings developed on or adjacent to the site, including provision for mitigation of any impacts identified; (c) monitoring of groundwater; (d) identification of any use restrictions on the site; (e) provisions for the continued proper operation and maintenance of the groundwater treatment system and other components of the remedy.

7. The property owner would provide a periodic certification of institutional and engineering controls, prepared and submitted by a professional engineer or such other expert acceptable to the Department, until the Department notifies the property owner in writing that this certification is no longer needed. This submittal would: (a) contain certification that the institutional controls and engineering controls put in place are still in place and are either unchanged from the previous certification or are compliant with Department-approved modifications; (b) allow the Department access to the site; and (c) state that nothing has occurred that would impair the ability of the control to protect public health or the environment, or constitute a violation or failure to comply with the site management plan unless otherwise approved by the Department.

8. The soil cover would be maintained periodically. Maintenance would include mowing the cover and repair of any areas of the cover that were damaged or compromised in any way. Since the remedy results in untreated waste remaining at the site, a long-term monitoring program would be instituted. This program would allow the effectiveness of the landfill cover and treatment system to be monitored and would be a component of the long-term management for the site.

TABLE 1
Nature and Extent of Contamination
Groundwater

Groundwater	Contaminants of Concern	Concentration Range Detected (ppb)	SCG (ppb)	Frequency of Exceeding SCG
Volatile Organic Compounds (VOCs)	Cis-1,2 Dichloroethene	1 – 69	5	6 of 38
	Dichlorodifluoromethane	0.6 – 9	5	1 of 38
	1,2 Dichloroethene	0.6 – 2	0.6	1 of 38
	Benzene	0.6 - 2	1	1 of 38
	Chloroethane	1-7	5	1 of 38
	Vinyl Chloride	1 – 600	2	6 of 38
	Xylene (total)	ND - 11	5	1 of 38
Semivolatile Organic Compounds (SVOCs)	4-Methylphenol	ND – 60	1	1 of 5
	4-chloro-3-Methylphenol	ND- 5	1	1 of 5
	4- Nitrophenol	ND – 2	1	1 of 5
Inorganic Compounds	Arsenic	2.7 – 87.8	25	8 of 31
	Barium	97.2 - 1230	1000	1 of 31
	Chromium	0.94 - 112	50	2 of 31
	Iron	32.7 – 82,600	300	30 of 31
	Lead	0.74 – 157	25	5 of 31
	Manganese	41.1 - 12300	3000	4 of 31

Key:
ppb = parts per billion, which is equivalent to micrograms per liter, µg/L
SCG = standards, criteria, and guidance values – NYSDEC Technical and Operational Guidance Series 1.1.1 (TOGS 1.1.1) – Class GA groundwater Criteria.

TABLE 1
Nature and Extent of Contamination
Leachate

Leachate	Contaminants of Concern	Concentration Range Detected (ppb)	SCG (ppb)	Frequency of Exceeding SCG
Inorganic Compounds	Lead	9.9 – 302	5	3 of 3
	Aluminum	998 – 110,000	100	3 of 3
	Arsenic	2.7 – 156	150	1 of 3
	Cadmium	0.2 – 24.9	4	1 of 3
	Cobalt	0.99 – 291	5	1 of 3
	Copper	4.9 – 365	18	1 of 3
	Iron	14,600 – 721,000	300	3 of 3
	Mercury	0.02 – 0.78	0.77	1 of 3
	Nickel	5.7 – 2560	101	1 of 3
	Selenium	2.7 – 31.23	4.6	1 of 3
	Thallium	3.7 – 22.9	8	1 of 3
	Vanadium	1.1 – 195	14	1 of 3
	Zinc	56.3 – 4150	152	1 of 3

Key:
ppb = parts per billion, which is equivalent to micrograms per liter, µg/L
SCG = standards, criteria, and guidance values – NYSDEC Technical and Operational Guidance Series 1.1.1 (TOGS 1.1.1) – Class C Surface Water Criteria.

TABLE 1
Nature and Extent of Contamination
Surface Water

Surface Water	Contaminants of Concern	Concentration Range Detected (ppb)	SCG (ppb)	Frequency of Exceeding SCG
Semivolatile Organic Compounds (SVOCs)	Phenol	ND – 11	5	1 of 5
Inorganic Compounds	Lead	8.4 – 22.5	5	4 of 5
	Aluminum	253 – 10,200	100	5 of 5
	Cobalt	0.99 – 11.2	5	3 of 5
	Iron	1350 – 38,000	300	5 of 5
	Vanadium	1.1 – 16.6	14	1 of 5
	Zinc	8.8 – 210	152	1 of 5

Key:
ppb = parts per billion, which is equivalent to micrograms per liter, µg/L
SCG = standards, criteria, and guidance values – NYSDEC Technical and Operational Guidance Series 1.1.1 (TOGS 1.1.1) – Class C Surface Water Criteria.

TABLE 1
Nature and Extent of Contamination
Soil Vapor and Surface Soil

Soil Vapor	Contaminants of Concern	Concentration Range Detected (ppbv)	SCG (ppbv)	Frequency of Exceeding SCG
Volatile Organic Compounds (VOCs)	Dichlorodifluoro-methane	0.6 - 7600	400	1 of 4
	Trichoroethylene	ND - 18	4.1	1 of 4
	1,2,4-Trimethylbenzene	0.6 - 19	12	1 of 4

Key:
ppbv = parts per billion volume
SCG = standards, criteria, and guidance values – USEPA, 2002 - OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils

Surface Soil	Contaminants of Concern	Concentration Range Detected (ppm)	SCG (ppm)	Frequency of Exceeding SCG
Inorganic Compounds	Barium	81.3 - 448	300	1 of 5
	Cadmium	0.4 – 2.9	2.5	1 of 5
	Lead	16.1 - 98	63	1 of 5
	Nickel	18.8 – 52.4	30	2 of 5
	Zinc	42.8 - 381	109	2 of 5

Key:
ppm = parts per million, which is equivalent to milligrams per kilogram, mg/kg, in soil
SCG = standards, criteria, and guidance values – "Technical and Administrative Guidance Memorandum [TAGM 4046]; Determination of Soil Cleanup Objectives and Cleanup Levels" and 6 NYCRR Subpart 375-6 – Remedial Program Soil Cleanup Objectives).

TABLE 1
Nature and Extent of Contamination
SubSurface Soil

Subsurface Soil	Contaminants of Concern	Concentration Range Detected (ppm)	SCG (ppm)	Frequency of Exceeding SCG
Inorganic Compounds	Arsenic	5.3 – 29.7	13	2 of 8
	Cadmium	0.87 – 23.9	2.5	1 of 8
	Chromium	15 - 8870	30	3 of 8
	Copper	11.3 - 1800	50	3 of 8
	Mercury	0.04 – 2.2	0.18	2 of 8
	Nickel	23 – 30,700	30	3 of 8
	Zinc	56.4 - 1820	109	6 of 8

Key:
ppm = parts per million, which is equivalent to milligrams per kilogram, mg/kg, in soil
SCG = standards, criteria, and guidance values - “Technical and Administrative Guidance Memorandum [TAGM 4046]; Determination of Soil Cleanup Objectives and Cleanup Levels” and 6 NYCRR Subpart 375-6 – Remedial Program Soil Cleanup Objectives.

Table 2
Remedial Alternative Costs

Remedial Alternative	Capital Cost ($)	Annual Costs ($)	Total Present Worth ($)
No Action	0	0	0
Landfill Cover with Monitored Natural Attenuation	2,720,000	11,300	2,941,500
Landfill Cover with In Situ Treatment	3,845,000	11,300	4,066,500
Landfill Cover with Ex Situ Treatment	3,032,000	38,200	3,291,700

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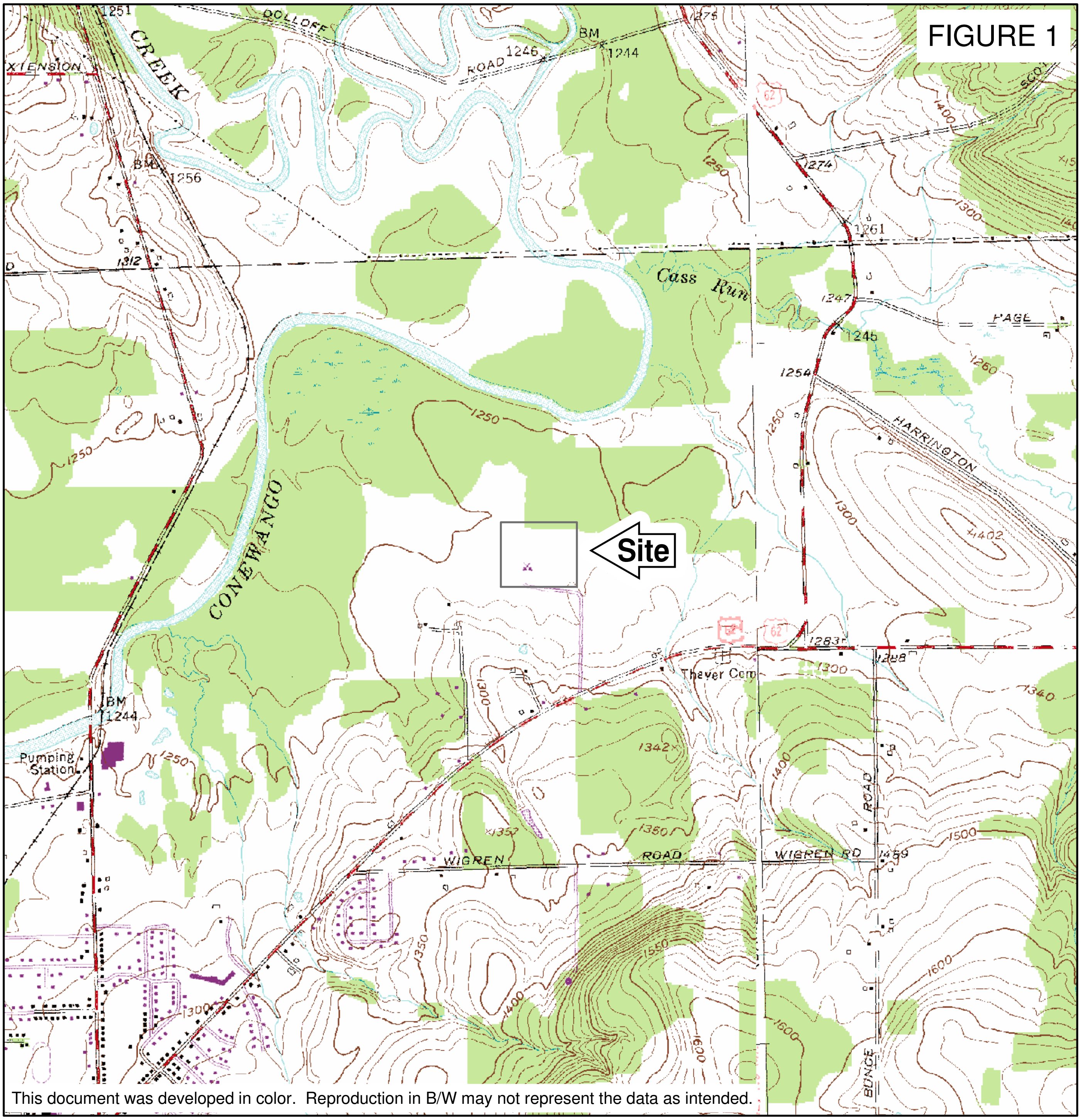
PLOT DATE: 03/03/05 DIV. 84 JPS



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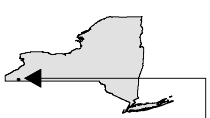

QUADRANGLE LOCATION

TOWN OF CARROLL
LANDFILL SITE
FREWSBURG, NEW YORK

SITE LOCATION

0 1,000 2,000 4,000 6,000 8,000

Feet

1:24,000

10653.34241
MARCH 2005

O'BRIEN & GERE ENGINEERS, INC.

Jan 06, 2006 - 8:24am

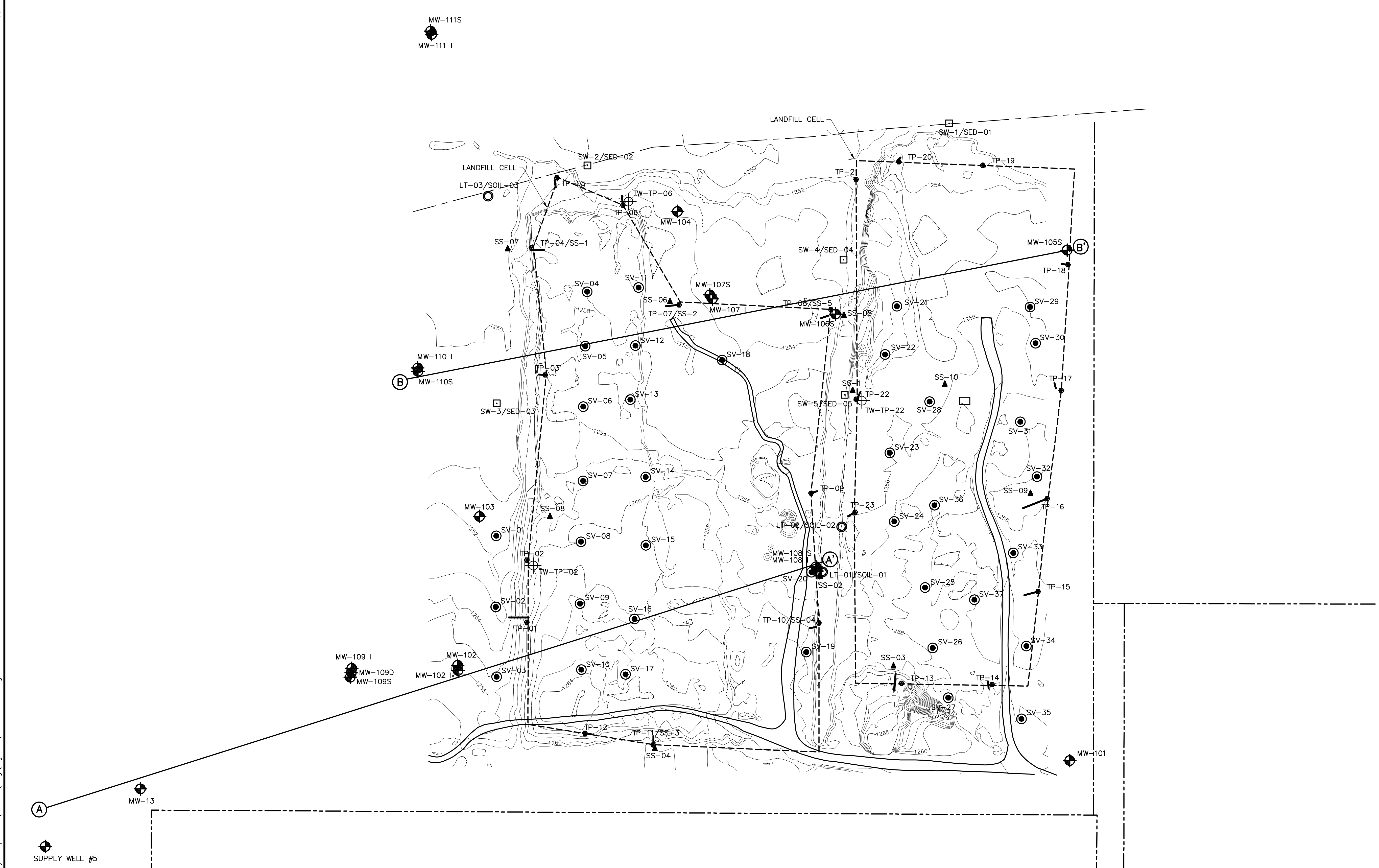

FIGURE 2

LEGEND

- PROPERTY LINE
- EDGE OF CREEK
- ACCESS ROAD
- SV-30 SOIL VAPOR LOCATIONS
- SW-1/SED-01 SURFACE WATER AND SEDIMENT LOCATIONS
- SS-07 SURFACE SOIL LOCATIONS
- LT-01 LEACHATE SEEP LOCATIONS
- TP-18 TEST PIT LOCATIONS
- MW-105S MONITORING WELL LOCATIONS
- A CROSS SECTION LINES
- TW-TP-02 TEMPORARY WELL

TOWN OF CARROLL
LANDFILL SITE
FREWSBURG, NEW YORK
NYSDEC SITE #9-07-017

SAMPLE LOCATION PLAN

0 80 160
SCALE IN FEET

FILE NO.10653.34241.013
DECEMBER 2005

O'BRIEN & GERE ENGINEERS, INC.

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Town of Carroll Landfill Site
Frewsburg, New York
NYSDEC SITE #9-07-017

September 2008

MW-111S

CHEMICAL NAME	10/13/04	03/09/05	08/28/08
Inorganics	µg/L	µg/L	µg/L
Arsenic	**30.5***	NS	NA
Iron	**48,800***	NS	NA

MW-111I

CHEMICAL NAME	10/13/04	03/09/05	08/28/08
Inorganics	µg/L	µg/L	µg/L
Iron	**20,700***	NS	NA

MW-110I

CHEMICAL NAME	10/13/04	03/10/05	08/28/08
Inorganics	µg/L	µg/L	µg/L
Arsenic	**87.8***	23.0	NA
Beryllium	**3.6 B***	0.72 B	NA
Chromium	**112***	24.5	NA
Iron	**191,000***	**37,000***	NA
Lead	**92.4***	15.7	NA
Magnesium	**70,900***	26,300	NA
Manganese	**3,720***	880	NA
Thallium	**14***	4.5 U	NA

MW-110S

CHEMICAL NAME	10/13/04	03/10/05	08/28/08
Inorganics	µg/L	µg/L	µg/L
Arsenic	**35.1***	10.9	NA
Iron	**74,900***	**6,310***	NA
Lead	**26.8***	2.1B	NA

MW-103

CHEMICAL NAME	10/12/04	03/09/05	08/28/08
Inorganics	µg/L	µg/L	µg/L
Iron	**1,030***	NS	NA
VOCs			
Vinyl Chloride	10 U	10 U	2

MW-102

CHEMICAL NAME	10/11/04	03/08/05	08/28/08
Inorganics	µg/L	µg/L	µg/L
Cadmium	0.2 U	**8.4***	NA
Iron	32.7 B	**6,220***	NA
VOCs			
Vinyl Chloride	2 J	1 J	**30 D***
Chloroethane	1 J	1 J	**11***
Trichloroethene	10 U	10 U	**9***
cis-1,2-Dichloroethene	2 J	1 J	**130 D***

MW-102I

CHEMICAL NAME	10/11/04	03/09/05	08/28/08
Inorganics	µg/L	µg/L	µg/L
Iron	**3,800***	**12,200***	NA
VOCs			
Vinyl Chloride	**5.0 J***	**3.0 J***	0.6 J
Chloroethane	**7.0 J***	5.0 J	1 U
cis-1,2-Dichloroethene	**14***	**6.0 J***	**12***
Trichloroethene	10 U	10 U	**20***

MW-109I

CHEMICAL NAME	10/12/04	03/08/05	08/28/08
Inorganics	µg/L	µg/L	µg/L
Arsenic	17.8	**37***	NA
Iron	**36,000***	**68,300***	NA
Lead	**40.7***	**87.1***	NA
Manganese	1,970 U	**3,720***	NA
Thallium	3.7 U	**7.2 B***	NA

MW-109D

CHEMICAL NAME	10/12/04	03/08/05	08/28/08
Inorganics	µg/L	µg/L	µg/L
Iron	**8,440***	**29,900***	NA
VOCs			
Vinyl Chloride	1.0 J	**108***	0.4 J
cis-1,2-Dichlorethene	10 U	1 J	**9***

MW-109S

CHEMICAL NAME	03/13/04	03/09/05	08/28/08
Inorganics	µg/L	µg/L	µg/L
Iron	**2,520***	**18,400***	NA

MW-13

CHEMICAL NAME	09/03/04	10/14/05	08/28/08
Inorganics	µg/L	µg/L	µg/L
Iron	NA	**979***	NA

MW-104

CHEMICAL NAME	10/14/04	03/10/05	08/28/08
Inorganics	µg/L	µg/L	µg/L
Arsenic	**53.2***	24.1	NA
Iron	**13,200***	**37,300***	NA
Magnesium	R	**39,500***	NA
Sodium	**R**	**27,100***	NA

MW-107I

CHEMICAL NAME	10/12/04	03/09/05	08/28/08
Inorganics	µg/L	µg/L	µg/L
Iron	**12,100***	NS	NA

MW-107S

CHEMICAL NAME	10/12/04	03/10/05	08/28/08
Inorganics	µg/L	µg/L	µg/L
Iron	**24,900***	**679***	NA
Magnesium	**R**	**37,600***	NA
VOCs			
Dichlorodifluoromethane	**9.0 J***	3.0 J	0.8 J
Vinyl Chloride	**600.0 D***	**250***	**48 D***
cis-1,2-Dichloroethene	**69.0 J***	**25.0***	1
1,2-Dichloroethane	**2.0 J***	0.6 J	1 U

MW-105S

CHEMICAL NAME	10/14/04	03/10/05	08/28/08
Inorganics	µg/L	µg/L	µg/L
Arsenic	**29.2***	22.1	NA
Iron	**53,400***	**50,100***	NA

MW-106S

CHEMICAL NAME	10/14/04	03/10/05	08/28/08
Inorganics	µg/L	µg/L	µg/L
Iron	**8,440***	NS	NS

MW-108I

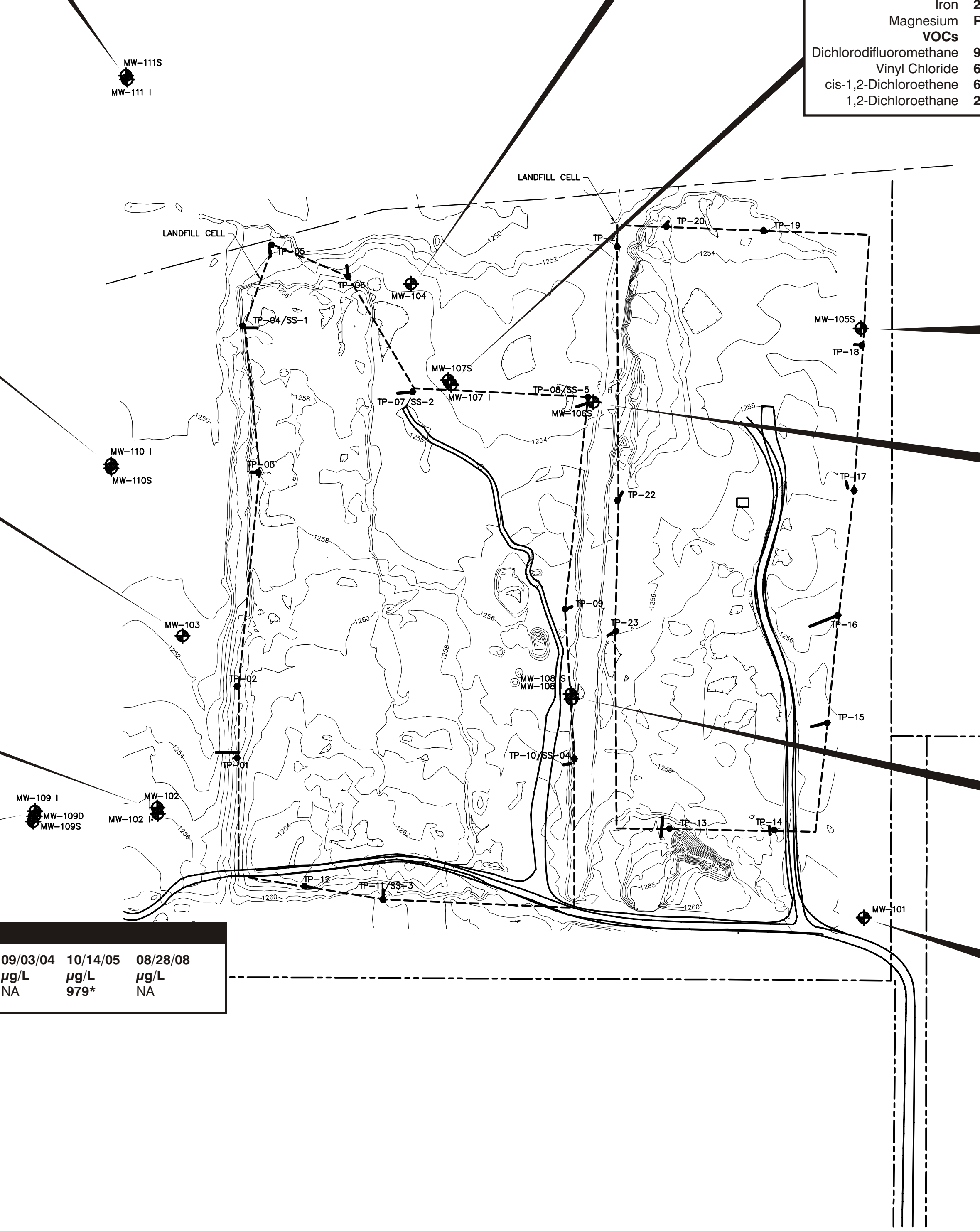
CHEMICAL NAME	10/13/04	03/07/05	08/28/08
Inorganics	µg/L	µg/L	µg/L
Iron	**15,300***	**1,740***	NA

MW-108S

CHEMICAL NAME	10/14/04	03/10/05	08/28/08
Inorganics	µg/L	µg/L	µg/L
Arsenic	12.1	**28.2***	NA
Barium	**1,230***	890	NA
Chromium	8.3 B	**68.4***	NA
Iron	**55,100***	**82,600***	NA
Manganese	**3,150***	2,890	NA

MW-101

CHEMICAL NAME	10/14/04	08/28/08
Inorganics	µg/L	µg/L
Arsenic	**46.1***	NS
Iron	**4,910***	NS



SOURCE: O'Brien & Gere Engineers, Inc., 2005.

APPROXIMATE SCALE IN FEET

0 150 300

LEGEND

- Property Line
- Edge of Creek
- Access Road
- Test Pit Locations (TP-18)
- Monitoring Well Locations (MW-105S)

NOTES

NA	Not Applicable
NS	Not Sampled
U	Analyte Not Detected
B	Value is Greater than IDL but less than CRDL
*	Concentration Exceeds Water Quality Standard
J	Estimated Concentration
R	Analytical Result Rejected During Validation
D	Compound Identified at Secondary Dilution Factor

NYS CLASS GA WATER QUALITY STANDARDS AND GUIDANCE (6NYCRR Part 703 or TOGS 1.1.1)

CHEMICAL NAME	
Inorganics	µg/L
Arsenic	25
Barium	1000
Beryllium	3.0
Cadmium	5.0
Chromium	50
Iron	300
Lead	25
Magnesium	35000
Manganese	3000
Sodium	20000
Thallium	0.5
VOCs	
Dichlorodifluoromethane	5
Vinyl Chloride	2
Chloroethane	5
cis-1,2-Dichloroethene	5
1,2-Dichloroethane	0.6
Benzene	1
Xylene (Total)	5
Trichloroethene	5
SVOCs	
4-Methylphenol	1
4-chloro-3-Methylphenol	1
4-Nitrophenol	1

Figure 3 Groundwater Detections Greater than Criteria

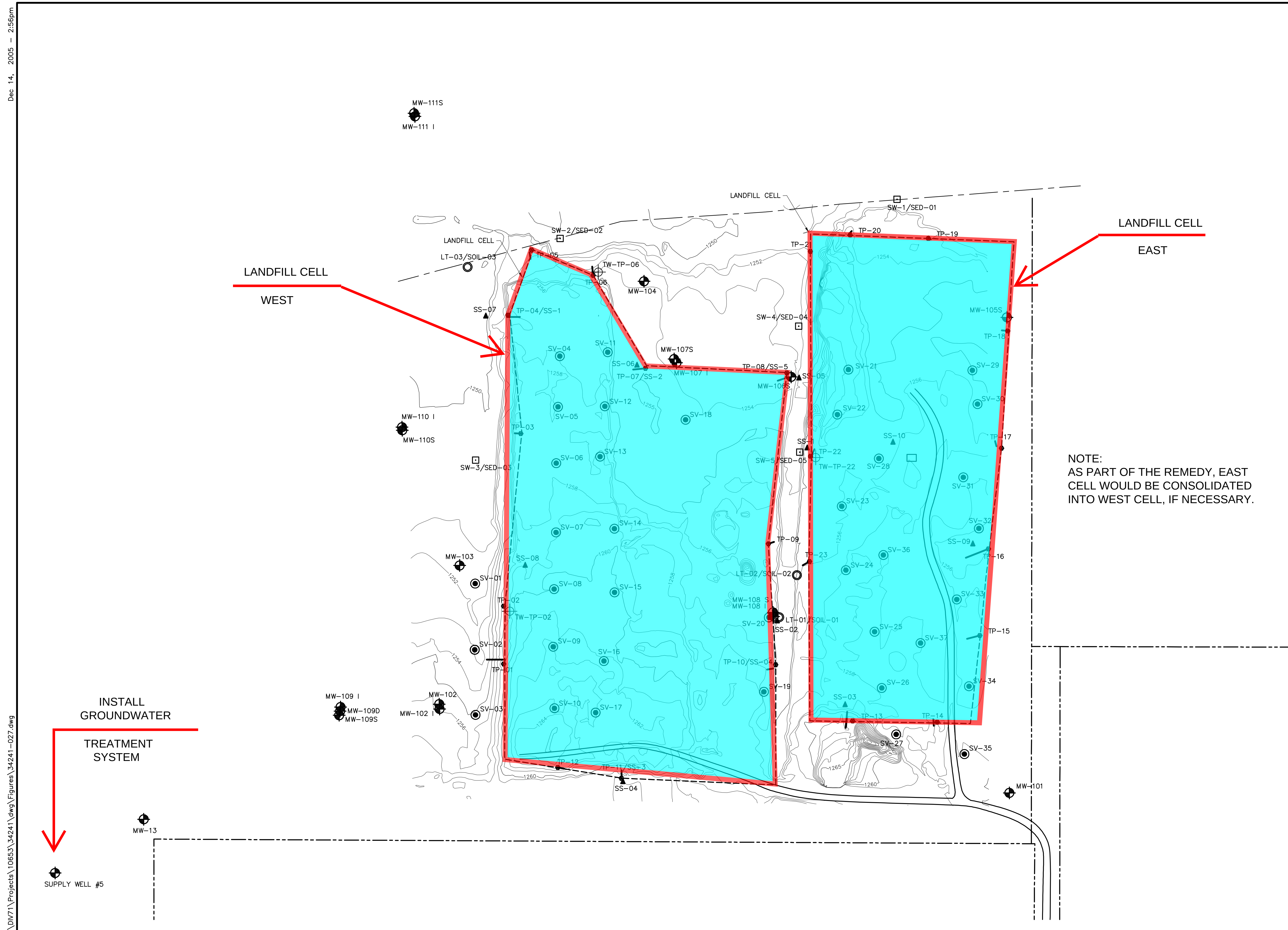


FIGURE NO. 4

LEGEND

- PROPERTY LINE
- EDGE OF CREEK
- ACCESS ROAD
- SV-30 SOIL VAPOR LOCATIONS
- SW-1/SED-01 SURFACE WATER AND SEDIMENT LOCATIONS
- SS-07 SURFACE SOIL LOCATIONS
- LT-01 LEACHATE SEEP LOCATIONS
- TP-18 TEST PIT LOCATIONS
- MW-105S MONITORING WELL LOCATIONS
- TW-TP-02 TEMPORARY WELL

TOWN OF CARROLL
LANDFILL SITE
FREWSBURG, NEW YORK
NYSDEC SITE #9-07-017

PROPOSED REMEDY LAYOUT

0 80 160
SCALE IN FEET

FILE NO.10653.34241.027
MAY 2005

O'BRIEN & GERE ENGINEERS, INC.