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Soil Vapor Intrusion Assessment Report

Data Review, Site Screening & Site Prioritization
Former Emerson Street Landfill
NYSDEC Site #828023

Location:

Former Emerson Street Landfill
Rochester, New York

Prepared for:

City of Rochester
Division of Environmental Quality
Room 300-B
Rochester, New York 14614

LaBella Project No. 210173

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EXECUTIVE SUMMARY

This Soil Vapor Intrusion Assessment Report: Data Review, Site Screening and Site Prioritization (herein after referred to as the "SVI Report") presents the initial phase of work for evaluating Soil Vapor Intrusion (SVI) due to historic landfilling activities at the 45 parcels located within the Former Emerson Street Landfill (FESL) footprint also referred to hereinafter as the "Site". A portion of the Site (4 parcels) is listed as a Class 3 New York State Department of Environmental Conservation (NYSDEC) Inactive Hazardous Waste Disposal Site #828023 while the remaining parcels within the FESL have been de-listed. A Class 3 facility is defined as a facility where "contamination does not presently constitute a significant threat to public health or the environment". Although a majority of the Site has been de-listed by the NYSDEC, the site is still on the list of 'legacy' sites maintained by NYSDEC all of which are being evaluated for SVI. A 'legacy' site is a site which has been identified by the NYSDEC, completed Remedial Investigation (RI) and remedy selection processes and is being evaluated for vapor intrusion. The City of Rochester entered into an Order-on-Consent with NYSDEC in August 2009 which initially required the development and implementation of an SVI assessment. This SVI Report fulfills this initial obligation and subsequent to review and approval by NYSDEC will serve as the basis for further work required at the Site.

This SVI Assessment by LaBella Associates, P.C. (LaBella) included a detailed review of historic information available for the Site which included not only previous subsurface environmental investigations but also a detailed review of aerial photography, subsurface data from redevelopment projects (e.g., geotechnical borings and test pits), available newspaper articles from the time the landfill was operating, and reports/papers relating to City of Rochester and Monroe County waste handling and disposal practices both historically and in particular in the 1960s/1970s. In addition, groundwater sampling of existing wells was completed, additional groundwater monitoring wells were installed, developed and sampled and a site reconnaissance was conducted at every parcel where access was granted by the property owner.

The historic document reviews provided detailed information on where filling operations were being conducted over the years and the anticipated types of fill materials both spatially and vertically throughout the landfill. This information was utilized during the groundwater investigations and the site reconnaissance work in order to evaluate the accuracy of the information (e.g., correlations between type of fill and methane generation). The historic information, subsurface testing and site reconnaissance results were utilized to develop a conceptual site model and this was utilized for determining the potential for SVI at each parcel due to the FESL. It should be noted that the historic information reviewed and actual site reconnaissance results correspond well overall, which allows for a higher degree of certainty with the conclusions and recommendations presented herein.

The City of Rochester developed a Property Owner Soil Vapor Intrusion Technical Assistance Program which included four (4) steps for working with property owners in order to assess, investigate, and mitigate VOCs/landfill gases associated with the Former Emerson Street Landfill. These four (4) steps included 1) an initial consultation with the property owner to discuss project scope and NYSDEC requirements, 2) an initial building survey (i.e., site reconnaissance) to evaluate for building conditions/factors that could impact SVI, 3) SVI investigation (if necessary), and 4) building mitigation (if necessary).

The site reconnaissance work included conducting an interview with a representative of the owner and/or tenant occupying the building and then conducting a detailed sampling of interior and exterior locations that would be the most probable SVI locations (e.g., cracks, holes in floor, support column floor penetrations, subsurface features (e.g., drain lines, sumps, etc.)). The site reconnaissance work was conducted by a team of consultants (Stantec, Day Environmental, Inc., Lu Engineers, and O'Brien & Gere) under the supervision of LaBella. A 'site summary' sheet along with the interview form, pictures and readings obtained from each site were provided to LaBella. LaBella met with each consultant and reviewed each property to evaluate the site reconnaissance work completed and discuss readings of interest obtained that may be related to SVI due to FESL.

The site reconnaissance work, groundwater sampling and filling information researched was input into a customized worksheet that ranked these various factors via a weighted scoring system which was used in part to rank and prioritize properties based on the potential for vapor or landfill gas intrusion associated with the FESL.

The significant findings for each of these activities are summarized below and discussed in greater detail in the main text of the report.

Historic Documentation Review

The aerial photography review indicated that landfilling operations appear to have initiated sometime after 1930 but prior to 1951. The West Side Incinerators located at 110-210 Colfax Street on the FESL were not constructed until 1954 and placed into operation in January 1955. Landfill materials brought to FESL prior to 1955 are most likely from the Falls Street Garbage Reduction Plant which appears to have operated until the West Side Incinerators began operation. It should be noted that the Falls Street Garbage Reduction Plant also incinerated municipal waste.

The 1958 and 1961 aerial photographs indicated disturbed areas (and thus assumed landfilling operations) generally south of Emerson Street, although some limited areas of disturbance are present north of Emerson Street. A 1964 aerial photograph (not reviewed directly by LaBella) and a 1966 aerial photograph are significant pieces of data for two reasons: 1) active landfilling appears limited to areas north of Emerson Street (whereas south of Emerson Street appears to be 'recovering'), with the exception of one 'lobe' of filling south of Emerson Street but east of Colfax in 1964; and, 2) additional information (discussed further below) indicates that the first indications of decreased incinerator efficiency began in late 1964 (fire reported in a newspaper article) with numerous sources of information indicated that the incinerators were not working well in 1968 and thereafter.

The decrease in incinerator efficiency appears to be a function of two variables. The first is a reported increase in incineration processing volume of approximately 29% in 1963-64 (based on the November 1965 Solid Waste Disposal Report for Monroe County, NY prepared by Nussbaumer, Clarke & Velzy Consulting Engineers) and the second is a reported need for maintenance and upgrades to the facility in the May 1970 Comprehensive Solid Waste Study Volume I & II prepared by Greeley and Hansen Engineers. The increase volume may not have contributed significantly to a decrease in efficiency since the 1965 Solid Waste Study Report also indicates that the facility was still under the design capacity. However, the first reported fire in 1964 may indicate that the increased capacity began to cause issues with the ability of the facility to completely combust the materials prior to landfilling. It would appear that as the plant aged, this become an increasing problem with numerous newspaper reports in 1968 citing issues with fires and potentially open dumping (i.e., dumping of unincinerated or partially incinerated waste) at the facility. By 1966 it appears that all landfilling activites were north of Emerson Street and materials landfilled around this time may not have been completely combusted or potentially direct burial was taking place. This point is important as, fully incinerated municipal waste should not generate methane gas due to the complete combustion of the waste; however, partially incinerated municipal waste or open dumping can generate methane gas upon decomposition.

This information indicates that methane gas issues should be generally limited to areas north of Emerson Street. It should also be noted that areas directly north of Emerson Street and in proximity to the street may have received ash material and not petruscible waste. This is supported by test pit and test boring information from previous work completed at the Site. The ash material north of Emerson Street could be due to pre-1964 filling operations (as shown on the 1961 aerial photograph) and/or the spreading of ash material in proximity to Emerson Street in order to provide a visual and olfactory barrier at the time of spreading operations. The ash was also likely a better base material to drive trucks and equipment over, especially during wet periods. Regardless of the reason, the test borings and test pits advanced within approximately 250 ft. of Emerson Street indicated only ash materials.

In addition to potential methane issues, the historic filling research also provided several other significant pieces of information in relation to potential landfilling of liquid waste and incinerator operations. Specifically, a July 7, 1969 City of Rochester Inter-Departmental Correspondence refers to the writer's review of the preliminary Comprehensive Solid Waste Study report by Greeley and Hansen which indicated that liquid waste disposal in the County includes disposal in landfills and illegal discharges to sewer systems. However, it appears that the City was not practicing such disposal at landfills since the memo goes on to request that Greeley and Hansen provide further information in the final report that details how to handle such liquids in this manner. Based on this it appears that the City was not allowing disposal of liquid waste in landfills as late as July 1969 and probably more likely after the final report, which appears to have been issued in May 1970 at which time the landfilling activities are limited to northwest portion. It is assumed that any burial of liquid waste would have been conducted after this date. It should also be noted that a 1970 earth cover contract included placing cover material over the northeastern portion of the landfill and a newspaper article from November 28, 1970 included an aerial photograph which shows the area as covered. Furthermore a hand drawing indicated the 1970 'working area' (assumed to mean active landfilling) was limited to the northern central portion of the FESL north of Emerson Street. Based on this information it appears that if active liquid waste disposal occurred at the FESL it was limited to the northern and western portion of the FESL north of Emerson Street. This corresponds with the P-1 area as potentially being an FESL related release; however, there are two other relatively minor (in comparison to P-1 based on the current data) plumes that would appear to be due to post FESL activities. Additional information on this is included with the groundwater discussion.

Groundwater Evaluation

Groundwater evaluations at the FESL have been conducted since 1988 and have included the installation and sampling of 44 wells. In addition, this SVI Assessment also included the installation, development and sampling of an additional nine wells. The cumulative results of these efforts has indicated that there are three distinct chlorinated VOC (CVOC) plumes at the FESL. As discussed above, one of these plumes (P-1 Plume) appears attributable to historic filling operations or possibly due to unregulated filling after closure of the FESL. The other two CVOC plumes appear likely due to post landfill activities involving manufacturing operations in the area (i.e., GW-7R and GW-9). This appears to be the case due to the following factors:

- Both plumes show increasing CVOC trends compared to the P-1 plume.
- Both plumes do not appear to be associated with the P-1 plume based on non-detect levels in wells located between the two plumes and the P-1 plume, and the groundwater flow direction.
- The GW-9 area would appear to have been filled prior to 1966 when the incinerators were working efficiently and direct burial was likely not being conducted.
- The GW-9 area is located hydraulically downgradient of four manufacturing operations with histories of metal working operations. The buildings in this area were constructed between 1966 and 1973 and thus it is likely that one or all of these operations utilized chlorinated solvents as part of their operations.
- GW-7R is located hydraulically downgradient from a building built in 1985 and utilized for metal fabrication.

Based on the apparent post FESL nature of the GW-7R and GW-9 plumes and the requirements of the Order-on-Consent, it does not appear that these plumes are the responsibility of the City of Rochester and thus these plumes are not included in ranking properties/buildings in proximity to these areas.

FESL P-1 Plume Area

The P-1 Plume area is generally defined and significantly influenced by the storm sewer system that runs through McCrackanville Street, west down Emerson Street and then south parallel to (but west of) 'W' Street and eventually to an outfall into the Barge Canal. This sewer was installed (reportedly by blasting) into the bedrock in order to obtain the proper drainage slope and the bedding and bedrock fracture network appears to be significantly influencing the direction of groundwater flow and thus a CVOC migration pathway. The influence of the sewer system on groundwater flow was previously documented in the 2001 Geomatrix/LaBella report and additionally by a site-wide collection of groundwater elevations in December 2010. The December 2010 groundwater elevations were compared to the sewer inverts and indicated steep gradients in proximity to sewers where the invert is at or below the interpolated groundwater elevation. This results in groundwater flows on both sides of the storm sewer piping/bedding flowing towards the sewer.

The groundwater sampling data confirms the sewer influence on groundwater flow and thus contaminant migration. These two significant pieces of data were used to develop a conceptual model of the P-1 Plume area and this is illustrated on Figure 14. As shown the highest concentrations are around P-1 which is assumed to be in proximity to the actual source of CVOCs. The plume extends to the south and southeast towards McCrackanville Street which is consistent with elevated detections in wells in this location (GMX-MW-3 and GMX-MW-6S). CVOCs are detected in wells east and southwest of P-1; however, these concentrations area significantly lower and thus some diffusion/dispersion of contaminants is likely occurring cross-gradient of groundwater flow; however, this is only relatively minor in concentration. A monitoring well directly east of the McCrackanville Street storm sewer indicated significantly lower concentrations than a well on the west side of the sewer. Additionally, a well installed approximately 150 feet east of the storm sewer did not detect any VOCs. Within Emerson Street and near McCrackanville Street, groundwater flows towards the sewer from the north and south and appears to move toward the west in the downgradient direction of the storm sewer. Groundwater impacts south of Emerson Street are significantly lower than north of Emerson

Street; however, are still present at concentrations above the NYSDEC TOGS 1.1.1 groundwater standards. A monitoring well approximately 800 feet south of Emerson Street (in the VanGaurd Parkway Right of Way) was non-detect for CVOCs. The groundwater plume appears to extend to the west slightly beyond W Street. Although additional wells were not installed south of the intersection of W Street and Emerson Street, it is not anticipated that significant impacts extend south and impacts that do extend in this direction are likely limited to in direct proximity of the storm sewer.

Site Reconnaissance

In preparation of the site reconnaissance, available records and historic information was reviewed in order to have an understanding of current and former operations/locations at the Site. This information was used to confirm operations at the time of the site visit. The historic information review and site reconnaissance information indicated that all properties but three have moderate to heavy use of VOCs for their operations (petroleum storage, parts washers, solvents, paints, etc.). The three exception to this are 1727-1755 Emerson Street (RG&E substation), 480 Ferrano Street (American Tower Systems radio tower) and 1555 Emerson Street (GBH Family Corp – warehouse and distribution); however, even these properties had some minor form of VOC use (bug spray can, printer inks, etc.). It should also be noted that a majority of the properties also were documented (i.e., fire department records, permits, etc.) or highly suspected (i.e., machine shops, metal fabrication, chemical packaging, waste handling, etc.) to have had chlorinated solvent use in the past.

The use of VOCs at each occupied property resulted in the need to differentiate between VOCs due to current or former operations and VOCs potentially due to a subsurface source of VOCs which may or may not be associated with the FESL. In order to differentiate between these two potential causes of VOCs, a detailed evaluation was conducted that included noting operations in the area and VOC emissions due to those operations. Specifically, background/operational VOC readings were recorded throughout each facility in order to be able to evaluate readings obtained from cracks and floor penetrations. For a majority of the facilities, VOC readings would decrease as the meter was brought down from the breathing zone and to the floor, crack, or other penetration through the slab. In these instances, the reading was deemed to be below background and thus not considered a reading of concern for SVI. One exception to this was readings that were collected from locations that were clearly in communication with the subsurface (e.g., holes in floors or passive vent system piping, etc.). In locations where the reading increased, possible on-site operations were evaluated and if present (e.g., dense vapors migrating along the floor from an operation or actively used trench drain), the reading was not considered to be due to SVI. In the event that a reading was noted to be above the apparent operational/background VOC reading, then this reading was identified as a PID reading of interest.

LaBella reviewed each summary completed for the properties on the FESL and evaluated each of the readings of interest in comparison to the groundwater conceptual model, fill progression, and type/location of fill materials. This evaluation resulted in an opinion on if a PID reading of interest was due to the FESL or if such readings were likely due to historic private operations at that property (e.g., solvent use, USTs, etc.).

Methane readings were generally considered due to FESL with the exception of methane readings obtained from sewer manholes/vaults or deemed to be naturally occurring methane from a thermogenic source (three deep wells installed within the Rochester Shale Formation) where laboratory testing confirmed methane readings were due to a thermogenic source.

Methane Evaluation

LaBella performed methane testing on groundwater monitoring well MW-15D (located at 1769 Emerson Street) in order to determine the source of elevated methane concentrations in this well (i.e., >65% on the Landtec GEM 2000 field meter). A representative gas sample was collected from MW-15D and from a soil gas point from a location known to have methane gas due to FESL in order to evaluate the source of the gas (i.e., pipeline gas source, thermogenic source (naturally occurring gas deposit), or landfill gas source). The samples were analyzed for compositional analysis (methane, ethane, butane, propane) and isotope analysis of methane and carbon dioxide. Sample results indicated that the gas identified in MW-15D is generated from thermogenic processes and thus is a naturally occurring gas deposit that MW-15D is venting. This also appears to be the case for DEC-MW-18 and DEC-MW-20 which also appear to be installed at similar or greater depths.

Prioritizations

The results of the cumulative work were utilized in a ranking system that use weighted numerous criteria for each building. The criteria can be separated in to two major categories, Non-FESL related factors and FESL related factors:

Non-FESL Factors:

- *Building Use Factors* – these factors include how many people generally occupy the building on a daily basis and the type of use/potential receptor population (e.g., sensitive receptors like children). It should be noted that these factors increase the concern for SVI; however, these factors do not increase the potential for SVI and specifically SVI due to FESL.

- *Building Condition Factors* – these factors include the type of building and foundation construction (e.g., slab-on-grade, caisson and grade beam, basement, crawl space), condition of the floor slab (e.g., presence of cracking, sealants, number/type of floor penetrations), and heating, ventilation and air conditioning (HVAC) systems related to building pressurization. These factors can increase the potential for SVI; however, it should be noted that a subsurface source of VOCs must be present for these factors to be of concern.

FESL Related Factors

- *Building Location Factors* – these factors include where on the FESL the building is located and specifically in relation to the P-1 plume area (i.e., an increased potential for SVI of VOCs due to FESL) and/or if the building is located over pre or post-1964 landfilling operations (i.e., an increased potential for SVI of landfill gases). These factors increase the potential for SVI specifically due to FESL. Increased potential for SVI landfill gas such as methane is of concern due to the characteristics of methane which include the following:
    - Explosive range of 5% to 15%;
    - Methane can be carried under pressure into overlying buildings and can also carry other VOCs with it; and
    - At a high enough concentration, methane could displace oxygen and create and unsafe condition.

- *Site Reconnaissance Readings* – this category does not account for all readings collected at the Site. Rather, this category only accounts for readings that could not be attributed to current or in some cases, former site operations and thus appeared to be due to FESL. Since these readings may represent actual SVI occurring, each instance of a reading above background was included in the weighting sheet (i.e., multiple readings were included multiple times).

The above weighting/prioritization work resulted in developing three scores for each property: 1) FESL related factors score, 2) Non-FESL related factors score, and 3) overall prioritization score. The overall scores were separated into three "Tiers" of sites. Tier 1 sites were determined to be of the highest concern for SVI due to the FESL, Tier 2 sites were determined to be of moderate to low concern for SVI due to the FESL and Tier 3 sites were determined to be of low to no concern for SVI due to FESL. Based on this work, Table 7 indicates the prioritization of sites. In addition, Tables 8 through 10 provide a brief summary of the results and recommendations for any further work to be conducted. A summary of the results and general recommendations are below. This is further defined below and in Section 6.4.

- **Tier 1 Properties** - Nine (9) buildings are considered Tier 1 buildings. This represents approximately 21% of the building space with an estimated total of 400,985 ft^2. These properties are all in proximity to the inferred extent of the P-1 plume area and generally scored higher on FESL related factors (range between -2 and 12) and received the highest overall prioritization scores. As such, these buildings appear to be at a higher risk for SVI due to the FESL. All but one of these are recommended for additional work (either mitigation or further investigation). The one property not recommended for additional work is an open air, during operations (i.e., occupancy) transfer station that is not heated and as such the potential for exposure is minor (additionally, this building also scored the lowest of the Tier 1 properties for FESL related factors).

- **Tier 2 properties** – Thirteen (13) buildings are considered Tier 2 buildings. This represents approximately 27% of the building space with an estimated 503,239 ft^2. These properties generally scored lower on the FESL related factors; however, their Non-FESL factors (occupancy, use, building characteristics) scored high. As such, the overall prioritization score for these properties fell within Tier 2. However, these properties, with the exception of one, appear to be low to no risk of SVI due to FESL and as such, all but two (2) of the buildings are recommended for no additional work. The two buildings recommended for additional work are associated with Edison Technical School which has air handling equipment in the basement that could be utilized for an added measure of safety and as such is recommended for additional work.

- **Tier 3 properties** – Eighteen (18) buildings are considered Tier 3 buildings. This represents approximately 49% of the building space with an estimated 924,648 ft^2. These properties generally scored lowest on the FESL related factors and also scored lower on the Non-FESL factors. As such, the overall prioritization score for these properties were low and they appear to have low to no risk of SVI due to FESL. Based on this, only one of the Tier 3 buildings are recommended for additional work. The one building recommended for additional work detected methane during the site reconnaissance. However, the floor was subsequently sealed and a follow up monitoring event did not detect methane. The further work recommended is to conduct two (2) more rounds of follow up monitoring to confirm the results. It should be noted that the ranking of this property used the post sealing testing results.

In addition to the above, there were also several properties that were determined to be vacant, undeveloped, buildings not designed for occupancy, already effectively mitigated and one property where access was not granted. These are also summarized below:

- **Vacant/Undeveloped Lands** – Ten (10) properties were determined to be vacant or undeveloped lands. The City of Rochester owns six of these parcels (5 of which are part of the IHWDS). The other 4 are privately owned and either parking lot areas (DeCarolis Truck Parking – 3 properties) and one undeveloped land (partially a wetland, 180 Ferrano Street).
- **Unoccupied Buildings** – Eight (8) buildings were determined to be not designed for occupancy. This represents approximately 0.4% of the building space with an estimated 6,874 ft^2. These buildings were generally storage shed, warehouse space, an RG&E substation, and 5 buildings were associated with the Radio Tower at 480 Ferrano Street. These buildings are infrequently utilized and do not have regular occupants (generally occupied once a week for one hour). Based on this these buildings do not appear to warrant any further work.
- **Buildings with active SSDS In-Place** – Two (2) buildings have an active sub-slab depressurization system (SSDS) in-place and micro-manometer readings of monitoring points indicated adequate sub-slab depressurization was occurring (generally greater than 0.02 inches of water column). Based on this no further work appears warranted with these buildings. This represents approximately 2% of the building space with an estimated 32,448 ft^2.

City of Rochester Institutional Controls

The recommendations made for each of these properties take into account the existing Institutional Controls the City of Rochester has in place. The City of Rochester has a flagging system which requires any property requesting a permit to include a review by the City of Rochester Department of Environmental Quality (DEQ). This control is one check that will allow future changes in occupancy/use or building characteristics to be evaluated by the City which could affect the overall prioritization score.

1.0 Introduction and Purpose

This Soil Vapor Intrusion Assessment Report: Data Review, Site Screening and Site Prioritization (herein after referred to as the "SVI Report") presents the initial phase of work for evaluating Soil Vapor Intrusion (SVI) at the 45 parcels located within the Former Emerson Street Landfill (FESL) footprint also referred to hereinafter as the "Site". A portion of the Site (4 parcels) is listed as a Class 3 New York State Department of Environmental Conservation (NYSDEC) Inactive Hazardous Waste Disposal Site #828023 while the remaining parcels within the FESL have been de-listed. A Class 3 facility is defined as a facility where "contamination does not presently constitute a significant threat to public health or the environment". Although a majority of the Site has been de-listed by the NYSDEC, the site is still on the list of 'legacy' sites maintained by NYSDEC all of which are being evaluated for SVI. A 'legacy' site is a site which has been identified by the NYSDEC, completed Remedial Investigation (RI) and remedy selection processes and is being evaluated for vapor intrusion. The City of Rochester entered into an Order-on-Consent with NYSDEC in August 2009 which initially required the development and implementation of an SVI assessment. This SVI Report fulfills this initial obligation and subsequent to review and discussion with NYSDEC will serve as the basis for further work required at the Site. This work was conducted in accordance with the NYSDEC approved Vapor Intrusion Assessment Work Plan: Data Review, Site Screening and Site Prioritization herein after referred to as the "Work Plan".

2.0 Site Description and General History

The Site consists of approximately 250-acres of land comprised of 45 individual parcels and approximately 45 buildings (some small storage sheds have not been counted). The City of Rochester owns 7 parcels and three of the buildings. The remaining 38 parcels are owned by 25 private owners. The FESL is predominantly occupied by industrial and commercial properties (15 and 20, respectively based on use codes). In addition, City use codes indicate 5 parcels as vacant land, one parcel as unknown (McCrackanville St.) and 4 parcels are listed as community/public service (one of which is a school, Edison Technical School [Edison Tech]). The surrounding area also contains industrial and commercial properties; however, residential properties are also located to the northeast. Figure 1 provides a project locus map that indicates the general area of the Site. Figure 2 is an aerial photograph that provides the boundary of the Site and also shows the surrounding area. Figure 3 illustrates the uses of the Site and the surrounding properties (based on City use codes). In addition, Table 1 includes the following information for each parcel within the FESL:

- Parcel address
- Parcel size
- Occupant/Owner
- Estimated building size and construction date

Prior to FESL operation, the area was primarily vacant and relatively flat lying, with an apparent wetland located in the north-central portion of the site. As a result of landfilling activities, the site has been elevated approximately 15+ feet above the surrounding area. An industrial park presently occupies most of the FESL site, including larger facilities and various smaller industrial/commercial facilities, as well as several undeveloped parcels and undeveloped land on otherwise developed parcels.

The Site was operated by the City from the 1930s or 1940s to 1971 as a landfill. The landfill was used to dispose of ash derived from the burning of municipal waste at the City's incinerators. Ash fill and lesser amounts of construction and demolition debris were the primary waste materials placed in the landfill. Landfilling began south of Emerson Street and gradually expanded northward and eastward to include areas between Emerson Street and Lexington Avenue and east of Colfax Street and south of Emerson Street. Open burning of refuse reportedly occurred in the late 1960s and early 1970s due to operational problems with the incinerators. Fill during this time frame was reportedly being placed north of Emerson Street. In May of 1971 the City's incinerators were shut down; however un-incinerated municipal refuse continued to be placed north of Emerson Street until August of 1971. A detailed description on the history of the site and specifically the type and location of the landfilling is included in Section 4.

For purposes of this report, the FESL is broken up into four (4) Quadrants (A, B, C, and D). Quadrant A is the northwestern portion of the FESL and is defined on the north by Lexington Avenue, the west by Lee Road, the south by Emerson Street, and the east along the property line between 1570 and 1580 Emerson Street and bisects 60 McCrackanville, 575 Colfax and 655 Colfax. Quadrant B is the northeastern portion of the FESL and is defined on the north by Lexington Avenue, the east by Colfax Street and the South by Emerson Street. The western border of Quadrant B is Quadrant A. Quadrant C is the southwestern portion of the FESL. The eastern border of Quadrant C is Quadrant D at Colfax Street. Quadrant D is the southeastern portion of the FESL. As discusses in later sections, the quadrants are based on significant differences in subsurface conditions (i.e., fill materials, groundwater impacts, etc.)

3.0 Previous Investigations

A significant number of investigations have been previously conducted at the Site. A list of reports and relevant documents related to FESL is included as Table 2; however, additional documents (e.g., Phase I and II Environmental Site Assessments) have been developed for private owners. Any additional documents obtained were also reviewed in the context of SVI relating to the FESL. Pertinent information from each of the previous reports is included in Sections 4 and 5.

4.0 Filling History & Source Type of Materials

This section describes the filling history at the Emerson Street Landfill based on multiple sources of information which included reviewing: historic records, previous reports, aerial photographs and discussions with property owners with knowledge of the landfill. The historic records review included City of Rochester documents related to filling at the site and newspaper articles from the 1960s (i.e., during active filling operations). The aerial photographs reviewed included photographs from 1930, 1951, 1958, 1961, 1966, 1970, and 1971. [*Note: Although a copy was not obtained/reviewed by LaBella, a 1963 aerial photograph was discussed in a previous report and this information is included herein.*] The previous reports reviewed as part of this project are provided in Table 2. These multiple sources of information were utilized to evaluate the source/type of fill material and the location/date it was being placed within the FESL.

4.1 Review of Aerial Photographs

The review was conducted by observing locations of apparent disturbed areas that were attributed to filling operations. Disturbed areas were typically lighter in color and tone and unvegetated than surrounding areas and this contrast provided a good indication of man-made disturbance in the area. Additional apparent man-made disturbances that appeared linear in fashion (e.g., haul roads) were also attributed to landfilling operations. It should be noted that some discrete and limited disturbed areas were not attributed to the City of Rochester operations at FESL and these areas appear to be associated with unregulated filling; however, in general these areas are 'consumed' by the FESL in later years. These areas were limited in extent and not connected to obvious large-scale filling operations at the time. Additionally, LaBella also reviewed 'stereo pairs' of aerials which allowed for observation vertical relief for further evaluating locations that were not obvious filling based on a single aerial photograph. This was beneficial for some areas in the southern portions of the FESL.

Geo-referencing Methodology

In order to complete the review and differentiate between locations, LaBella georeferenced each of these aerials to the North American Datum 1983 New York State Plane West (NAD83 NY State Plan West (feet)) spatial projection by aligning major visible features and/or landmarks with common features observed in a modern (2009) aerial photograph projected in NAD 83 NY State Plane West (feet). The projected 2009 aerial photograph was provided courtesy of the NYSGIS Clearinghouse (http://www.nysgis.state.ny.us/). The georeferencing was performed using the Georeferencing toolbar in ESRI ArcMap 9.3.1.

After georeferencing the historic photographs, LaBella digitized apparent active landfill deposition areas for each photograph year, except for 1930. There were no disturbances observed to indicate active filling in 1930. To digitize these apparent active filling areas by year, blank polygon shape files were first created in ArcCatalog (projected in NAD83 New York State Plane West (feet)). The blank shape files were then added to Arcmap for editing. In ArcMap, the Editor Toolbar was utilized to add the filling area features to the shape files. Each shape file was digitized individually by observing the aerial photograph for a given year and then tracing over areas that appeared to be actively disturbed in the photograph (these areas appear very light and scarified in the photographs, compared to the darker vegetated and urbanized areas). Features that appeared to be prior filling (i.e., filling that appears to have occurred prior to the given photograph year, but have started establishment of initial ground cover and vegetation) were also digitized and differentiated by designating as 'prior filling'. It was assumed that these 'prior filling' areas were disturbed between photograph years and had started vegetating over by the time that the given photograph was taken.

A summary of each aerial photograph is provided below.

1930 Aerial Photograph

The 1930 aerial photograph is included as Figure 4A and has been used as the 'baseline' of the filling operations for the FESL since no apparent filling is observed in this aerial. The aerial illustrates that the area was mostly agricultural in nature with some vacant and some residential (i.e., houses/barns) properties. The Barge Canal is present at this time along the southwestern portion of the Site and Emerson Street is also present. There appears to be only one non-residential structure within the entire footprint of the FESL and this is located in the southeast corner of the FESL on the 200 Ferrano Street parcel. Apparent 'shot' rock from the construction of the Barge Canal is also apparent along the northern edge of the canal.

1951 Aerial Photograph

The 1951 aerial photograph is included as Figure 4B and provides the first indication of significant man-made disturbance at the Site. Specifically, the south-central portion of the Site indicates filling operations had initiated at the FESL. Based on the extent of disturbed area it would appear that filling operations began in the 1940s or possibly the 1930s. The West Side Incinerator located at 110-210 Colfax Street was not constructed in 1951 and did not begin operation until January 1955 and as such, the filling at this time appear to be from an off-site source. Based on the other documentation reviewed, it would appear that the fill material distributed here was from the City of Rochester Fall Street Waste Reduction Plant which contained an incinerator to incinerate municipal waste. The filling in each quadrant is described below:

Quadrants A & B – These areas do not appear to be receiving any fill material and appear to be generally similar to the 1930 aerial photograph (residential and agricultural use).

Quadrant C - Filling at this time is limited to the southeast portion of the quadrant. The southeast corner is occupied by a non-residential structure that was not present in 1930, which based on Sanborn mapping (refer to Appendix 1) is a meat packing plant. It should be noted that four (4) apparent above ground storage tanks are also present in the west-central portion of this quadrant in this aerial photo do not appear to be associated with the FESL based on location and access roads.

Quadrant D – Filling extends from the southwest corner of this quadrant and to the north and east with some apparent filling extending nearly to the east-central portion of this quadrant. It should also be noted that the facility at 200 Ferrano Street appears to have expanded with numerous smaller 'out buildings' present in proximity to the main building previously observed on the 1930 aerial photo.

1958 Aerial Photograph

The 1958 aerial photograph is included as Figure 4C and is summarized in relation to each quadrant below

Quadrant A – This quadrant remains largely undisturbed with the exception of some limited apparent filling in the northeast portion of this quadrant. This filling area is not connected with the other areas and could be due to unregulated filling unassociated with the FESL; however, based on the extent of the filling, this area has been assumed to be associated with FESL due to the extent of the disturbed area. The remaining portions of Quadrant A appear to be wooded or residential.

Quadrant B – This quadrant appears to be undisturbed with the exception of two limited disturbed areas in the southern portion of this quadrant. These areas are relatively limited and could be due to unregulated filling; however, these areas align with apparent filling south of Emerson Street that appears to be associated with FESL and as such are assumed to be due to FESL. Additionally, these areas are impacted by obvious FESL filling in later years.

Quadrant C – The filling in this quadrant has significantly increased in extent since the 1951 aerial photo and has extended further to the north and west from the previous area. The filling to the north extends as far as Emerson Street and to the west to approximately the center of this quadrant. Two non-contiguous limited areas of filling are also present, which could be due to unregulated filling; however, these areas are later impacted by obvious FESL filling operations in later years. In addition to the apparent active filling operations, the southeastern portion of this quadrant which appeared to be filled in the 1951 aerial, now appears to be covered and vegetated and as such does not appear to be undergoing filling operations and thus assumed to not receive fill materials after this date.

Quadrant D – The West Side Incinerator is present now in the southwest portion of this quadrant. In addition, the current City of Rochester garage and an asphalt batch plant are also is present directly north of the incinerator. The filling in this quadrant extends to the north and east to distinct lines that appear to generally align with the current property lines associated with the 110-210 Colfax Street property boundaries. Two previously disturbed areas appear to be covered by 1958 and vegetated and thus have been assumed to not receive fill material after this date. It should also be noted that an apparent radio tower is present in the east-central portion of this quadrant and several structures (potentially non-residential) are present in the northwest corner of this quadrant (present-day 1425 Emerson Street parcel) in this aerial.

1961 Aerial Photograph

The 1961 aerial photograph is included as Figure 4D and described by quadrant below:

Quadrant A – This quadrant remains largely undisturbed in 1961; however, some filling has apparently extended north across Emerson Street and is present on the southeast portion of this quadrant. There also appears to be an increase in wooded area in the central portion of this quadrant and several non-residential structures appear along the western edge of this quadrant.

Quadrant B – This quadrant remains largely undisturbed in 1961 with the exception of a significant filled area in the southern portion of this quadrant where it appear that the filling south of Emerson Street likely reached its peak and filling began to move north of Emerson Street.

Quadrant C – Filling in this quadrant appears at it's peak in 1961 with a majority of the quadrant observed to be filled; however, it should be noted that the western and southwestern portions of this quadrant appear undisturbed in relation to filling operations. The western and southwestern portion of this quadrant do appear to have activities unrelated to filling and include the previously noted ASTs and what would appear to be 'mining' of the canal shot rock that was piled along the canal and noted in the 1958 aerial photo.

Quadrant D – Filling in this quadrant east of the incinerator appears to have ceased and vegetation present. However some apparent filling is observed north and northeast of the incinerator; however, this does not appear to be continuous and some of this filling appears to be coming south from Emerson Street.

1966 Aerial Photograph

The 1966 aerial photograph is included as Figure 4E and described by quadrant below:

Quadrant A – Filling has increased significantly in this quadrant by 1966. The filling extends from the southeast and eastern extent of the quadrant and to the central portion of the quadrant. An area of disturbance is also present in the northwest but this disturbed area is non-contiguous and appears to be related to the I-390 construction project to the west, which is evident in the 1970 aerial photograph. In addition, this area of disturbance also did not display relief during a viewing of the stereo pairs (i.e., only surficial disturbance and not filling).

Quadrant B – The disturbed areas have increased substantially in this quadrant from the extent observed in the 1961 aerial. Specifically, apparent filling has progressed to the north and northeast from 1961 and covers nearly half of this quadrant. There are also some sporadic disturbed areas in the northeast corner of the quadrant but this may not be attributable to FESL.

Quadrant C – The previously disturbed areas in this quadrant do not appear to have active filling taking place and vegetation appears to be present over a significant portion of these previously filled areas. In addition, two parcels have been developed along the eastern extent of this quadrant (Colfax Street) and include the 1425 Emerson Street building (Federal Stamping - a metal working company) on the corner of Emerson and Colfax Streets and 305 Colfax Street (Howard and Bowen – a chemical packaging and liquid waste management company).

Quadrant D – The areas of disturbance within this quadrant noted in the 1961 aerial appear to be inactive and vegetation beginning to take hold. In addition, the 330 Colfax Street building is present and the 1335 Colfax Street property appears to be developed with two structures (the current 'eastern building' and shed).

1970 Aerial Photograph

The 1970 aerial photograph is included as Figure 4F and described by quadrant below:

Quadrant A – This quadrant is significantly disturbed with the eastern half of the quadrant nearly all undergoing apparent active filling operations; however, the western approximate 1/3 portion of the quadrant does not appear disturbed and several small structures are present. The previously disturbed area in the northwest corner of this quadrant (area apparently associated with I-390 construction) appears to be unused and vegetation returning.

Quadrant B – This quadrant appears disturbed over nearly the entire quadrant with the exception of the northeast corner where there does appear to be some man-made disturbances however, these do not appear to be associated with the filling operations. An apparent drainage feature proceeds across the northern extent of filling operations in this area.

Quadrant C – This quadrant appears to have no further active filling operations. There is an apparent main haul road from Colfax Street that runs northwest to Emerson Street where it crosses to the active filling area described in Quadrants A and B. The previously noted developments in quadrant C are still present and it also appears that the radio tower is present (current 480 Ferrano Street Property). In addition, there appears to be a drainage channel that runs from the central southern limit of the quadrant to the north then northwest then north again to Emerson Street where it appears to cross to an apparent surface water body on the north side of Emerson Street near the entrance to McCrackanville Street.

Quadrant D – This quadrant appears to have no further active filling and the previously disturbed areas appear to be generally vegetated. It should be noted that some areas in this quadrant appear disturbed; however, these areas appear to be associated with operations around the incinerator and asphalt batch plant rather than filling activities. In addition, two new structures are present in the northeast corner of this quadrant (1425 & 1385 Emerson Street buildings).

1971 Aerial Photograph

The 1971 aerial photograph is included as Figure 4G and described by quadrant below:

Quadrant A – Filling operations in this quadrant appear to be decreasing; however, there are still significantly disturbed areas that would appear to be active filling operations. However, there are also section of this quadrant that would appear to be covered with vegetation beginning to be present. The structures present on the western portion of this quadrant do not appear to be significantly different.

Quadrant B –Filling operation in this quadrant appear to be generally completed and cover material and the beginning of vegetation is evident over a large portion of this quadrant. The light-toned disturbed area appears homogeneous for the northern portion of the quadrant, indicating the lack of active filling. As such, it would appear that this quadrant did not receive fill after covering was completed. Based on City of Rochester records (refer to Section 1.2), there was a contract to cover this area in 1970.

Quadrant C – This quadrant is largely unchanged from 1970, with the exception that the 225 Colfax Street building appears to be present by this time. The haul road and drainage features are still present.

Quadrant D – This quadrant appears to be generally unchanged from 1970, with the exception of some exterior changes (not structures) to areas east of the incinerator on the current 110-210 Colfax Street Parcel. In addition, some exterior changes area also apparent directly west of the 200 Ferrano Street building.

4.2 Review of Historic Documents

The available historic documents reviewed are summarized below in chronological order and copies of these documents (or pertinent sections) are included in Appendix 2:

- Rochester Democrat & Chronicle, January 4, 1958 – This article documented an agreement with the City of Rochester and the towns of Gates and Chili to utilize the West Side incinerator. This agreement was reached due to complaints from operations and fires at the Chili dump. This article does not indicate any problems or issues with the FESL.

- Times Union, September 1, 1967 – This article was mainly focused on the volume of waste generated and where the volume of solid waste generated by Rochester; however, the article includes a picture illustrating what appears to be direct burial of solid waste at the FESL.

- EBS Management Consultants Incorporated report titled "Feasibility Study for an Industrial Park in Rochester, New York" dated July 1969 – LaBella was able to obtain only portions of this report for review; however, the portions available provided the following pertinent information in relation to SVI at the FESL:

- This report estimated 700,000 cubic yards of material had been placed within the FESL.
- At the time of the report it was noted that the active filling operations were north of Emerson Street.
- The maximum depth of fill material north of Emerson Street was 20 feet and south of Emerson Street was 10 feet.

- March 12, 1968 Meeting on Disposal of Solid and Liquid Wastes – LaBella only has a list of persons/representatives at an apparent meeting on disposal of solid and liquid waste for industry. Consultants/Engineers Greeley and Hansen were present and this meeting is likely associated with the study being completed for the City at the time (refer to additional references below). However, it should be noted that this does not specify FESL in the document.

- Rochester Democrat & Chronicle, July 13, 1968 – This article documented a fire at the FESL and the efforts to put the fire out.

- July 7, 1969, City of Rochester, Inter-Departmental Correspondence – This memo refers to the preliminary Comprehensive Solid Waste Study being conducted by Greeley and Hansen for the City of Rochester. The memo references the City of Rochester Sewer Use Ordinance which controlled the disposal of industrial waste to the sewer system. The memo further discusses that liquid waste disposal in the County includes disposal in landfills and illegal discharges to sewer systems; however, it appears that the City was not practicing such disposal at landfills since the memo goes on to request that Greeley and Hansen provide the City with further information in the final report that details how to handle such liquids in this manner. Based on this it appears that the City was not allowing disposal of liquid waste in landfills as late as July 1969.

- Technical Specifications for Earth Embankment at the Emerson Street Landfill dated May 29, 1970 – This technical specification referenced a requirement for providing 2-ft. of cover material over the entire contract area. The contract area appears to be specified on a drawing titled Existing Land Use, Mt. Read-Emerson Area.

- Times Union, November 28, 1970 – This article discussed the upcoming closing of the FESL and the options for future solid waste disposal. In addition, an aerial photograph is also included with the article and clearly indicates a majority of Quadrant B as being covered and graded by this time.

- Comprehensive Solids Waste Planning Studies, May 1970 by Greeley and Hansen, Engineers – This report may have been the preliminary report since 'preliminary' was hand written across the cover; however, based on the July 1969 Inter-Department Correspondence which commented on this report, it would appear this is at least a second draft or possibly the final report. This report was not specific to the FESL; however, there are numerous references to FESL and City of Rochester disposal practices at the time. Below is a list of pertinent information from this report:

    - Pg. 7 of the report indicates that the City (at the time of the report) was operating three incinerator plants and one landfill (i.e., FESL). The landfill was described as 100-acres in size and was limited to the areas bounded by Lexington Avenue, Lee Road, Emerson Street and Fisher Street (current Colfax Street).

- Pg.7 of the report indicates the FESL is used for "the disposal of all nonburnable solid wastes, including incinerator residue, generated within the City, except for hazardous wastes, demolition wastes, dead animals, tree debris, junk vehicles, boiler house cinders, sludges and liquid wastes".
- Table 5 of the report indicates there are two types of commercial waste one of which includes manufacturing and industrial establishments (although the specific type of waste is not mentioned). Both of these types of commercial wastes are listed under the burnable category.
- Pg. 20 of the report is part of Section 10 "Special Wastes, (d) Liquids" and indicates "The methods of disposal presently in use in Monroe County include… (b) cleaning and reuse of solvents…. (d) incineration of oils and solvents…. (f) disposal of various liquids in landfills and (g) illegal discharge to sewers and water courses."

4.3 Review of Previous Environmental Investigation Reports

Summary of Pertinent Filling Information from the 1989 RCRA Report

The RCRA report indicated the following pertinent information on filling operations at the FESL in relation to SVI:

- RCRA indicated four typical soil/waste profiles in the test boring logs reviewed by RCRA. These typical profiles included the following:
  - Municipal rubbish and ash (up to 16.5 feet) directly over dolomite bedrock.
  - Municipal rubbish and ash (up to 20 feet) directly over glacial till/recent deposits (at variable thicknesses of 0.5 to 10.5 feet) thence dolomite bedrock.
  - Reworked soils (up to 10 feet) directly over glacial till/recent deposits (at variable thicknesses of 1 to 8.5 feet), thence dolomite bedrock.
  - Glacial till/recent deposits (up to 16.5 feet) directly over dolomite bedrock.

- Bedrock contours indicated the rock surface elevation decreases in the north central and southeastern section of the FESL.

- An article in the Rochester Times-Union in November 1964 provides a picture of several drums within burning solid waste. [Note: To date, LaBella has not obtained a copy of this article or reviewed the picture.]

Additional information on filling operations was also included; however, much of this information is presented in other reports or documents that are also summarized herein or is not pertinent to SVI at the FESL.

Summary of Pertinent Filling Information and Soil Gas Data from the January 1994 H&A Report

The H&A report indicated the following pertinent information on filling operations at the FESL in relation to SVI:

- The report included a review of aerial photographs. A 1963 aerial was reviewed that indicated the following: "Fill placement from 1961 to 1963 was primarily to the north of the 1961 limit, with a major lobe of fill also extending to the west. Some fill activity was also apparent overlying much of the 1961 fill area north of Emerson Street. Fill activity south of Emerson Street appeared to be very limited." The limited area south of Emerson Street was noted on a figure as within the current location of the 1425 and 1385 Emerson Street Parcel. [Note: As of the date of this report, LaBella has not been able to procure a copy of the 1963 aerial.]

- Open burning of waste was reported to have occurred in the late 1960s and early 1970s.

- This investigation included collecting landfill gas measurements across the FESL area with specially-designed gas flux chambers. As summarized in the report, landfill gas is typically composed of 58% methane, 42% carbon dioxide, and trace amounts of hydrogen sulfide and other organic compounds. Methane emission rates varied in the FESL samples from a minimum of 7.8 to a maximum of 1200 $\mu g/m^2$-minute.

- The H&A report also included analytical information for Chlorinated-VOCs in soil, groundwater, and utility vault water samples, and PID readings for utility vaults and manholes. Analytical results indicated the presence of Chlorinated-VOCs at various locations throughout the landfill, but concentrated in the IHWDS portion.

Additional details on the landfill gas (methane) and CVOC soil gas sampling by H&A are summarized with results by LaBella/Geomatrix for each quadrant below.

Summary of Pertinent Soil Gas Data from the LaBella and Geomatrix March 2001 Report

The LaBella/Geomatrix report indicated the following pertinent information on filling operations at the FESL in relation to SVI:

Sampling was completed in soil, groundwater, sewers, and extensive soil gas points on the IHWDS portion of the FESL in previous studies (discussed above). Analytical results confirmed and further delineated (as compared with previous reports) the presence of Chlorinated-VOCs in the IHWDS portion of the landfill. The soil gas results for the specific constituents detected are briefly summarized below:

- Vinyl chloride concentrations ranged from 0.02 milligrams per cubic meter (mg/m3) to 9 mg/m3;
- Benzene concentrations ranged from 0.02 mg/m3 to 0.6 mg/m3;
- Total BTEX concentrations ranged from 0.48 mg/m3 to 499 mg/m3;
- Chlorobenzene concentrations ranged from 0.02 mg/m3 to 1.6 mg/m3; and,
- Methane concentrations ranged from 380 ppm to 790,000 ppm (i.e., 79%).

Summary of the Pertinent Soil Gas Testing from Each of the Previous Investigation Reports

The information in relation to previous soil gas testing for the above reports are discussed for each quadrant below.

Quadrant A (Northwest Portion of FESL):

Quadrants A is characterized by landfill gas flux measurements between 100 and 1200 $\mu g/m^2$-minute, and/or soil gas methane concentrations above 5,000 ppm. In addition, this quadrant has also been documented with chlorinated-VOC contamination in soil gas, soil, and groundwater. The listed Inactive Hazardous Waste Disposal Site (IHWDS) portion of the landfill is located within Quadrant A.

Quadrant B (Northeast Portion of FESL):

Quadrants B is characterized by landfill gas flux measurements between 15 and 140 $\mu g/m^2$-minute. An apparent discrete CVOC plume is also present in this quadrant (i.e., separate from the P-1 plume in Quadrant A); however, this plume appears limited in extent and generally is within the 535 Colfax Street parcel (refer to Section 5 for greater detail). Additionally, this may be related to post-landfill operations, refer to below. CVOCs in soil gas were not extensively studied within this quadrant.

Quadrant C (Southwest Portion of FESL):

Quadrant C is characterized by landfill gas flux measurements between 33 and 35 $\mu g/m^2$-minute; however, only two soil gas sampling locations were located within this quadrant. In addition, the presence of organic rich marsh-derived soils at depth in this quadrant could also be a source of methane.

Quadrant D (South of Emerson Street, West of Colfax Street):

Quadrant D is characterized by landfill gas flux measurements between 57 and 190 $\mu g/m^2$-minute. In addition, there is one apparent small area of Chlorinated-VOC contamination in this quadrant, which appears to be the result of post-landfill industrial activity rather than landfill operations (refer to below).

4.4 Cumulative Investigative Points Data Interpretation

The previous environmental investigation work completed for the FESL (discussed above and listed in Table 2) consisted of 72 test borings, 45 test pits, 43 monitoring wells (including the wells from this study) and 88 soil gas sampling points. Additional test pits, borings and wells were also completed over the years for private properties as part of environmental due diligence efforts and/or geotechnical evaluations for development. All of these sources of subsurface information were utilized to develop an isopach map of the fill material for the entire landfill, which is included as Figure 6. This map and the information utilized in developing it are discussed for each of the quadrants.

Quadrant A – The fill material in this area ranges in thickness from no fill material observed in the western portion of the quadrant to approximately 23-ft. thick in the central portion of the quadrant. The cover thickness in this quadrant ranges from less than 1-ft. in the northeastern portion of the quadrant to greater than 3-ft. in the central portion of the quadrant. Underlying the cover material, the fill consists of petruscible waste (wood, paper, misc. refuse,), metal, plastic, rubber, brick, glass and some ash in the central and northern portions of the quadrant and predominantly ash in the southern portion of the quadrant in proximity to Emerson Street. This is consistent with the historic information reviewed. Some locations within this quadrant were noted to have fill material placed directly on bedrock, which would indicate portions of the quadrant were excavated prior to filling. Some testing locations indicated apparent native material beneath the fill materials and overlying the bedrock. This native material included in some locations silt and peat deposits which would be consistent with a marsh/swamp area. Locations without fill materials (generally the western portion of the quadrant), the native material consisted of silts and sands.

Quadrant B – The fill material in this area ranges from no fill material in the northeast portion of the quadrant to 22.5-ft. thick in the western central in portion of the quadrant. The cover thickness in this quadrant ranged from less than 6-inches to up to 2-feet thick. Underlying the cover material, the fill consists of ash, petruscible waste (wood, paper, and misc. refuse), metal, plastic, rubber, brick, glass, etc. in the central and northern portions of the quadrant and predominantly ash with some petruscible waste in the southern portion of the quadrant. Fill material in some locations was noted to be directly on top of bedrock, while other locations indicated apparent native material between the fill and bedrock. Native organic materials (peat) were noted in several borings overlying the bedrock. Locations without fill materials (generally the western portion of the quadrant), the native material consisted of silts and sands.

Quadrant C – The fill material in this area ranges from no fill material in the western portion of the quadrant to 11.2-ft. thick in the central and north-central portion of the quadrant. The cover thickness in this quadrant ranged from no cover to up to 3-ft. thick. Underlying the cover material, the fill consists predominantly of ash material with some slag and cinders. It should be noted that some borings indicated lesser (trace) amounts of paper or wood; however these were not the predominant material. Some locations within this quadrant were noted to have fill material overlying directly on bedrock, while others contained native materials between the fill and bedrock. The native materials included apparent marsh deposits (clayey silt with organics) in some locations up to 5-ft. thick.

Quadrant D – The fill material in this area ranges from no fill material in the eastern and portions of the northern section of the quadrant to 11.5-ft. thick in the central portion of the quadrant. The cover thickness in this quadrant ranged from less than 6-inches to less than 3-ft. thick. Underlying the cover material, the fill consists predominantly of ash with some cinders, slag and glass noted. In addition, some wood and charred paper were noted in select borings. Some locations within this quadrant were noted to have fill material overlying directly on bedrock, while other locations noted apparent native material between the fill material and bedrock. The native material in some locations included apparent marsh deposits (clayey silt with organics) in some locations up to 6.8-ft. thick.

Summary of Significant Findings Relating to Historic Filling Location/Type

The work completed to evaluate the type, location and date of filling throughout the FESL resulted in the following findings:

- Filling operations at the site began in the 1930s or 1940s prior to construction and operation of the West Side Incinerator which began operating in January 1955. The fill material prior to 1955 appears to have come from the Falls Street incinerator plant and was placed in quadrant C and D.
- The filling progressed north, east and west over the years. Quadrants C and D appear to be filled until about 1961 at which time operations moved north of Emerson Street and little to no filling was conducted south of Emerson Street.
- The incinerator began operation in January 1955 and appears to have operated well for approximately 10 years at which time the historic information indicates that the incinerator efficiency was decreased and materials may not have been completely combusted. The first incidence of this appears to be a November 1964 Times-Union article that indicates a fire at the landfill; however, all remaining documentation indicates the late 1960s are when incomplete combustion and fires were occurring or direct burial of waste was occurring.
- Based on H&A's review of a 1963 aerial photograph, the last filling south of Emerson Street appears to be in 1963 and was in Quadrant C and specifically around the current 1425 and 1385 Emerson Street Parcels. After about 1963, landfilling was limited to Quadrants A & B.
- Although the Comprehensive Solid Wastes Planning Studies report dated May 1970 by Greeley & Hansen indicated that disposal practices in Monroe County at the time included incineration of liquid waste and landfilling of such waste, this report also indicates that the City of Rochester landfilled non-burnable waste that included incinerator residue but excluded hazardous waste and liquid waste (among other wastes). In addition, the July 7, 1969 City of Rochester inter-office memo inquires about what conditions are necessary for direct disposal of liquid waste. Based on this, it is inferred that as of the time the work was completed (by Greeley & Hansen); liquid waste was either not accepted by FESL operators or liquid waste was incinerated. This appears consistent with the lack of CVOC impacts south of Emerson Street.

The remaining findings are summarized based on the quadrants:

Quadrant A – This quadrant was generally the last to be filled and as such the fill material varies from fully combusted ash material in the southeastern corner to partially incinerated or direct burial of unincinerated or petruscible solid waste in the central portions. The western portion of this quadrant was generally not filled and the 500 Lee Road parcel underwent a fill relocation project during construction and as such fill materials are not located beneath the main building or power house building. The central portion of Quadrant A contains the P-1 plume area which is likely due to either 1) direct disposal of waste solvents sometime around the closing of the landfill (1971) or after closure or 2) fire training operations by GM during at which time the property was owned by the State of New York. The central portion of this quadrant also has been documented to have methane due to the FESL in soil gas at concentrations (based on field meters) to be within the explosive range and CVOCs in soil gas. The fill material in the central portion of this quadrant can be over 20-feet thick and placed directly on bedrock.

Quadrant B – This quadrant began to be filled sometime around 1960 and until 1970. A majority of this quadrant was covered and seeded in 1970 based on a review of contract documents and this appears consistent with the 1971 aerial photo. This quadrant does not have as many soil gas points and thus methane in soil gas is not well known; however, the available data shows significantly lower concentrations in soil gas than in the central portion of Quadrant A. The fill materials in this quadrant consist of ash material in the southern portion and some partially incinerated or direct burial/petruscible waste in the central to northern portions. The thickness of fill materials ranges from no fill to greater than 20 feet in the western central portion of the quadrant. The 655 Colfax Street building (Edison Tech) contains a basement built directly on bedrock and thus a complete removal of fill material was completed for the north and south portions of the main building. The service station building appears to be outside the filling limits. In addition, the 1560 Emerson Street building has underwent two additions and both of these received partial fill removals at that time.

The impacted CVOCs in groundwater within the southeastern portion of this quadrant may be due to post-landfill operations. This is apparent since as late as July 1969 it appears that the City of Rochester was not accepting liquid waste, at least for direct burial and incineration even when incomplete would likely provide complete combustion of a solvent. Furthermore, this area was developed in 1985 as a metal fabrication facility which could have used chlorinated solvents and concentrations of CVOCs in this area have been found to increase over time.

<u>Quadrant C –</u> This quadrant began to be filled in the 1930s or 1940s in the southeastern corner and expanded north and west until about 1961 when landfilling likely ceased in this quadrant. The fill materials generally consist of ash materials; however, some paper and wood were noted in select testing locations. Portions of this quadrant were also noted to have fill material placed directly on bedrock and in other locations to contain marsh deposits between the fill material and bedrock. The soil gas testing in this quadrant is limited; however, the testing complete did not indicate significant landfill gas flux readings. Two fill material removal actions have occurred in this quadrant during redevelopment work. Specifically, all fill material beneath the 55 Vanguard Parkway building was removed during construction and all fill material encountered on the 105 Vanguard Parkway was removed during site development.

<u>Quadrant D –</u> This quadrant began to be filled in the 1930s or 1940s in the southwestern corner and expanded north and east until about 1963 when landfilling likely ceased in this quadrant. The fill materials generally consist of ash materials; however, some charred paper and wood were noted in select testing locations. Portions of this quadrant were also noted to have fill material placed directly on bedrock and in other locations to contain marsh deposits between the fill material and bedrock. The soil gas testing in this quadrant is limited; however, the testing complete did not indicate significant landfill gas flux readings.

The CVOC impacts to groundwater in this quadrant may be due to post-landfill operations. This is apparent since landfilling operations south of Emerson Street appear to have ceased around 1963. The FESL does not appear to have accepted liquid waste for direct burial until at least after July 1969 (if at all). In the event that liquid waste was accepted prior to July 1969, this material would have been incinerated and the incinerators appear to have been working properly prior to the mid-1960s. As such, any incineration of liquid waste should have been completely combusted.

5.0 Groundwater Investigation

This section summarizes the assessment of groundwater in the FESL, and incorporates findings of previous investigations as well as the recent SVI investigation complete by LaBella.

5.1 Previous Groundwater Investigations

Environmental assessments of the FESL site involving subsurface explorations have occurred since approximately 1979. Groundwater has been investigated at the FESL site since approximately 1988. The following is a brief summary of historic environmental investigations that have included some level of assessment of groundwater flow and/or quality:

Year	By (Study Area)	Description
1988-1989	Recra Environmental, Inc. (Entire FESL)	Sampling of soil and bedrock, installation of 13 monitoring wells ("GW" series) and 5 piezometers ("P" series)
1992-1993	Haley & Aldrich (Entire FESL)	Sampling of soil, bedrock and soil gas, installation of 6 shallow bedrock wells and 4 deep bedrock wells ("MW" series), and 2 shallow 'well points.'
2000	Geomatrix Consultants, Inc./ LaBella Associates, PC (Inactive Hazardous Waste Site at 1655 Lexington Ave.)	Sampling of soil and bedrock and installation of 6 shallow and 1 deep bedrock monitoring wells ("GMX" series).

Several other phases of subsurface investigations were performed historically for the Site, however these investigations generally focused on the nature and extent of overburden and landfill materials for smaller sites within the FESL and did not include detailed groundwater assessment. Exceptions to this include an investigation at the Chemical Sales site (located off-site to the south beyond the barge Canal) which included installation of three IWBZ wells (Designated DEC-MW-17, DEC-MW-18 and DEC-MW-20) on the FESL located at 55 and 105 Vanguard Parkway in 2000. In addition, five shallow monitoring wells (MW-5 through MW-9) were installed at 330 Colfax Street (currently leased by PEKO); these wells were installed to investigate petroleum impacts related to a former asphalt batch plant at this property.

These historic investigations have resulted in the installation and sampling 53 total wells at the Site. This includes 45 shallow bedrock (or overburden/bedrock interface) and 8 deep bedrock wells. During the ensuing years, several of the historic monitoring wells were damaged, lost or otherwise rendered unusable. Some of these monitoring wells were damaged or lost due to development and new construction. As part of the recent investigation by LaBella and Geomatrix, an inventory and assessment of all existing wells on the site was performed. The resulting inventory indicates that a total of 47 monitoring wells were still present on the site and in a serviceable condition. Table 4 provides a summary of all historic and new wells installed at the Site, and those which are no longer present or usable. The recent investigation utilized 29 of these monitoring wells.

The following table details those wells which have historically been non-detect or contained CVOCs below NYSDEC Part 703 Groundwater Standards and therefore were not sampled as part of recent investigations:

Well	Non-Detect	CVOCs Below NYSDEC Part 703 Groundwater Standards	CVOCs Above NYSDEC Part 703 Groundwater Standards	Wells Lost or Destroyed
P-2			✓	✓
P-3*	✓			✓
GW-1	✓			✓
GW-2*	✓			✓
GW-3	✓			✓
GW-4		✓		
GW-8S**	✓			✓
GW-8D	✓			✓
GW-10S	✓			✓
GW-10D		✓		✓
GW-11		✓		✓
GW-12	✓			✓
GW-13	✓			✓
MW-14S	✓			
MW-14D	✓			
MW-15S	✓			
MW-15D*	✓			
DEC-MW-20	✓			

Notes:

* *Denotes petroleum detected above NYSDEC Part 703 Groundwater Standards*

** *Methylene chloride detected in this well; however, PCE, TCE, DCE, and vinyl chloride were not detected. Additionally, methylene chloride was also detected in the method blank.*

The following is a generalized summary of findings with regard to groundwater conditions from these previous investigations:

Summary of highlights from the 2000 Study

- The groundwater flow system at the Site is comprised of two hydrostratigraphic units, an Upper Water Bearing Zone (UWBZ) and Intermediate Water Bearing Zone (IWBZ). Both zones are located in bedrock.
- Water levels typically reside in the rock but occasionally exist in the lower portions of the overburden/fill.
- Groundwater in the UWBZ is influenced by large diameter storm sewers running north/south along

the eastern edge of McCrackanville Street and east/west within Emerson Street. These storm sewers were reportedly installed in blasted bedrock. All storm sewer inverts appear to be below bedrock in McCrackanville and Emerson Streets. Invert elevations of these sewers correspond closely to groundwater elevations. The table below illustrates the approximate bedrock elevation, and groundwater elevation for select wells and the nearest invert elevation available from Monroe County mapping.

Well	Bedrock Elevation	Groundwater Elevation	Nearest Sewer Invert Elevation
GMX-MW-3	525.39'	519.86'	517.08' (90 feet Southeast)
GMX-MW-6S	524.26'	516.51'	515.93' (150 feet East)
LAB-106	531.16'	514.06'	514.33' (90 feet North/Northeast)

Note: All elevations are NGVD 29.

As shown in the table above, the bedrock elevations range between about 6 and 16 feet above the groundwater elevation and about 8 to 17 feet above the elevation of the sewer inverts. The groundwater levels range between about 2.8 feet above the sewer inverts to about 0.3 feet below the sewer invert. Although the invert elevations are 90-feet away or more from the wells, this indicates that the sewers in McCrackanville and Emerson Street are at least 6 feet below the top of bedrock and appear to extend deeper into rock down Emerson Street and the portions west of W Street. Additionally, the groundwater levels correlate closely with the invert elevations, which indicates that groundwater is influenced by the fracture network in the bedrock in close proximity to the storm sewers which provide a preferential pathway for groundwater and thus a flow zone.

- The storm sewers are constructed in bedrock and some sections below the water table. Thus the sewer pipes and/or associated bedding are preferential flow paths for groundwater and act as linear drains.
- The UWBZ at the FESL in the area of P-1 plume at 1655 Lexington Avenue detected 17 VOCs in seven groundwater samples in 2000. Copies of the data summary tables are included in Appendix 3.
- Degradation products of CVOCs are present.
- The total CVOCs detected in 2000 in well GMX-MW-3 (located on the west side of the McCrackanville storm sewer) was 5,408 ppb while well GMX-MW-5 (also in 2000) showed a
- concentration of only 11 ppb. Well GMX-MW-5 is approximately 100-ft. east of well GMX-MW-3 and east of the McCrackanville sewer. This is further evidence of the hydraulic barrier of the sewer.
- Petroleum hydrocarbons were identified in the IWBZ; however, groundwater in this zone appears to flow to the north, does not appear to be influenced by the sewer system and appears to be associated with an off-site source to the south.
- Sampling and analysis of water in the storm sewer identified CVOCs in a manhole at the intersection of W Street and Emerson Street and two manholes south of this location. However, a sample from the canal outfall did not detect VOCs.

Summary of highlights from the 1993 Study

- The groundwater contour modeling indicated a groundwater divide generally coinciding with a bedrock surface high in the area. The groundwater flow, in general, was promoted to the northeast for the northeastern portions of the site and to the southeast for the remaining portions of the site.

- Petroleum hydrocarbons identified in deep well MW-15D appeared to be due to an off-site source.
- Groundwater flow is controlled by sewer trenches installed into bedrock.

5.2 Recent Field Investigation Overview

The recent groundwater investigation included the following elements:

- Inventory, assessment and re-development of the previously-installed monitoring wells
- Drilling of nine test borings through overburden and into bedrock, and obtaining soil and rock core samples
- Installation of nine new groundwater monitoring wells, designated LAB-101 through LAB-109
- Decommissioning and replacement of existing well GW-7 (with replacement well GW-7R), due to excessive siltation
- Rehabilitation of existing well GW-9, due to partial burial of the well casing
- Sampling for VOCs and water quality indicator parameters (i.e., ORP, pH, DO, etc.) of all newly-installed and previously-installed wells using primarily low-flow sampling methodology
- Survey of all new, replaced and rehabilitated wells and collection of groundwater elevations

The following sections provide a summary of the methodology used for the recent investigation, the results of the sampling and analysis, and interpretation of the results in light of previous data generated for the site.

5.2.1 Test Boring and Well Installation

All test borings and monitoring wells were installed in general accordance with the project Work Plan at the locations shown on Figure 7. The wells were installed during the periods September 27-30, and December 13-14, 2010 by Nothnagle Drilling Company, Inc. of Scottsville, New York, under observation by Labella and Amec. The wells were installed using rotary drilling methodology.

A summary of monitoring well construction for both the newly- and previously-installed wells is provided on Table 5. Well construction logs for the 2010 wells are included in Appendix 4. It should be noted that the Work Plan proposed nine wells for installation. The well proposed to be located near the intersection of Emerson Street and Polaris Road (the easternmost location of the study) was not installed due to interference with several underground utilities at that location. [Note: This does not appear consequential as there were a lack of VOCs in the nearest new wells (i.e., LAB-102), refer to Section 5.3.3.] Further, two well locations were added to the project subsequent to completion of the Work Plan. In addition, some of the well locations were adjusted in the field from the locations shown in the Work Plan, in order to remain within the City-owned street rights-of-way, or due to utility interference. Most notably, well LAB-104 was installed approximately 75 ft from the desired location, which was adjacent to the former P-2 well.

Test borings were advance through the overburden to the top of bedrock at each location. Boreholes were advance using 4-1/4-in. inner diameter (I.D.) hollow stem augers. Soils were continuously sampled using either a Geoprobe Macrocore sampler or a Standard Split Spoon Sampler. All soil samples were screened for the relative presence of VOCs using a photoionization detector (PID) and the presence of alpha, beta, and gamma radiation using a Ludlum Digital Survey Meter with a "pancake" probe.

The overburden drilling was continued until auger refusal on bedrock was experienced. A 6-in. diameter "socket" was drilled to a minimum depth of 2 ft. into rock using a roller bit. A 4-in diameter black steel casing was then installed to the bottom of the rock socket and the annulus outside the casing was continuously grouted to ground surface. The grout was allowed to set for a minimum of 14 hours in accordance with the Work Plan. Residual grout left inside the bottom of casing was then drilled out, and bedrock coring was performed. Total well depths ranged from approximately 21.5 to 30.5 ft below ground surface (bgs), as indicated on the test boring logs and well completion reports in Appendix 4 and as summarized in Table 5. Bedrock was cored with either NX (2.2-in. I.D., 2.9-in O.D.) or HQ (2.5-in I.D., 3.8-in. O.D.) double-tube core barrels. Boreholes drilled with the smaller NX barrel were then reamed with a roller bit to a final diameter of $3^{7/8}$-in. All newly-installed bedrock wells were constructed with an open rock monitoring interval.

The test borings performed at locations LAB-105 and LAB-109 encountered saturated overburden material below approximate depths of 21 to 22 ft bgs. In accordance with the project Work Plan, overburden/bedrock interface wells were installed at these locations. For these wells, upon encountering refusal on the top of rock, a rock socket was drilled using a $3^{7/8}$-in. roller bit to approximately 3 ft. (LAB-105) or 6.8 ft. (LAB-109) into bedrock. Both of these interface wells were completed with a 2-in PVC monitoring well consisting of a 15-ft-long, 0.010-in slot well screen and sufficient casing to reach the ground surface was installed in the completed borehole.

Each well was completed at ground surface with a flush-mounted road box and a concrete surface seal, with the exception of Well LAB-105 located at 60 McCrackanville Street, which was completed with a square stainless steel protective casing extending approximately 2.5 ft above ground surface.

Rock core obtained from each boring was placed in wooden core boxes. Photographs of the core are included in Appendix 5. A discussion of subsurface conditions encountered at the boring/well locations is included below in Section 5.3.1.

Original well GW-7 was decommissioned by overdrilling, removing the existing PVC well casing, and tremie-grouting the borehole from the bottom to the ground surface.

5.2.2 Well Development

Subsequent to completion of installation, each newly-installed well was developed to remove sediment and establish proper hydraulic connection with the formation. In addition, if drilling fluid loss occurred while advancing the core barrel or roller bit, a corresponding or greater volume of water was removed during the development process. Initial development was performed immediately following the completion of rock coring and well completion, using submersible pumps. The volume of drilling fluid (water) loss during coring and reaming was recorded, as shown on the following table:

Well Location	Volume Lost (gal.)	Volume Recovered (gal.)
LAB-101	25	45
LAB-102	10	20
LAB-103	10	15
LAB-104	0	0
LAB-105	0	0
LAB-106	15	35
LAB-107	500	500
LAB-108	30	50
LAB-109	250	250
GW-7R	70	70

Subsequent development was performed using a submersible pump on October 13, 14, and December 22 2010. Water quality parameters measured during well development included pH, temperature, conductivity, turbidity, oxidation reduction potential, and dissolved oxygen. Copies of the Well Development forms are included in Appendix 6.

5.2.3 Investigation-Derived Waste

Drill cuttings from overburden augering and bedrock drilling were containerized in 55-gallon drums and temporarily stored on the City IHWDS property at 1655 Lexington Ave (accessed from McCrackanville Street). Drilling fluids and initial well development water were containerized either in a 1,500-gallon plastic tank or 55-gallon drums staged at the same location.

All wastes were sampled for waste disposal characterization. Copies of laboratory analytical reports for this sampling are included in Appendix 8. The laboratory results indicated that for both the liquid (groundwater and drilling fluids) and solid (drill cuttings) wastes, contaminants were either not present or were present at very low levels. Accordingly, all materials were deemed non-hazardous and disposed as such.

Approximately 1400 gallons of drilling fluids and development water from the tank and drums was discharged on November 24, 2010 to the sanitary sewer in accordance with a Specialty Short Term Discharge Permit No. ST-174 issued to LaBella by the Monroe County Department of Environmental Services (see copy, Appendix 9).

Approximately 12 drums of drill cuttings were disposed of at the 1655 Lexington Avenue (IHWDS) property. The material was placed in an active filling area where potential ash-containing soils from the 1770 Emerson Street parcel (also within the FESL) were being relocated as part of a construction project. The fill relocation work was conducted in accordance with the NYSDEC-approved *Fill Relocation Plan* dated August 2010 and revised September 2010. The drummed soils were placed in the berm on-site and covered with the clean soil from the 1770 Emerson Street parcel. The empty drums were removed from the Site and recycled.

Additional drums of waste development or sampling water are currently stored on the IHWD site and will be characterized and disposed in a similar manner in the Spring of 2011.

5.2.4 Well Sampling

Each monitoring well was sampled during one of five sampling events, as summarized below.

Date Sampled	Wells Sampled	Consultant(s)
July 13-14, 2010	GMX-MW-1, GMX-MW-2, GMX-MW-3, GMX-MW-4, GMX-MW-6S, GMX-MW-6D, GW-5, MW-5, MW-7, P-1, P-5	LaBella AMEC
August 26, 2010	GW-6, MW-16S, MW-16D, MW-17	AMEC
October 19-10, 2010	LAB-101, LAB-102, LAB-103, LAB-104, LAB-105, LAB-106, LAB-107, LAB-108	LaBella AMEC
December 9, 2010	LAB-101, P-4, MW-19, GW-9	LaBella AMEC
December 29, 2010	LAB-109, GW-7R	LaBella

All wells were sampled at least seven days after development. Groundwater samples were collected from each existing monitoring well using low-flow sampling techniques. Prior to sample purging, each well was checked with an oil/water interface probe to evaluate for potential light or dense non-aqueous phase liquids (LNAPL or DNAPL) in the wells. The following table summarizes the wells sampled during each sampling event:

Low-flow sampling of the monitoring wells was conducted in general accordance with American Society of Testing and Materials (ASTM) Standard Practice D6771-02 to minimize groundwater drawdown and to obtain a representative sample of groundwater conditions. In order to accomplish this task, the following steps were taken:

1. The following low flow equipment was utilized to conduct low flow groundwater sampling. This equipment includes:
   - QED Sample Pro Bladder Pump
   - Horiba U-22 Water Quality Monitoring System (with flow thru cell)
   - Air Compressor
   - QED MP10 Low Flow Controller
   - ~100' of ¼" Polyethylene Tubing

2. Low flow purging of the monitoring wells included collection of water quality indicator parameters. Water quality indicator parameters were recorded at five (5)-minute intervals during the purging of the well. These water quality indicator parameters included:
   - Water Level Drawdown
   - Temperature
   - pH
   - Dissolved Oxygen
   - Specific Conductance
   - Oxidation Reduction Potential
   - Turbidity

3. Groundwater sampling commenced once the groundwater quality indicator parameters were stabilized for at least three consecutive readings for the following parameters:

   - Water Level Drawdown <0.3'
   - Temperature - +/- 3%
   - pH - +/- 0.1unit
   - Dissolved Oxygen - +/-10%
   - Specific Conductance - +/-3%
   - Oxidation Reduction Potential - +/-10 millivolts
   - Turbidity - +/-10% for values greater than 1 NTU

   Copies of groundwater sampling logs are included in Appendix 10.

4. All purge water was containerized in 55-gallon drums, and temporarily stored at the IHWD site at 1655 Lexington Avenue.

5. Groundwater samples were collected for USEPA Target Compound List (TCL) VOCs using USEPA Method 8260B.

Quality Assurance/Quality Control Sampling

Laboratory quality assurance/quality control (QA/QC) sampling included analysis of sample blanks as follows: one trip blank, one field blank, and one method blank. Field blanks consisting of trip blank, routine field blank, and rinsate blanks were obtained at a frequency of one per shipment. Additionally, one Matrix Spike/Matrix Spike Duplicate (MS/MSD) was collected and analyzed at a frequency of one per shipment. The MS/MSD was analyzed for the same parameters as that of the field samples.

5.2.5 Laboratory Analysis

Groundwater samples were collected for USEPA Target Compound List (TCL) VOCs using USEAP Method 8260. All groundwater samples were submitted for analysis to Chemtech of Mountainside New Jersey, a New York State Department of Health ELAP-Certified laboratory. The laboratory provided a NYSDEC ASP Category B Deliverables data package for all samples. Copies of the laboratory analytical reports are included in Appendix 7.

Data Usability Study Reports (DUSRs) were completed for all five ASP-B laboratory data packages per NYSDEC's DER-10 guidance document. The DUSRs include the laboratory data summary pages showing corrections made by the data validator and each page has been initialed by the data validator. All groundwater sample results were found to be compliant with the data quality objectives for the project and useable. The laboratory data summary pages are included in Appendix 11.

5.3 Geology and Hydrogeology

5.3.1 Geology

Overburden Geology

Most (but not all) of the FESL is underlain by waste fill materials placed in the landfill (refer to Section 4.0). The thickness and nature of the fill materials varies in different portions of the landfill and reflect variations in waste types, incineration and disposal practices, and pre-filling topography (refer to Section 4.0 for detailed filling information).

Based on historical and recent investigations the fill (waste material or fill soil) thickness overlying native soil or bedrock across the site ranges from approximately 5 to 28 ft. The 1993 H&A of New York report contained a thorough discussion of overburden and fill material presence for the entire site. In addition, a more detailed description of the fill history is included earlier in this report in Section 4.0.

The 2010 subsurface explorations were performed primarily in street rights-of-way where waste fill presence was often minimal. Exceptions to this include borings performed at locations LAB-105 (on 60 McCrackanville Street) and Lab-109 (on 1640 Emerson Street), where deposits of waste fill materials were observed to be 26.5 and 17 ft. thick, respectively. At the LAB-105 location as well as several historical exploration locations to the north and south of Emerson Street, the waste materials were found to rest directly or nearly directly on bedrock. This is indicative that native soils were mined from the site prior to filling, and were probably used for cover materials.

In areas where native soils were still present overlying bedrock, they ranged in composition from fine-grained lacustrine silt and clay to fluvial sands with varying amounts of gravel. The native materials, where present, were up to 6-ft. in thickness. Organic-rich soil (peat) deposits were also observed across the site and predominantly in the southeast and northwest portions of the Site. This is important to note as these materials can also be a source of methane production. Additional information on location and thickness of native materials is provided in the discussion on Filling History in Section 4.0.

Bedrock Geology

The top of bedrock surface has been relatively well defined by numerous subsurface explorations advanced during several investigations. The elevation of the top of rock surface ranges from approximately el. 518.7 to el. 532.5, a total relief within the FESL of over 12 ft. The highest point in the rock surface encountered to date appears to be test boring B-119 (H&A, 1992) located on Emerson Street south of 1560 Emerson Street, and the lowest point was encountered at former well GW-12, located just north of Emerson, near the area where the 60 McCrackanville and 535 Colfax Street properties join. The elevation data indicate a curved buried escarpment in the rock surface that roughly parallels Emerson Street were the surface drops off sharply to the north.

Figures 9 through 12 provide cross sections at selected locations.

The bedrock unit immediately underlying the central and southern portions of the Site is generally interpreted to be the Penfield member of the Eramosa Dolostone (formerly referred to in the Rochester area as the Lockport Dolomite). The Penfield is generally a light gray, medium to thin-bedded siliceous dolostone, with occasional argillaceous partings, and zones of pits and vugs. Secondary crystallization with dolomite, selenite and quartz in pits, vugs and joints is common.

The Decew Dolostone member of the Rochester Formation immediately underlies the Penfield in the vicinity of the site. The Decew generally has a similar makeup to the Penfield, but is often characterized by a wavy, or enterolithic bedding structure.

Test borings advanced as part of this investigation extended between 3 and 22 feet below the top of bedrock. The rock quality designation (RQD) value was determined for all rock core obtained in this investigation. RQD is a measure of the occurrence of discontinuities (joints or fractures) in a rock mass, and is defined as the length of rock core recovery for solid and complete core pieces that are longer than 100 millimeters (approximately 4 inches) in length, measured along the centerline of the core, expressed as a percentage of the total length of a core run.

The RQD values for rock core obtained in this investigation are summarized in Table 6. RQD values in the first core run (the upper 5 to 10 ft) ranged from 7 to 92%, and averaged 43%. Of the 17 core runs (core runs ranged up to approximately 10 ft in length) made, 13 runs exhibited rock with RQD values below 75%. RQD values below 75 percent are generally considered to represent poor quality rock. For those borings where multiple core runs were made, the RQD values typically increased with depth indicating that contaminant flow is retarded as depth increases. This finding is consistent with previous investigations performed at the site.

Test boring LAB-107, which was drilled in close proximity to the Emerson Street storm sewer (which is installed below the top of rock), encountered materials overlying the competent bedrock that appeared to be a potentially blasted zone of rock.

Previous geologic investigations performed in the Rochester area have identified the presence of apparent structural deformation in bedrock in selected locations. Most notably, investigations by Haley & Aldrich for the Monroe County Combined Sewer Overflow Abatement Program (CSOAP) in the early 1980s included deep test borings and mapping of bedrock outcrops in relatively close proximity to the vicinity of the FESL.

Based on correlations of marker stratigraphic units and an exposed fold/fault structure present in the Barge Canal near Lyell Avenue a short distance south of the FESL site, a potential zone of deformation in bedrock was identified that may potentially include some of the southern portion of the FESL. Additionally, a linear feature was identified in 1994 H&A report that corresponds with the P-1 area and indicates possible deformation of bedrock in this area. A copy of the H&A Figure is included in Appendix 12. The bedrock mass in this zone of deformation may be characterized by a greater presence of discontinuities (faults, joints, fractures and weathering) and a corresponding increase in permeability. The depth of this zone is not clearly identified but it is likely to extend relatively deeply in the rock mass. Accordingly, groundwater flow in both the UWBZ and IWBZ may be impacted.

5.3.2 Hydrogeology

Groundwater flow conditions were assessed using the entire well network at the Site, including the nine newly-installed wells, 24 previously-installed wells and one replacement monitoring well (See Table 5). The newly-installed wells were generally installed within the upper 5 to 10 ft of bedrock and accordingly, these wells monitor only the UWBZ. Well LAB-106 was installed to a depth of 22 ft below the top of rock due to high RQD values and apparent lack of groundwater in the upper 10 ft. of rock.

Water levels were obtained in all wells 8 and 9 December 2010. Figure 8 is a groundwater contour map that depicts water table elevations across the site for those dates and the inferred groundwater flow directions. The groundwater contour plan depicts a relatively wide variation in flow direction in the UWBZ. Groundwater highs exist in the northwest portion of the site and in a large area occupying the central portion of the site. Groundwater lows tend to exist in the vicinity of the storm and/or sanitary sewers that exist within the main road rights-of-way (ROWs). This indicates that portions of these sewers function as "linear drains" and intercept groundwater flow in those areas of the site where the sewers have been installed into bedrock at elevations below the natural groundwater table.

The groundwater flow impact from the sewers may be a result of one or more of the following factors:

- flow into and through sewer bedding material (exact bedding material is unknown but is likely select stone bedding or blasted rock fragments)
- flow into and within zones of bedrock that have been artificially fractured by blasting performed to construct the sewers
- infiltration of groundwater into the sewer pipes

The following section provides a more detailed discussion of groundwater flow, as well as groundwater quality.

<u>Quadrant-Based Discussion of Hydrogeology</u>

As previously discussed in Section 2.0, quadrants for the Site have been selected based on groundwater impacts, filling history/potential for methane, and property boundaries. These quadrants are further discussed below in relation to the groundwater flow for each quadrant.

Quadrant A

Quadrant A is defined in the northern and western extent by the boundary of the FESL (i.e., Lexington Avenue and Lee Road). The eastern extent of Quadrant A corresponds with a groundwater divide that is evident between McCrackanville Street and Colfax Street. In relation to property lines, the eastern extent of Quadrant A is along the property line between 1570 and 1580 Emerson Street and bisects 60 McCrackanville, 575 Colfax and 655 Colfax (through the athletic fields of Edison Technical High School. The southern limit of Quadrant A is defined as Emerson Street.

Groundwater flow in this quadrant is generally characterized by:

- Groundwater migration onto this quadrant from offsite northwest areas;
- Substantial influence by the storm sewers that runs north-south in McCrackanville Street and east-west in Emerson Street. These storm sewers are constructed below the top of bedrock.
- Eastward flow in the area west of McCrackanville Street, in the northern portions of 500 Lee Road and 1655 Lexington Avenue (i.e., from 500 Lee towards 1655 Lexington then to the sewer in McCrackanville Street).
- Southward flow towards Emerson Street in the southern portion of 500 Lee Road and 1655 Lexington and all of 1740 Emerson Street, (i.e., in the southern portion of 500 Lee Road and 1655 Lexington these properties would be cross-gradient of each other).
- Flow in the eastern portion (east of McCrackanville Street) is generally toward the west to the storm sewer in McCrackanville Street. This would include westward flow beneath the western portions of the properties of 655 Colfax, 575 Colfax and 60 McCrackanville, and essentially all of the property at 1640 Emerson.
- Potentially westward or southward flow beneath the property at 1580 Emerson Street, which sits atop an apparent groundwater high.
- A hydraulic gradient ranging from approximately 0.007 in the central area to 0.035 in the southern portion of the quadrant.

The storm sewers (see cross sections, Figures 9 through 12) are constructed of corrugated metal pipe, range from 54 to 72 inches in diameter, and are installed below the top of bedrock. The storm sewer ultimately discharges to the Barge Canal in the southwest portion of the FESL.

Quadrant B

Quadrant B is the northeastern portion of the FESL and is defined on the north by Lexington Avenue, the east by Colfax Street and the South by Emerson Street. The western border of Quadrant B is Quadrant A and is located in proximity to the groundwater divide identified in the western portions of 655 Colfax Street, 575 Colfax Street and 60 McCrackanville.

Groundwater flow in this quadrant is generally characterized by:

- A groundwater high (at approximate elevation 526-feet during the December 2010 monitoring) in the southwestern portion of the quadrant (eastern portion of 60 McCrackanville)
- A groundwater gradient ranging from approximately 0.005 to 0.014
- Northwest flow in the northern portion of Quadrant B, including the portions of the 655 Colfax and 575 Colfax properties within Quadrant B. This northeast flow is likely influenced by the sanitary and storm sewers in Lexington Avenue and Colfax Street
- Easterly flow beneath 535 Colfax Street, and generally southerly flow beneath 1444, 1520, 1560, and 1570 Emerson Street. The flow beneath the Emerson properties appears to be controlled by the Emerson Street storm sewer

The northern portion of Colfax Street contains separate storm and sanitary sewers; however, the sanitary sewer is generally deeper and appears to be below the water table south of Edison Technical HS. This sewer, which is likely intercepting groundwater flow in that area due to fractured bedrock networks and porous sewer bedding, ultimately connects to the Lexington Avenue combined sewer.

Quadrant C

Quadrant C is the southwestern portion of the FESL. Groundwater in this quadrant is generally characterized by:

- Southerly to southwesterly flow across much of the quadrant, at gradients ranging from approximately 0.035 to 0.01. This general flow appears to encompass properties at 1769 Emerson, 1684/1685 Emerson (southern portion), 1575 Emerson (southern portion), 1555 Emerson (southern portion), 1525 Emerson (southern portion), 361 Colfax, 395 Colfax (western portion), 351 Colfax (western portion), 480 Ferrano Street, 55 Vanguard Parkway, and 105 Vanguard. Groundwater flow in this portion of Quadrant C appears to be controlled by capture on the southern boundary by the 78-in. reinforced concrete Ferrano Street storm sewer pipe and/or the Barge Canal.
- Generally northerly flow in the northern portion of the quadrant due to apparent groundwater capture by the Emerson Street storm sewer , including beneath 1727-1755 Emerson and the northern portions of 1684-1685 Emerson, 1575 Emerson, 1555 Emerson, 1525 Emerson and 1465 Emerson.
- Easterly groundwater flow along the eastern edge of the quadrant beneath 1465 Colfax, 395 Colfax (eastern portion), 351 Colfax (eastern portion) and 305 Colfax (eastern portion). This easterly flow appears ft be controlled by the 36 to 42-in. reinforced concrete Colfax Street combined sewer.
- Potentially northeasterly or northerly flow in the southeastern corner of the quadrant, beneath properties at 400 Ferrano, 145 Colfax, 225, Colfax, and 304 Colfax. This is also due to capture by the Colfax sewer as evidenced by enclosed groundwater contours at the sewer location in the vicinity of these properties.

As indicated above, the Barge Canal is likely also influencing groundwater in this quadrant, and the gradient toward the south may steepen during winter months when the canal is drained to an elevation below the natural water table. This gradient, and potentially flow directions may change significantly after approximately May1st, when the canal water level is raised for the navigation season, which lasts until mid-November.

Quadrant D

Quadrant D is the southeastern portion of the FESL. Groundwater flow in much of Quadrant D is not thoroughly defined due to a lack of monitoring well coverage resulting from several historic wells being lost or destroyed. Based on the remaining historic wells and new wells installed as part of this investigation, groundwater flow in the western portion of the quadrant is toward the west and appears to be captured by the Colfax Street combined sewer. This includes properties at 1425 Emerson, 330 Colfax and 333-337 Colfax. It should be noted that groundwater flow in this Quadrant was not deemed to be critical since groundwater impacts due to FESL have not been identified in this quadrant and thus additional wells do not appear warranted for this evaluation.

5.3.3 Groundwater Quality

This section provides a summary of the groundwater quality observed in sampled wells. This discussion includes results from historic sampling events as well as the recent 2010 sampling.

Previous investigations completed at the FESL have documented groundwater conditions across most of the site, both on a site-wide and parcel-specific scale. The following is a summary of significant findings from these previous investigations:

- A chlorinated VOC (CVOC) plume in groundwater is located on the City-owned parcel at 1655 Lexington Avenue, which comprises approximately 60% of the approximate 24 acre NYSDEC-listed IHWD Site. Given that total CVOCs in Monitoring Well P-1, located in the apparent source area of the plume, have historically been as high as approximately 54 parts per million, dense non-aqueous phase liquid (DNAPL) may be present based upon the > 1% solubility for CVOCs per DER-10. Although the P-1 well location is presumed to be located at or near the source of contamination, the entire source area is not clearly defined.

  The CVOC plume extends generally toward the east and south from well P-1. Capture of the impacted groundwater by the storm sewers located along the east and south limits of the IHWDS appears to have limited the extent of the plume. Some extension of the plume to the south and east beyond the storm sewers in Emerson Street and McCrackanville has occurred; however, the extent is limited and CVOC concentrations were greatly reduced from wells on the opposing side of these sewers.
- Chlorinated VOCs at significantly lower concentrations than the IHWDS area described above have been identified in other areas of the FESL. These occurrences appear to be limited in lateral extent and may be the result of post-landfill site uses.
- At least one off-site source of non-chlorinated, petroleum-related VOCs has been identified. The petroleum-impacted groundwater is in the IWBZ, at deeper levels than the CVOC impacts discussed above.

As indicated above, the recent investigation included groundwater sampling of nineteen previously-installed, one replacement and nine newly-installed monitoring wells. The primary focus of the analyses was VOCs, using USEPA Method 8260B. Table 3 provides a summary of all groundwater analytical results. Appendix 3 contains summary tables from historical investigation reports. A temporal comparison is provided on Figure 13, which shows results for the 2010 groundwater investigation and the 2000 investigation.

As a general summary: twenty of the twenty nine recently-sampled wells contained VOCs at levels at or above the method detection limit (MDL); nine wells showed no detectable VOC presence. Of the twenty wells with VOCs detected, eleven did not contain VOCs at concentrations in excess of the NYSDEC's Part 703 Drinking Water Standards. The remaining nine wells contained one or more VOCs at a concentration that exceeded the standards. Seven of these nine wells exhibiting exceedences were located on or in close proximity to the IHWD site, and are related to the previously-identified VOC plume. The remaining two wells (GW-7R and GW-9) are located on Colfax Street and appear to represent sources of VOCs separate from the IHWD site. Additional information on this assumption is provided in the Filling History (Section X), which details information on the location, type and dates of filling and subsequent redevelopment for each quadrant.

The following is a discussion of groundwater quality on a quadrant-by-quadrant basis.

Quadrant A

Quadrant A contains the highest VOC impacts to groundwater in the entire FESL site. A sample from monitoring well P-1 located at 1655 Lexington Avenue, the apparent source area, in 2000 contained total VOCs at 54,422 parts per billion (ppb). This was entirely related to CVOCs at the time. The most recent sampling event (July 2010) showed a decrease in CVOC concentrations to 34,007 ppb (a decrease of 37 percent). However, total concentrations are still within percent levels and there is a potential for DNAPL. Relatively low levels (19.2 ppb) of petroleum-related VOCs (benzene, toluene, ethylbenzene and xylene, or BTEX) were also detected in the 2010 event.

The groundwater sampling results indicate a relatively narrow CVOC plume exists in Quadrant A which extends to the southeast and south from the P-1 source area. The plume extends southward to Emerson Street and slightly beyond (into Quadrant C). In Quadrant A, well GMX-MW4, located only 225 feet east of P-1 showed only 1.5 ppb CVOCs. Wells GMX-MW-3 and GMX-MW-6S (both located on the east side of the McCrackanville Street storm sewer), which appear to represent the most direct downgradient well locations in relation to well P-1 (based on the inferred flow directions), showed CVOC concentrations of 2,031and 89.5 ppb, respectively in the July 2010 sampling event. These results are approximately one to two orders of magnitude less than the source area well. It should be noted that CVOC concentrations in well MW-6S increased from 3 ppb in 2000 to 89.5 ppb in 2010. As such, it appears that buildings in proximity to this portion of the P-1 plume are at an increased risk for SVI.

The portion of the storm sewer along McCrackanville Street appears to have effectively served as a "cutoff" for the eastern extent of the plume. This is evidenced by the fact that well GMX-MW-3 located directly west of the sewer contained a total CVOC concentration of 2,035.6 μg/L and well GMX-MW-5 located approximately 25 feet east of the sewer contained a total CVOC concentration of 8.6 μg/L. Individual CVOC concentrations in well GMX-MW-5 were below groundwater standards. Well LAB-109, located 90 ft. east of the sewer did not contain VOCs at detectable levels. This implies that as the distance from the sewer and fracture network increases, groundwater contamination decreases significantly.

Limited migration of the plume toward the west and southwest from the well P-1 area has also occurred. Wells MW-14D and MW-14S located at 500 Lee Road, approximately 400 feet to the west of P-1 were non-detect for CVOCs during the last sample round in July 2000. Additional groundwater data provided by Day Environmental, Inc. (Day) for two wells, one located at the 500 Lee Road property (designated DAY-MW-1) and the second (DAY-MW-2) located at 1770 Emerson Street further delineates the western aerial extent of the P-1 plume. Well DAY-MW-1 located approximately 400 ft. northwest of P-1 and 200 ft north of MW-14S/D, was non-detect for VOCs during a 2001 sampling event. Additionally, well DAY-MW-2 located approximately 625 ft. to the southwest of P-1 and 175 ft southwest of GMX-MW-1, was also non-detect for VOCs during a 2001 sampling event. Groundwater sampling data and boring logs for wells DAY-MW-1 and DAY-MW-2 are included in Appendix 3. Well GMX-MW-1, located approximately 500 ft. south-southwest of P-1, contained 8.9 ppb CVOCs in the recent investigation (significantly reduced from the 117 ppb detected in the 2000 study). The detections in GMX-MW-1 could be due to dispersion of the plume or potentially due to a sump located at the 500 Lee Road Powerhouse building. This sump is located in the deepest portion of the basement within this building and the bottom of the sump is at approximately el. 514 ft. Based on this depth and the interpolated groundwater elevation in this area of 520-ft. (refer to Figure 8), it is likely that this sump influences groundwater flow locally and could potentially be drawing groundwater towards the southern portions of 500 Lee Road from 1655 Lexington Avenue. It should be noted that sampling results obtained in both 1992 and 2000 from monitoring wells MW-14S and MW-14D (located immediately west of the IHWD site on 500 Lee Road) did not show detections of VOCs and as such, it is not anticipated that the sump influences groundwater in the central and northern portions of 500 Lee Road property.

Quadrant B

The groundwater quality in Quadrant B varies significantly from that of Quadrant A. VOC presence is limited to: wells LAB-102 and LAB-107, located along Emerson Street in close proximity to the storm sewer; well GW-7R, located along Colfax Street just north of Emerson Street; and well MW-16D, located on 655 Colfax Street (Edison Tech HS). The wells along Emerson Street (LAB-102 and LAB-107) contained CVOCs at levels below their respective groundwater standards and appear to contain primarily breakdown product compounds indicating the final stages of contaminant degradation. Well GW7R contained CVOCs at approximately 71 ppb. Note that the original well GW-7 (now decommissioned) contained CVOCs at 36 ppb when last sampled in 1992. The source of this CVOC presence is unknown but based on the groundwater flow direction in the vicinity and the increase in total concentrations of CVOCs is presumed to be associated with a nearby source unrelated to the Quadrant A source at the IHWDS.

Well MW-16D (on Edison Tech HS property) contained only one CVOC compound, 1,1-dichloroethane, at 1.1 ppb, below its respective groundwater standard. Historically (1992) this well contained 6 ppb of petroleum-related VOCs and 1 ppb of trichloroethene, but these compounds were not present in the 2010 sampling. Note also that the shallow bedrock monitoring well at the same location (MW-16S) has not contained VOCs in historic or recent sampling events. The other wells on the Edison Tech HS property have not shown VOC presence in recent or historic investigations.

The basement of the Edison Tech HS building is constructed down to, or even slightly below the top of bedrock, at approximate elevation 521.5 ft. The groundwater elevation in MW-16S on December 8, 2010 was 520.5, or one ft. below the Edison Tech basement floor. This would appear to correlate with the level of water within the basement sumps. It should also be noted that the deeper well west of the building, MW-16D, had a slightly deeper water level (el. 520.35) and more importantly the open-rock interval (sampling interval) of this well is between el. 499.2 and 507.2 and as such is representative of groundwater at least 13-ft. below the level of the sump water. Based on this, the shallow bedrock groundwater (which did not detect any VOCs above the reported laboratory detection limit) is representative of groundwater in the sumps, and thus, the detection of 1.1 ppb of 1,1-DCA in MW-16D does not appear to be a concern for the sumps in the basement.

These data and the observed groundwater flow directions indicate the CVOC plume present in Quadrant A has generally not impacted Quadrant B. The presence of CVOCs in well GW-7/GW-7R are presumed to be from an unidentified source separate from that of the P-1 plume area. It should be noted that the facility located at 535 Colfax Street, immediately adjacent to the well GW-7R location, historically contained a metal fabrication business. Although metal fabrication operations often utilize solvents, specific information regarding usage or potential release of such materials was not found during this investigation. The current occupant of 535 Colfax does not appear to utilize chlorinated solvents.

Quadrant C

Recent sampling results indicate groundwater in this quadrant is largely free of CVOC presence, with the exception of a narrow zone located along the western portion of Emerson Street. The contamination in this area appears to be an extension of the Quadrant A (P-1 area) plume, where CVOCs have migrated across Emerson Street (and across the storm sewer alignment) into Quadrant C. Total CVOC levels are most pronounced in wells LAB-104 (67 ppb), and LAB 106 (48 ppb). Former well P-2 (originally located approximately 75 ft. southwest from LAB-104, and now lost/destroyed) contained CVOCs in 1993 at approximately 1,088 ppb.

Monitoring well LAB-101, located to the south, did not contain VOCs in the most recent sampling round; however, LAB-106, located near the junction of the Emerson Street and W Street storm sewers, contained total CVOCs at approximately 48 ppb. This well is located in relatively close proximity to the sewer alignment and these results may indicate migration of contaminants along the sewer pipes or bedding material. Bedding material is likely a porous material consisting of either select stone bedding or blasted rock fragments put in place around the sewer. This migration may extend southward along W Street, however the extent is not well defined. Sampling of the storm sewer water in Emerson Street between W Street and McCrackanville Street in 1992 and 2000 also indicated primarily CVOC presence in the sewers themselves (with the exception of xylene at a concentration of 4.1 ppb or less in 2000 and lower level petroleum compounds in 1992), with the highest concentrations observed in the W street portion.

Other current or former wells in Quadrant C have generally shown little to no VOC presence. Well P-4, located on the property at 1465 Colfax near the intersection of Emerson and Colfax, contained VOCs at a concentration of 3 ppb in the 1992 sampling event, but showed no VOCs in the recent sampling event. Well MW-19, located in the southeast corner of the quadrant at 145 Colfax Street, contained 27 ppb CVOCs in 1992, but showed no VOC presence in the recent investigation.

Bedrock monitoring wells DEC-MW-17, DEC-MW-18 and DEC-MW-20 (constructed in the IWBZ) by URS for NYSDEC in 2000 were installed on the 105 and 55 Vanguard Parkway properties. These wells were installed as part of an investigation of the Chemical Sales facility located south of the FESL and to the south of the Barge Canal. Analytical results from a samples obtained at that time did not detect CVOCs; however, BTEX compounds were present in the IWBZ at these locations, but were attributed to be from a source to the south of the FESL.

Quadrant D

The majority of wells installed in Quadrant D historically have not contained VOC compounds. Exceptions to this are well GW-9 (1425 Emerson Street), which contained 94 ppb CVOCs in 1992, and contained 115.8 ppb in December 2010. The source of this contamination is uncertain but may be related to the presence of current or former metal fabrication/machine shop operations in close proximity (1425, 1385, 1365, and 1335 Emerson) which are located generally upgradient or cross-gradient of GW-9). An investigation performed in 2009 for the facility at 1365 Emerson Street (Celmet) found TCE in a soil sample on the west side of the property at a depth of 6-8 ft. A shallow overburden groundwater well located in the east-central portion of the property did not detect CVOCs (one minor petroleum-related VOC was detected).

Two overburden monitoring wells installed on the property at 330 Colfax Street (MW-5 an MW-7; PEKO Precision) contained one CVOC (chloromethane) at 1.2 and 0.6 ppb, respectively in the recent investigation; these levels are below drinking water standards. These wells were installed in 2006 for the purpose of investigating a previous asphalt plant at this site. The presence of chloromethane is likely related to breakdown of chlorinated VOCs in the vicinity of GW-9 and these wells may represent the location of the edge of a plume emanating from the GW-9 area.

Anaerobic Biodegradation of CVOCs

Chlorinated VOCs are known to degrade via natural processes. Most notably, biodegradation of chlorinated alkene compounds can readily occur under anaerobic conditions. Microbial activity can catalyze chemical reactions that result in a dechlorination process whereby source CVOCs are reduced in concentration and "daughter" compounds with fewer chlorine atoms are generated. This reductive dechlorination process can continue in a step-wise fashion resulting in a series of these daughter products, each with a lower number of chlorine atoms. In this way tetrachloroethene (also referred to as perchloroethene, or PCE) is reduced to trichloroethene (TCE), then to cis- or trans-1,2 dichloroethene (DCE), then to vinyl chloride (VC), and ultimately to other compounds such as ethene and chloroethane. The products generated are known as 'daughter products'. This process is cited in numerous literatures (e.g., Bouwer 1994; Dolfing 2000) and is known to be able to significantly reduce CVOCs under anaerobic conditions. However, the rate of dechlorination tends to decrease for the daughter products and thus DCE and VC can show increases in concentration over time. It should be noted that VC is more toxic than TCE or DCE and thus incomplete degradation is a potential concern.

A detailed study to confirm anaerobic biodegradation and the specific mechanisms at the Site (e.g., methanogenesis, reduction in nitrate, ferrous iron, sulfate, etc.) was not completed as part of the SVI Investigation. However, field indicator parameters and the CVOC testing results from groundwater sampling provide strong evidence that reductive dechlorination is occurring in the P-1 plume area. This is based on the following:

- Groundwater in proximity to the P-1 Plume area is anaerobic. Specifically, the dissolved oxygen (DO) concentrations measured in wells GMX-MW-2, GMX-MW-3, GMX-MW-4, GMX-MW-5, GMX-MW-6 and P-1 ranged between 0.0 to 1 mg/L with an average concentration of 0.2 mg/L for these wells. Anaerobic conditions are generally considered to be present when DO is less than 1.0 to 1.5 mg/L.

- The area around P-1 and downgradient is under strong reducing conditions (which is typical in a landfill). Specifically the oxidation-reduction potential readings measured for wells GMX-MW-2, GMX-MW-3, GMX-MW-4, GMX-MW-5, GMX-MW-6, LAB-104, LAB-106, and P-1 were all negative with the exception of GMX-MW-6S. The ORP readings ranged between -319 mV to 68 mV with an average ORP of -213 mV. A reducing environment is generally considered to be present with mV readings less than -50 to -100 mV.
- 'Parent' compounds (designated as PCE or TCE for the P-1 Plume area) were not present in a majority of the wells sampled. Specifically for the P-1 Plume area, only wells P-1, GMW-MW-1, GMW-MW-3, LAB-104 and LAB-106 detected these parent compounds. The concentration of the parent compounds in relation to the concentration of CVOC breakdown compounds were also evaluated and below is a percentage breakdown of parent compounds compared to degradation products for each of these wells. It should be noted that the remaining wells in proximity to the P-1 plume area only detected degradation products.

Well ID	Percent of Parent Compounds (PCE & TCE)	Percent of Daughter Compounds (DCE, VC, DCA, Chloroethane, Chloromethane)
P-1	24.7%	76.3%
GMW-MW-3	0.1%	99.9%
GMW-MW-1	61.8%	38.2%
LAB-104	1.7%	98.3%
LAB-106	1.5%	98.5%

As shown, the concentration of degradation products is significantly higher in each well, with the exception of GMX-MW-1; however, this well detected a total CVOC concentration of 8.9 ppb (5.5 ppb of TCE). The above ratios of parent to daughter compounds and the fact that no other wells in proximity to P-1 detected PCE or TCE indicates that reductive dechlorination is occurring.

A temporal evaluation of wells sampled in 2010 and 2000, refer to Figure 13, indicates concentrations of CVOCs are generally declining for the P-1 Plume area. Specifically, the following table indicates a comparison in total CVOCs over time for the P-1 Plume area.

Well ID	Percent Change in Total CVOC Concentrations between 2000 and 2010
P-1	-37.6%
GMW-MW-1	-92.4%
GMW-MW-2	-95.0%
GMW-MW-3	-62.4%
GMW-MW-4	*
GMW-MW-5	-21.8%
GMW-MW-6S	+2,883% (1)

Notes:

* *This well did not detect CVOCs in 2000 and as such a percent change could not be calculated. The total concentration of CVOCs detected in 2010 was 1.5 ppb.*

(1) Although this well registered a high percent change (increase) in total CVOCs, the total concentration detected in 2010 of CVOCs was 89.5 ppb, all of which were breakdown products.

The likely presence of historic and on-going reductive dechlorniation of the P-1 Plume indicates that the plume has generally declined or stabilized based on the reduction in total CVOC concentrations between 2000 and 2010 in all but one groundwater monitoring well within this P-1 Plume area.

As indicated previously, two other discrete locations (GW-7/GW-7R and GW-9) have indicated a presence of CVOCs historically and currently. These locations are dissimilar to the P-1 Plume area in several ways which are highlighted below:

- The total concentration of CVOCs in GW-7/7R and GW-9 increased in concentration, 96% and 23%, respectively.
- The ORP measurements do not indicate as strong a reducing environment in these locations (-21 mV and -89 mV for GW-7R and GW-9, respectively).
- The dissolved oxygen levels do not indicate anaerobic conditions (DO readings of 3.14 and 1.83 mg/L for GW-7R and GW-9, respectively).

These measurable contrasts and the significant influence and control the sewer systems have on groundwater flow indicate that the source of these plumes are separate from the P-1 plume area. Furthermore, based on the apparent increase in concentrations, the lack of a strong reducing environment and aerobic conditions indicate that these plumes may not have stabilized to date. Furthermore, based on the information obtained in the review of historical documents, aerials, and redevelopment history (refer to Section 4.0), these plumes do not appear to be attributable to the FESL.

Summary of Significant Findings in Relation to Groundwater Conditions

The review of previous investigations and the work completed as part of this study lead to the following conclusions in relation to groundwater conditions at the Site and specifically in regards to this SVI Investigation.

- Groundwater flow across the entire site generally flows to the nearest storm, sanitary or combined sewer or the Barge Canal, which results in a complicated groundwater flow regime and numerous divides in areas between sewers.
- The storm sewer system in McCrackanville Street provides good hydraulic control of the P-1 plume area and has limited the extent of this plume predominantly to the 1655 Lexington Avenue Parcel, 1740 Emerson Street Parcel and in close proximity to the storm sewer system and associated bedding materials in McCrackanville and Emerson Streets and along the west side of W Street. One exception to this is in the southwest direction, where the influence of the 500 Lee Road Powerhouse building may be drawing groundwater slightly to the southwest and thus may explain

the relatively low ppb detections of CVOCs in GMX-MW-1.

- The 500 Lee Road Main building is upgradient of the P-1 plume.
- The storm sewer in Emerson Street also captures groundwater south of Emerson Street (i.e., groundwater flows to the north in proximity of the sewer south of Emerson Street) and this has essentially 'cut-off' the southern extent of the P-1 plume, as evidenced by well LAB-101 which did not contain detectable CVOCs. An exception to this appears to be in proximity to the storm sewer on the west side of W Street where the plume is not well defined; however, it is not anticipated to extend to the Barge Canal based on the 2000 groundwater and sewer testing and the relatively low-level VOC concentrations in well LAB-106.
- The P-1 plume appears to be under anaerobic conditions, stable and undergoing some reductive dechlorination of CVOCs; however, a continuing source area is most likely still present in proximity to P-1.
- The CVOC impacts associated with wells GW-7/7R and GW-9 appear to be associated with post Emerson Street Landfill operations. The impacts in these two apparent discrete areas appear to have increased in concentration and may indicate an on-going source upgradient of these wells.

6.0 Methane Evaluation

LaBella accessed monitoring wells MW-15S and MW-15D (located at 1769 Emerson Street) on December 8, 2010 while collecting a complete round of static water levels (SWLs) for the groundwater evaluation portion of the project (refer to Section 5). Upon opening well MW-15D, a strong sulfur like odor was noted. Since the FESL SVI Site Reconnaissance for 1769 Emerson Street was occurring at the same time by O'Brien & Gere (OB&G), the Landtec GEM 2000 landfill gas meter was on-site and thus utilized to collect gas readings from well MW-15D. The field meter indicated methane at a concentration of >65%, which exceeds the explosive range for methane which is 5% to 15%. Additionally, later in the same day, two other wells (which are located off the 1769 Emerson Street property) that appear to be NYSDEC Wells MW-18 and MW-20 (designated DEC-MW-18 and DEC-MW-20, herein) utilized as part of an environmental investigation of the Chemical Sales site to the southwest of FESL, were also accessed and a slight sulfur odor was noted in these wells also (refer to Figure 7 for well locations).

Based on these findings, Rochester, Gas and Electric (RG&E) was contacted to determine if they have utilities in the area and if the cause could be a pipeline gas leak. RG&E mobilized to the Site and also collected tedlar bag samples from MW-15D and apparent well MW-18 for subsequent laboratory analysis. Although the type of testing completed and the results have not been provided to date, it was indicated by RG&E that the results were inconclusive.

Based on the above, LaBella recommended two additional steps that were designed to evaluate if the impacts were related to pipeline gas, landfill gas or thermogenic gas from a naturally occurring methane deposit in the Rochester Shale formation. These two steps included: 1) conducting a 'design ticket' Underground Facility Protection Organization (UFPO) stakeout in order to evaluate potential pipelines in the area of these wells, and 2) collecting representative gas samples from one of the wells and from a soil gas point from a location known to have methane gas due to FESL in order to evaluate the source of the gas (i.e., pipeline gas source, thermogenic source (naturally occurring gas deposit), or landfill gas source). These recommendations were made after evaluating the vertical and lateral locations of these wells on the FESL.

Vertical Profile of Wells

The vertical extent of these wells with apparent methane gas is important since each of these wells appear to be dedicated deep bedrock wells that are isolated from the overburden and shallow bedrock by steel casings that are sealed into the deep bedrock and thus any gas encountered would appear to be from the deep bedrock and thus not from landfilling operations that were above the top of bedrock (and over 900 feet away from MW-15D). The available construction information for each well is below:

- Well MW-15D is a dedicated rock well which consists of a 4-inch steel casing that was set to approximately 32.9 feet below grade with approximately 7 feet of open rock hole below the steel casing. Bedrock in this well was encountered at 8.5 feet below grade and the casing was sealed into the rock with a cement/bentonite grout from the ground surface to the bottom of the steel casing. Based on this well construction, the open portion of the well where gases and water can flow into the well is between about 33 and 40 feet below the ground surface (assuming that the well integrity is good, refer to below for a discussion on this).
- DEC-MW-18 – LaBella does not have a well construction diagram for this well; however, the depth to bottom of the well (measured while collecting the SWLs) was 57 ft. below the top of the casing.
- DEC-MW-20 – LaBella does not have a well construction diagram for this well; however, the screened interval of this well based on previous reports (LaBella/Geomatrix April 2004) indicated a screened (open rock hole) depth of 42.2-52.2 feet below the ground surface.

Rochester Shale Formation

The Rochester Shale Formation is a natural geologic feature and is present throughout western New York State. The Rochester Shale in the Rochester area is actually not a true shale but rather is a dolomitic mudstone, with interbeds of limestone and dolomite. The thickness locally is approximately 120 ft. The upper 30 ft. or so is referred to as the Gates Dolostone member, which consists primarily of thin dolostone beds. The Rochester Formation is overlain by the Decew dolostone and underlain by the Irondequoit Limestone. In the western portions of Rochester the formation subcrops roughly between Lexington Avenue and Ridgeway Avenue. It outcrops most notably in the Genesee River gorge in downtown Rochester immediately below the Upper Falls.

The Rochester Shale has been documented in the Rochester area to contain significant "pockets" of natural gas and petroleum hydrocarbons. During the early 1980s, the Monroe County Pure Waters Department's Combined Sewer Overflow Abatement (CSOAP) program included subsurface investigations across much of Rochester to characterize local bedrock formations for the design and construction of deep, bored sewer tunnels. Numerous test borings were drilled into and through the Rochester Formation. Natural gas was encountered in several of these test borings. In some cases the gas was of sufficient quantity and pressure to cause periodic rapid evacuation of drilling fluids and groundwater from the drilled well bores for periods of several hours.

Based on the available information for well MW-15D, DEC-MW-18 and DEC-MW-20, it appears that each of these wells were constructed such that the open portion of the well (screened area) is in communication with the Rochester Shale.

6.1 Utility Location Evaluation

LaBella performed a design ticket Underground Facility Protection Organization (UFPO) stakeout of the entire FESL site and within 100-ft. of the site boundary (refer to the attached figure for the boundary of the FESL). The drawings obtained were reviewed to specifically evaluate for any gas pipelines in the area of the wells. It should be noted that Sunoco and Buckeye Pipeline indicated that they did not have utilities within the area requested. In addition, the RG&E gas lines appear to be located along Emerson Street and gas service for 1769 Emerson Street buildings are located on the north sides of the buildings and 300 feet (or more) away from MW-15D.

6.2 Evaluation of Monitoring Well Gas Composition

The evaluation of the type of well gas was conducted in two stages. The first evaluated the composition of the gas and specifically for 'markers' of pipeline gas (e.g., odorants). The second stage was designed to conduct a detailed evaluation of the gas composition, specifically the ratio of carbon and hydrogen atoms in order to evaluate the age of the gas. This includes analyzing for carbon-12 and carbon-13 isotopes and evaluating these ratios ($^{13}C/^{12}C$). This is performed on both the carbon from the methane molecules and carbon from the carbon dioxide molecules. In addition, hydrogen-2/hydrogen-1 ($^{2}H/^{1}H$) ratios were also analyzed. [Note: If necessary, carbon-14 (^{14}C) isotope testing could also have been completed; however, it was determined that this additional testing was not warranted based on the high degree of certainty from the carbon and hydrogen ratio evaluations.]

Based on the apparent high concentration of gas from MW-15D (based on the Landtech GEM 2000 field meter), this well was selected to evaluate the unknown methane gas. Based on the apparent well construction, it was assumed that well MW-15D would be representative of wells DEC-MW-18 and DEC-MW-20. In addition to sampling of the gas from MW-15D, a soil gas sampling point from the post-1964 landfill area known to have elevated concentrations of methane was selected as a control sample for comparison purposes. The soil gas sampling point selected was based on the April 2001 Former Emerson Street Landfill Remedial Investigation Report of City of Rochester Parcels 4, 10 and 11 by Labella Associates and Geomatrix Consultants, Inc. Specifically, Figure 9 of this report indicated methane concentrations measured as part of a soil gas survey from work completed at that time. To confirm that this historic soil gas sampling point was operational and still contained measurable methane gas, LaBella conducted a site visit on December 28, 2010 and located several soil gas sampling points and evaluated their integrity and collected a field measurements with the Landtech GEM 2000 field meter. The soil gas point selected for testing as the control sample was determined to be in satisfactory condition and the field meter registered approximately 30% methane gas. The approximate location of this soil gas sampling point is shown on the attached figure (designated "Stickup Gas Well").

Field Collection

On December 31, 2010, LaBella collected the first phase (pipeline gas evaluation) and second phase (thermogenic gas evaluation) samples. The samples were collected by Labella from the well head using tedlar bags for the pipeline gas analysis and "Cali-5-Bond" gas bags for the thermogenic gas evaluation. The samples were collected by lowering poly-tubing approximately 5-ft. into the top of the well and soil gas sampling point in order to collect a representative sample of the well head gas. The tubing was initially connected to the Landtec GEM 2000 meter to allow the meter to purge the tubing and confirm methane gas was present at the location at the time of sampling. Subsequently, the tedlar bags and Cali-5-Bond gas bags were filled. The tedlar bags for 'pipeline' gas analysis were shipped to Centek Laboratories in Syracuse, New York and the Cali-5-Bond for thermogenic analysis were shipped to IsoTech Laboratories, Inc. (ISOTECH) in Champaign, Illinois. The bags were sent under chain of custody control and initially the thermogenic testing was placed on hold until the pipeline gas testing was completed.

It should also be noted that subsequent to collecting any gas samples and replacing caps/covers on wells, LaBella screened the area and well cover/cap to ensure that the cover/cap were properly seated/sealed and no methane was detected at concentrations greater than those observed prior to the start of work.

Pipeline Gas Analysis

The pipeline gas testing results are summarized below and a copy is included as Appendix 13.

- **Fixed Gases (CO2, CO, CH4, Nitrogen and Oxygen) by USEPA Method** 3 – The 'fixed' gases were analyzed for in order to evaluate the percentage of these compounds in the gases emanating from the sampling locations. This testing indicated 4.17% methane in MW-15D and 1.45% methane in the 'Stickup Gas Well'.

  It should be noted that the methane gas concentration as measured by the tedlar bag sample was significantly lower than the Landtec GEM 2000 field meter (>65% in MW-15D and 30% in the Stickup Gas Well). This discrepancy in methane concentrations between field meter and the laboratory detections are due to the limitations of the field meter. The field meter operates by utilizing an infrared sensor that is calibrated to methane and while accurate for methane, cannot differentiate between various gases. As such, there is a potential for 'cross-gas' effects (e.g., butane, ethane, propane, etc.) that could bias the methane measurement shown on the meter as high. Section 5.6 (Cross-Gas Effects) in the GEM2000, GEM2000 Plus Operation Manual indicates "If there are other hydrocarbons present, the methane reading will be higher (never lower) than the actual Methane concentration being monitored. The extent to which the Methane reading is affected depends upon the concentration of the Methane in the sample and the concentration of the other hydrocarbons. The effect is non-linear and difficult to predict."

  Based on this, it appears that the actual concentration of methane (as measured by the laboratories) is significantly lower than that measured by the field meter.

- **Sulfur Series by USEPA Method TO-15** – This testing was also completed to further compare the composition of the gas in MW-15D to the known FESL gas in the Stickup Gas Well and also evaluate if typical odorants utilized in natural gas pipelines for leak detection were present. As shown in the attached laboratory results dimethly sulfide and hydrogen sulfide were detected at 17,000 parts per billion-Volume (ppbV) and 8,100 ppbV in MW-15D, respectively. Dimethyl sulfide and hydrogen sulfide were detected at 40 ppbV and 14 ppbV in the Stickup Gas Well, respectively.

The above pipeline gas analysis indicated three significant results: 1) The laboratory test results indicate the actual methane concentration (4.17%) is below the lower explosive limit (as opposed to the field meter reading of >65%). The gas in MW-15D contained approximately three times the concentration of methane than the Stickup Gas Well; however, neither of these results are within the range of typical pipeline gas (which is 70%-90% methane), and 2) The gas in MW-15D contained significantly different concentrations of sulfides (400 to 500 times the concentration) than the Stickup Gas Well. These two findings appear to show significantly different sources of gas. It should be noted that the MW-15D evaluation of odorants was inconclusive since the detection limits were significantly elevated.

Thermogenic Gas

The thermogenic gas analysis consisted of further gas composition analysis (including methane, ethane, propane, butane, etc.) and the isotope analysis. These testing results are summarized below:

- **Compositional Analysis** - The Compositional Analysis results showed significantly different detections of gases present and BTUs of each gas. Specifically, the sample from MW-15D detected ethane, propane, butanes and pentanes, whereas, the sample from the Stickup Gas Well did not detect these compounds, which is expected for landfill gases. Additionally, the BTUs for the gas collected from MW-15D and the Stickup Gas Well were 267 and 25, respectively These results concur with the fixed gas testing and sulfur series testing which indicated different sources of gas.

- **Isotope Analysis** – Although the previous testing indicated a high degree of certainty that the gases were different sources, isotope analysis was conducted as an additional and conclusive measure to confirm that the gas identified in MW-15D was due to a thermogenic source (i.e., natural gas deposit associated with the Rochester Shale Formation). The laboratory results are included with and summarized in a letter from ISOTECH which concludes that the gas from MW-15D is thermogenic in origin.

A copy of the ISOTECH letter and results are included as Appendix 13.

6.3 Methane Evaluation Conclusions & Recommendations

Based on the information on historic filling operations, distance of fill materials from the wells where methane gas was encountered, type of materials landfilled south of Emerson Street, depth of the wells where the methane gas was encountered, documented methane gas within the Rochester Shale Formation and the testing completed from MW-15D and the control sample from the Stickup Gas Well on 1655 Lexington Avenue, the gas identified in MW-15D (and thus it is assumed DEC-MW-20 and DEC-MW-18 also) are gases generated from thermogenic processes and thus are naturally occurring gas deposits that these wells are venting.

Based on the lack of contaminants of concern from the FESL in these wells historically, the thermogenic source of these gases, and the fact that methane (and other gases identified) can be a concern for explosive conditions, LaBella recommends that these wells be properly decommissioned. Specific recommendations are provided below:

1. Develop a list of the wells that appear to be screened within the Rochester Shale Formation.
2. Access wells within the Rochester Shale Formation and evaluate for odors and collect field meter readings with the Landtec GEM2000 landfill gas meter to evaluate the relative concentration of gases within the well headspace.
3. Once the list is completed and the wells evaluated for potential thermogenic gas issues, the need for these wells in relation to current and future work associated with the FESL or other IHWDS such as Chemical Sales should be evaluated.

4. Based on the results of #1 through #3 above, create a list of wells recommended for decommissioning and contact NYSDEC to discuss decommissioning procedures and for approval to decommission.

7.0 Site Reconnaissance

Site reconnaissance at each property included a visual inspection of the exterior grounds and accessible building interiors including basements, crawlspaces or other below-grade structures. The site reconnaissance work included a detailed sampling with field meters, refer to methodology Section 7.1, of floor penetrations and cracks which would provide the highest potential for SVI. In addition to this purpose, two additional goals were in mind: 1) identify obvious recognized environmental conditions, uses, processes, materials, or activities which could be attributable to post landfill activities (i.e., uses of hazardous substances identified by regulatory information, historical documentation, chemical storage/usage, etc.) that may also impact the site reconnaissance field readings or any future SVI investigations, and 2) building construction and conditions that will influence mitigation techniques and sizing (i.e., foundation system, floor slab condition, HVAC system, etc.).

7.1 Methodology

The site reconnaissance work consisted of the following steps:

1. **Historic Use & Regulatory Records Review:** Prior to the on-site work, each property was researched to provide an understanding of the post-FESL activities that could affect the site reconnaissance work.
2. **Property Representative Interview:** A site representative was interviewed as part of the site reconnaissance work to obtain information on the current uses of the site including the location and type of chemical usage, HVAC equipment, building condition (e.g., settlement issues, cracking, etc.) and building construction (e.g., foundation type, existence of crawl spaces or basements).
3. **Field Meter Survey:** Subsequent to the interview a complete field meter survey of the entire interior and exterior of each property was completed.

Additional details on each of these steps are provided below.

Historic Use and Regulatory Records Review

The historic use evaluation included utilizing numerous sources of information to identify suspect site uses that could contribute to SVI. The United States Environmental Protection Agency (USEPA) and NYSDEC databases were reviewed for the 45 FESL parcels to determine the presence of any known or reported local, state, or federal spills, releases, or discharges of hazardous substances containing VOCs that may potentially impact the SVI Investigation. This information also documented storage or use of hazardous substances or if parcels formerly or currently operated above ground storage tanks (ASTs) or underground storage tanks (USTs).

Historic sources including Sanborn maps, Plat maps, street directories, deed information (provided by the City), Fire Department records, and site plans (if available) were reviewed to determine historic or former uses of potential environmental concern which have the potential to affect the SVI Investigation.

The results of the historic uses are summarized in each of the site summaries included in Appendix 14.

7.1.1 Field Meters

The following meters were used during site reconnaissance:

- RAE Systems PPB RAE - Parts-Per-Billion Photoionization Detector (PID) Surveyor Model PGM 7240 (with a detection limit of VOC <1.0 part per billion (ppb)) and a 10.6 eV lamp. It should be noted that the 10.6 eV lamp detects most, but not all CVOCs. However, CVOC contaminates known to be associated with the FESL such as PCE, TCE, 1,2-DCE and vinyl chloride have ionization potentials that are detected by the 10.6 eV lamp.

- Landtec GEM2000 PLUS Landfill Gas Analyzer

These meters were calibrated on a weekly basis by Ashtead Technology Rentals. Copies of the calibration sheets are included in Appendix 15.

PPB RAE

Information on the operation of the PPB RAE and limitations of the PPB RAE are summarized here. According to the Operation and Maintenance Manual for the ppbRAE Parts Per Billion VOC Monitor PGM-7240, Integrated Sampling Pump Section 2.7, the PPB RAE PID operates by continuously drawing air via an integrated diaphragm type pump through the sensor at a flow rate of 450-500 cc/min and discharging it through a gas outlet port on the side of the monitor. Section 6.0 of the manual (Theory of Operation) indicates: "As organic vapors pass by the lamp, they are photo-ionized and the ejected electrons are detected as a current. The first channel current primarily results from the ionized gases. The second channel current measures the ionized gases plus photoelectric emission of electrons from the metal surface, which is a function of the UV light intensity. The dual channel currents can thus be used to compensate the variation of the light intensity due to lamp contamination and degradation."

The above information indicates two limitations that required professional judgment and in some cases additional site visits to further evaluate the initial readings. These limitations are further discussed below:

1. Total VOC Reading: Based on the way the PPB RAE operates it measures total VOC concentrations and does not differentiate between specific VOC compounds. This limitation of the meter does not allow for differentiating between FESL VOCs (specifically PCE, TCE and their breakdown products which are attributed to the P-1 plume, refer to Section 5) and VOCs used as part of current or historic post-FESL uses on the property.

2. Meter Sensitivity: Due to it's low detection limits the PPB RAE PID is sensitive and results in continuous fluctuation of readings in environments where there is active VOC use as part of operations. In addition the PPB RAE also has a sensitivity to moisture and readings can appear to increase in areas of elevated moisture.

All but a few properties were found to use VOCs currently or historically, such as paints, thinners, inks, solvents, lubricants, oils, cleaning products, silicones, fuel additives, alcohols, resins, glues, pesticides/herbicides, etc. To account for the total VOC readings and meter sensitivity, background readings from the breathing zone were collected throughout the site reconnaissance work in order to differentiate between operational VOC use and potential SVI readings. Floor penetration readings that were within 10% of the comparable background were not considered to be due to soil vapor intrusion. During the site recon work, observations were made in the area of each reading to evaluate if readings could be due to an operation in the area and thus account for an increase greater than 10% of the background. In the absence of an obvious operational VOC source (e.g., trench drain with liquid, parts washer, UST in area, etc.), the reading was attributed potential SVI either due to on-site operations or to the FESL. [Note: Additional details are included in the 'Collection of Readings' and 'Development of Site Summaries' discussions below.]

Landtec GEM2000 Plus

The landfill gas analyzer measures concentrations of oxygen (O_2), carbon dioxide (CO_2), carbon monoxide (CO), hydrogen sulfide (H_2S), methane CH_4), and Lower Explosive Limit (LEL). The landfill gas analyzer operates by drawing air at 300 cubic centimeters per minute (cc/min). CO_2 and CH_4 are detected by dual wavelength infrared cell with reference channel. O_2, CO, and H_2S are detected by an internal electrochemical cell. Limitations of the landfill gas analyzer include artificially high readings of methane due to the presence of other hydrocarbons. According to the Landtec GEM2000 Plus Operation Manual, Cross-Gas Effects, Methane, Carbon Dioxide and Oxygen Section 5.6.1, "the Methane reading is filtered to an infrared absorption frequency of 3.41 μm (nominal), the frequency specific to hydrocarbon bonds. Instruments are calibrated using certified Methane mixtures and will give correct readings provided there are no other hydrocarbon gases present within the sample (e.g. ethane, propane, butane, etc.). If there are other hydrocarbons present, the Methane reading will be higher (never lower) than the actual Methane concentration being monitored. The extent to which the Methane reading is affected depends upon the concentration of the Methane in the sample and the concentration of the other hydrocarbons. The effect is non-linear and difficult to predict."

It does not appear that 'false negatives' are a concern with the meter; however, where readings were obtained, there is the potential that the readings are biased high. This situation was confirmed in one location and is described in detail in Section 6.0. As detailed in Section 6.0, two locations with field meter readings of ~30% and >65% methane indicated laboratory sample results of 2.46% and 4.46%, respectively.

Site Representative Interview

The initial step of the site reconnaissance work included conducting an interview using the Preliminary Building Assessment and Site Reconnaissance Form included in the Work Plan. This form collected general information on the owner contact, tenants, interviewer, etc. and detailed information on the use of the property which included four sections:

1. Section I – Building Construction Information – This section of the interview form collected information on building construction plans, foundation construction, floor treatments, utilities servicing the site, settlement issues, existence of a vapor barrier, passive venting system or active venting system, etc.

2. Section II – Heating, Ventilation and Air Conditioning Information – This section requested information on the size, location and areas served for each piece of HVAC equipment.
3. Section III – Indoor Air Quality Influence Factors – This section requested information on chemical usage and location (e.g., parts cleaners, solvent use, petroleum use and powered equipment, drum storage, etc), air handling equipment (exhaust fans), overhead door usage, etc.
4. Section IV – Occupancy/General Use – This section requested information on the type of use and occupancy of each portion of the building including number of people and typical operating hours.

This information was verified during the building survey work.

Collection of Field Meter Readings

Field meter readings were taken from all accessible sub slab penetrations. Floor penetrations included but were not limited to cracking, gaps or holes in the floor (e.g., expansion joints, control joints, etc.), electrical penetrations, structural penetrations (support columns), floor/trench drains, pits, sumps, scales, and cleanouts. Background readings (or operational VOC readings) were collected from the breathing zone throughout each building to evaluate site operational levels of VOCs. In general, a picture was taken of each reading location.

In the event that an instrument reading above the apparent background concentration of VOCs or methane was noted at a penetration, the instrument was removed from the penetration and the process was repeated to confirm that the reading was in-fact elevated above background. As discussed above, each reading above background was further evaluated for potential operational sources in the area that may have been the cause for the reading. If upon further evaluation the reading was attributed to an operational source, then this was noted in the description portion of the instrument readings table. In the event that the source of the reading was not determined, the reading was assumed to be due to potential SVI. However, it should be noted that due to the significant post-FESL uses on many of the properties, not all such readings were attributed to potential SVI due to FESL, see below 'Development of Site Summaries'. This conclusion was based on a variety of evidence, data collection, and professional judgments.

Development of Site Summaries

Subsequent to completing the site reconnaissance work, a Site Summary was developed for each property. LaBella met with each sub consultant and reviewed the work completed for each site reconnaissance. The site summaries for each property include the following:

- Site Summary Write-Up: This includes a summary of the historic document and regulatory records review. In addition, a brief description of the current site use and the overall results of the site recon work are also included (listing of penetrations, background ranges and readings above background).
- Preliminary Assessment Form (owner/occupant questionnaire): The completed property owner interview form is included.
- Preliminary Assessment Form (Instrument Readings Portion): This portion of the preliminary assessment form is a table that includes all the reading from the site reconnaissance along with a brief description of the reading location.

- Photographs: In general a photograph from each location was collected; however, in an effort to minimize superfluous information, only pictures of pertinent readings are included in the Site Summaries included with this report.

These Site Summary packages for each property are included in Appendix 14. [*Note: Access was not obtained from the property owner for 225 Colfax Street and as such, a site summary was not included for this property.*]

This review also considered other FESL-related information, specifically the filling information (refer to Section 4) and the groundwater evaluation results (refer to Section 5). This overall view of the FESL was used to differentiate potential SVI readings due to post-FESL uses and the FESL.

7.2 Summary of Results

In order to objectively evaluate each property for SVI due to FESL, the information obtained throughout the project and specifically the site recon work was utilized with Property Prioritization Worksheet A and B in order to evaluate if the information obtained was due to FESL and if so, the importance and thus priority of the conditions at the property.

Property Prioritization Worksheet A

Property Prioritization Worksheet A was completed in order to determine the course of action for each property. Using the flow chart in Property Prioritization Worksheet A, properties of vacant land received a "No Further Evaluation" recommendation. It should be noted that future development on such properties would be identified by the City of Rochester Flagging system when a permit was applied for (refer to Section 7.4). Any future development would require that the development be conducted in accordance with the City of Rochester Former Emerson Street Landfill Sub-Slab Ventilation Guidance Document Update 2007 by LaBella Associated dated November 2007 (refer also to recommendation to update this document in Section 7.5). For developed properties designed for occupancy, Preliminary Building Assessments (site recons) were completed and Prioritization Sheet B was completed. For developed properties designed for occupancy where methane readings from cracks/penetrations were greater than 2.5% and due to the FESL, "Design and Installation of a Mitigation System" was recommended (this included one property – 575 Colfax Street). A copy of the Prioritization Worksheet A in included in Appendix 16.

Property Prioritization Worksheet B

The information obtained in each Site Summary (i.e., the historical data review, government agency review, and site reconnaissance), groundwater monitoring and sampling, and historic filling research were used to prioritize properties for potential SVI due to the FESL. Prioritization Sheet B is a ranking system developed by LaBella and the City of Rochester DEQ with input from both the NYSDEC and NYSDOH to conduct an objective evaluation of all the parcels in the same manner. A list of criteria included in this ranking system is provided below and a copy of this form is included in Appendix 17.

1. Building Use (i.e., residential, commercial, industrial, etc.)
2. Building Occupancy (i.e., number of occupants per day during the heating season)
3. Sub-Slab Systems (i.e., presence or lack of active and/or passive venting system and/or vapor barrier)

4. Lowest Floor Slab Condition/Construction (i.e., presence of floor cracking, sealants, penetrations, basements, etc.)
5. HVAC (i.e., building pressurization)
6. Location of Building on Landfill (i.e., location of building related to filling areas, location of building related to documented FESL Plume)
7. Site Reconnaissance Meter Readings (i.e., VOC or methane readings from floor penetrations attributable to FESL)

The above criteria can be separated in two major categories, Non-FESL related factors and FESL related factors:

Non-FESL Factors:

- *Building Use Factors* – these factors include how many people generally occupy the building on a daily basis and the type of use (e.g., commercial, industrial, school, etc.) and potential receptor population (e.g., sensitive receptors like children). It should be noted that these factors increase the concern for SVI; however, these factors do not increase the potential for SVI and specifically SVI due to FESL.

- *Building Condition Factors* – these factors include the type of construction, condition of the foundation system, heating, ventilation and air conditioning (HVAC) system number and type of floor penetrations (i.e., piping, trench drains, pits, etc.), sealants on floors, vapor barriers, etc. These factors can increase the potential for SVI; however, it should be noted that a source of VOCs must be present for these factors to be of concern.

FESL Related Factors

- *Building Location Factors* – these factors include where on the FESL the building is located and specifically in relation to the P-1 plume area (i.e., an increased potential for SVI of VOCs due to FESL) and/or if the building is located over pre or post-1964 landfilling operations (i.e., an increased potential for SVI of landfill gases). These factors increase the potential for SVI specifically due to FESL.

- *Site Reconnaissance Readings* – this category utilized professional judgment and multiple lines of evidence to differentiate between a "FESL attributable reading" or a reading that appeared to be due to site operations in the area or post FESL operations specifically for VOC readings above background from building within 100-ft. of the inferred P-1 plume area (refer to Section 7.1.1) and does not account for all readings collected at the Site. As such, this category included readings that were not attributable to a current or former operation and thus appeared to be due to FESL. Since these readings may represent actual SVI occurring, each instance of a reading above background was included in the weighting sheet (i.e., multiple readings were included multiple times).

The above ranking system was used to develop three scores for each property: 1) the non-FESL related factors score; 2) the FESL related factors score; and, 3) the total or overall prioritization score for the building. Each building was scored separately (i.e., parcels with multiple buildings received multiple scores) and in some buildings an apparent continuous building was sub-divided into multiple buildings based on the construction and HVAC set up of the building since SVI would be different based on these factors. Table 11 summarizes the non-FESL and FESL related factors and scores and Table 7 provides a breakdown of the overall prioritization score. The overall scores were sub-divided into three Tiers. The three Tiers represent the risk of SVI due to FESL and are defined as:

- Tier 1 – higher risk of SVI due to FESL with scores of 5 or greater;
- Tier 2 – moderate to low risk of SVI due to FESL with scores between 1 and 4; and,
- Tier 3 – low to no risk of SVI due to FESL with scores of 0 to -4.

The site summaries included in Appendix 14 provide details on each property/building evaluation. The results of these are summarized in the context of the Tiers (i.e., SVI due to FESL) in Section 6.3 below.

8.0 Summary of Prioritizations and Recommendations

This section summarizes the major findings based on the prioritization rankings and recommendations for these properties. It should be noted that due to the number of properties, readings collected and significant manufacturing history (e.g., up to 45 years of post-landfill manufacturing operations), the complete details obtained for each property/building are not included in this section. Rather, details on each property are provided in the site summaries included in Appendix 14. In addition, the information provided herein, is related to apparent FESL related SVI due to the inferred extent of the P-1 Plume area and any methane identified (which unless proved otherwise was assumed to be due to FESL) and readings that did not appear due to FESL are not discussed. It should also be noted that all recommendations take into account that the City of Rochester will be entering into agreements with each property in order to determine long term management of any remedial actions, changes in use/construction of the building or should additional data become available in the future. This is further discussed in Section 6.4.

TIER 1 PROPERTIES

Properties receiving a total prioritization score (through use of Prioritization Sheet B) equal to or greater than 5 are considered Tier 1 properties. Tier 1 properties are properties which exhibit a higher risk of SVI due to the FESL. Descriptions and recommendations for each Tier 3 property are detailed below:

1740 Emerson Street (Owner: LeChase Construction) – Main Building & Office Trailer
Quadrant A

Main Building
FESL Related Factors Score = 12
Non-FESL Related Factors Score = 2
Total Prioritization Score = 14

Main Building Description

The building was built in 1975 and is 17,358 sq. ft. The building is currently owned/occupied by Raymond LeChase & Company (LeChase) and is utilized for vehicle and equipment repair and warehousing with an office area in the southern portion. The building is occupied by approximately 25 employees during weekdays. No sub-slab system (i.e., vapor barriers, passive/active venting systems, etc.) are in place at this building. During site reconnaissance minor floor cracking was observed. No sealants were observed on any portion of the floor slab. Approximately 19 general floor penetrations including drain lines, cracks, utility piping, etc. were observed. No significant floor penetrations (i.e., unsealed sumps, pits, oil/water separators, etc.) were observed. The foundation system for this building appears to be slab-on-grade construction, although detailed building construction drawings were not available. Building pressurization is unknown; however, some parts of the building have bay doors which are opened routinely throughout the work day. This building appears to be located over greater than 10 feet of post 1964 fill material (refer to Figure 6) and over the P-1 plume area with inferred total CVOCs concentrations in groundwater between 20 and 100 µg/L (refer to Figure 14). Site reconnaissance indicated several locations where VOC readings were above background (of up to 210 ppb, or 36.2% for this location) from floor penetrations. Based on the lack of an obvious VOC source in the immediate area of these readings and the location of this building on the landfill (i.e., above the inferred extent of the P-1 plume area) these readings appear to be attributable to the FESL.

Main Building Recommendations

LaBella recommends that a mitigation system be designed and installed for this building. It is anticipated that a sub-slab depressurization system (SSDS) will be needed as positive pressurization may be difficult to achieve with existing interior heating units. Subsequent to installing a SSDS, pressure field testing should be completed to confirm the influence of the system beneath the building.

Office Trailer
FESL Related Factors Score = 4
Non-FESL Related Factors Score = 1
Total Prioritization Score = 5

Office Trailer Description

This trailer is utilized as office space and is occupied by approximately 2 employees during weekdays. This building is a trailer that does not have direct contact with the subsurface (i.e., trailer is elevated and sitting on asphalt pavement). The trailer only has electric service which is overhead from the main building and does not have sewer or water service (i.e., no direct conduit to the subsurface). Building pressurization is unknown. No elevated VOC or methane readings were observed at any penetrations through the trailer or from measurements collected from beneath the skirt of the trailer.

Office Trailer Recommendations

LaBella recommends that the existing trailer skirt be removed and replace with a skirt that would allow air flow beneath the trailer. Additionally, LaBella recommends that the bottom of the trailer be insulated.

1769 Emerson Street (Owner: County of Monroe) – RRF & TS Buildings
Quadrant C

This property consists of two separated buildings; however, the main building is operated as two separate facilities (i.e., Resource Recycling Facility [RRF] and the Transfer Station [TS]) and the HVAC equipment are separate and there are no direct connections between the portions of the building. For purposes of this evaluation, the property has been split into three buildings. The RRF and TS are in Tier 1 and the third building (Monroe County Recycling Center [MCRC]) is in Tier 2.

Resource Recycling Facility
FESL Related Factors Score = -1
Non-FESL Related Factors Score = 9
Total Prioritization Score = 8

RRF Description

The RRF was built in 1978 and is utilized for office space and storage purposes in the northern portion and as a resource recovery facility (sorting and shipping recycled materials). The RRF is 145,000 sq. ft. and is occupied by less than 50 employees during weekdays. No sub-slab system (i.e., vapor barriers, passive/active venting systems, etc.) are in place at this building. Building characteristics indicate an increased potential for SVI (i.e., presence of a basement, some cracking, and significant penetrations). Building pressurization is unknown. The RRF is outside of the apparent historic FESL filling limits (refer to Figure 6); however, the inferred extent of the P-1 plume area (with concentrations of total CVOCs between 20 and 100 µg/L) extend beneath the northeast portion of this building (based upon current data), refer to Figure 14. It should be noted that the finished floor elevation of this portion of the building is at approximately at elevation 535' (based on building plans) and groundwater contouring based on the December 2010 static water levels indicates groundwater elevation between elevations 512' and 514' (i.e., the groundwater is approximately 21 ft. beneath this portion of the building. It should also be noted that the storm sewer that is controlling groundwater and contaminant migration (i.e., bedding and blasted bedrock fracture network) runs south between the building and W Street in this area. The storm sewer ranges between approximately 20 to 70 feet to the east of the RRF. The Site reconnaissance did not identify readings of concern attributable to the FESL.

RRF Recommendations

LaBella recommends the following additional evaluation for this building:

1. Conduct a detailed preferential pathway evaluation and evaluate building pressurization.
2. Install groundwater monitoring wells in close proximity to the north/northeast corner of the RRF to evaluate groundwater quality in close proximity to the building.
3. Evaluate any dewatering being conducted as part of the foundation drain system (including the TS building as it may be influencing groundwater flow beneath the RRF).

Transfer Station
FESL Related Factors Score = -3
Non-FESL Related Factors Score = 9
Total Prioritization Score = 6

TS Description

The TS was built in 1978 and is utilized as a transfer station for municipal waste and leaf composting materials. The TS is 42,000 sq. ft. and is occupied by less than 50 employees during weekdays. No sub-slab system (i.e., vapor barriers, passive/active venting systems, etc.) are in place at this building. Although the building characteristics include significant sub-grade structures (two pits with sub-grade operations extend to approximately elevation 510') and there was significant cracking observed; however, this building, when operating, has numerous overhead doors that are left open all day due to truck traffic. The overhead doors are positioned (north and south ends of the building) such that there is a significant 'cross-breeze' through the building. Additionally, the main portion of this building is not heated. Although the inferred extent of the P-1 plume is located approximately 120 feet to the north and there may be potential preferential pathways from the storm sewer in close proximity to building, the site reconnaissance did not identify readings of concern attributable to the FESL.

TS Recommendations

Although this building falls within Tier 1, the nature of the operations limits the potential for actual SVI to occur and the continuous open air operations mean the fresh air exchange within the building also minimizes the potential for 'build up' of vapors within the building and thus the concern for exposure to contaminants from FESL is low. As such at this time no further evaluation is recommended in relation to this building (except as it relates to the RRF).

575 Colfax Street (Owner: First Student)
Quadrant B

575 Colfax Building
FESL Related Factors Score = 6
Non-FESL Related Factors Score = 3
Total Prioritization Score = 9

Building Description

The building was built in 1982 and is 16,153 sq. ft. The building is utilized for school bus maintenance and repair and there are offices on the eastern side of the building and on the second floor. Approximately 12 employees occupy the office areas on the second floor and approximately 12 employees occupy the maintenance portion of the building during the work day. Approximately 250 drivers occupy the building for approximately 1 hour per day (morning and afternoon) in the driver areas. Building pressurization is unknown. The foundation system for this building is a caisson and grade-beam construction (based on available site plans). Building characteristics indicate an increased potential for SVI (i.e., floor cracking, lack of floor sealants, greater than 25 general sub-slab penetrations, etc.). This building is located over greater than 10 feet of post 1964 fill material (refer to Figure 6) but is located greater than 500 feet, hydraulically cross-gradient from the inferred extent of the P-1 plume (refer to Figure 14). Site reconnaissance indicated three locations where elevated methane readings were observed above background. One location with a field meter methane concentration of 8.6% was an electric outlet where the conduit was connected to an I-Beam and extended vertically beneath the floor. The other three locations (floor drain in men's bathroom, oil/water separator, and hydraulic lift reservoir) could be due to sewer gas; however, due to the apparent FESL related methane reading in the electric conduit mitigation appears necessary (see recommendations below). Site reconnaissance indicated some VOC readings above background; however, these readings are likely attributable to on-site VOC use (petroleum).

A detailed review of existing site plans indicated that a passive venting system was installed during construction which appears to include several 4-inch perforated PVC pipe laterals connected to a header pipe that extends vertically above the floor and through the roof along the center portion of the interior western wall. A copy of the site plan is included with the Site Summary for this property in Appendix 14. LaBella conducted a second site visit to confirm the initial methane readings from the electrical outlet, hydraulic lift reservoir, oil/water separator, and men's bathroom floor drain. The methane readings were confirmed with similar concentrations. LaBella also retained AP Plumbing to 'sewer cam' the passive venting system lines to verify the passive venting system was installed per the site plans. The sewer cam work indicated the exhaust piping was plugged where the vertical portion of the exhaust pipe turns horizontal beneath the floor.

Building Recommendations

LaBella recommends that the piping associated with the existing passive venting system be cleared or replaced and that the use/effectiveness of the system be evaluated through pilot testing. The system should be activated into a sub-slab depressurization system by installing and activating a SSDS fan. In the event the system is deemed to be unusable a 'retro-fitted' sub-slab depressurization system should be installed. Subsequent to completing the system installation, pressure field testing should be completed to confirm the SSDS influence beneath the building.

1770 Emerson Street (Owner: Vampiro Ventures LLC) – Older Building
Quadrant A

This property has two buildings; however, one of the buildings was recently constructed in 2010 and 2011, and a SSDS was installed during construction under the supervision of LaBella and the approval of the NYSDEC and NYSDOH, and as such does not require further evaluation (a separate report is being completed that documents the SSDS and confirmation of system influence). The building discussed below is the 'older building' which is the former Hazardous Waste Storage Building associated with the former General Motors Plant at 500 Lee Road.

1770 Older Building
FESL Related Factors Score = 2
Non-FESL Related Factors Score = 6
Total Prioritization Score = 8

1770 Older Building Discussion

This building was built in 1980 and is 12,000 sq. ft. The building is occupied by New York Commercial Flooring, a flooring warehouse, retailer, and installer; and by Kimmins Coffee Service, a coffee supply and service company is. Approximately 14 employees occupy the building during weekdays. [Note: New York Commercial Flooring has relocated since the site recon work was completed and reportedly this portion of the building is currently vacant.] No sub-slab system (i.e., vapor barriers, passive/active venting systems, etc.) is in place at this building. During site reconnaissance minor floor cracking was observed. Sealants (including paint) were observed on a portion of the floor slab. Building characteristics indicate an increased potential for SVI (i.e., interior forced hot air furnaces, numerous general and significant floor penetrations). The foundation system for this building is a slab-on-grade construction. Building pressurization is unknown but with the interior heating units may be under negative pressure. This building is located over 5 to 10 feet of post 1964 fill material (refer to Figure 6) and approximately 150 feet west and cross gradient of the inferred extent of the P-1 plume area (refer to Figure 14). It should be noted that a private sewer pipe on building drawings appears to extend from the building and south to Emerson Street and likely connects to the sewer within the inferred extent of the P-1 plume area and thus may be a preferential pathway to the building. The site reconnaissance did not identify VOC or methane readings of concern attributable to the FESL. Historic use of the building included Hazardous Waste Storage, including flammable liquid waste.

1770 Older Building Recommendations

LaBella recommends the following:

1. Install monitoring points (consistent with the 2006 NYSDOH guidance on sub-slab vapor sampling techniques) to initially evaluate building pressure in comparison to the subsurface. In the event that the building is positively pressurized, LaBella recommends monitoring of pressure over time. [*Note: Pressure monitoring should be completed during both the heating and cooling seasons.*]
2. In the event that the building is not positively pressurized, conduct an SVI investigation consistent with the 2006 NYSDOH guidance. It is recommended that compound specific testing be conducted only for FESL related CVOCs (i.e., PCE, TCE and their breakdown products). The specific number of testing locations should be tailored to building size and footer locations. Currently it appears that three sub-slab soil vapor with three co-located indoor air samples (and one exterior ambient air sample) would adequately assess this building for SVI. The results of this testing (and potentially a second confirmation test) would determine if mitigation is warranted.

1640R Emerson Street (Owner: Emerson Street, LLC, Occupant: Laird Plastics, Inc) Quadrant A

1640 Emerson Building
FESL Related Factors Score = 4
Non-FESL Related Factors Score = 4
Total Prioritization Score = 8

1640 Emerson Discussion

This building was built in 1983 and is 25,000 sq. ft. The building is currently occupied by Laird Plastics, a plastics distribution company and utilized for plastic warehousing and distribution, with an area on the north-central side for fabrication and at the northeast corner for plastic cutting. Office space is located at the southeast corner. The building is occupied by approximately 9 employees during weekdays. No sub-slab system (i.e., vapor barriers, passive/active venting systems, etc.) is in place at this building. This building has some characteristics that would increase the potential for SVI (i.e., significant cracking, interior heating units, and greater than 25 general sub-slab penetrations); however, portions of the building also have a sealed floor. The foundation system for this building is a slab-on-grade construction. Building pressurization is unknown.

This building is located over greater than 10 feet of post 1964 fill material (refer to Figure 6) and within 100 feet of the inferred extent of the P-1 plume; however, VOCs were non-detect in the groundwater sample from well LAB-109 (located approximately 60 feet to the west of the building). However, there may be preferential pathways to the building from the P-1 plume in proximity to the storm sewer in Emerson Street. The site reconnaissance indicated several locations where VOC readings from floor penetrations were slightly above background (up to 53 ppb above background, which for this location was 25.6% above background) and these did not appear to be obviously attributable to an operational source.

1640 Emerson Recommendations

LaBella recommends the following:

1. Install monitoring points (consistent with the 2006 NYSDOH guidance on sub-slab vapor sampling techniques) to initially evaluate building pressure in comparison to the subsurface. In the event that the building is positively pressurized, LaBella recommends monitoring of pressure over time. [*Note: Pressure monitoring should be completed during both the heating and cooling seasons.*]
2. In the event that the building is not positively pressurized, LaBella recommends SVI testing consistent with the 2006 NYSDOH guidance. Based on the extensive groundwater testing completed in relation to the P-1 Plume (refer to Section 5) and the relatively limited list of contaminants attributable to FESL, the testing should be limited to chlorinated VOCs and specifically, PCE, TCE and their breakdown compounds (refer to Section 5.0). The specific number of testing locations should be tailored to building size and footer locations. Currently it appears that three sub-slab soil vapor samples with three co-located indoor air samples (and one exterior ambient air sample) would adequately assess this building for SVI. The results of this testing (and potentially a second confirmation test) would determine if mitigation is warranted.

500 Lee Road (Maguire Family Properties, LLC) – Power House Building
Quadrant A

It should be noted that the 500 Lee Road property has two buildings. The Main building scored as a Tier 3 building and is not discussed in this section, but rather included with the Tier 3 discussion. The Power House building scored as a Tier 1 building and is further discussed below.

Power House Building
FESL Related Factors Score = -1
Non-FESL Related Factors Score = 8
Total Prioritization Score = 8

Power House Discussion

The Power House was constructed in approximately 1980 and consists of approximately 16,000 sq. ft. plus loft space above the first floor. The Power House is connected to the main building by a tunnel, which has an area of approximately 2,000 sq. ft. The first floor of the Power House (~8,000 sq. ft.) is currently occupied by Residential Steel Services and is utilized for metal fabrication. The basement (~8,000 sq. ft.) of the Power House appeared to be utilized for storage purposes, and did not appear to be occupied. Approximately four people occupy the Power House during the day shift working hours. No sub-slab system (i.e., vapor barriers, passive/active venting systems, etc.) is in place at this building. During site reconnaissance minor floor cracking was observed. No sealants were observed on any portion of the floor slab. The Power House has characteristics that would increase the potential for SVI (i.e., presence of a basement, significant penetrations, etc.); however, during operations numerous doors are continuously open. Due to basement construction, it is assumed that all fill materials were removed during construction. The building is approximately 150 feet cross-gradient of the inferred extent of the P-1 plume area (refer to Figure 14); however, the building has a basement and a sub-basement that has two sumps. The deep sump is self contained sump and used for pumping sanitary waste to the sewer system. The shallow sump is tied to the foundation drain system and discharges to the storm sewer. A former coal chute also is present that is generally at the level of the basement. LaBella surveyed the floor of the sub-basement and bottom of the foundation drain sump. The survey indicated that the foundation drain sump (el. 514.95 ft) is below the uppermost water bearing zone (approx. el. 520 ft) and thus could be actively dewatering groundwater (refer to Figures 8 and 11).

Power House Recommendations

LaBella recommends the following:

1. LaBella recommends that a water sample be collected from the foundation drain sump to determine the presence or absence of CVOCs related to FESL. Based on the extensive groundwater testing completed in relation to the P-1 Plume (refer to Section 5) and the relatively limited list of contaminants attributable to FESL, the testing should be limited to chlorinated VOCs and specifically, PCE, TCE and their breakdown compounds (refer to Section 5.0). Results of this sample would determine the need for additional evaluation or mitigation of this building, if any.

1645-1685 Emerson Street (Owner: Val Tech Holdings, Inc.)
Quadrant C

1645-1685 Emerson Building
FESL Related Factors Score = 5
Non-FESL Related Factors Score = 2
Total Prioritization Score = 7

1645-1685 Emerson Building Discussion

This building was constructed in 1990. The 70,000 sq. ft. building is currently owned/occupied by Val-Tech Holdings and utilized for plastic injection molding. A total of approximately 100 employees occupy the building regularly. Specifically, 30 office workers occupy the building during the weekdays and approximately 70 manufacturing workers occupy the building 7 days a week over 3 shifts. This building has characteristics that would increase potential for SVI (i.e., significant floor cracking confirmed to extend through the floor slab). The building is also located directly down-gradient and within 100-ft. of the inferred extent of the P-1 plume area. In addition, there are apparent preferential pathways from the plume to the building (i.e., storm sewer, sanitary sewer, etc.). In addition, a passive vent system was installed beneath the entire building during construction and consists of three perforated PVC pipes that run the length of the building (north-south). After the initial site visit, several follow-up site visits were completed and are summarized below:

- Floor Cracking Assessment – Based on the significant cracking observed during the Site Recon work, four (4) cores of the concrete floor were removed to evaluate the vertical extent of cracking. Pictures of these cores are attached. to the Site Summary. As shown, each of the four floor crack locations exhibited cracks that penetrated the entire floor slab. Petrographic analyses were completed on two of the four cores to further evaluate the cause of the cracks. The petrographics testing indicated that the cracks were likely due to shrinkage of the concrete during the curing process. This would indicate that the cracks are not likely to deteriorate; however, operations with vibrations were observed at the time of the site reconnaissance which may exacerbate the cracking over time. Additional details on this work are included in the Site Summary in Appendix 14 along with the locations of the core holes.

- Building Pressurization Assessment – Based on the building characteristics, specifically HVAC set up, heat off processes, and the passive venting system, it was recommended that an evaluation of building pressurization (in comparison to the sub-slab soil vapor) be conducted. This work included converting the core holes from the floor crack assessment to monitoring points that were used to collect differential pressure readings. On March 28th, 2010 a TPI 621 Digital Micromanometer was used to collect differential pressure readings across the floor slab using the monitoring points installed in the core holes. It should be noted that the monitoring points are all located within the main manufacturing/warehouse portion of the building and that no monitoring points were installed within the office areas. A summary of the differential pressure readings are provided below:

Core Hole Location	Differential Pressure (Inches Water Column)
#1	0.002 – 0.003
#2	0.032 - 0.042
#3	0.015 - 0.024
#4	0.048

The USEPA Engineering Issue: Indoor Air Vapor Intrusion Mitigation Approaches dated October 2008, states "as a practical matter SSD systems are normally designed to achieve a pressure differential of at least 0.02 inches of water (5 Pascal) during the worst case season, to provide an adequate safety factor for long-term variations". Although the positive building pressure is not a SSD system, the principal is the same and thus the 0.02 inches of water column is a good metric for evaluating performance. According to the table above, all but one core hole location (i.e., Location #1) achieve this pressure differential. Location #1 is located at the southeast corner of the building near the loading dock which may contribute to a decrease in differential pressure. Additionally, this location is the furthest from the P-1 plume area. As such, it appears the manufacturing area has adequate positive building pressurization.

1645-1685 Emerson Building Recommendations

Based on the LaBella initial readings of positive building pressure from the four (4) monitoring points, LaBella recommends the following:

1. Installation of two monitoring points within the office areas to confirm the positive pressure also is present in these locations.
2. A limited additional evaluation of the HVAC system be completed to ensure that air handling equipment does not have the potential to impact the pressurization periodically (i.e., evaluation of major air handling equipment and CFM ratings).
3. Conduct one year of quarterly testing (i.e., 4 complete rounds) to confirm that the building pressurization is maintained throughout seasonal changes and throughout the entire building. In the event that positive building pressure is not observed in the office areas or throughout the course of the quarterly monitoring for both areas, additional work would be recommended (e.g., potentially modifications to the HVAC equipment, installation of additional monitoring wells, SVI investigation or activation of the existing passive system, etc.).

TIER 2 PROPERTIES

Properties receiving a total prioritization score (through use of Prioritization Sheet B) between 1 and 4 are considered Tier 2 properties. Tier 2 properties are properties which exhibit a moderate to low risk of SVI due to the FESL. These properties are located in Quadrants B, C, and D and are generally located in areas that appear to have received only ash fill materials or fill was removed from the building footprints prior to construction. These properties are also generally greater than 250 feet from the P-1 plume area and considered cross-gradient or up-gradient. In general, the buildings in Tier 2 exhibit characteristics that increase the potential for SVI (i.e., basement, floor cracking, number of slab penetrations, etc.) or have uses/occupancy that increase the concern for SVI; however, these properties scored low for FESL related factors (ranged between 1 and -8) and thus although the overall score showed a moderate to low SVI risk, the 'Non-FESL' factors generally contributed to an increased prioritization score. Based upon the characteristics of these properties, LaBella recommends "No Further Evaluation" for all Tier 2 properties with the exception of 655 Colfax Street (Edison Technical High School). LaBella's recommendations for this property is detailed below. It should be noted that all Tier 2 recommendations take into account that the City of Rochester will be coordinating with each property regarding potential SVI due to the FESL which will take into account changes in building use, changes or modifications to building construction or HVAC systems, or should additional data become available in the future. This is further discussed in Section 7.4.

655 Colfax Street, Edison Tech (Owner: Rochester City School District) – North & South Buildings Quadrant B

It should be noted that the discussion below is for the North and South portions of the Main Building at the parcel. A third building is also located on the parcel; however, this structure (former service station building) ranked as a Tier 3 site and is thus included in that discussion.

North Portion of Main Building
FESL Related Factors Score = -8
Non-FESL Related Factors Score = 10
Total Prioritization Score = 2

South Portion of Main Building
FESL Related Factors Score = -8
Non-FESL Related Factors Score = 12
Total Prioritization Score = 4

Discussion

Although these buildings were scored as two buildings based on HVAC and separation of the ground floors and basements, these buildings are discussed together below since their use, occupancy and construction are similar. [Note: The difference in scores is due to the sizes of the buildings and thus more penetrations and sumps in the South building which would slightly increase the potential for SVI (should a source be present)]. These buildings were constructed in 1979. The North building is approximately 41,900 sq. ft and the South building is approximately 126,900 sq. ft. These buildings are currently owned and operated by the Rochester City School District. Approximately 1,430 students occupy the school from approximately 7 am to 5 pm Monday through Friday. Approximately 130 school faculty (i.e., teachers, administrators, nurses, cafeteria workers, custodians, etc.) occupy the school from approximately 7 am to 5 pm Monday through Friday. These buildings have characteristics that would increase the potential for SVI (e.g., basement, sumps in basement, no floor in portions of basement) and the use of the buildings as a school heightens the concern for SVI; however, fill materials were removed from beneath the building during construction and groundwater sampling of the uppermost water bearing zone did not identify VOCs above detection limits in the three wells that surround the buildings. Deep monitoring well MW-16D which is approximately 150 feet west of the southern building did detect one VOC (1,1-DCA) at a concentration of 1.1 ppb (which is below it's NYSDEC Part 703 Class GA groundwater standard of 5 ppb); however, the sampling interval for this well is between elevations 499' and 507', whereas the basement sumps are at approximately elevation 518'. As such there appears to be approximately 13 ft. of 'clean' (VOC free) groundwater between the water from the deep well and water that would enter the sump. In addition, the site reconnaissance did not identify readings of concern that would be attributable to SVI from the FESL. Lastly, the first floor of the building was reported to be under positive pressure in relation to the basement space since musty odors were a nuisance and as such the 1st floor space was pressurized to eliminate such odors. The positive pressurization in the first floor relative to the basement was experienced upon entering the basement during the site reconnaissance.

North and South Building Recommendations

Based on these results there does not appear to be a concern with soil vapor intrusion due to the FESL at Edison Tech. However, the site reconnaissance observed two (2) large air handler units at Edison Tech in the basement of both the North and South buildings (i.e., 4 units in total). LaBella understands that the facilities HVAC system is automated. These two building characteristics could be used in order to ensure that the 1st floor and basement are positively pressurized. Although mitigation does not appear warranted due to the FESL, this would add a factor of safety with only minimal additional evaluation and modifications to the HVAC system. In order to confirm the existing pressurization and determine the need for any modifications, the following additional evaluations is recommended:

1. Conduct airflow measurements on existing air handler units by a contracted air balancer.
2. Seal obvious penetrations between the first floor and basement.
3. Completion of a full design drawing airflow evaluation. This will entail reviewing full building drawings and establishing an airflow balance based on all outside air intakes, exhausts, and reliefs.
4. Implement varying levels of design schemes.

It is LaBella's understanding that Edison Tech will undergo renovations under the Rochester City School District's Comprehensive School Facilities Modernization Plan. As such, LaBella recommends that the HVAC explorations/modifications be conducted in association with this Modernization Plan. LaBella met with the Rochester City School District on January 21, 2011 to discuss this approach.

TIER 3 PROPERTIES

Properties receiving a total prioritization score (through use of Prioritization Sheet B) between 0 and -4 are considered Tier 3 properties. Tier 3 properties are properties which exhibit a low or no risk of SVI due to the FESL. These properties are located in Quadrants A, B, C, and D and generally located in areas that appear to have received only ash fill materials or fill was removed from the building footprints prior to construction. These properties are also generally greater than 100 feet from the inferred extent of the P-1 plume area in an up-gradient location or more than 250 feet in a cross-gradient location. Buildings on these properties are generally in good condition with characteristics indicating a low potential for SVI (i.e., minor cracking, no heaving, no basements, etc.). Additionally, no elevated VOC or methane readings presumed to be attributable to the FESL were observed at floor penetrations in these buildings. Based upon the characteristics of these properties and their location compared to known FESL issues, LaBella recommends "No Further Evaluation" for all Tier 3 properties with the exception of 1525 Emerson Street, which is discussed below. It should be noted that the no further evaluation recommendation for the Tier 3 properties take into account that the City of Rochester will be coordinating with each property regarding potential SVI due to the FESL which will take into account changes in building use, changes or modifications to building construction or HVAC systems, or should additional data become available in the future. This is further discussed in Section 7.4.

1525 Emerson Street (Owner Pheonix Graphics (formerly Printing Methods, Inc.,))
Quadrant C

1525 Emerson Building
FESL Related Factors Score = -3
Non-FESL Related Factors Score = 2
Total Prioritization Score = -1

1525 Emerson Street Discussion

The building was constructed in (10,086 sq. ft.) with two (2) additions constructed in 1978 (8,476 sq. ft.) and 2001 (16,155 sq. ft.). This building was utilized for commercial printing operations and is currently undergoing renovations for the new owner which will also conduct similar operations. There will be approximately 30 employees in the building once occupied. No sub-slab system (i.e., vapor barriers, passive/active venting systems, etc.) is in place at this building. During site reconnaissance minor floor cracking was observed. No sealants were observed on any portion of the floor slab; however, epoxy sealants are being placed as part of the renovation work (see below). The building is over 750 feet cross-gradient of the inferred extent of the P-1 plume area. During the initial site reconnaissance, elevated methane readings were observed at two adjacent structural support beam penetrations with associated roof drain down spouts located in the 2001 addition.

Methane concentrations between 0.6% and 1.2% were observed at the western most column. Another column approximately 40-ft. to the east and in-line with the first also showed methane between 0.3% and 0.9%. No methane readings were observed in any other locations throughout the building (total of 46 readings of penetrations, cracks, I-Beams, etc.). The building appears to be located over pre-1964 fill material; however, it was located near the haul road and some limited disturbances are observed in the 1970 aerial photograph in the area of the 2001 addition to the building. It should be noted that there were numerous locations where an obvious conduit to the subsurface existed (gaps between the floor slab and wall, where there has been some separation) within about 30 feet of the methane readings observed at the columns. As such, methane gas intrusion appears to be a relatively isolated issue.

In addition to the methane detected, the eastern column also detected VOCs well above background in expansion joints and a crack around the column; however, further evaluation of the VOCs appears to indicate a surficial source that may have been associated with a temporary drum storage area (ring observed on concrete in area). In addition, debris/dust removed from an expansion joint with readings was placed in a 4-ounce jar and indicated higher readings than the crack or expansion joint. As such, this appears to be an operational surface spill and not related to SVI due to FESL.

Follow-up Work

To further evaluate the initial results, LaBella conducted a second and third site visit to collect methane readings. The second site visit did not duplicate the results of the first site visit. Specifically, methane readings were 0.1% and 0.0% at these locations. During the second site visit, LaBella retained the services of a professional plumber to 'sewer cam' the two apparent roof drains that are attached to the structural I-beam support columns. The sewer cam work was conducted to evaluate if there was a break in the lines and potentially sewer gas was the source. The lines were observed to be in good condition and confirmed to be discharging to the storm sewer and not the sanitary. As such, it does not appear the readings are related to sewer gas (and natural gas lines are overhead in the building).

Based on the lack of readings during the second site visit, a third site visit was conducted in order to evaluate these areas once more. During the third site visit, methane readings on the field meter were observed to be 0.5% and 0.8% at these locations. The barometric pressure was lower during the third site visit compared to the second one and thus may be (in part) the reason for the difference in readings.

Based on the relatively low-level concentrations of methane, intermittent occurrences and apparent isolated area the methane is present, this area was recommended for epoxy sealing. LaBella contracted EL Jon Enterprises LLC to scarify an area around the two structural support beams in the center of the 2001 addition (1,600 square foot area); seal cracks and expansion joints as needed; and, apply a two part epoxy to seal the area.

LaBella performed a post-sealing walk through and collected readings with the landfill gas meter at the previous locations with readings and locations in proximity to these areas (within ~50 ft.). It was confirmed that the previous reading locations did not exhibit methane readings. Additionally, areas previously tested in the 2001 addition were re-tested and it was confirmed that the methane had not traveled to these outlet locations.

It should be noted that this property was initially ranked as a Tier 2 property; however, based upon the post-sealing readings, which did not exhibit methane readings, this property was reclassified as a Tier 3 property.

1525 Emerson Street Recommendations

Subsequent to the sealing work, LaBella recommends that two additional site visits be conducted to confirm that the previous reading locations do not exhibit methane readings. Additionally, areas previously tested in the 2001 addition should be re-tested to confirm that the methane is not travelling to another outlet location.

9.0 City of Rochester Institutional Control

The recommendations made for each of these properties take into account the existing Institutional Controls the City of Rochester has in place. The City of Rochester has a flagging system which requires any property requesting a permit to include a review by the City of Rochester Department of Environmental Quality (DEQ). This control is one check that will allow future changes in occupancy/use or building characteristics to be evaluated by the City which could affect the overall prioritization score.

10.0 General Recommendations

In addition to recommendations associated with specific buildings requiring additional evaluation, LaBella recommends that groundwater monitoring wells MW-15S, MW-15D, DEC-MW-18 and DEC-MW-20 be properly decommissioned. Specific recommendations are provided below:

1. Develop a list of the wells that appear to be screened within the Rochester Shale Formation.
2. Access wells within the Rochester Shale Formation and evaluate for odors and collect field meter readings with the Landtec GEM2000 landfill gas meter to evaluate the relative concentration of gases within the well headspace.
3. Once the list is completed and the wells evaluated for potential thermogenic gas issues, the need for these wells in relation to current and future work associated with the FESL or other IHWDS such as Chemical Sales should be evaluated.
4. Based on the results of #1 through #3 above, create a list of wells recommended for decommissioning and contact NYSDEC to discuss decommissioning procedures and for approval to decommission.

LaBella also recommends that the City of Rochester Former Emerson Street Landfill Sub-Slab Ventilation Guidance Document Updated 2007 by LaBella Associates dated November 2007 be updated based upon the additional information obtained as part of this Soil Vapor Intrusion Assessment Report.

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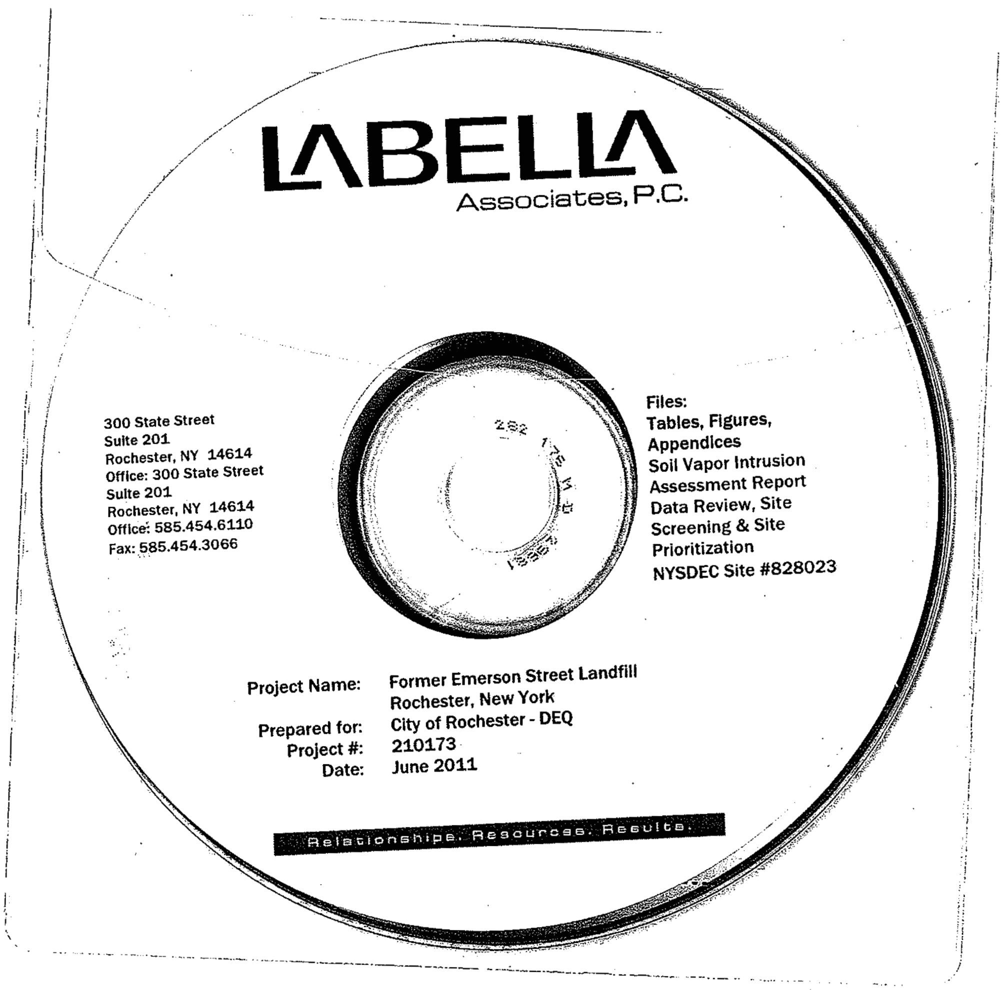
Tables, Figures and Appendices

PDF on CD (Attached)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Tables, Figures,
Appendices
Soil Vapor Intrusion
Assessment Report
Data Review, Site
Screening & Site
Prioritization
NYSDEC Site #828023
Project Name: Former Emerson Street Landfill
Rochester, New York
Prepared for: City of Rochester - DEQ
Project #: 210173
Date: June 2011
Relationships. Resources. Results.