FEASIBILITY STUDY REPORT

BRANDT AIRFLEX

(NYSDEC Site Number 152183)

NYSDEC STANDBY ENGINEERING CONTRACT

Work Assignment #D006129-11

PREPARED FOR

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

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December 2014

Table of Contents

1.0 EXECUTIVE SUMMARY 1

2.0 INTRODUCTION 3

3.0 SITE DESCRIPTION AND HISTORY 4

3.1 General Site Description 4

3.2 Physical Setting 4

3.3 History 5

4.0 REMEDIAL INVESTIGATION AND EXPOSURE ASSESSMENT SUMMARY 7

4.1 Remedial Investigation Summary 7

4.1.1 Site Characterization Criteria 7

4.1.2 Soil Contamination 7

4.1.3 Groundwater Contamination 9

4.1.4 Vapor Intrusion 11

4.2 Nature and Extent of Contamination 11

4.3 Exposure Assessment 14

5.0 REMEDIAL GOALS AND REMEDIAL ACTION OBJECTIVES 16

5.1 Remedial Goals 16

5.2 Remedial Action Objectives 16

6.0 GENERAL RESPONSE ACTIONS 20

7.0 IDENTIFICATION AND SCREENING OF TECHNOLOGIES 21

7.1 Introduction 21

7.2 Identification and Screening of Technology for Soil 21

7.2.1 Institutional Controls 22

7.2.2 Containment 22

7.2.3 In-Situ Biological Treatment 23

7.2.4 In-Situ Physical/Chemical Treatment 24

7.2.5 In-Situ Thermal Treatment 25

7.2.6 Ex-Situ Biological/Physical/Chemical and Thermal Treatment 26

7.2.7 Removal 26

7.3 Identification and Screening of Technology for Groundwater and Off-Site Soil Vapor Intrusion 26

7.3.1 Institutional Controls 28

7.3.2 Containment 28

7.3.3 In Situ Biological Treatment ... 28
7.3.4 In-Situ Physical/Chemical Treatment ... 29
7.3.5 Ex-Situ Biological Treatment ... 32
7.3.6 Ex-Situ Physical/Chemical Treatment ... 33
7.3.7 Discharge/Disposal ... 34
7.3.8 Soil Vapor Intrusion ... 34
7.4 Evaluation of Technologies and Selection of Representative Technologies ... 35
8.0 DEVELOPMENT AND ANALYSIS OF ALTERNATIVES ... 37
8.1 Alternative Development ... 37
8.1.1 Soil Alternative Development ... 37
8.1.1.1 Alternative S1 – No Action ... 37
8.1.1.2 Alternative S2 – Institutional Controls ... 37
8.1.1.3 Alternative S3 – Excavation and Off-Site Disposal ... 38
8.1.2 Groundwater and Off-Site Soil Vapor Intrusion Alternative Development ... 38
8.1.2.1 Alternative G1 – No Action ... 41
8.1.2.2 Alternative G2 – ISCO and Off-Site SSDS ... 41
8.1.2.3 Alternative G3 – In-Situ Thermal Treatment and Off-Site SSDS ... 43
8.1.2.4 Alternative G4 – Pump and Treat and Off-Site SSDS ... 44
8.1.3 On-Site Soil Vapor Intrusion Alternative Development ... 46
8.1.3.1 Alternative SV1 – No Action ... 47
8.1.3.2 Alternative SV2 – SSDS ... 47
8.1.3.3 Alternative SV3 – SVE ... 48
8.2 Evaluation of Alternatives ... 49
8.2.1 Introduction ... 49
8.2.2 Soil Alternative Evaluation ... 51
8.2.2.1 Alternative S1 - No Action ... 51
8.2.2.2 Alternative S2 – Institutional Controls ... 52
8.2.2.3 Alternative S3 - Excavation and Off-Site Disposal ... 53
8.2.3 Groundwater Alternative Evaluation ... 54
8.2.3.1 Alternative G1 – No Action ... 55
8.2.3.2 Alternative G2 – ISCO and Off-Site SSDS ... 56
8.2.3.3 Alternative G3 – In-Situ Thermal Treatment and Off-Site SSDS ... 60

8.2.3.4 Alternative G4 – Pump and Treat and Off-Site SSDS 64
8.2.4 On-Site Soil Vapor Alternative Evaluation 67
8.2.4.1 Alternative SV1 – No Action 68
8.2.4.2 Alternative SV2 – SSDS 69
8.2.4.3 Alternative SV3 – SVE 70
8.3 Comparative Analysis of Alternatives 72
8.3.1 Soil Alternative Comparative Evaluation 72
8.3.1.1 Overall Protectiveness of the Public Health and the Environment 72
8.3.1.2 Compliance with SCGs 73
8.3.1.3 Long Term Effectiveness and Permanence 73
8.3.1.4 Reduction of Toxicity, Mobility or Volume with Treatment 73
8.3.1.5 Short Term Impact and Effectiveness 73
8.3.1.6 Implementability 74
8.3.1.7 Cost Effectiveness 74
8.3.1.8 Land Use 74
8.3.2 Groundwater Alternative Comparative Evaluation 74
8.3.2.1 Overall Protectiveness of Public Health and the Environment 74
8.3.2.2 Compliance with SCGs 76
8.3.2.3 Long Term Effectiveness and Permanence 76
8.3.2.4 Reduction of Toxicity, Mobility or Volume with Treatment 77
8.3.2.5 Short Term Impacts and Effectiveness 78
8.3.2.6 Implementability 79
8.3.2.7 Cost 79
8.3.2.8 Land Use 80
8.3.3 On-Site Soil Vapor Alternative Comparative Evaluation 80
8.3.3.1 Overall Protectiveness of Public Health and the Environment 80
8.3.3.2 Compliance with SCGs 80
8.3.3.3 Long Term Effectiveness and Permanence 81
8.3.3.4 Reduction of Toxicity, Mobility or Volume with Treatment 81
8.3.3.5 Short Term Impacts and Effectiveness 81
8.3.3.6 Implementability 82
8.3.3.7 Cost 82

8.3.3.8 Land Use *82*

9.0 CERTIFICATION **84**

10.0 REFERENCES **85**

Table of Contents (continued)

List of Tables

Table 1	Range of VOCs in Soil
Table 2	Range of SVOCs in Soil
Table 3	Range of PCBs in Soil
Table 4	Range of Metals in Soil
Table 5	Range of VOCs in Groundwater
Table 6	Range of Metals in Groundwater
Table 7	Range of Pesticides in Groundwater
Table 8	Range of VOCs in Groundwater Profiling Results
Table 9	Range of SVOCs in Groundwater Profiling Results
Table 10	Range of Metals in Groundwater Profiling Results
Table 11	Range of VOCs in Subslab Soil Vapor
Table 12	Range of VOCs in Indoor (Ambient) Air
Table 13	Summary of Qualitative Human Health Exposure Assessment
Table 14	General Response Actions
Table 15	Identification and Screening of Technologies – Soil
Table 16	Identification and Screening of Technologies – Groundwater
Table 17	Evaluation of Soil Alternatives
Table 18	Cost Estimate for Alternative S2
Table 19	Cost Estimate for Alternative S3
Table 20	Evaluation of Groundwater and Soil Vapor Alternatives
Table 21	Cost Estimate for Alternative G2
Table 22	Cost Estimate for Alternative G3
Table 23	Cost Estimate for Alternative G4
Table 24	Evaluation of Soil Vapor Alternatives
Table 25	Cost Estimate for Alternative SV2
Table 26	Cost Estimate for Alternative SV3

Table of Contents (continued)

List of Figures

Figure 1	Site Location Map
Figure 2	Site Map
Figure 3	Groundwater Contours Section A-A’ Plan View
Figure 4	Geologic Cross Section A-A’
Figure 5	Investigation Locations
Figure 6	Soil Contaminated Above SCOs
Figure 7	Summary of Groundwater PCE Analytical Results
Figure 8	Vertical Extent of PCE Contamination
Figure 9	Off-Site Sub-Slab Depressurization System Layout
Figure 10	Alternative G2 In Situ Chemical Oxidation
Figure 11	Alternative G3 In Situ Thermal Treatment
Figure 12	In-Situ Thermal Treatment System Process Flow Diagram
Figure 13	Alternative G4 Pump and Treat
Figure 14	Groundwater Treatment System Process Flow Diagram
Figure 15	On-Site Sub-Slab Depressurization System Layout
Figure 16	Soil Vapor Extraction Layout
Figure 17	Typcial Soil Vapor Extraction Treatment System Process Flow Diagram

List of Acronyms

1,1,1-TCA	1,1,1-Trichloroethane
1,2-DCE	cis-1,2-dichloroethene
6 NYCRR	Title 6 of the New York Code of Rules and Regulations
acfm	actual cubic feet per minute
ART	Accelerated Remediation Technologies
AS	Air Sparging
AS/SVE	Air Sparging/Soil Vapor Extraction
atm	atmosphere
BGS	below ground surface
CVOCs	chlorinated volatile organic compounds
DDC	Density Driven Convection
ECL	Environmental Conservation Law
EPCRA	Emergency Planning and Community Right-to-Know Act
ERH	Enhanced Resistive Heating
eV	eletron volt
FS	Feasibility Study
GAC	Granulated Activated Carbon
gpm	gallons per minute
GRA	General Response Actions
GWQS	Groundwater Quality Standards
HDR	Henningson, Durham, and Richardson Architecture and Engineering P.C.
IEG	IEG Technologie
ISCO	In-Situ Chemical Oxidation
ISTT	In-Situ Thermal Treatment
LTM	Long Term Monitoring
MFR	Modified Fenton's Reagent®
MNA	Monitored Natural Attenuation
NAPL	Non-aqueous phase liquid
ND	non-detect
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
NPL	National Priority List
O&M	Operation and Maintenance
OSHA	Occupational Saftey and Health Administration
PAHs	Polycyclic aromatic hydrocarbons
PCBs	polychlorinated biphenyls
PCE	Tetrachloroethene also known as Perchloroethylene
PID	photo-ionization detector
POTW	Publicly Owned Treatment Works
PVC	Polyvinyl chloride
RAOs	Remedial Action Objectives
RI	Remedial Investigation
ROD	Record of Decision

List of Acronyms (continued)

SARA	Superfund Amendments and Reauthorization Act
SCDHS	Suffolk County Department of Heath Services
SCG	Standards, criteria and guidance
SCOs	Soil Cleanup Objectives
SEE	Steam Enhanced Extraction
S/S	Solidification/Stabilization
SSDS	Sub Slab Depressurization System
SSF	State Superfund Program
SVE	Soil Vapor Extraction
SVOCs	semi-volatile organic compounds
TAL	Target Analyte List
TCE	Trichloroethene
TCH	thermal conductive heating
TCL	Target Compound List
TCLP	Toxicity characteristic leaching procedure
TOC	total organic carbon
TSDF	Treatment, storage and disposal facility
USEPA	United States. Environmental Protection Agency
UVB	Udterdruck-Verdampfer-Brunnen
VOCs	volatile organic compounds
WE	Wasatch Environmental Inc.

1.0 EXECUTIVE SUMMARY

Henningson, Durham & Richardson Architecture and Engineering P.C. (HDR) prepared this Feasibility Study (FS) to evaluate remedial alternatives for the Brandt Airflex Superfund Site, located at 937 and 965 Conklin Street in the Hamlet of East Farmingdale, Town of Babylon, Suffolk County, New York. A Remedial Investigation (RI) was completed by HDR from January 2011 through November 2013. Conclusions drawn from the RI activities, documented in the Remedial Investigation Report dated June 2014 are the basis for the treatment areas and media of concern addressed in this FS. The RI made the following conclusions:

- Soil samples collected adjacent to and within drywells at the site showed some impacts associated with metals at concentrations exceeding the unrestricted use soil cleanup objectives (SCOs) but below the industrial use SCOs.
- Groundwater sample results collected down gradient of the source area showed significantly less chlorinated volatile organic compound concentrations (CVOCs), which indicates contamination may not have migrated far from its source or the contamination may be diluted from groundwater flow in the vicinity of the source.
- A silty clay layer was encountered at approximately 157 feet below ground surface (bgs) which may act as a barrier preventing contamination from migrating vertically downward.
- The source for groundwater contamination is the drywell located north of Brandt Airflex building located at 937 Conklin Street.
- A dissolved-phase plume extends beyond the source area with concentrations greater than the NYS Class GA groundwater quality standards (GWQS).
- Concentrations of CVOCs in soil vapor samples collected within the two on-site buildings and the neighboring building to the west indicate mitigation is recommended.

Based on the results of the RI this FS focuses on evaluating remedial alternatives for three media identified in the RI:

- Soils in and adjacent to the drywells;
- Groundwater in the source area; and
- Soil vapor in both the on-site and off-site buildings, north of Conklin Street and immediately west of the site.

2.0 INTRODUCTION

HDR was retained by the New York State Department of Environmental Conservation (NYSDEC) to conduct a RI and FS of the Brandt Airflex Site (NYSDEC Site #152183), located at 937 and 965 Conklin Street in the Hamlet of East Farmingdale, Town of Babylon, Suffolk County, New York.

HDR conducted a RI from January 2011 through November 2013. The investigation consisted of a geophysical survey to mark underground utilities and subsurface features, followed by the installation and sampling of 10 direct-push soil borings, 13 direct-push vertical profiling groundwater borings, drywell sampling, sub-slab soil vapor and co-located indoor air samples, the installation of temporary piezometers and the installation and sampling of cluster monitoring wells at seven locations and single depth monitoring wells at two locations around the site. This FS was prepared to evaluate remedial alternatives to address the soil and groundwater impacts identified in the RI.

HDR has prepared this FS in general conformance with Section 4 of the *Technical Guidance for Site Investigation and Remediation (DER-10)* (NYSDEC Division of Environmental Remediation, May 3, 2010). The FS identifies technologies and evaluates alternatives which are capable of achieving cleanup to pre-disposal or unrestricted conditions, or those that may achieve a cleanup appropriate for the identified use of the site. The primary objective of the FS is to ensure that appropriate remedial alternatives are identified and evaluated such that an appropriate remedy can be selected for the site. For this site the FS evaluates alternatives which are capable of cleaning up the site to pre-disposal conditions and for the current and future intended use of the site which is an industrial use.

3.0 SITE DESCRIPTION AND HISTORY

3.1 General Site Description

The Brandt Airflex Site is located in a mixed-use area within a suburban portion of Suffolk County, New York. The 2.07-acre site is located on the north side of Conklin Street, west of Broad Hollow Road in East Farmingdale, within the Town of Babylon (Figure 1). The site consists of the two parcels at 937 Conklin Street (approximately 1.5 acres) and 965 Conklin Street (approximately 0.6 acres), each with one single-story industrial building (Figure 2). The building at 937 Conklin Street is a 30,000 square feet masonry building that is used for light manufacturing (design and production of architectural and ornamental metal workings). The majority of the products are decorative metals such as brass, aluminum, and stainless steel which do not require chemical coatings or treatment. Finishing, if required, is performed off-site by subcontractors. The building at 965 Conklin Street (approximately 10,300 square feet) is used for packaging and storage of finished ornamental metal products prior to shipping. The property is zone G – Industry (Light).

The surrounding properties are used for a combination of commercial, light industrial, and residential. Vacant land, the East Farmingdale Fire Department, and residential properties are to the South. To the east is Suffolk Truck Wash and storage yard. A mix of commercial and light industrial tenants occupies the properties to the north and west.

3.2 Physical Setting

The site lies at an elevation of approximately 72 to 79 feet above mean sea level. The general area around the site and the site itself is relatively flat. A fence exists along the east, south east, north and north west property lines of both properties separating the site from the neighboring properties. There are no existing wetlands or streams in the vicinity of the site. The closest surface water body is an artificial pond (since filled) located approximately 550 feet southeast of the site listed as a Class 02 Inactive Hazardous Waste Site (Fairchild Republic Old Sump Site No 152004). The site is paved with the exception of two small landscaped areas south of both buildings. The property is sloped to drain storm water runoff via overland flow to twelve existing drywells. Four drywells are located north of Building 937 and three north of Building 965. The remaining five drywells are located south or east of the buildings.

The site is underlain by the Upper Glacial and Magothy Aquifers which are designated by the United States Environmental Protection Agency (USEPA) as sole source aquifers. Depth to groundwater ranges from 23 to 25 feet below ground surface (bgs) and flows generally to the south (Figure 3). Based on borings completed at the site, the subsurface geology is comprised of fine to coarse brown sand and rounded gravel to a depth of approximately 80 feet bgs. Below this is a layer of a mottled fine to medium sand with trace silt and mica. Mixed in with this layer are silt and clay lenses. The subsurface geology is shown on Figure 4.

3.3 History

Historic land use information indicates that the site was at one time part of a larger tract of land that was used for dyeing and silk screening textile-related operations. During this period, the larger tract was owned by the Independent Silk Dyeing Company, Inc. (later the Independent Textile Dyeing Company, Inc.) which conducted silk and textile screening operations from 1914 until 1958. In 1972, the former Independent property was subdivided into a northern and a southern parcel and subsequently sold. The southern parcel became the Brandt Airflex (and later the Airflex Industrial Corp.) facility and the northern parcel became the Kenmark property. Screen and textile printing operations continued on the northern parcel under a new company and in 1986, the Kenmark Site which is up gradient of the site was listed on the USEPA National Priority List (NPL) due to the discharge of metal- and phenol-contaminated wastewater into an on-site leaching pit. The primary areas of concern were wastewater sludge drying beds and the leachate pit for wastewater derived from the sludge. The RI at the Kenmark Site found that the contaminants of concern were limited to metals. A Remedial Action in 1985 reportedly removed the most contaminated soils and wastes. RI groundwater sampling showed decreasing metals contamination and only negligible volatile organic compounds (VOCs) contamination in wells at and down gradient of the (identified) disposal areas. On March 30, 1994, USEPA issued a No Further Action decision for the Kenmark Site (NYSDEC 2009).

The building at 937 Conklin Street was reportedly constructed in the mid-1960s and used for textile-related operations until 1975 (PWGC 2000). Brandt Airflex and namesakes have occupied the property since 1976.

During an inspection of the Brandt Airflex property in 1993, the Suffolk County Department of Health Services (SCDHS) observed outdoor storage of five gallon pails and drums containing paints and waste oil in addition to an unpermitted paint spraying operation. One or more of the drums appeared to have leaked into a storm drain (drywell) located behind the 965 Conklin Street building. Samples were subsequently collected from both the drywell observed to have received the spillage and a drywell connected to the shallow loading dock catch basin behind 937 Conklin Street. Analytical results for sludge samples collected from the two drywells indicated the presence of contamination requiring remedial action. In 1994 American Environmental Assessment Corporation was hired to remove and properly dispose the leaking containers off-site and excavate sediment/soil from the drywells and dispose off-site. Endpoint samples collected (DW1 – 0.056 mg/kg and DW2 – 30 mg/kg) indicated additional remediation was needed for the drywell behind 937 Conklin Street. This drywell was further excavated to a depth of 18 feet bgs. Additional remedial investigations were conducted in August 1994 and January 1995 which revealed groundwater at the site to be impacted with tetrachloroethene (PCE). A more detailed Site history and descriptions of prior investigations are provided in the RI report.

4.0 REMEDIAL INVESTIGATION AND EXPOSURE ASSESSMENT SUMMARY

4.1 Remedial Investigation Summary

4.1.1 Site Characterization Criteria

The RI/FS characterizes the site and identifies and evaluates alternatives which are capable of achieving the goal, which is cleanup to pre-disposal or unrestricted Site conditions, to the extent feasible. Title 6 of the New York Codes, Rules and Regulations (6 NYCRR) Part 375-2.8(c) sets forth the criteria for completing a FS. For sites with soil contamination the FS must include the development and evaluation of one or more alternatives that achieve the unrestricted use SCOs for soil. The FS may also include the development and evaluation of one or more alternatives that achieve a restricted use. The SCOs are promulgated at 6NYCRR Part 375-6, with specific SCOs for unrestricted and restricted use promulgated within 6NYCRR Part 375-6.8(a) and (b). Unrestricted use SCOs would equate to pre-disposal conditions, protection of groundwater, protection of ecological resources, and four protection of public health categories: residential, restricted-residential, commercial and industrial. For the Brandt Airflex Site, the applicable SCOs are unrestricted for the pre-disposal cleanup goal and industrial given the site's zoning and current uses (zoned Light Industry and used for manufacturing purposes). Protection of groundwater SCOs are applicable at restricted use sites where contamination has been identified in on-site soil and groundwater standards have been, or are threatened to be, contravened. For this site, contaminants in soil detected at concentrations greater than the unrestricted use SCOs were not detected in groundwater samples at concentrations greater than the NYS Class GA GWQS. Protection of groundwater SCOs were considered but not selected as the SCOs for this site.

4.1.2 Soil Contamination

The RI included the installation of ten soil borings on the site. Borings were installed at or near observed and suspected drywells to identify and delineate areas of contamination. The borings were advanced to the water table to a maximum depth between 25 and 30 feet bgs. The recovered soil cores were visually inspected and descriptions of the encountered material and pertinent other observations were recorded in boring logs. HDR used a MiniRAE 2000 model photo-ionization detector (PID) equipped with a 10.6 electron volt (eV) lamp to screen the soil cores for the presence of volatile organic vapors. At all but two borings, the PID vapor readings were at background (0.0 units). At the two borings with vapor readings, background was exceeded only marginally (up to 1.2 units).

Eight soil boring samples were collected from depths between 15 and 26 feet bgs and analyzed for Target Compound List (TCL) VOCs, semi-volatile organic compounds (SVOCs), pesticides and polychlorinated biphenyls (PCBs), Target Analyte List (TAL) metals, and cyanide (one sample each from borings DWB-2, -4, -7, -8, -9, and -10 and two samples from boring DWB-6). Results for all samples collected from the borings met unrestricted use soil cleanup objectives (SCOs) except for the sample collected at 15 feet bgs at DWB-6 which exceeded the unrestricted use SCOs of 0.10 mg/kg for PCBs (0.19 mg/kg). Results did contain elevated concentrations of metals having no standard. These metals included aluminum (480 mg/kg to 1,400 mg/kg) and iron (1,000 to 2,700 mg/kg).

In addition to soil borings, bottom samples were collected from three drywells (DW-8, DW-9 and DW-11) and one sample was collected from abrasive washing sands collected from a pile of material located behind the building at 937 Conklin Street. Three drywell sample results and the washout sample results exceeded the unrestricted use SCOs for metals, PCBs, SVOCs and/or VOCs. Metals exceeding the unrestricted use SCOs included mercury, chromium, copper, lead, nickel, selenium, and zinc. Elevated concentrations of metals with no promulgated standard included: aluminum (1,200 to 11,000 mg/kg), calcium (3,200 to 42,000 mg/kg), and magnesium (1,600 to 24,000 mg/kg). Both aluminum and calcium concentrations exceeded the NYSDEC Policy CP-51/Soil Cleanup Guidance Table 1 Protection of Ecological Resources Supplemental Soil Cleanup Guidance of 10,000 mg/kg.

Drywell DW-11 was the only location having SVOC concentrations including benzo[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, benzo[k]fluoranthene chrysene, and indeno[1,2,3-cd]pyrene exceeding unrestricted use SCOs. Drywell DW-9 was the only location having VOC concentrations including ethylbenzene and total xylene greater than unrestricted use SCOs. Both samples from DW-9 (0.31 mg/kg) and DW-11 (2.2 mg/kg) had concentrations of PCBs greater than the unrestricted SCO of 0.1 mg/kg. Drywells DW-9 and DW-11 also had detections of PCE, both less than the unrestricted use SCOs.

All soil and drywell bottom samples analyzed met the industrial use SCOs with the exception of benzo[a]pyrene collected from DW-11. The result of 2.2 mg/kg was greater than the industrial use SCO of 1.1 mg/kg for this compound. Benzo[a]pyrene is a polycyclic aromatic hydrocarbon (PAH). According to NYSDEC Policy CP-51 Soil Cleanup Guidance for non-residential use sites where ecological SCOs are not applicable NYSDEC may approve the use of a soil cleanup level of 500 mg/kg for total PAHs for subsurface soil in lieu of the PAH-specific SCOs in 6 NYCRR 375-6. The total PAHs concentration at DW-11 was 26.19 mg/kg which is less than the 500 mg/kg total PAH soil cleanup guidance.

The ranges of chemical concentrations in soil are provided in Tables 1 through 4.

4.1.3 Groundwater Contamination

The RI included groundwater profiling and the installation of piezometers and permanent groundwater monitoring wells (Figure 5). A cluster of three permanent wells including one triplet well (BAW-07C, BAW-07D, BAW-07E) was installed within the suspected location of the shallow catch basin connected to the original source area (DW-11) north of the building at 937 Conklin Street. The triplet well (3 wells installed in one borehole), BAW-07C was installed at 40, 55, and 75 feet bgs. Permanent wells BAW-07D and BAW-07E were installed and screened at 95 feet and 130 feet bgs, respectively. Four additional monitoring wells (BAW-02F – 175 feet bgs, BAW-02E – 277 feet bgs, BAW-02D – 120 feet bgs) including one triplet (BAW02C – 30, 70, and 100 feet bgs) were installed south and southeast of the building at 937 Conklin Street, down gradient of the suspected source area (DW2). Eight monitoring wells including three triplets were installed down gradient and off the site. The three triplet wells (BAW-03C, BAW-05C, and BAW-06C) were installed at depths of 27 to 40 feet bgs, 55 to 85 feet bgs, and 75 to 100 feet bgs, respectively. The five additional single monitoring wells were installed at 117 feet bgs (BAW-04D), 130 feet bgs (BAW-05D and BAW-06D), and 225 feet bgs (BAW-08E). One monitoring well (BAW-09E) was constructed west of the site on property at 931 Conklin Street. This well was installed to 277 feet bgs. The locations of all monitoring wells are shown on Figure 5.

Analytical results indicate that groundwater at the site is impacted with CVOCs at concentrations greater than applicable standards, most notably PCE, trichloroethene (TCE), cis-1,2,-

dichloroethene (1-2-DCE), and 1,1,1-trichloroethane (1,1,1-TCA). PCE was the most prevalent contaminant with the greatest concentrations and number of exceedences and was used to develop a plume map for groundwater exceeding the NYS Class GA GWQS. Monitoring well BAW-07E, which was installed directly down gradient of the suspected source area DW-11 (former DW2), had the greatest concentration of PCE.

Five samples collected at monitoring wells BAW-01C, BAW-02C, BAW-03C, BAW-04C, and BAW-05C were also analyzed for metals, PCBs, pesticides, and SVOCs. Metals detected included aluminum, calcium, iron, lead, magnesium, manganese, sodium, and zinc. Of these detections only iron, manganese, and sodium exceeded the NYS Class GA GWQS. Pesticides were detected in monitoring well BAW-04C at concentrations exceeding the NYS Class GA GWQS for chlordane (0.28 µg/L) and dieldrin (0.31 µg/L). There were no detections of PCBs or SVOCs.

The ranges of chemical concentrations detected in groundwater monitoring wells are provided in Tables 5 through 7.

In addition to groundwater sampling vertical profiling at the groundwater soil interface (26-30 feet bgs) was completed at 13 locations and analyzed for VOCs. In addition to VOCs four locations were analyzed for metals, PCBs, pesticides and SVOCs. No PCBs or pesticides were detected. Metals detected included aluminum, calcium, chromium, iron, lead, magnesium, manganese, sodium, and zinc. One SVOC was detected, bis(2-ethylhexyl)phthalate. Of the contaminants detected chromium (70 µg/L) and manganese (380 µg/L) had one detection above their applicable NYS Class GA groundwater quality standard of 50 µg/L and 300 µg/L, respectively and all samples for iron (4,600 – 21,000 µg/L) were detected above the NYS Class GA groundwater quality standard of 300 µg/L. Results for metals in groundwater profiling were unfiltered and as a result potentially indicate greater concentrations due to turbidity in the sample. Samples collected from monitoring wells analyzed for metals were considered more indicative of the groundwater quality at the site than the samples collected during groundwater profiling. Tables 8 through 10 summarize the range of contaminants detected from the groundwater profiling samples.

4.1.4 Vapor Intrusion

A total of seven sub slab soil vapor points with co-located indoor air and five exterior locations were included in the vapor intrusion investigation (Figure 3). Of these seven sub slab points, four were collected off site at the 931 Conklin Street property (west of 937 Conklin Street), two at the 937 Conklin Street property, and one at 965 Conklin Street. Concentrations of PCE and TCE were present in the sub slab soil vapor and air samples collected at all three buildings. Concentrations of 1,1,1-TCA were also identified in the sub slab soil vapor samples obtained from each of the three buildings, but not in any indoor air samples.

The determination of the need to mitigate is based on the New York State Department of Health (NYSDOH) vapor intrusion guidance decision matrices for these compounds as well as consultation with the NYSDOH. The NYSDOH has developed two matrices for use in making decisions when soil vapor may be entering buildings. Matrix 1 was developed for TCE and Matrix 2 was developed for PCE and 1,1,1-TCA. Based on the sub slab concentrations of PCE for each of the three buildings, mitigation is recommended for all three buildings even though the co-located indoor air sample locations were less than the corresponding NYSDOH air guideline values.

NYSDOH has not established an air guideline value for 1,1,1-TCA, but has developed Matrix 2 for making decisions regarding when soil vapor mitigation may be necessary. According to Matrix 2 mitigation is necessary for the building at 937 Conklin Street due to elevated 1,1,1-TCA concentrations.

The ranges of VOC concentrations in sub slab soil vapor and indoor air samples are provided in Tables 11 and 12, respectively.

4.2 Nature and Extent of Contamination

Major conclusions related to the nature and extent of contamination at the site includes the following:

Subsurface Soil:

- As shown on Figure 6, subsurface soil impacted with metals, PCBs, SVOCs and VOCs greater than the unrestricted use SCOs are limited to the north of Building 937 in drywells DW-8, DW-9, and DW-11. Contaminants with no standard were compared to the protection of groundwater standard published in NYSDEC's Policy CP-51/Soil Cleanup Guidance. One sample was collected from material adjacent to DW-11. Sample results for this location (Washout-1) also exceeded the unrestricted use SCOs, but were below the industrial use SCOs.
- Aluminum, iron and manganese were observed in all subsurface soil samples collected in 2011. Concentrations of aluminum ranged from 480 to 11,000 mg/kg, concentrations of iron ranged from 1,400 to 53,000 mg/kg, and concentrations of manganese ranged from 12 to 440 mg/kg. The greatest concentrations of these compounds were observed in drywells DW-9 and DW-11.
- Concentrations of compounds met the unrestricted use SCOs at all soil sample locations except for DW-8, DW-9, Washout-1, and DW-11. At these locations metals exceeded the unrestricted use SCOs including mercury (ND to 1.7 mg/kg), copper (270 to 1,400 mg/kg), lead (11 to 120 mg/kg), chromium (140 mg/kg to 630 mg/kg), nickel (87 to 490 mg/kg) and zinc (210 to 1,200 mg/kg). Samples collected in drywells DW-9 and DW-11 also showed concentrations of PCBs in excess of the unrestricted use SCOs. DW-11 results had SVOCs in excess of the unrestricted use SCOs including benzo[a]anthracene (1.9 mg/kg), benzo[a]pyrene (2.2 mg/kg), benzo[b]fluoranthene (3.5 mg/kg), benzo[k]fluoranthene (0.92 mg/kg), chrysene (2.5 mg/kg), and indeno[1,2,3-cd]pyrene (1.6 mg/kg). Drywell DW-9 had VOC results greater than the unrestricted SCOs. VOCs included ethylbenzene (1.2 mg/kg) and total xylene (2.4 mg/kg). The only detection of PCE was in drywell DW-9 at a concentration of 1.1 mg/kg which is less than the unrestricted use SCO of 1.3 mg/kg.
- All detected compounds with the exception of benzo[a]pyrene result from DW-11 are below the industrial use SCOs. The sample result is 2.2 mg/kg which is slightly greater than the industrial standard of 1.1 mg/kg. According to NYSDEC

Policy CP-51 Soil Cleanup Guidance for non-residential use sites where ecological SCOs are not applicable NYSDEC may approve the use of a soil cleanup level of 500 mg/kg for total PAHs for subsurface soil in lieu of the PAH-specific SCOs in 6 NYCRR 375-6. The total PAHs concentration at DW-11 was 49.36 mg/kg which is less than the 500 mg/kg total PAH soil cleanup guidance.

- All compounds detected at concentrations greater than the unrestricted use SCOs in soil were not detected at concentrations greater than the NYS Class GA GWQS in samples collected from monitoring wells at the site. Metal concentrations greater than the NYS Class GA GWQS were iron, manganese, and sodium which could be naturally present in groundwater and may not be indicative of groundwater contamination resulting from site industrial activities.
- The locations with soil impacted above the unrestricted use SCOs are shown on Figure 6. To calculate the volume of soil impacted above unrestricted use SCOs, each drywell was assumed to be approximately 12 feet in diameter and filled with 10 feet of soil. Based on this assumption the total estimate of impacted soil above unrestricted use SCOs was calculated to be approximately 130 cubic yards. There were no soils impacted above industrial use SCOs.

On-Site Groundwater:

- According to historic records PCE was released into drywells located north of both buildings. The original designations for the drywells were DW1 (currently DW-6) located at 965 Conklin Street and DW2 (currently DW-11) located at 937 Conklin Street.
- The RI confirmed groundwater contamination greater than the NYS Class GA GWQS within the site area including the 937 and 965 Conklin Street properties. The detected contamination consisted of CVOCs, predominately PCE. Additional contaminants detected at concentrations greater than the Class GA GWQS included 1,1,2-trichloro-1,2,2-trifluoroethane, 1,1-DCE, and 1,2-DCE. The greatest concentration of PCE (13,000 µg/L) was detected in a groundwater profile sample collected at location DWB-11 at a depth of 65 to 70 feet bgs. Elevated PCE concentrations were also detected at this location in a sample

collected from 26 feet to 80 feet bgs. The concentrations detected may indicate the presence of non-aqueous phase liquid (NAPL) in the saturated subsurface soils.

- Metals concentrations greater than the NYS Class GA GWQS were iron, manganese, and sodium which could be naturally present in groundwater and may not be indicative of groundwater contamination resulting from site industrial activities. Metals detected in groundwater profiling results could be skewed as a result of turbidity and were not considered to represent the groundwater quality at the site.
- Figure 7 shows the horizontal extent of the proposed groundwater source remediation area. The actual remediation area will be refined during the pre-design investigation conducted prior to implementing the selected groundwater remedial action. The estimated groundwater source treatment area is approximately 550 square feet and in the depth horizon of 25 to 130 feet bgs. Figure 7 also shows the extent of groundwater contaminated with PCE above the NYS Class GA GWQS.

Vapor Intrusion:

- Sub-slab soil vapor concentrations of TCE, PCE and 1,1,1-TCA are present at all three buildings; however, concentrations of PCE and TCE at co-located indoor air sample locations were less than the corresponding NYSDOH air guideline values.

4.3 Exposure Assessment

The most significant potential exposure route is the migration of vapor-phase CVOCs into overlying structures at the site and adjacent off-site building (931 Conklin Street). Based on the data collected during the RI the vapor phase CVOCs is potentially a result of the groundwater plume beneath the building; however, soil impacts may also contribute to the vapor-phase. There were minimal other direct contact or ingestion exposure routes identified because the area is an industrial site and soil concentrations are generally less than the industrial use SCOs. However, as required by Part 375-2.8(c) at least one alternative was developed and evaluated that achieves the unrestricted use SCOs. Groundwater at the site is not used for consumption and is not considered an exposure pathway. A summary of the exposure routes are provided in Table 13.

5.0 REMEDIAL GOALS AND REMEDIAL ACTION OBJECTIVES

5.1 Remedial Goals

The remedial action goals for remedial actions undertaken pursuant to the New York State Inactive Hazardous Waste Disposal Site Remedial Program (State Superfund Program or SSF), are defined by Environmental Conservation Law (ECL), Article 27, Title 13. The goal of the SSF program is to complete cleanup of the site through the elimination of the significant threat to the environment posed by the disposal of hazardous wastes at the site and of the imminent danger of irreversible or irreparable damage to the environment caused by such disposal.[1]

5.2 Remedial Action Objectives

Remedial Action Objectives (RAOs) are developed to define site specific concerns that must be addressed and to what levels to protect human health and the environment. The RAOs for the Brandt Airflex site are presented below.

<u>Groundwater RAOs for Public Health Protection</u>

- Prevent ingestion of groundwater with contaminant levels exceeding drinking water standards.
- Prevent contact with, or inhalation of volatiles, from contaminated groundwater.

<u>Groundwater RAOs for Environmental Protection</u>

- Restore groundwater to pre-disposal/pre-release conditions, to the extent practicable.
- Remove the source of ground or surface water contamination to the extent practicable

Chapter X - Division of Water, Part 703: Surface Water and Groundwater Quality Standards and Groundwater Effluent Limitations, contains promulgated water quality standards and

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[1] Environmental Conservation Law, Article 27, Title 13, §27-1313 Remedial Programs.

groundwater effluent limitations for discharges to Class GA waters to be used for the restoration of the groundwater aquifer to pre-disposal/pre-release conditions. VOCs have been detected in the groundwater at the site at concentrations greater than the groundwater Class GA GWQS.

Groundwater at the site is designated as a sole source aquifer; however, there are no potable water supply wells in the vicinity of the site. Currently, there is minimal exposure to contaminants in groundwater; however, over time as contaminated groundwater continues to migrate further from the site a public health exposure pathway could become possible, if no action is taken.

<u>Soil RAOs for Public Health Protection</u>

- Prevent ingestion/direct contact with contaminated soil.
- Prevent inhalation of or exposure from contaminants volatilizing from contaminants in soil.

<u>Soil RAOs for Environmental Protection</u>

- Prevent migration of contaminants that would result in groundwater contamination.

<u>Soil Vapor RAOs for Public Health Protection</u>

- Mitigate impacts to public health resulting from existing, or the potential for, soil vapor intrusion into buildings on-site and off-site.

Applicable Standards, criteria, and guidance (SCG) for soil are contained in 6 NYCRR Part 375 – Environmental Remediation Programs, Section 6.8. This section sets forth soil cleanup objectives that will satisfy the RAOs for soil at the site (i.e., protection of public health and the environment). Soil cleanup objectives have been developed for unrestricted and restricted uses. The types of restricted use soil cleanup objectives include: residential; restricted-residential; commercial use; industrial use; protection of groundwater; and protection of ecological resources. The unrestricted soil cleanup objectives represent the most conservative of the values and "pre-disposal" conditions.

The ultimate goal of site remediation as set forth at Part 375-2.8(a) is to restore the site to "pre-disposal" conditions, to the extent feasible. The regulation requires that a FS be conducted that develops and evaluates at least one alternative that achieves the unrestricted use SCOs and may also evaluate one or more alternatives that achieve a restricted use. The site is currently zoned and used for an industrial facility and no impacts to groundwater from soil contamination were identified during the RI. As such the SCOs proposed for the site are the industrial SCOs. However, as required by Part 375-2.8(c) the FS includes the development and evaluation of at least one alternative that will achieve the unrestricted use SCOs. VOCs, SVOCs, metals, and PCBs have been detected in the soils at the site at concentrations greater than the SCOs outlined in Part 375 Section 6.8 as follows:

- VOCs exceed unrestricted use SCOs
- SVOCs exceed unrestricted use, commercial and one PAH compound exceeds the industrial use SCO
- Metals exceed unrestricted use and commercial use SCOs
- PCBs exceed unrestricted use SCOs

New York State does not currently have any SCG for subsurface vapors. However, the matrices in Section 3.4.2 of the Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York, October 2006 were used to determine the most appropriate actions given the concentrations of TCE and PCE in sub slab soil vapor and indoor air on site. Determination of whether mitigation is recommended is based on two matrices included in Section 3.4 of the vapor intrusion guidance document. Determination of whether to mitigate for TCE is based on Matrix 1 and mitigation for PCE and 1,1,1-TCA is based on Matrix 2. The matrices take into account both the sub slab vapor concentrations and indoor air concentrations to determine whether mitigation is recommended. For this site, at least one sample from beneath each building had PCE sub slab vapor concentrations greater than 1,000 $\mu g/m^3$. Mitigation is recommended per Matrix 2. In addition to providing the decision matrices, the NYSDOH has derived Air Guideline Values for five chemicals, including PCE and TCE. The air guideline values are provided to identify unacceptable levels of exposure from indoor air concentrations and where mitigation is urgent. The developed air guideline values for PCE and TCE are provided in Table 3.1 of the Soil Vapor Intrusion Guidance document, and are 30 $\mu g/m^3$ and 5 $\mu g/m^3$, respectively.

6.0 GENERAL RESPONSE ACTIONS

Both the soil and groundwater have been impacted at the site. VOCs, SVOCs, metals, and PCBs have been detected in soil; and VOCs have been detected in groundwater at concentrations exceeding SCGs. General Response Actions (GRAs) are broad categories of remedial alternatives and include non-technology specific types of actions such as treatment, containment, excavation, extraction, disposal, institutional controls or various combinations. Table 14 lists the GRAs for soil and groundwater. Information for each type of GRA includes an estimate of the areas and volumes of contaminated media to be addressed and remediated; the medium being addressed; the identified use of that area of the site; and whether or not the GRA category includes a Presumptive Remedy.

7.0 IDENTIFICATION AND SCREENING OF TECHNOLOGIES

7.1 Introduction

In this section, specific technologies associated with the GRAs are further assessed. The technologies are grouped by medium (soil, groundwater) and screened to identify those that appear to be most appropriate to the site-specific conditions and site contamination, technically implementable, and capable of achieving the site's RAOs. Presumptive remedies are given preference. Presumptive remedies include technologies that are proven and appropriate for the specific set of site conditions which, based on experience gained at remediated sites and scientific and engineering evaluation of performance data, can be used to streamline the remedy selection process.

Site specific conditions, including contamination type, concentration, location (aerial extent and depth), geology/hydrogeology and estimated quantity were considered during the initial screening process. Estimated dimensions / quantity of contaminated soil are provided on Table 14. The initial screening was also based on the effectiveness for treating the contaminants present at the site, implementability given site-specific conditions, and relative cost.

Remedial technologies that were deemed to be not technically appropriate or cost prohibited were dropped from further consideration. Tables 15 and 16 summarize the technology identification and screening process for soil and groundwater, respectively. The tables are grouped by the GRA (i.e., in-situ treatment, ex-situ treatment, containment, and reduction). Technologies that may be appropriate for addressing the contaminants at the site and that were thus retained for further evaluation are identified on the second to last columns of Tables 15 and 16. Technologies that were screened out and not retained for further analysis are designated as "no" in the second to last columns of Tables 15 and 16.

The most promising technologies were combined into remedial alternatives, which are described in the development of alternatives section of this report.

7.2 Identification and Screening of Technology for Soil

As discussed in Section 3, VOCs, SVOCs, metals and PCBs have been detected in on-site soil at concentrations greater than the 6 NYCRR Part 375 unrestricted use SCOs but less than the industrial use SCOs. As required by Part 375-2.8(c) technologies are identified and screened based on achieving both an unrestricted use and an industrial use. Based on the investigation analytical results, the areas of soil impacted greater than the unrestricted use SCOs includes three drywells, (DW-9, DW-11 and DW-8) and the washout area north of the building at 937 Conklin Street. The volume of soil impacted greater than the unrestricted use SCOs is approximately 130 cubic yards. There are no soils impacted above the industrial use SCOs with the exception of benzo(a)pyrene in one soil sample.

The GRAs for impacted on-site soils include no action, institutional controls, containment, treatment, and removal. Remedial technologies are grouped by GRA and discussed in detail in the following sections. A summary of the soil screening process is provided in Table 15.

7.2.1 Institutional Controls

Institutional controls are non-physical means of enforcing a restriction on the use of real property that limits human or environmental exposure and restricts actions that would interfere with the effectiveness of a remedial program. Institutional controls are typically used along with other remedial technologies when the remedial action leaves contaminants at levels determined to be safe for a specific use, but not all uses or when engineered structures or controls must be maintained or protected. The site is an industrial property with soil contamination at concentrations below the industrial use SCOs, with the exception of benzo(a)pyrene in one soil sample. This technology was retained.

7.2.2 Containment

The in-place containment of contaminated soils will be accomplished through capping, enhancement of existing capping or surface sealing. These containment technologies would eliminate or reduce storm water infiltration to contaminated areas, thereby reducing a mechanism for contaminant migration from soil to groundwater or surface water. These technologies are effective at minimizing human exposures to impacted soils and other media. Capping does not lessen toxicity, mobility, or volume of contaminated soil, but does mitigate migration and exposure pathways. Capping systems are most effective where most of the underlying contaminated soil is above the water table. The technology requires long-term inspection and maintenance.

Concentrations of chemicals in soil are less than SCOs specified for an industrial use and are protective of health without needing a cap to reduce human exposures. Because of the inorganic nature of contaminants in soil, exposure to volatilized contaminants is not a concern and capping is not necessary to reduce or eliminate the vapor pathway. Additionally, chemicals in soil do not appear to be contravening groundwater quality at the site; therefore, a cap to minimize infiltration is also not necessary. Capping would require the implementation of institutional controls and restrictions on future uses of the site along with long-term operation and maintenance of the cap. Drywells that are capped would need to be replaced with the installation of new drywells which could be costly and difficult due to the limited available space on-site. As a result capping was not retained for further evaluation.

7.2.3 In-Situ Biological Treatment

In-situ biological treatment such as bioventing, enhanced bioremediation, and phytoremediation is a process in which indigenous or inoculated microorganisms degrade (metabolize) organic contaminants found in soil and/or groundwater, converting the contaminants to innocuous end products. In-situ biological treatments are most effective for remediating residual organic contamination in conjunction with source removal. Implementation of in-situ biological treatments does not require the excavation of contaminated media; therefore, minimizing potential worker exposure to contaminants. In-situ biological treatment is generally applied at the site where a sign of natural biodegradation is present at some degree or conditions are favorable for natural biodegradation. It requires a longer period of time to meet remedial objectives and can result in high operation and maintenance requirements compared to ex-situ technologies.

Biological treatment is less proven than other technologies for metals and PCBs and is a presumptive remedy only for petroleum hydrocarbons. Based on the inorganic nature of the soil contamination this technology has been screened out and will not be evaluated further.

7.2.4 In-Situ Physical/Chemical Treatment

In-situ physical/chemical treatment includes various treatment processes that occur in the subsurface to physically/chemically convert contaminants to less toxic compounds. In-situ physical/chemical treatment includes the following:

- Chemical Oxidation: In-situ chemical oxidation (ISCO) is a process where powerful oxidizing chemicals are injected into the subsurface to chemically convert contaminants to less toxic compounds. ISCO is a viable remediation technology for mass reduction of organic contaminants in source areas, has a relatively rapid treatment time, and can be implemented with readily available equipment. This technology is widely used for soil and groundwater treatment in the saturated zone; however, there are limitations associated with achieving effective distribution and retention in the unsaturated zone. Based on the inorganic nature of the soil contamination at the site, this technology has been screened out and will not be evaluated further.
- Electrokinetic Separation: The electrokinetic separation process consists of the application of a low-intensity direct current through the soil via ceramic electrodes installed in and around soil contamination areas. The induced current mobilizes charged contaminants toward the polarized electrodes to concentrate the contaminants for subsequent removal and ex-situ treatment/disposal. The electrokinetic separation process is generally used to remove inorganics. Based on the soil contamination already being concentrated within three drywells at the site, this technology will not be cost effective and has not been retained for further analysis.
- Soil Flushing: Soil flushing is a process where contaminants are extracted from the soil by passing uncontaminated water or water containing an additive to enhance contaminant solubility, through in-place soils. Contaminants are leached into the water, which is then extracted and treated. By applying soil flushing, there is a potential for contaminant migration if contaminants are flushed beyond the capture zone. In addition, ex-situ treatment costs for recovered fluids can add significantly to the remedial costs associated with this process. Due to the

concerns raised above and the discrete locations of soil contamination at the site, this technology has not been retained for further analysis.

- Soil Vapor Extraction (SVE): SVE is an in-situ unsaturated (vadose) zone soil remediation technology where a vacuum is applied to the subsurface soil to induce air flow through the soil medium and remove VOCs and some SVOCs. Contaminants captured in the extracted soil vapor are typically treated above grade, via activated carbon or other process. Based on the non-volatile nature of the soil contamination this technology has been screened out and will not be evaluated further.
- Solidification/Stabilization (in-situ): Solidification/stabilization (S/S) reduces the mobility of hazardous substances and contaminants in the environment through both physical and chemical means. During solidification, contaminants are physically bound or enclosed within a solidified mass, or during stabilization, chemical reactions are induced between the stabilizing agent and contaminants to reduce their mobility and are effective for metals. Solidification reduces the soils ability to infiltrate water and would reduce the usefulness of the drywells requiring the installation of a new storm water drainage system to replace the existing system. As a result this technology has been screened out and will not be evaluated further.

7.2.5 In-Situ Thermal Treatment

In-situ thermal treatment (ISTT) involves steam/hot air injection, electrical induction or heating via electrical resistance, fiber optics, radio frequency, or other means that can be utilized to increase the volatilization rate of VOCs and SVOCs and facilitate extraction, but is not effective for metals. The process is otherwise similar to conventional SVE but requires heat resistant extraction wells. Thermal treatment heats soil to enhance SVE in the followings ways: VOC and SVOC volatility are increased by heating; the soil permeability is increased by drying; water vapor converted to steam can facilitate stripping of volatile contaminants in the overburden; and heating may cause a decrease in contaminant viscosity which improves contaminant mobility. In-situ thermal has been used for treating surface contamination using heating blankets and for treating subsurface contamination using heater/vacuum wells. Based on the non-volatile nature of the soil contamination at the site this technology has been screened out and will not be evaluated further.

7.2.6 Ex-Situ Biological/Physical/Chemical and Thermal Treatment

All the ex-situ treatment technologies involve controlled staging of excavated soils and any type of treatment including any biological, physical, chemical and thermal at the site. Implementation of ex-situ technologies requires a portion of the site to be dedicated for a moderate to long-term timeframe to the treatment and monitoring of excavated soils. Based on the limited area of soil contamination, the industrial use of the site, small size of the site, and limited exterior area available, ex-situ technologies do not appear to be compatible for the site. Therefore, ex-situ technologies have been screened out and will not be evaluated further.

7.2.7 Removal

Removal of soil containing elevated contaminant concentrations and transportation to a permitted off-site treatment and/or disposal facility is a commonly used technology for soil remediation and is a presumptive remedy for metals contamination in soil. Soil excavation may be accomplished using conventional earthmoving equipment. Limitations that may affect the applicability and effectiveness of excavation at a site include: proximity to structures of sub-standard condition, potential generation of fugitive emissions requiring monitoring and suppression; exposure of subsurface contaminants to workers; and depth and composition of the soil requiring excavation. Excavation at this site can be implemented in a relatively short time frame and has no long-term monitoring and maintenance considerations. The applicability and cost-effectiveness of off-site disposal may be limited by the distance from the subject site to the nearest disposal facility. Excavation and off-site disposal has been retained for further analysis.

7.3 Identification and Screening of Technology for Groundwater and Off-Site Soil Vapor Intrusion

As discussed in Section 3, CVOCs have been detected in groundwater at concentrations greater than the NYS Class GA GWQS. PCE is the most prevalent CVOC with the greatest concentrations and was used to estimate the groundwater source area requiring treatment. The estimated groundwater source treatment area is approximately 550 square feet and in the depth horizon of 25 to 130 feet bgs. A dissolved phase plume having CVOC concentrations greater than the NYS Class GA GWQS extends beyond the source area to the western and southwestern limits of the property. The horizontal and vertical extent of groundwater contamination greater than the NYS Class GA GWQS and the source area are shown on Figures 7 and 8. The final treatment zone will be determined during the pre-design investigation prior to implementing the selected remedial action.

The dissolved phase groundwater plume is located beneath the building and although impacted soil could potentially be a contributor, impacted groundwater is considered to be the major contributor to soil vapor intrusion at the site and at the neighboring property. The potential for soil vapor intrusion to impact the indoor air within the on- and off-site buildings will be address through mitigation. The most common mitigation method recommended by the NYSDOH is the use of sub slab depressurization systems (SSDS), a presumptive remedy which includes a network of vapor collection points or horizontal pipes under a building. These systems are designed to create a pressure differential between the sub-slab environment and the building interior to prevent infiltration of contaminated vapors into the work area of a building or structure, and to provide a preferential pathway for the vapors to leave the building via the SSDS. The network of collection points or horizontal pipes is connected to a blower or fan-powered vent designed to maintain a continuous flow of air under the building or structure. Based on the contaminant concentrations, the vapor is either treated and discharged to the atmosphere or discharged without treatment. SSDS for the building west of the site (931 Conklin Street) is included with all groundwater alternatives and is retained for further analysis with the exception of the No Action alternative.

For the on-site (937 and 965 Conklin Street) buildings two alternatives were evaluated for mitigating soil vapor intrusion. Alternatives evaluated for the on-site buildings include SSDS and SVE and are discussed in Section 7.3.8. These alternatives were evaluated separately and were not combined with the groundwater alternatives to allow NYSDEC to make a selection of the remedial approach for the on-site buildings.

The GRAs for impacted groundwater include no action, institutional controls, monitored natural attenuation, containment, treatment, and removal. Remedial technologies are grouped by GRA and discussed in detail in the following sections. A summary of the groundwater screening process is provided in Table 16.

7.3.1 Institutional Controls

Institutional controls are non-physical means of enforcing a restriction on the use of real property that limits human or environmental exposure and restricts actions that would interfere with the effectiveness of a remedial program. Institutional controls are typically used along with other remedial technologies. Institutional controls for groundwater contamination typically restricts the use of groundwater as a potable water supply when concentrations are greater than the NYS Class GA GWQS. This technology was retained.

7.3.2 Containment

Containment involves remediation technologies such as physical barriers to slow groundwater flow and minimize migration of contaminated groundwater off-site. Subsurface physical barriers generally consist of vertically excavated trenches filled with slurry and often are used where the waste mass is too large for treatment and where soluble and mobile constituents pose an imminent threat to a sensitive receptor. Also, physical barriers are more effective when geologic conditions allow for connection to a low permeability layer to enhance the containment.

Groundwater contamination at the site is a small area that can be treated and does not require a barrier due to the mass being too large for treatment. Additionally groundwater does not pose an imminent threat to any sensitive receptors since groundwater in the vicinity of the site is not used as a public water supply. Additionally, to construct a containment remedy, the barrier depth would need to be installed to the clay confining unit observed at approximately 280 feet bgs. Installation to this depth would be difficult due to the size of the site and would not be cost effective. Based on these factors, containment has been screened out from further evaluation.

7.3.3 In Situ Biological Treatment

- Enhanced Bioremediation: Enhanced bioremediation is a process that attempts to accelerate the natural biodegradation process by introducing nutrients, electron acceptors, and/or competent contaminant-degrading microorganisms to the subsurface. The rate of bioremediation can be enhanced by increasing the concentration of oxygen for aerobic degradation or adding a carbon substrate to support anaerobic degradation. Analytical results from the RI indicate an absence of natural biodegradation on-site. Therefore, in-situ biological treatment has been screened out for further evaluation.

- Monitored Natural Attenuation (MNA): MNA is a process where natural subsurface processes such as dilution, volatilization, biodegradation, adsorption, and chemical reactions with subsurface materials are allowed to reduce contaminant concentrations to acceptable levels. Regulatory approval of this option usually requires modeling and evaluation of contaminant degradation rates and pathways, and predicting contaminant concentration at potential down gradient receptor points. The primary objective of site modeling is to demonstrate that natural processes of contaminant degradation will reduce contaminant concentrations below regulatory standards or risk-based levels before potential exposure pathways are completed. In addition, long-term monitoring must be conducted throughout the process to confirm that degradation is proceeding at rates consistent with meeting cleanup objectives. MNA can be implemented with other active remediation technologies and has been retained for further evaluation for the site.
- Phytoremediation: Phytoremediation is a set of processes that uses plants to remove, transfer, stabilize and destroy organic/inorganic contamination in groundwater. Phytoremediation processes are limited to shallow groundwater and are not implementable given the depth to groundwater at this site. Therefore, phytoremediation technology for groundwater remediation will not be considered further.

7.3.4 In-Situ Physical/Chemical Treatment

- Air Sparging: Air sparging is an in-situ technology and presumptive remedy in which clean air is injected into a contaminated aquifer. Injected air traverses horizontally and vertically in channels through the soil column, creating a subsurface "air stripper" that removes contaminants by volatilization. The injected air helps to flush the contaminants upward into the unsaturated zone where a vapor extraction system is usually implemented in conjunction with air sparging to remove the generated vapor phase contamination. Air sparging is very effective for high permeability aquifers and VOCs are effectively remediated via air sparging. The depth of contamination at this site extends to 130 feet bgs. Injection of air becomes the limiting factor for air sparging because it becomes difficult and expensive to inject air below 100 feet bgs. Additionally the lower aquifer is a sandy silt layer with lenses of silt/clay between 100 to 105 feet bgs and 125 to 130 feet bgs which would reduce the efficiency of air sparing. The upper 80 feet is a highly permeable layer of sand and gravel. However, the existence of underground utilities and drywells at the Brandt Airflex site will make it difficult to capture the vapors for treatment. As a result air sparging has been screened out from further evaluation.

- In-Situ Chemical Oxidation: ISCO chemically converts contaminants to less toxic compounds that are more stable, less mobile, and/or inert. The oxidizing agents most commonly used are ozone, hydrogen peroxide, potassium permanganate, and persulfate. Matching the oxidant and in-situ delivery system to the contaminants of concern and the site conditions is the key to successful implementation and achieving performance goals. ISCO is a presumptive remedy that is a viable remediation technology for mass reduction of organic contaminants in groundwater. Chemical oxidation can have a relatively rapid treatment time, and can be implemented with readily available equipment. Limitations associated with chemical oxidation include: requirements for handling and administering large quantities of hazardous oxidizing chemicals; and naturally occurring organic material in the formation can consume large quantities of oxidant. Because of its effectiveness in reducing VOCs in rapid treatment time, ISCO has been retained for further analysis.
- Directional Wells: Drilling techniques can be modified to position wells horizontally, or at an angle, to reach contaminants not accessible by direct vertical drilling. Directional drilling may be used to enhance other in-situ or in-well technologies such as groundwater pumping, SVE, soil flushing, and in-well air stripping. Due to the limited space on-site for installation, directional wells do not appear to be an applicable technology. Therefore, this technology will not be retained for further evaluation.

- Thermal Treatment: In this technology, groundwater is heated to the boiling point through electrical resistivity or steam injection to vaporize VOCs and SVOCs. Vaporized components rise to the unsaturated zone where they are removed by vacuum extraction and the off-gases are treated above grade. Groundwater contamination at the site is as deep as 130 feet bgs and may make the implementation of thermal treatment difficult. Additionally published groundwater data indicates relatively high hydraulic conductivities, up to 54 feet per day, which may also reduce the efficiency of thermal treatment of groundwater. However, because actual hydraulic conductivities of the site are unknown at this time and use of thermal treatment is effective at reducing VOC concentrations in a potentially short time period, thermal treatment has been retained for further evaluation.
- In-Well Air Stripping: With in-well air stripping technology, air is injected into a vertical well that has been screened at two depths. The lower screen is set in the groundwater saturated zone, and the upper screen is set in the unsaturated zone. Pressurized air is injected into the well below the water table, aerating the water. The aerated water rises in the well and flows out of the system at the upper screen, inducing localized movement of groundwater into and up the well as contaminated groundwater is drawn into the system at the lower screen. VOCs vaporize within the well at the top of the water table. The contaminated vapors accumulating in the wells are collected via vapor extraction contained within the well. Vapor phase treatment typically occurs above grade. The partially treated groundwater is never brought to the surface; it is forced into the unsaturated zone, and the process is repeated as water follows a hydraulic circulation pattern or cell that allows continuous cycling of groundwater. As groundwater circulates through the treatment system in-situ, and vapor is extracted, contaminant concentrations are gradually reduced.

  There are three main types of in-well air stripping systems, which include the Unterdruck-Verdampfer-Brunnen (UVB) or "vacuum vaporizer well" system, the NoVOCs™ system, and the Density Driven Convection (DDC) system. Three vendors manufacture in-well air stripping systems, including IEG Technologies

(IEG) who manufactures the UVB system, Wasatch Environmental Inc. (WE) who manufactures the DDC system, and Accelerated Remediation Technologies (ART). Both the DDC system and the ART system use compressed air introduced into the wellhead to create an upward circular motion. Injection of air becomes the limiting factor for both these technologies since it becomes difficult and expensive to inject air below 100 feet bgs. The UVB system uses submersible pumps to pump contaminated groundwater to a low-profile air stripper installed at the wellhead and is not as limited by depth.

Although in-well air stripping is a presumptive remedy, there are a limited number of vendors, and as discussed above the number is limited even further by the depth of contamination (130 feet bgs) making it difficult to obtain competitive bids and evaluate it against other technologies for cost effectiveness. Additionally the existence of clay and silt lenses in the lower subsurface can reduce the creation of a circulation cell which will reduce the overall treatment efficiency. Therefore, in-well air stripping has not been retained for further evaluation.

- Passive/Reactive Treatment Walls: Treatment walls or, treatment barriers allow the passage of impacted groundwater while causing the degradation or removal of contaminants. Passive/reactive treatment walls do not appear to be an efficient/effective technology for addressing groundwater contaminants given the physical characteristics of the site and concentrations, configuration and depth of the groundwater contamination. Therefore, passive/reactive treatment walls have been screened out and will not be evaluated further.

7.3.5 Ex-Situ Biological Treatment

Ex-situ biological treatment involves the pumping of impacted groundwater at the site and implementing biological treatments such as bioreactors and constructed wetlands. Ex-situ biological treatment requires a portion of the site dedicated for treatment for a moderate to long-term timeframe. Given the physical characteristics, limited space and active industrial use of the site, ex-situ biological treatments have been screened out and not retained for further evaluation.

7.3.6 Ex-Situ Physical/Chemical Treatment

Ex-situ physical/chemical treatment involves the pumping of impacted groundwater at the site and implementing physical/chemical treatment such as adsorption, advanced oxidation process, air stripping, ion exchange, precipitation/coagulation/flocculation, separation, and sprinkler irrigation.

- Adsorption: The adsorption process consists of passing contaminated groundwater through a sorbent media. Contaminants are adsorbed onto the media, reducing their concentration in the bulk liquid phase. The most common adsorbent is granular activated carbon (GAC) which is also a presumptive remedy. Adsorption is a viable technology for VOC treatment of extracted groundwater and vapors. Therefore, adsorption via GAC has been retained for further evaluation.
- Advanced Oxidation Processes: Advanced oxidation processes including ultraviolet (UV) radiation, ozone, and/or hydrogen peroxide are used to destroy organic contaminants as impacted water is pumped into a treatment vessel. If ozone is used as the oxidizer, an ozone destruction unit(s) may be required to treat off-gases from the treatment tank and where ozone gas may accumulate or escape. Advanced oxidation technology is associated with high energy requirements. Therefore, advanced oxidation process technology has been screened out and will not be retained for further analysis.
- Air Stripping: Air stripping is a presumptive remedy that involves the mass transfer of volatile contaminants from water to air. VOCs are separated from extracted groundwater by exposing the contaminated water to a flow of air. Air stripping configurations include packed towers, diffused aeration, tray aeration, and spray aeration. Treatment of the air stripper effluent air stream with vapor phase GAC would be required with this process option. This is a well-established technology that can be effective in reducing contaminant toxicity, mobility and concentration through the use of treatment equipment that is readily available, although it is likely to have an extended remedial timeframe and relatively high capital and operational costs. Air stripping has been retained for further analysis.

- Groundwater Pumping/Pump and Treat: Pump and treat is a presumptive remedy. Groundwater pumping consists of pumping groundwater from an aquifer to remove dissolved phase contaminants and/or achieve hydraulic containment of contaminated groundwater to prevent migration. Processes typically evaluated or used in Pump and Treat systems include ex-situ physical and chemical treatments. Generally, treatment and monitoring of extracted groundwater is required. A multiple treatment train may be required for groundwater with multiple types of contaminants. A groundwater monitoring program is a component of any groundwater extraction system to verify its effectiveness. Potentially long time periods are required for groundwater pumping to achieve remediation goals. Operation and maintenance considerations associated with treatment systems may be more extensive than other treatment technologies. Groundwater pumping has been retained for further analysis due to its proven and long track record as a remediation technology.

7.3.7 Discharge/Disposal

Groundwater that has undergone treatment must ultimately be disposed of or discharged. Groundwater treated by the above technologies can be discharged to the sanitary sewer, surface water or re-injected to groundwater. Discharge options including re-injection to groundwater and sanitary sewer have been retained. Air emissions and GAC adsorption media will also require discharge, disposal or regeneration.

7.3.8 Soil Vapor Intrusion

The most common mitigation method recommended by the NYSDOH is the use of SSDS. However, due to spatial constraints inside the on-site buildings, in addition to SSDS, SVE was also screened for use in mitigating vapor intrusion into the on-site buildings.

- Sub Slab Depressurization System (SSDS): SSDS is a presumptive remedy for removal of VOC vapors from beneath building slabs. It includes the use a fan powered vent and network of collection points or horizontal pipes installed under a building slab. For retrofits inside existing buildings extraction points are installed to penetrate the slab into the underlying aggregate beneath the building. Points are then connected using piping run along the walls and ceiling to the fan powered vent located outside the building either on the roof or inside a separate shed. SSDS has been retained for further evaluation.

- Soil Vapor Extraction (SVE): SVE is an in-situ remedial technology typically used for VOC or SVOC soil contamination in the unsaturated zone. This remediation technology can also be used to capture soil vapors from beneath a building slab. The remedial technology includes the installation of vacuum wells outside the building and use of a blower to apply a vacuum to the subsurface soil to induce air flow through the soil medium and remove VOCs and some SVOCs. Contaminants captured in the extracted soil vapor are typically treated above grade, via activated carbon or other process. To be used to mitigate vapors beneath the on-site buildings sufficient vacuum would need to be applied to affect a radius of influence large enough to capture vapors beneath the interior portions of the building slab. SVE has been retained for further evaluation.

7.4 Evaluation of Technologies and Selection of Representative Technologies

As listed in Table 15, soil remedial technologies under each type of GRA were screened for potential applicability, effectiveness, and implementation at the site. The No Action alternative is retained to provide a comparison for the other alternatives as required by DER-10. In addition to No Action, the following soil technologies pass the screening process:

- Institutional Controls
- Excavation and Off-Site Disposal

As listed in Table 16, groundwater and soil vapor remedial technologies for each type of GRA were screened for potential applicability, effectiveness, and implementation at the site. Because the vapor intrusion is a potential result of the groundwater (and potentially soil) contamination, remedial technologies for soil vapor intrusion mitigation for the off-site buildings will be included with the groundwater technologies. Remedial technologies for the on-site buildings will be considered separately to allow NYSDEC flexibility in selecting a remedial approach for these buildings. In addition to No Action, the following technologies pass the screening process:

- LTM
- ISCO
- In-Situ Thermal Treatment
- Adsorption (vapor and liquid phase GAC)

- Air Stripping
- Pump and Treat
- Disposal/Discharge
- SSDS
- SVE

8.0 DEVELOPMENT AND ANALYSIS OF ALTERNATIVES

8.1 Alternative Development

In accordance with NYSDEC's *DER-10 Technical Guidance for Site Investigation and Remediation*, May 3, 2010, remedial alternatives for a site are developed by combining the remedial technologies that have successfully passed the screening stage into a range of alternatives.

NYSDEC's *DER-10* requires a No-Action alternative and an alternative that would restore the site to "pre-disposal conditions". Other alternatives are to be included based on:

- Current, intended, and reasonably anticipated future use of the site;
- Removal of source areas of contamination; and
- Containment of contamination.

8.1.1 Soil Alternative Development

The soil remedial technologies retained for further analysis include:

- Institutional Controls
- Excavation and Off-Site Disposal

8.1.1.1 Alternative S1 – No Action

The "no action" option is included as a basis for comparison with active soil remediation technologies in accordance with Section 4.2 of DER-10. If no remedial action is taken, contaminants already present in the soil will remain in and no restrictions on the future use of the site will be executed.

8.1.1.2 Alternative S2 – Institutional Controls

Alternative S2 consists of restricting the future use of the site to industrial. Under this alternative a deed restriction will be placed prohibiting future uses such as residential or commercial. Restriction to an industrial use is consistent with the current zoning district, Light Industry.

8.1.1.3 Alternative S3 – Excavation and Off-Site Disposal

Alternative S3 represents the removal GRA. Alternative S3 consists of excavating soil contaminated above unrestricted use SCOs from drywells DW-8, DW-9, DW-11 and the washout area north of the building at 937 Conklin Street. Areas proposed to be excavated are shown on Figure 6. Approximately 130 cubic yards of material will be removed and properly disposed at a permitted landfill under this alternative.

The time to complete the remediation under this alternative will be short (1 to 2 months) and will involve some disruption to the site.

Excavations of the drywells will need to be completed with small equipment and support may be necessary to keep the drywells intact during the work. Soil removed from drywells will be placed in 55 gallon drums or lined trucks for off-site disposal. Water pumped from the drywells will be temporarily stored in factional tanks before being transported off-site for treatment at a permitted facility. Upon completion of the excavation confirmatory soil samples will be collected from the bottom of each drywell and beneath the washout pile.

Under this alternative no use restrictions or site management will be necessary.

8.1.2 Groundwater and Off-Site Soil Vapor Intrusion Alternative Development

VOCs were detected in on- and off-site groundwater at concentrations greater than the NYS Class GA GWQS to a depth of 130 feet bgs. Groundwater flow is towards the south. PCE that appears to have originated on-site has migrated vertically downward and horizontally in the direction of groundwater flow. The estimated source area requiring groundwater remediation is approximately 550 square feet. A dissolved phase plume extends beyond the source area to the south. The estimated groundwater depth requiring source remediation is 25 to 130 feet bgs.

The groundwater remedial technologies retained for further analysis include:

- LTM
- ISCO
- In-Situ Thermal Treatment
- Adsorption (Vapor Phase)

- Air Stripping
- Pump and Treat
- Disposal/Discharge

In addition to the GRAs, alternatives were assembled to address the on-site source area or provide containment to minimize further migration of contaminated groundwater. Based on the retained remedial technologies and site-specific conditions, groundwater remedial alternatives were developed, and are described in the following sections.

Four remedial alternatives were developed, based on the retained remedial technologies and site-specific conditions, and are described in the following sections. Except for the no action alternative, each of the three alternatives includes the common elements of the SSDS for the off-site building, LTM and institutional controls. As discussed previously, the mitigation systems for the on-site buildings were evaluated separately to allow NYSDEC to make a selection between SSDS and SVE.

<u>Off-Site Sub Slab Depressurization System (SSDS):</u>

The off-site SSDS will include a fan-powered vent or blower and piping system to draw vapor from the soil beneath the building's slab (i.e., essentially creating a small negative pressure beneath the slab) and discharge the vapors to the atmosphere. The piping system will consist of 3 or 4-inch polyvinyl chloride (PVC) extraction points that will be installed through the building slab into the underlying aggregate bed beneath the building. Pipes will then run parallel along walls, columns, or beams up to the ceiling or exposed building trusses (depending on building construction). The pipes will then run along the roof trusses or ceiling overhead to the wall where the fan-powered vent will be located either outside the building in a separate shed or on the roof (depending upon the building construction). For purposes of this FS it was assumed that a separate shed would be constructed outside the building along the north wall. If during design it is determined that the fan can be located on the roof, the shed would not be constructed. The SSDS will result in a lower sub slab air pressure relative to the indoor air pressure, which will prevent the migration of contaminated sub slab soil vapors into the building. The depressurization approach needs to be determined on a building-specific basis due to building-specific features that may be conducive to a specific depressurization approach. A connectivity test will be performed to measure the ability of a negative pressure field and air flow to extend through the material beneath the slab. This test is commonly conducted by applying suction on a centrally located penetration drilled through the concrete slab and simultaneously measuring the vacuum at various locations across the slab using a digital micro manometer or comparable instrument. Depending on test results, multiple slab penetration points may be needed to achieve the desired effectiveness of the system. The final system design will be based on the results of the connectivity test.

The groundwater alternatives cost estimates assume the installation of an SSDS system for the building located at 931Conklin Street. The building is approximately 160 feet long by 169 feet wide. As shown on Figure 9, the installation of 10 extraction points was assumed. The SSDS will be connected to a fan designed to maintain a continuous flow of air. Based on the contaminant concentrations, the vapor will be either treated through GAC and emitted to the atmosphere, or emitted without treatment. For purposes of the cost estimate it was assumed that the vapor will be emitted without treatment.

It was also assumed that the SSDS will run for 30 years.

Long Term Monitoring (LTM) and Institutional Controls:

All the groundwater alternatives will include LTM and institutional controls. LTM will be conducted in areas outside the source remediation zone. LTM will consist of monitoring a total of 12 wells located throughout the groundwater contamination both on and off the site. Existing wells assumed to be sampled include BAW-02C (triplet well), BAW-02D, BAW-05C (triplet well), BAW-05D, and BAW-05E. It was assumed that three new wells will be installed along the southern property line to monitor the potential for off-site migration of contaminated groundwater, and these new wells will also be sampled during LTM. The actual selection of specific wells and location of newly installed monitoring wells will depend on the layout of the remedial technologies and can be adjusted during the treatability, remedial design and implementation phases of the project. LTM will be used to monitor any diluted residual plume that may remain after the source remedial action is complete.

For cost estimating, it was assumed that LTM will be conducted for a period of 30 years. For the first year monthly groundwater samples will be collected. For years 2 through 4 samples will be collected quarterly per year and from years 5 though 30 sampling will be conducted annually.

Institutional controls (environmental easement, Site Management Plan) will be required for all alternatives. An environmental easement would be implemented to prevent human consumption of contaminated groundwater through restrictions or limitations on groundwater uses. For cost estimating it was assumed that an annual site inspection would be required to certify the site is in compliance with the environmental easement and would be submitted along with a periodic report summarizing data collected during the LTM program.

8.1.2.1 Alternative G1 – No Action

The "no action" option is included as a basis for comparison with active groundwater remediation technologies in accordance with Section 4.2 of NYSDEC DER-10. If no remedial action is taken, contaminants already present in the groundwater will remain in place and/or move down gradient in the direction of groundwater flow. Contaminants, particularly CVOCs, will possibly degrade via natural processes and transform to form other compounds over time.

If no action is taken, occupants in the building located at 931 Conklin Street will continue to be exposed to contaminants identified in indoor air samples. As vapors continue to collect beneath the slab, indoor air concentrations may also increase and in time exceed the air guideline values for PCE and TCE developed by the NYSDOH.

8.1.2.2 Alternative G2 – ISCO and Off-Site SSDS

Alternative G2 consists of ISCO for the source area, with LTM for the remediation of VOCs in the down gradient groundwater. This alternative would include the installation of shallow (50 feet bgs), intermediate (80 feet bgs), deep (100 feet bgs) and very deep (125 feet bgs) injection wells within the groundwater source remediation area to inject the chemical oxidation solution. Chemical oxidation would consist of the injection of a chemical reagent such as liquid peroxide (H_2O_2), permanganate ($KMnO_4$) or Modified Fenton's Reagent® (MFR) into the subsurface to degrade the organic contaminants.

The chemical oxidant used for cost estimating purposes was MFR from Isotec. MFR is very effective at destroying organic contamination through co-existing chemical oxidation and reduction; however, its shortcomings include incomplete treatment, energetic reactions, organic vapor generation and contaminant migration. MFR was selected because it is equally as effective as Fenton's Reagent but its catalysts allow reagents at background neutral pH conditions to be effectively distributed within the aquifer, destroying contaminants in groundwater without generating organic vapors or high temperatures.

For estimating purposes, it was assumed that four permanent injection wells will be installed at the locations shown on Figure 10. Wells will be installed as nested wells using four 1-inch casings for each depth installed in a 10-inch borehole and sealed with bentonite. The injection wells will be placed approximately 15 feet apart with an assumed radius of influence of 10 feet based on site geology. A pre-design investigation will be required to better delineate the source area and quantify the mass of CVOCs that will be treated to refine the number and placement of wells and determine the type and amount of oxidizing agent required to fully treat the source area. Following the pre-design investigation a pilot study will be conducted to verify the effectiveness of ISCO and determine the radius of influence before proceeding with full scale implementation.

The time for remediation may be relatively short, on the order of months, depending on the need for subsequent injections. Groundwater monitoring will occur subsequent to chemical oxidation events to confirm that CVOC concentrations are being effectively reduced. Although a significant portion of the contaminant mass is reduced using ISCO, it is frequently subject to re-bound with concentrations returning to near pre-treatment levels in source areas. Based on the monitoring data, additional chemical oxidation injection events may be required. For the cost estimate it was assumed two injections will be performed 6-7 months apart. To monitor performance of the ISCO it was assumed that three monitoring wells would be installed inside the source treatment area and for the first injection sampled weekly for two months followed by monthly until the second injection event. After the second injection event sampling was assumed to be weekly for one month followed by monthly samples for five months following the injection event.

8.1.2.3 Alternative G3 – In-Situ Thermal Treatment and Off-Site SSDS

Alternative G3 consists of in-situ thermal treatment (ISTT) for the source area with LTM for the remediation of CVOCs in the down gradient groundwater. There are three technologies; each employs a different method to increase the temperature within the saturated or unsaturated contaminated zone which results in the volatilization, mobilization, or destruction of CVOCs. The three technologies include steam enhanced extraction (SEE), enhanced resistive heating (ERH) and thermal conductive heating (TCH). Due to the depth of contamination at this site and the existence of lower permeability zones ERH was selected as the method for treating the CVOCs. All three technologies use a vacuum recovery system such as SVE to collect and treat volatilized CVOCs before emitting the vapor stream to the atmosphere.

For the purpose of this FS, approximately 10 electrodes collocated with 10 vacuum extraction wells are estimated to address removal of CVOCs in the groundwater source area. The silty clay lenses observed between 80 and 130 feet bgs within the source area are not expected to affect the rate of heat flux throughout the treatment zone as electrical and thermal conductivity values do not vary much between most soil types. The placement of electrodes and vacuum extraction wells approximately 10 feet apart at an average depth of 130 feet bgs will be sufficient to achieve temperatures close to 100°C throughout the source treatment zone. A conceptual layout of the electrodes and vacuum wells for the ISTT system is shown on Figure 11.

A vacuum blower with a total system suction flow rate of approximately 150 actual cubic feet per minute (acfm) would be used for the vacuum extraction system. A vacuum would be generated by a blower, and collected vapor would by treated via vapor-phase GAC units. A schematic of a typical ERH ISTT system with vacuum extraction is shown on Figure 12. A temporary building will be constructed to house the treatment equipment. It was assumed a part time operator will be needed to operate and maintain the ISTT/vacuum extraction system. Operation and maintenance costs include electricity to operate the system, repair and replacement of system parts/components, routine inspection, system monitoring, performance monitoring, compliance sampling and replacement of GAC media.

ISTT treatment periods are generally measured in months. For this site it was assumed that the ISTT system would be run for three months and then shut off for a period of one month. After shutting off the system, weekly samples for one month from three new monitoring wells installed in the source would be collected and analyzed for VOCs to verify treatment goals are reached. After goals are reached, the ISTT system will be shut down and decommissioned. It was assumed the system would be decommissioned a year after its installation.

8.1.2.4 Alternative G4 – Pump and Treat and Off-Site SSDS

Alternative G4 consists of a groundwater extraction system to capture and treat impacted groundwater within the source area, with LTM to be conducted down gradient from the source area. The groundwater extraction system would include both shallow and deep extraction wells to remove contaminated groundwater from the upper and lower aquifers in the source area. Extracted groundwater would be treated at the surface using air stripping and liquid phase GAC for polishing. Treated groundwater would then be discharged to the public owned treatment works (POTW) or infiltrated into the ground using infiltration wells. For cost estimating it was assumed that infiltration wells would be used. Stripped vapor would be treated using vapor phase GAC.

Preliminary calculations were completed to estimate a pumping rate that would affect a capture zone greater than the estimated source contamination area. A pump test in the pre-design phase of the work will more accurately determine the well spacing, capture zone, flow rates, and remediation time. For the purpose of the FS, a hydraulic conductivity of 54 feet per day based on literature was used to determine the number of wells, and pumping rates.

Alternative G4 includes installation of one shallow extraction well and one deep extraction well as shown in Figure 13 to treat the upper and lower portion of the contamination in the aquifer. The shallow extraction well will be installed to approximately 80 feet bgs and have a screened length of about 40 feet. The deep extraction well will be installed to a depth of 130 feet bgs with a screen length of about 40 feet.

The pumping rate for each of the shallow and deep extraction wells is estimated to be about 10 gallons per minute (gpm) to affect a capture zone of approximately 50 feet in diameter based on the site geology and hydraulic conductivity of 54 feet per day. The total estimated flow for the treatment plant is 20 gpm. The actual remedial pumping rates for the extraction wells will be optimized based on the results of the pump test that will be conducted during a pre-design investigation. The contaminated groundwater from each extraction well will be pumped to an on-site groundwater treatment system.

For this alternative, a total peak flow of approximately 40 gpm, twice the estimated total flow was used to size the treatment system. This was assumed to allow flexibility in the event that the pump test results indicate that a higher flow rate will be needed to affect hydraulic control over the contaminant plume. An approximately 1,200 square foot groundwater treatment plant is proposed north of the building at 937 Conklin Street and is shown on Figure 13. The actual location will be confirmed with the site owner during the design phase. Groundwater will be conveyed through a bag filter to remove suspended solids before entering the air stripper followed by liquid phase GAC for CVOC treatment. The vapors emitted from the air stripper will be treated using vapor phase GAC before being emitted to the atmosphere. The treated effluent water will be discharged into newly installed drywells located near the northwest boundary of the 937 Conklin Street property. A schematic of the proposed treatment process is shown on Figure 14. Pilot testing and field measurements collected during the pre-design phase of the work will be required to determine if any type of pre-treatment of the groundwater is required prior to passing through the air stripper. During the RI, iron was not detected in groundwater samples collected from the monitoring wells on-site. Manganese concentrations ranged from 72 µg/L to 330 µg/L. Based on these concentrations it is assumed that pre-treatment will not be necessary and was not included in the cost estimate for this alternative.

The discharged effluent will be subject to the NYS Class GA groundwater effluent limitations and will be detailed in a State Pollutant Discharge Elimination System (SPDES) permit issued by the NYSDEC.

To confirm that the groundwater extraction and treatment system is achieving remedial objectives, groundwater samples will be collected from three monitoring wells installed for system performance monitoring and analyzed for CVOCs. The results of these analyses will be used to determine whether remedial action objectives are being satisfied, and whether changes in the system design, configuration, and operation are required. Samples will also be collected to verify the system is operating within the permit limits and samples will be collected from the influent and effluent of the treatment system.

A remediation time frame of 20 years was estimated for the cost estimate.

The operation and maintenance (O&M) costs associated with treatment system includes the collection of monthly groundwater and air samples for the 20 years that the groundwater treatment plant will be operated. Groundwater samples would be collected at the two extraction wells, at the influent to the treatment system, at the influent and between the liquid phase GAC, and at the effluent of the treatment system prior to discharge to the infiltration wells. Air samples would be collected at the influent of the vapor phase GAC, between the GAC vessels and after the GAC. The treatment system was assumed to be decommissioned in year 21.

8.1.3 On-Site Soil Vapor Intrusion Alternative Development

There are two buildings on-site that are in active use. The building located at 937 Conklin Street is approximately 195 feet long by 150 feet wide and the building located at 965 Conklin Street is approximately 125 feet long by 95 feet wide. The building at 937 Conklin Street is currently used for the design and production of architectural and ornamental metal workings and is very limited in space as a result of the machinery and materials used in the manufacturing process. The building at 965 Conklin Street is used for packaging and storage of finished goods and is also spatially limited inside the building. As previously mentioned the sub slab concentrations for PCE and TCE indicate mitigation is recommended based on NYSDOH guidance. Different alternatives apart from the typical SSDS were evaluated to mitigate sub slab vapors for these buildings to allow NYSDEC flexibility in determining the appropriate alternative for the on-site buildings. Alternatives evaluated include:

- No Action
- SSDS
- SVE

The alternatives developed are described in the following sections.

8.1.3.1 Alternative SV1 – No Action

If no action is taken, occupants in buildings located at 937 and 965 Conklin Street will continue to be exposed to contaminants identified in indoor air samples. As vapors continue to collect beneath the slab, indoor air concentrations may also increase and in time exceed the indoor air guideline values for PCE and TCE developed by the NYSDOH.

8.1.3.2 Alternative SV2 – SSDS

As described for the off-site building, a SSDS will be installed for both buildings consisting of a fan-powered vent and piping system to draw vapors from the soil beneath the building slabs and emit the vapors to the atmosphere. The piping systems for each building will consist of 3 or 4-inch PVC extraction points that will be installed through the building slab into the underlying aggregate bed beneath the building. Extraction points can be located to minimize disruption to the existing activities conducted inside the building and around equipment. Pipes will run parallel along walls, columns, or beams up to the ceiling or exposed building trusses (depending on building construction). The pipes will then run along the roof trusses or ceiling overhead to the wall where the fan-powered vent will be located either outside the building in a separate shed or on the roof (depending upon the building construction). For purposes of this FS it was assumed that a separate shed would be constructed outside each building along the north walls. If during design it is determined that the fan can be located on the roof, the shed would not be constructed. Connectivity testing will be performed for each building to measure the ability of a negative pressure field and air flow to extend through the material beneath the slab. Depending on test results, multiple slab penetration points may be needed to achieve the desired effectiveness of the system. The final system design will be based on the results of the connectivity test and may be different for each building. As indicated above, both on-site buildings are actively used, and it will be difficult to install slab penetrations within the building. The success of this alternative may be limited depending upon the number of slab penetrations required for successful operation of the SSDS. For the purpose of this FS, it was assumed that10 extraction points would be installed for the building located at 937 Conklin Street and five extraction points would be installed for the building located at 965 Conklin Street. Conceptual layouts for both systems are shown on Figure 15. Each SSDS will be connected to a fan designed to maintain a continuous flow of air. Based on the contaminant concentrations, the vapor will be either treated through GAC and emitted to the atmosphere or emitted without treatment. For the cost estimate it was assumed vapors would be emitted without treatment.

For cost estimating it was assumed that the SSDS for both buildings will run for 30 years.

8.1.3.3 Alternative SV3 – SVE

Alternative SV3 consists of implementing a SVE system to mitigate sub slab vapors for the two buildings located at 937 and 965 Conklin Street. Both buildings are actively used and substantial amount of equipment and materials are being stored inside the building which makes it difficult to install extraction points inside the buildings. This alternative includes installing the vapor extraction wells outside of the buildings as shown on Figure 16. The slab on-grade buildings will act as a cap over the ground surface. This will improve the effectiveness of the SVE system and prevent migration of soil vapor inside the buildings thereby minimizing short circuiting between extraction points and maximizing air flow through the sub-slab aggregate bed.

The SVE system will be sized to maintain a vacuum over approximately 42,000 square feet of area as shown on Figure 16. The FS cost estimate assumes the installation of five vapor extraction wells total. Each vacuum extraction well will be flush mounted with the existing ground surface and installed to a depth of approximately 10 feet bgs. Each well will be 3 inches in diameter, and constructed of schedule 40 PVC. The extraction wells will have an approximately five (5)-foot screen length at 5 to 10 feet bgs. Based on the site geology, each well in the sand/gravel layer is expected to have a radius of influence of approximately 100 feet using the blower capacity of 150 acfm at an inlet vacuum of 0.1 atmosphere (atm). However, pilot testing and field measurements in the pre-design phase of the work will determine the required blower capacity and the number of vacuum extraction wells, placement, and depth of each well. Subsurface piping will be used to connect the wells to a centrally located blower/treatment system. Collected vapor will be treated via vapor phase GAC units.

Components of the SVE system include a blower or liquid-ring pump, filters, air/water separator, vapor-phase GAC units, liquid phase GAC, piping and control system. A schematic of a typical SVE system is show in Figure 17. A temporary building will be constructed to house the treatment equipment. Operation and maintenance costs include electricity to operate the system;

periodic repair and replacement of system parts and components; routine inspection; system monitoring; replacement of media for the GAC units; and performance and compliance sampling.

The time for mitigating sub slab vapors for the two buildings by SVE is assumed to be 3 years. Replacement of the GAC will be required several times depending on actual mass removal rates achieved. Air emissions must meet State and Federal ambient air quality regulations.

8.2 Evaluation of Alternatives

8.2.1 Introduction

This Section presents the detailed evaluation of the remedial alternatives described in Section 7.1. The purpose of the evaluation is to identify the advantages and disadvantages of each alternative as well as key trade-offs among the alternatives. The evaluation was based on criteria established under NYSDEC's *DER-10 Technical Guidance for Site Investigation and Remediation*, Section 4.2. The evaluation criteria are as follows:

- **Overall protection of human health and the environment:** This criterion is an evaluation of the alternative's ability to protect public health and the environment, assessing how risks posed through each existing or potential pathway of exposure are eliminated, reduced or controlled through removal, treatment, engineering controls or institutional controls. The alternative's ability to achieve each of the RAOs is evaluated.
- **Compliance with Standards, Criteria and Guidance:** This criterion evaluates the compliance of the alternative with all identified SCGs. All SCGs for the site will be listed along with a discussion of whether or not the remedy will achieve compliance.
- **Long term effectiveness and permanence**: Each alternative is evaluated for its long-term effectiveness after implementation. If wastes or treated residuals remain on-site after the selected remedy has been implemented, the following items are evaluated:

    - The magnitude of the remaining risks (i.e., any significant threats, exposure pathways, or risks to the community and environment from the remaining wastes); and
    - The adequacy of the engineering and institutional controls intended to limit the risk.

- **Reduction of toxicity, mobility, or volume of contamination through treatment:** The alternative's ability to reduce the toxicity, mobility or volume of site contamination is evaluated. Preference should be given to remedies that permanently and significantly reduce the toxicity, mobility, or volume of the wastes at the site.
- **Short term impacts and effectiveness:** The potential short-term adverse impacts and risks of the remedy upon the community, the workers, and the environment during the construction and/or implementation are evaluated. A discussion of how the identified potential adverse impacts to the community or workers at the site will be controlled, and the effectiveness of the controls, should be presented. Provide a discussion of engineering controls that will be used to mitigate short term impacts (i.e., dust control measures). The length of time needed to achieve the remedial objectives is also estimated.
- **Implementability:** The technical and administrative feasibility of implementing each alternative is evaluated for this criterion. Technical feasibility includes the difficulties associated with the construction and the ability to monitor the effectiveness of the remedy. For administrative feasibility, the availability of the necessary personnel and material is evaluated along with potential difficulties in obtaining specific operating approvals, access for construction, etc.
- **Cost Effectiveness:** This criterion is an evaluation of the overall cost effectiveness of an alternative or remedy. This criterion evaluates the estimated capital, operations, maintenance, and monitoring costs. Costs are estimated and presented on a present worth basis.
- **Land Use:** This criterion evaluates the current, intended and reasonably anticipated future use of the site and its surroundings, as it relates to an alternative or remedy, when unrestricted levels would not be achieved.

8.2.2 Soil Alternative Evaluation

The three soil alternatives that were identified and pre-screened for evaluation include:

- Alternative S1 - No Action
- Alternative S2 – Institutional Controls
- Alternative S3 – Excavation, Off-Site Disposal

An individual analysis of the soil alternative against the criteria outlined above was conducted and is presented below. A summary of the evaluation is provided in Table 17.

8.2.2.1 Alternative S1 - No Action

The "no action" option is included as a basis for comparison with active soil remediation technologies in accordance with Section 4.2 of DER-10. If no remedial action is taken, contaminants already present in the soil will remain in place or continue to impact the underlying groundwater.

- **Overall protection of human health and the environment:** Alternative S1 provides no control of exposure to contaminated soil and no reduction in risk to human health posed by contaminated soil. The alternative allows for the potential for migration of contaminated soil and potential for impact to groundwater from contaminated soil.
- **Compliance with SCGs:** Alternative S1 does not comply with any of the SCGs.
- **Long term effectiveness and permanence**: Alternative S1 does not provide any long-term effectiveness or permanence. No long-term management or controls for exposure would be included in this alternative. Long term potential risks will remain unchanged under this alternative.
- **Reduction of toxicity, mobility, or volume of contamination through treatment:** Alternative S1 does not provide reduction in toxicity, mobility, or volume of the contaminated soil.
- **Short term impacts and effectiveness:** This alternative does not result in disruption of, or removal of the subsurface impacts; therefore, no additional risks are posed to the community, workers, or the environment from additional

exposure to the soil impacts as a result of implementing this alternative. Remedial objectives are not achieved so no remedial time frame is associated with this alternative.

- **Implementability:** There are no implementability concerns posed by this remedy as no remedial actions are being implemented.
- **Cost Effectiveness:** Because this is a no action alternative, the capital, operations and maintenance, and net present value costs are estimated to be $0. Therefore, no cost estimate is provided.
- **Land Use:** The no action alternative would result in soil contaminants exceeding unrestricted SCOs remaining in place at the site. Under the no action alternative there would be no restrictions placed on the future use of the site to prevent redevelopment to a residential or industrial use that would expose future occupants to soils impacted above SCOs identified for residential or commercial uses.

8.2.2.2 Alternative S2 – Institutional Controls

Alternative S2 consists of deed restricting the future use of the site to an industrial use.

- **Overall protection of human health and the environment:** Alternative S2 provides overall protection of human health and the environment through execution of a deed restriction which will limit the future intended use to industrial. Contaminated soil on-site meets the industrial SCOs and is protective of public health and the environment for the current use.
- **Compliance with SCGs:** Alternative S2 will achieve compliance with the industrial use SCOs and will be compliant with SCGs. Based on groundwater samples collected from the on-site monitoring wells, soil contaminants that exceed the unrestricted use and protection of groundwater SCOs do not appear to have impacted groundwater quality at the site. Therefore, use of the industrial use SCOs is applicable. With the implementation of a Site Management Plan and institution controls future use of the site would be restricted to industrial and would comply with applicable SCGs.

- **Long term effectiveness and permanence**: Alternative S2 provides long-term effectiveness and permanence. However, the effectiveness and permanence is dependent on the enforcement of the institutional controls by regulating agencies and adherence to the restrictions by the property owner.
- **Reduction of toxicity, mobility, or volume of contamination through treatment:** Alternative S2 will not provide a reduction in toxicit**y,** mobility, and volume of contamination in soils**.**
- **Short term impacts and effectiveness:** Alternative S2 will not result in any short term impacts to the site or neighboring properties. The effectiveness of the alternative will depend on the enforcement of the deed restriction by regulating agencies.
- **Implementability:** Alternative S2 is easy to implement and does not require any special equipment or materials.
- **Cost Effectiveness:** Alternative S2 estimated total present value cost is approximately $43,000 which includes execution of a deed restriction and preparation of a Site Management Plan. This alternative also includes O&M for annual deed restriction certification and site inspection. The estimated cost for Alternative S2 is summarized in Table 18.
- **Land Use:** Alternative S2 will be consistent with the intended and reasonably anticipated future use of the site which is industrial.

8.2.2.3 Alternative S3 - Excavation and Off-Site Disposal

Alternative S3 consists of excavating soil contaminated above unrestricted use SCOs and disposal to a permitted landfill.

- **Overall protection of human health and the environment:** Alternative S3 provides overall protection of human health and the environment by permanently removing soil with contaminant concentrations greater than the unrestricted use SCOs from the site.
- **Compliance with SCGs:** Alternative S3 will achieve compliance with applicable SCGs. Under this alternative soils will be removed to meet an unrestricted use.

Soil removed from the site will be disposed of in accordance with all Federal, State, and local regulations.

- **Long term effectiveness and permanence**: Alternative S3 provides a high degree of long-term effectiveness and permanence. The contamination will be permanently removed from the site and disposed in a permitted landfill
- **Reduction of toxicity, mobility, or volume of contamination through treatment:** Alternative S3 will reduce the toxicity**,** mobility, and volume of contamination in soils on-site by transferring them from the site to a permitted landfill for disposal. The actual toxicity and volume will remain unchanged in the landfill, but the mobility will decrease.
- **Short term impacts and effectiveness:** Implementation of Alternative S3 will result in some disruption of the site and some risks will be imposed to the community, workers, and the environment. The additional risks will be generated from the excavation of contaminated soils from the drywells. These risks will be minimized by the development and implementation of a Remedial Action Work Plan including a Health and Safety Plan and Community Air Monitoring Plan. Alternative S3 is estimated to achieve the applicable SCGs in 1-2 months.
- **Implementability:** Alternative S3 is implementable with readily available equipment and materials. The excavation of contaminated soil from drywells may require use of temporary shoring and bracing to prevent collapse of the drywells during excavation.
- **Cost Effectiveness:** Alternative S3 estimated total present value cost is approximately $164,000 which includes the excavation and disposal of contaminated soils. This alternative does not have any O&M cost. The estimated cost for Alternative S3 is summarized in Table 19.
- **Land Use:** Alternative S3 will achieve unrestricted use SCOs and no restrictions on property use would be necessary.

8.2.3 Groundwater Alternative Evaluation

The four groundwater alternatives that were identified and pre-screened for evaluation include:

- Alternative G1 – No Action
- Alternative G2 – ISCO and Off-Site SSDS
- Alternative G3 – In-Situ Thermal Treatment and Off-Site SSDS
- Alternative G4 – Pump and Treat and Off-Site SSDS

An individual analysis of the groundwater alternatives against the criteria outlined in section 7.2.1 was conducted and is presented below. A summary of the evaluation is provided in Table 20.

8.2.3.1 Alternative G1 – No Action

The "no action" option is included as a basis for comparison with active groundwater remediation technologies in accordance with Section 4.2 of DER-10. If no remedial action is taken, contaminants already present in the groundwater will remain in place.

- **Overall protection of human health and the environment:** Alternative G1 provides no control of exposure to contaminated groundwater and no reduction in risk to human health posed by contaminated groundwater. The No Action alternative does not attain the groundwater RAOs (e.g., restoration of the resource) and does not enhance the protection of human health. The alternative allows for the continued migration of contaminated groundwater off-site.
- **Compliance with SCGs:** Alternative G1 does not comply with any of the applicable SCGs. Contaminated groundwater at the site will continue to exhibit concentrations above the NYS Class GA GWQS in the on-site area being considered for active groundwater remediation.
- **Long term effectiveness and permanence**: Alternative G1 does not provide long-term effectiveness and permanence. Existing groundwater contamination at the site poses potentially unacceptable human health risks under current and likely future groundwater use scenarios. No long-term management or controls for exposure are included in this alternative. Under the No Action Alternative, the human health and environmental risks would remain unchanged over the long-term for expected groundwater uses.

- **Reduction of toxicity, mobility, or volume of contamination through treatment:** Alternative G1 will not provide reduction in toxicity, mobility, or volume of the contaminated groundwater.
- **Short term impacts and effectiveness:** This alternative does not result in increased exposure to impacted groundwater as no remedial actions will occur at the site. Therefore, no additional risks are posed to the community, workers, or the environment. No remedial timeframe is associated with this alternative.
- **Implementability:** There are no implementability concerns posed by this remedy as no remedial actions are being implemented.
- **Cost Effectiveness:** Because this is a No Action Alternative, the capital, operations and maintenance (O&M), and net present value costs are estimated to be $0.
- **Land Use:** The No Action Alternative would result in groundwater contaminants exceeding standards remaining in the aquifer beneath the site. No environmental easement would be put in place to prevent the use of groundwater as a potable water supply source.

8.2.3.2 Alternative G2 – ISCO and Off-Site SSDS

Alternative G2 consists of ISCO with LTM for the remediation of VOCs in groundwater. This alternative would include the installation of permanent injection wells throughout the groundwater source remediation area to inject the chemical oxidation solution to degrade the organic contaminants. LTM would consist of a network of wells located within and down gradient of the site boundary to monitor groundwater concentrations outside the source remediation zone. Institutional controls will be implemented to restrict the use of groundwater at the site while contaminant concentrations are greater than the NYS Class GA GWQS. SSDS will be installed in the building west of the site to mitigate vapor intrusion into these buildings.

- **Overall protection of human health and the environment:** Alternative G2 will protect human health and the environment at the site through a combination of ISCO implementation in the source area and down gradient LTM. Institutional controls will restrict local groundwater use. There are no public water supply sources down gradient of the site and so the injection of oxidants is not of a concern to public health. Byproducts of the reaction will yield less toxic compounds to the environment and will be protective of the environment. LTM will be implemented outside the source remediation areas and as a contingency to monitor the contaminant concentrations in groundwater after ISCO treatment. SSDSs will be installed in the neighboring building west of the site. The SSDS will reduce exposure of volatilized CVOCs from contaminated groundwater to occupants inside the building. Vapors emitted from the SSDS may be further treated using vapor-phase GAC prior to emitting to the atmosphere if required to comply with applicable SCGs.

- **Compliance with SCGs:** Alternative G2 is expected to achieve compliance with SCGs including NYS Class GA GWQS for the source area. Injections of a chemical oxidant will require an underground injection control (UIC) permit mandated by the Safe Drinking Water Act (SDWA). In addition if large quantities of chemicals regulated under the Emergency Planning and Community Right to Know Act (EPCRA) are stored on-site during the injection events compliance with Sections 310, 311, and 312 under the act may be required. Areas outside the source remediation zone will degrade naturally over a longer period of time and eventually may achieve the NYS Class GA GWQS. Installation of the SSDS will maintain concentrations of TCE and PCE below the NYSDOH indoor air guideline values for these contaminants in the off-site building. Emissions from the SSDS installed in the off-site building will comply with the State and Federal ambient air quality regulations. If emissions will exceed applicable air quality standards vapor will be treated using vapor phase GAC prior to emitting vapors to the atmosphere.

- **Long term effectiveness and permanence**: ISCO treatment has been demonstrated to be effective and reliable at numerous sites for groundwater treatment for VOCs and is expected to be effective at this site. ISCO treatment will significantly reduce VOCs in the source area. However, groundwater concentrations may rebound depending of the effectiveness of the initial treatment. Multiple injections of ISCO treatment may be required to address rebounding that may result from slow mass transfer and mass transport mechanisms. It is assumed that although ISCO will significantly decrease the VOC concentrations in groundwater within the source area, the residual VOC concentrations in the dissolved phase plume will continue to exceed the NYS Class GA GWQS. Over time the concentrations in the plume will dissipate and eventually may meet the NYS Class GA GWQS. After ISCO treatment reduces concentrations of VOCs, institutional controls and LTM will provide adequate protection of human health from the diluted residual plume if properly implemented and maintained. For cost estimating it is assumed that areas outside the source area would meet the NYS Class GA GWQS in 30 years. The long term effectiveness and permanence of the SSDS installed in the neighboring building west of the site will depend on the routine maintenance and operation of the system. Periodic repairs and equipment replacement will be necessary for the system to work effectively.

- **Reduction of toxicity, mobility, or volume of contamination through treatment:** ISCO treatment uses chemical processes to transform VOCs in groundwater to less harmful compounds. ISCO will permanently reduce the toxicity, mobility and volume of contaminants in groundwater at the source. There will be minimal reduction in the toxicity, mobility or volume of contaminants outside the source area, and it will require a longer period of time to reduce the toxicity, mobility and volume of contaminants through natural processes. For cost estimating it was assumed contaminants outside the source area will take 30 years to achieve NYS Class GA GWQS. The SSDS installed in the off-site building will effectively reduce the concentrations of vapors beneath the building and minimize indoor air exposures. The use of vapor phase GAC prior to emitting vapors will reduce the overall toxicity, mobility and volume of contaminants.

- **Short term impacts and effectiveness:** Implementation of Alternative G2 will result in some disruption to the site given the limited amount of available space and it being an active manufacturing facility. Equipment, materials and vehicles currently located in the vicinity where injection wells will be installed will have to be temporary moved to get equipment in to install the wells and during the injection events. Disruptions during injection events can be minimized by the installation of a central injection vault which can be used to push chemicals to all injection wells at one location. Alternative G2 requires the use and handling of chemicals that could potentially pose a risk to workers. This risk is mitigated by wearing the appropriate level of personal protection equipment and using workers trained on the safe use and handling of the oxidizing agents. Use of hydrogen peroxide or Fenton's Reagent will cause an exothermic reaction; however, due to the depth of injections (30 – 125 feet bgs) the potential risks for on-site occupants and workers will be minimal. Although the risk is minimal, hydraulic short circuiting and/or preferential pathways could result in the migration of the oxidant into non-target off-site areas. Noise from drill rigs used to install injection wells and generators used by the injection equipment may be a nuisance for the on-site occupants and neighboring properties. The installation of SSDS inside the off-site building will temporarily disrupt ongoing activities conducted inside the building, but is not expected to expose workers or building occupants to contamination since the installation of ports will be accomplished through drilling into the slab and exposure to potentially contaminated soil beneath the slab will be minimal. Risks associated with this alternative will be minimized by the preparation of a Remedial Action Work Plan and a Health and Safety Plan. The remedial timeframe for the active portion of Alternative G2 is estimated to be one year the overall time frame to achieve applicable SCGs down gradient from the source area is 30 years.

- **Implementability:** ISCO is a well-established technology and the equipment and services to install and operate the injection system are commercially available. Implementation will require the use of secondary containment measures for oxidants and the use of personal protective equipment. Workers responsible for injecting the oxidant will be trained in the safe handling and storage of the chemicals. Additional pre-design investigation bench scale and pilot testing will be necessary to determine site conditions needed to determine the optimal well placement, oxidant demand, achievable radius of influence and number of injections. SSDS is a well-established technology and the equipment and services to install and operate the system are commercially available. Connectivity testing will be performed before installing the system to verify the number and placement of ports needed to effectively mitigate vapors intrusion inside the building.

- **Cost Effectiveness:** The estimated present value cost for Alternative G2 is approximately $2.8 million which includes the installation of permanent injection wells and assumes two injection events. The cost also includes the installation of the SSDS for the neighboring building to the west. O&M costs associated with this alternative include routine maintenance and operation of the SSDS and performance monitoring to verify the performance of ISCO in the source area and costs associated with the LTM program. The estimated cost for Alternative G2 is summarized in Table 21. The following assumptions were made in developing the cost estimate:
    - Short-Duration Remedy (with an assumed remedial timeframe of 1 year);
    - Two rounds of injections;
    - LTM to continue for a period of 30 years.
    - Off-Site SSDS O&M to continue for a period of 30 years.
- **Land Use:** Alternative G2 will achieve compliance with NYS Class GA GWQS which is sufficient for the current, intended and reasonably anticipated future use of the site which is industrial.

8.2.3.3 Alternative G3 – In-Situ Thermal Treatment and Off-Site SSDS

Alternative G3 includes the installation of 10 electrodes and 10 vacuum wells to provide source area treatment using ERH. LTM would consist of a network of wells located within and down gradient of the site boundary to monitor groundwater concentrations outside the source remediation zone. Institutional controls will be implemented to restrict the use of groundwater at the site while contaminant concentrations are greater than the NYS Class GA GWQS. SSDS will be installed in the building west of the site to mitigate vapor intrusion into the building.

- **Overall protection of human health and the environment:** Alternative G3 will protect human health and the environment at the site through a combination of ISTT for source area removal and LTM for areas outside the source area.

Institutional controls will restrict local groundwater use. ISTT may result in some environmental impacts. Environmental impacts associated with ISTT could include drying of the soil (mostly at or near the water table) that may affect the engineering properties of the soil such as shrinkage and desiccation or consolidation which could affect nearby or overlaying structures. Impacts associated with drying are not anticipated for this site due to the treatment depth being in the saturated zone; however, if this occurs soil rewetting after ISTT can be used to mitigate impacts associated with this. An increase in the groundwater temperature can alter the geochemical conditions. Additionally the solubility of materials may be modified by the increased temperature causing an increase in dissolved solids or other materials to precipitate near the treatment zone. LTM will be implemented outside the active remediation areas to monitor natural attenuation in these areas. SSDSs will be installed in the neighboring building west of the site. The SSDS will reduce exposure of volatilized CVOCs from contaminated groundwater to occupants inside the building. Vapors emitted from the SSDSs may be further treated using vapor phase GAC prior to emitting to the atmosphere if required to comply with applicable SCGs.

- **Compliance with SCGs:** Alternative G3 is expected to achieve compliance with SCGs including the NYS Class GA GWQS for the source remediation area. Areas outside the source area will degrade naturally over time and eventually may achieve the NYS Class GA GWQS. The Occupational Safety and Health Administration (OSHA) set the standard for safe working electrical voltages of less than 50 volts at the surface of a working site. The operator and installer of the ISTT system must meet this minimal requirement. Typically the vendors adopt safety policies that provide a significant safety margin by ensuring less than 15 volts are present at the surface during the ERH operation by implementing a combination of engineering controls and standard grounding techniques. Installation of the SSDS will maintain concentrations of TCE and PCE below the NYSDOH indoor air guideline values for these contaminants in the off-site building. Emissions from the SSDS installed in the building will comply with the State and Federal ambient air quality regulations. If emissions will exceed applicable air quality standards vapor will be treated using vapor-phase GAC prior to emitting vapors to the atmosphere.

- **Long term effectiveness and permanence**: ISTT has been demonstrated to be effective and reliable for groundwater treatment for CVOCs. ISTT will volatilize and/or destroy CVOCs in the source area. Institutional controls and LTM will provide adequate protection of human health from a diluted residual plume if properly implemented and maintained. For cost estimating it is assumed that areas outside the active treatment area would meet the NYS Class GA GWQS in 30 years. The long -term effectiveness and permanence of the SSDS will depend on the routine maintenance and operation of the system. Periodic repairs and equipment replacement will be necessary for the system to work effectively.
- **Reduction of toxicity, mobility, or volume of contamination through treatment:** ISTT will quickly reduce the toxicity and volume of contaminants within the source area at the site. There will be minimal reduction in the toxicity, mobility or volume of contaminants outside the source treatment area, and would require a longer period of time to reduce the toxicity, mobility and volume of contaminants through natural processes. For cost estimating it was assumed contaminants outside the source remediation area will take 30 years to achieve NYS Class GA GWQS. The SSDS will effectively reduce the concentrations of vapors beneath the building and minimize indoor air exposures. The use of vapor phase GAC prior to emitting vapors will reduce the overall toxicity, mobility and volume of contaminants.
- **Short term impacts and effectiveness:** Implementation of Alternative G3 will result in some impacts to the site. Equipment and vehicles located in the vicinity of the source area will need to be temporarily relocated to install the ISTT system. Electrodes and vacuum wells can be installed underground to allow for the continued use of this area once installation is final. Dry wells located in the source area will need to be covered and sealed during operation of the system to prevent the short circuiting of the vacuum wells and unintentional release of vapors into the atmosphere. Prior to implementing ISTT a survey for buried

objects and utilities will need to be completed to verify no damages will occur as a result of the electric current fields. Subsurface utilities may also allow water to accumulate within sewers or utility backfill after precipitation events, providing localized cooling of soils which may result in condensation of VOCs. The Occupational Safety and Health Administration (OSHA) set the standard for safe working electrical voltages of less than 50 volts at the surface of a working site. The operator and installer of the ISTT system must meet this minimal requirement. Typically the vendors adopt safety policies that provide a significant safety margin by ensuring less than 15 volts are present at the surface during the ERH operation by implementing a combination of engineering controls and standard grounding techniques. During operation the surface voltage will constantly be monitored to ensure voltages are within the safety limits. The use of vacuum wells to collect volatilized CVOCs will mitigate exposure from the vapor generated. Additionally the building will be surveyed prior to implementing ISTT to make sure any direct exposure pathways into the building from the subsurface (i.e., cracks in the slab, etc.) are repaired to ensure the vacuum system is not short circuited. The installation of SSDS inside the building will temporarily disrupt ongoing industrial activities at the site, but is not expected to expose workers or building occupants to on-site contamination since the installation of ports will be accomplished through drilling into the slab and exposure to contaminants beneath the slab will be minimal. Risks associated with implementation of this alternative will be minimized by the preparation of a Remedial Action Work Plan and a Health and Safety Plan. The remedial timeframe within the source area for Alternative G3 is approximately 6 months, and the overall time frame to achieve applicable SCGs down gradient from the source is 30 years.

- **Implementability:** ISTT is a well-established technology and the equipment and services to install and operate the injection system are commercially available. Additional pre-design investigation and pilot testing will be necessary to determine system requirements for implementation at the site. SSDS is a well-established technology and the equipment and services to install and operate the system are commercially available. Connectivity testing will be performed before installing the system to verify the number and placement of ports needed to effectively mitigate vapors intrusion inside the building.

- **Cost Effectiveness:** Alternative G3 estimated total present value cost is approximately $3.2 million which includes the installation of the ISTT system and SSDS in the building at 931 Conklin Street. This alternative includes O&M costs that include electricity to run the system, routine repair and maintenance of equipment, performance monitoring, and the O&M costs for the SSDS and the LTM program. The estimated cost for Alternative G3 is summarized in Table 22. The following assumptions were made in developing the cost estimate:
  - Short-Duration Remedy (assumed remedial timeframe of 6 months);
  - LTM to continue for a period of 30 years.
  - SSDS O&M to continue for a period of 30 years.
- **Land Use:** Alternative G3 will achieve compliance with NYS Class GA GWQS which is sufficient for the current, intended and reasonably anticipated future use of the site which is industrial.

8.2.3.4 Alternative G4 – Pump and Treat and Off-Site SSDS

Alternative G4 consists of a groundwater extraction system to capture and treat contaminated groundwater within the source area, and the LTM down gradient from the source. Extracted groundwater will be treated using air stripping and liquid-phase GAC, with vapor phase GAC for off-gas treatment. Treated groundwater will be infiltrated into the ground using infiltration wells. LTM would consist of a network of wells located within and down gradient of the site to monitor groundwater concentrations outside the active remediation zone. Institutional controls will be implemented to restrict the use of groundwater at the site while contaminant concentrations are greater than the NYS Class GA GWQS. SSDS will be installed in the building west of the site to mitigate vapor intrusion into the building.

- **Overall protection of human health and the environment:** Alternative G4 will protect human health and the environment at the site through implementation of a groundwater extraction and treatment system for removal of VOCs in the source area. Institutional controls will restrict local groundwater use. LTM will be implemented outside of the active remediation area to monitor the natural degradation of VOCs. SSDSs will be installed in the neighboring building west of the site. The SSDS will reduce exposure of volatilized CVOCs from contaminated groundwater to occupants inside the building. Vapors emitted from the SSDS may be further treated using vapor phase GAC prior to emitting to the atmosphere if required to comply with applicable SCGs.

- **Compliance with SCGs:** Alternative G4 will achieve compliance with SCGs including the NYS Class GA GWQS for the remediation area although treatment time frames will be relatively long. Remedial activities for Alternative G4 will continue until the NYS Class GA GWQS are met. Treated effluent from groundwater treatment system will meet the New York State groundwater effluent limitations prior to being discharged to on-site drywells. Areas outside the source area will degrade naturally over a longer period of time and eventually may achieve the NYS Class GA GWQS. Installation of the SSDS will maintain concentrations of TCE and PCE below the NYSDOH indoor air guideline values for these contaminants in the off-site building. Emissions from the SSDS installed in the off-site building will comply with the State and Federal ambient air quality regulations. If emissions will exceed applicable air quality standards vapor will be treated using vapor phase GAC prior to emitting vapors to the atmosphere.
- **Long term effectiveness and permanence**: Groundwater extraction and treatment systems have been demonstrated to be effective and reliable at numerous sites for groundwater treatment for VOCs and it is expected to be effective at this site. Institutional controls and LTM will provide adequate protection of human health from a diluted residual plume if properly implemented and maintained. For cost estimating it is assumed that areas outside the source area would meet the NYS Class GA GWQS in 30 years. The long term effectiveness and permanence of the groundwater extraction and treatment system and SSDS will depend on the routine maintenance and operation of the systems. Periodic repairs and equipment replacement will be necessary for the systems to work effectively.

- **Reduction of toxicity, mobility, or volume of contamination through treatment:** The pump and treat system will reduce the volume of contamination by extracting groundwater from the source area and treating it ex-situ. Extraction of VOCs from the contaminated groundwater will effectively reduce the mobility, toxicity, and volume of VOCs in the underlying aquifer. VOCs adsorbed to the GAC will ultimately be destroyed during GAC reactivation. There will be minimal reduction in the toxicity, mobility or volume of contaminants outside the active treatment area, and would require a longer period of time to reduce the toxicity, mobility and volume of contaminants through natural processes. For cost estimating it was assumed contaminants outside the source area will take 30 years to achieve NYS Class GA GWQS. The SSDS will effectively reduce the concentrations of vapors beneath the building and minimize indoor air exposures. The use of vapor phase GAC prior to emitting vapors will reduce the overall toxicity, mobility and volume of contaminants.
- **Short term impacts and effectiveness:** Implementation of Alternative G4 will result in minimal impacts to human health or the environment. However, normal site operations may temporarily be impacted during installation and startup, and increased traffic and noise during well installation is expected. Purge water resulting from well development poses a potential risk to workers. The installation of SSDS inside the off-site building will temporarily disrupt ongoing activities inside the building, but is not expected to expose workers or building occupants to contamination since the installation of ports will be accomplished through drilling into the slab and exposure to potentially contaminated soil beneath the slab will be minimal. Risks associated with this alternative will be mitigated by the preparation of a Remedial Action Work Plan and a Health and Safety Plan. The remedial timeframe for Alternative G4 is 20 years.
- **Implementability:** Pump and treat is a well-established technology. The equipment and services to install and operate the extraction, treatment system is commercially available. Shallow and deep extraction wells are identified to remediate both the upper and lower aquifers. Additional pre-design investigation and pilot testing will be necessary to determine optimal well placement, flow rates

and additional pre-treatment that may be necessary for the groundwater pump and treat system. SSDS is a well-established technology and the equipment and services to install and operate the system are commercially available. Connectivity testing will be performed before installing the system to verify the number and placement of ports needed to effectively mitigate vapors intrusion inside the building.

- **Cost Effectiveness:** The estimated total present value cost for Alternative G4 is $6.9 million. This alternative includes the O&M cost associated with the operation of the extraction and treatment system, the SSDS and implementing the LTM program. The estimated cost for Alternative G4 is summarized in Table 23. The following assumptions were made in developing the cost estimate:
    - Long-Duration Remedy (assumed remedial timeframe of 20 years);
    - LTM to continue for a period of 30 years.
    - SSDS O&M to continue for a period of 30 years.
- **Land Use:** Alternative G4 will achieve compliance with NYS Class GA GWQS which is sufficient for the current, intended and reasonably anticipated future use of the site which is industrial.

8.2.4 On-Site Soil Vapor Alternative Evaluation

Three alternatives identified for evaluation include:

- Alternative SV1 – No Action
- Alternative SV2 –SSDS
- Alternative SV3 – SVE

As discussed previously, alternatives were developed to allow flexibility in selecting a remedy to mitigate vapor intrusion into the on-site buildings due to the spatial constraints inside the building. An individual analysis of the on-site soil vapor alternatives against the criteria outlined in section 7.2.1 was conducted and is presented below. A summary of the evaluation is provided in Table 24.

8.2.4.1 Alternative SV1 – No Action

The "no action" option is included as a basis for comparison with active on-site soil vapor remediation technologies in accordance with Section 4.2 of DER-10. If no remedial action is taken, contaminants already present in the soil vapor will remain in place or continue to impact the two buildings located at 937 and 965 Conklin Street.

- **Overall protection of human health and the environment:** Alternative SV1 provides no control of exposure to contaminated soil vapor and no reduction in risk to human health posed by contaminated soil vapor. The alternative allows for the potential for migration of contaminated soil vapor.
- **Compliance with SCGs:** Alternative SV1 does not comply with any of the SCGs. Sub-slab soil vapor concentrations within the two buildings (937 and 965 Conklin Street) will continue to exhibit concentrations above the NYSDOH air guideline value.
- **Long term effectiveness and permanence**: Alternative SV1 does not provide a degree of long-term effectiveness and permanence. No long term management or controls for exposure are included in this alternative. Long term potential risks would remain unchanged under this alternative.
- **Reduction of toxicity, mobility, or volume of contamination through treatment:** Alternative SV1 does not provide reduction in toxicity, mobility, or volume of the soil vapor VOCs concentrations.
- **Short term impacts and effectiveness:** This alternative does not result in disruption of the buildings and no additional risks are posed to the community, workers, or the environment as no remedial actions will occur at the site. Remedial objectives are not achieved so no remedial time frame is associated with this alternative.
- **Implementability:** There are no implementability concerns posed by this remedy as no remedial actions are being implemented.

- **Cost Effectiveness:** Because this is a No Action Alternative, the capital, operations and maintenance, and net present value costs are estimated to be $0. Therefore, no cost estimate is provided.
- **Land Use:** The No Action Alternative would result in soil vapor concentrations greater than the NYSDOH air guideline values remaining in place. Over time indoor air concentrations could exceed the NYSDOH air guidelines making it unsafe to continue working inside the building.

8.2.4.2 Alternative SV2 – SSDS

Alternative SV2 consists of SSDS installed for both buildings consisting of a fan-powered vent and piping system to draw vapors from the soil beneath the building slabs and emit the vapors to the atmosphere.

- **Overall protection of human health and the environment:** Alternative SV2 provides overall protection of human health and the environment by mitigating vapor beneath the two buildings and preventing vapors from entering the buildings.
- **Compliance with SCGs:** Alternative SV2 will achieve compliance with chemical specific SCGs for the site, including the NYSDOH air guideline value. Emissions from the SSDS installed in the off-site building will comply with the State and Federal ambient air quality regulations. If emissions will exceed applicable air quality standards vapor will be treated using vapor phase GAC prior to emitting vapors to the atmosphere.
- **Long term effectiveness and permanence**: Alternative SV2 provides a high degree of long-term effectiveness and permanence. The long-term effectiveness and permanence of the SSDS installed in the buildings will depend on the routine maintenance and operation of the system. Periodic repairs and equipment replacement will be necessary for the system to work effectively.
- **Reduction of toxicity, mobility, or volume of contamination through treatment:** Alternative SV2 will effectively reduce the concentrations of vapors beneath the building and minimize indoor air exposures. The use of vapor phase

GAC prior to emitting vapors will reduce the overall toxicity, mobility and volume of contaminants.

- **Short term impacts and effectiveness:** Alternative SV2 will result in some disruption of the functionality of the building during installation. Measures will be taken during design and construction of the system to minimize the disruption. The installation is not expected to expose workers or building occupants to on-site contamination since the installation of ports will be accomplished through drilling into the slab and exposure to contaminants beneath the slab will be minimal. Risks associated with implementation of this alternative will be minimized by the preparation of a Remedial Action Work Plan and a Health and Safety Plan. Alternative SV2 will achieve SCGs in approximately 30 years.
- **Implementability:** Alternative SV2 is implementable with readily available equipment and materials; however, both buildings are actively used and substantial amount of equipment and materials are being stored inside the building which will require significant coordination with the facility operator for the installation of extraction points.
- **Cost Effectiveness:** Alternative SV2 estimated total present value cost is approximately $0.8 million which includes the installation of the SSDS for both buildings. This alternative includes O&M for the SSDS; the cost can vary based on the number of years of operation. The estimated cost for Alternative SV2 is summarized in Table 25.
- **Land Use:** Alternative SV2 will prevent contaminated soil vapor from entering the on-site buildings. Alternative SV2 is sufficient for the current, intended and reasonably anticipated future use of the site which is industrial.

8.2.4.3 Alternative SV3 – SVE

Alternative SV3 consists of a SVE system which includes installing four soil vapor extraction wells outside of the buildings located at 937 and 965 Conklin Street to remediate suspected soil contamination under the building slab and mitigate sub slab vapor into the buildings. A properly designed SVE may be capable of remediating vapors under the off-site building, potentially obviating the need for an off-site SSDS.

- **Overall protection of human health and the environment:** Alternative SV3 provides overall protection of human health and the environment by mitigating vapor beneath the two buildings and preventing vapors from entering the buildings.
- **Compliance with SCGs:** Alternative SV3 will achieve compliance with chemical specific SCGs for the site, including the NYSDOH air guideline value inside the building. Emissions from the SSDS installed in the off-site building will comply with the State and Federal ambient air quality regulations. Emissions will be treated using vapor phase GAC to meet applicable air quality standards.
- **Long term effectiveness and permanence**: Alternative SV3 provides a high degree of long-term effectiveness and permanence. The long-term effectiveness and permanence of the SVE system will depend on the routine maintenance and operation of the system. Periodic repairs and equipment replacement will be necessary for the system to work effectively.
- **Reduction of toxicity, mobility, or volume of contamination through treatment:** Alternative SV3 will effectively reduce the concentrations of vapors beneath the building and minimize indoor air exposures. The use of vapor-phase GAC prior to emitting vapors will reduce the overall toxicity, mobility and volume of contaminants.
- **Short term impacts and effectiveness:** Implementation of Alternative SV3 will result in minimal impacts to human health or the environment; however, normal site operations may temporarily be impacted during installation and startup, and increased traffic and noise during vacuum well installation and trenching is expected. Dry wells located in the source area may need to be covered and sealed during operation of the system to prevent the short circuiting of the vacuum wells. If dry wells are required to be sealed, an alternative means for stormwater management on the site will need to be designed. Risks associated with this alternative will be mitigated by the preparation of a Remedial Action

Work Plan and a Health and Safety Plan. Alternative SV3 will achieve SCGs in approximately 3 years.

- **Implementability:** Alternative SV3 is implementable with readily available equipment and materials. This alternative will result in minor disruption of the functionality of the building since the soil vapor extraction wells will be installed outside of the building.
- **Cost Effectiveness:** The estimated present value cost for Alternative SV3 is approximately $0.7 M. This alternative includes O&M for the SVE system; the cost can vary based on the number of years of operation. The estimated cost for Alternative SV3 is summarized in Table 26.
- **Land Use:** Alternative SV3 will prevent contaminated soil vapor from entering the on-site buildings. Alternative SV3 is sufficient for the current, intended and reasonably anticipated future use of the site which is commercial.

8.3 Comparative Analysis of Alternatives

In the previous sections, each of the remedial alternatives for soil and groundwater were individually evaluated with respect to the eight evaluation criteria. In this section, a comparative analysis was completed where the alternatives were evaluated in relation to each other for each of the evaluation criteria. The purpose of this analysis is to identify the relative advantages and disadvantages of each alternative.

8.3.1 Soil Alternative Comparative Evaluation

8.3.1.1 Overall Protectiveness of the Public Health and the Environment

All of the alternatives, except the no action Alternative S1, provide protection of human health and the environment. Risks from direct contact, ingestion and migration of soil contaminants are addressed by soil Alternatives S2 and S3. Exposure risks are greater with Alternative S2 compared to Alternative S3 as soil impacts greater than the unrestricted use SCOs will remain under Alternative S2 and will be permanently removed under Alternative S3.

8.3.1.2 Compliance with SCGs

Alternative S2 and S3 will achieve the SCGs established for the site including selected SCOs. Alternative S3 will remove soil contaminants greater than the unrestricted use SCOs whereas Alternative S2 will leave contaminants on-site but will meet the industrial use SCOs. Alternative S1 will not meet the SCGs established for the site.

8.3.1.3 Long Term Effectiveness and Permanence

Alternative S3 provides the highest degree of long-term effectiveness and permanence since contamination will be permanently removed from the site. Alternative S2 provides long-term effectiveness and permanence by imposing use restrictions which is effective as long as the institutional controls are enforced. The institutional controls implemented under Alternative S2 are not considered as effective as permanent removal under Alternative S3. In addition, Alternative S2 will not be effective in minimizing potential impacts to groundwater from soil contamination. Both Alternative S2 and S3 provide greater long-term effectiveness and permanence than Alternative S1.

8.3.1.4 Reduction of Toxicity, Mobility or Volume with Treatment

Alternatives S1 and S2 will not reduce the toxicity, mobility or volume of site contaminants. Alternative S3 will remove contaminated soils from the site which will reduce the toxicity, mobility and volume of contamination at the site. Excavated soil will be transported to a permitted landfill for disposal.

8.3.1.5 Short Term Impacts and Effectiveness

Alternatives S1 and S2 can be implemented without any disruption to the site operations. S3 will be the most disruptive to the site and poses the greatest degree of short term exposures to on-site personnel, workers, and neighboring properties. Alternative S1 has no associated remediation time frame. Alternative S2 will take the least amount of time to implement as opposed to S3 because S2 requires only administrative actions (execution of the environmental easement and preparation of the Site Management Plan). S3 will take the most amount of time to implement and complete. It is assumed that S3 will take a total of 6 months to prepare the necessary Work Plans and complete the remedial action.

8.3.1.6 Implementability

All of the alternatives are technically and administratively implementable. Alternative S3 may require shoring or bracing to fully excavate contaminated soils from the drywells and will be the most difficult to implement when compared with S1 or S2.

8.3.1.7 Cost Effectiveness

Cost evaluation of each alternative includes an estimation of construction/capital costs and O&M costs. Tables 17 through 18 include conceptual cost analyses (and assumptions) for the soil alternatives being considered for the site. The costing was based on conceptual remedy assumptions and the information developed for this FS (e.g., site geology, contaminant levels). The costs are presented in present worth basis for comparison purposes. Table 16 provides a summary of the remedial costs developed for the soil alternatives.

No cost is associated with the No Action Alternative (S1) because no activities are implemented. Alternative S2 has the lowest capital cost ($36,000) followed by Alternative S3 ($164,000). Alternative S3 has no O&M or periodic costs. Alternative S2 requires periodic inspections and certifications for the environmental easement and has periodic costs totaling $7,000. Alternative S3 has the greatest net present worth of $164,000 followed by Alternative S2 of $43,000.

8.3.1.8 Land Use

The site is presently zoned for Light Industry. Alternatives S2 and S3 will be consistent with the current and foreseeable future use of the site. Alternative S3 will require no restrictions on use and allow the most flexibility for future uses of the site.

8.3.2 Groundwater Alternative Comparative Evaluation

8.3.2.1 Overall Protectiveness of Public Health and the Environment

Alternative G1 provides no additional protection of human health and the environment. Alternatives G2, G3 and G4 are protective of human health and the environment, and are expected to achieve groundwater RAOs in the source remediation area. Alternative G3 provides a high degree of protectiveness since contaminants will be volatilized and removed from the site in the shortest time period (3-6 months). A survey of existing site conditions and possible modifications to the building slab may be needed to ensure complete collection of the vapor generated during ISTT and verify short circuiting of the vacuum system does not occur. Alternative G3 has the potential modify soil and groundwater properties at the site. Modification of soil properties could lead to structural instability; however, this is not a significant concern for this site as the treatment area is within the saturated zone. Prior to implementing alternative G3 a PDI and pilot study will need to be conducted to verify site conditions will be favorable for ITSS. Alternative G2 provides a high degree of protectiveness since contaminants will be chemically transformed to less toxic contaminants within a relatively short time period (1 – 2 years). Protectiveness under Alternative G4 is achieved through reducing contaminant concentrations at the source using via extraction and treatment of groundwater. Under Alternative G4 removal of CVOCs will take the longest and could potentially take up to 20 years or more to reach the NYS Class GA GWQS in the source area. A benefit of Alternative G4 is that it will provide hydraulic control over the source area and will mitigate the migration of contaminated groundwater from the source to down gradient areas. The NYS Class GA GWQS is achieved in a shorter timeframe with the ISTT in Alternative G3 than with Alternatives G2 and G4. Alternative G4 requires the longest remedial timeframe to achieve the RAOs.

Both Alternatives G3 and G4 transfer VOC concentrations from groundwater to vapor which is then treated using vapor phase GAC prior to being emitted to the atmosphere. VOC vapors could have potential impacts to human health and the environment, but will be mitigated with the use of GAC adsorption. Under Alternative G3 there exists the potential that the vacuum collection system could be short circuited due to the existence of underground utilities and/or preferential pathways beneath the building. Prior to implementation of Alternative G3 the area will need to be surveyed and any preferential pathways eliminated to prevent exposure to contaminated vapors.

Under Alternatives G2, G3, and G4 institutional controls will restrict local groundwater use. LTM will be also implemented outside the active remediation areas to monitor the contaminant concentrations in groundwater after and during active treatment for each alternative.

Under Alternatives G2, G3, and G4 SSDSs will be installed in the neighboring building west of the site. The SSDSs will reduce exposure of volatilized CVOCs from contaminated groundwater to occupants inside the building. Vapors emitted from the SSDSs may be further treated using GAC prior to emitting to the atmosphere if required to comply with applicable SCGs.

8.3.2.2 Compliance with SCGs

Alternative G1 will not achieve compliance with SCGs. Alternatives G2 and G3 will reduce the concentrations of VOCs in groundwater at the source area allowing natural processes to attenuate remaining contamination over time to comply with the SCGs. Alternative G4 should meet SCGs over time and will provide hydraulic control to prevent further migration of contaminated groundwater from the source area. For the dissolved phase plume extending beyond the source area natural processes will attenuate remaining contamination over time to comply with the SCGs

Under Alternatives G2, G3, and G4 LTM will be implemented outside the source remediation area. These areas will degrade naturally over a longer period of time and eventually will achieve the NYS Class GA GWQS. For all the alternatives it was assumed that natural degradation of contaminants would take at least 30 years. Institutional controls will also be implemented which will prevent the use of groundwater at the site until the NYS Class GA GWQS are met.

Under Alternatives G2, G3, and G4 SSDSs will be installed in the neighboring building west of the site to maintain concentrations of PCE and TCE below the NYSDOH indoor air quality guidelines. Emissions from the SSDS installed in the building will comply with the State and Federal ambient air quality regulations. If emissions exceed applicable air quality standards vapor will be treated using vapor phase GAC prior to emitting vapors to the atmosphere.

8.3.2.3 Long Term Effectiveness and Permanence

Alternative G1 provides no active reduction in contaminant levels or risk; therefore, it does not provide any long-term effectiveness.

ISCO treatment under Alternative G2, ISTT under Alternative G3 and Pump and Treat under Alternative G4 are reliable methods for reducing contaminant concentrations in groundwater. Alternatives G2, G3, and G4 will provide significant mass removal of contaminants, with Alternatives G3 and G2 providing the greatest mass removal over the shortest time periods. Alternatives G3 and G2 are expected to meet the RAOs in the source area in one year or less, while Alternative G4 will take 20 years or longer. Both Alternatives G3 and G4 require the use of the effective and continued operation of treatment equipment which is dependent on the overall operation and routine maintenance of the treatment systems. Periodic repairs and equipment replacement will be needed to maintain the treatment systems effectiveness; however, the equipment under Alternative G4 will require a longer term of operation and maintenance versus equipment required by Alternative G3.

All the alternatives will rely on institutional controls to restrict groundwater use until NYS Class GA GWQS are met. All the alternatives will rely on LTM for areas of groundwater contamination outside the active remediation zone to monitor the natural degradation of contaminants.

Under Alternatives G2, G3, and G4 SSDSs will be installed in the neighboring building west of the site. The long-term effectiveness and permanence of the SSDS will depend on the routine maintenance and operation of the system. Periodic repairs and equipment replacement will be necessary for the system to work effectively.

8.3.2.4 Reduction of Toxicity, Mobility or Volume with Treatment

Alternative G1 will not reduce toxicity, mobility or volume of groundwater contamination. Alternatives G2, G3 and G4 will reduce the mass of VOC contamination in groundwater. Alternative G2 uses a chemical oxidation process to destroy contaminants and eliminate them from the aquifer. Alternative G3 uses ISTT to vaporize contaminants and collect the contaminated vapor for treatment using vapor phase GAC. Alternative G4 uses pump and treat to extract VOC mass in the source area and provide mass removal and hydraulic control of the contaminated groundwater. Extracted groundwater is then treated using air stripping with liquid GAC for polishing and GAC for vapor treatment. Spent GAC under Alternatives G3 and G4 will be reactivated or destroyed which will permanent destroy VOC contaminants.

All the active remediation alternatives rely on LTM for areas outside the source treatment area. There will be minimal reduction in the toxicity, mobility or volume of contaminants outside the source area, and remediation of this area will require a long period of time to reduce the toxicity, mobility and volume of contaminants through natural processes. For cost estimating it was assumed contaminants outside the active remediation area will take 30 years to achieve NYS Class GA GWQS.

All the active remediation alternatives include SSDS. SSDSs will collect soil vapors from beneath the adjacent building and emit them to the atmosphere. Prior to emitting gases to the atmosphere it may be treated using GAC if required to meet applicable SCGs. As with the pump and treat and ISTT systems, spent GAC will be reactivated or destroyed which will permanently destroy VOC contaminants.

8.3.2.5 Short Term Impacts and Effectiveness

Alternative G1 creates no short-term impacts to human health or the environment because no action is conducted. Alternatives G2, G3 and G4 will have short-term impacts to remediation workers, the public, and the environment during implementation. All these alternatives implement monitoring, that will provide the data needed for proper management of the remedial processes and a mechanism to address any potential impacts to the community, remediation workers, and the environment.

All the Alternatives will have generally the same degree of short-term impacts. Equipment and vehicles in the vicinity of the source area will need to be temporarily relocated during installation and during the second injection event under Alternative G2. Alternative G4 will require the greatest amount of space to construct the treatment building. Alternative G3 also requires space for a treatment building, but the structure will be temporary in nature and will only remain at the site for up to 1 year. Under all the Alternatives wells and systems (apart from treatment) can be installed flush with the ground allowing the continued use of the area after installation of the systems. Both Alternatives G2 and G3 potentially pose the greatest risks to remediation workers due to the quantity of hazardous chemicals used for Alternative G2 and the high voltage used under G3. Construction during all the alternatives will create noise. The potential for remediation workers to have direct contact with contaminants in groundwater occurs when the wells are installed for all the alternatives and when the groundwater remediation system is operating under Alternative G4.

RAOs should be achieved under Alternatives G3, G2 and G4 within short, medium and longer timeframes, respectively. ISTT is expected to achieve groundwater RAOs within three to six months under Alternative G3 with LTM for 30 years. ISCO is expected to achieve groundwater

RAOs within one year under Alternative G2 with LTM for 30 years. Alternative G4, Pump and Treat, is expected to achieve RAOs in 20 years with LTM for 30 years.

The installation of SSDS inside the building will temporarily disrupt ongoing activities inside the building, but is not expected to expose workers or building occupants to contamination since the installation of ports will be accomplished through drilling into the slab and exposure to potentially contaminated soil and groundwater beneath the slab will be minimal. The operation of the SSDS was assumed to operate for a period of 30 years under each alternative.

8.3.2.6 Implementability

Alternative G1, No Action, is the easiest alternative to implement. Alternative G4 is a commercially available technology and is normally easy to install and operate. Alternative G2 is also commercially available technology and can be easily implemented. Implementation constraints for Alternative G2 include the limited space available to mix chemicals required for injection into the subsurface which may make it more difficult to implement than Alternative G4. Alternatives to on-site mixing may be necessary to effectively implement this remedy. Alternative G3 also requires space for the treatment system and power control unit needed to power the electrodes. Additionally implementability concerns include the existence of underground utilities and potential for preferential pathways which could short circuit the vacuum system exposing building occupants to CVOC vapors during implementation of ISTT.

The SSDS that will be implemented under all the alternatives is commercially available and generally easily implementable.

8.3.2.7 Cost

The cost evaluation for each alternative includes an estimation of capital costs and O&M costs. Tables 21 through 23 include conceptual cost analyses (and assumptions) for the groundwater alternatives being considered for the site. The costing was based on conceptual remedy assumptions and the information developed for this FS (e.g., site geology; contaminant levels). The costs are presented in present worth basis for comparison purposes. Table 20 provides a summary of the remedial costs developed for the groundwater alternatives.

The relative costs for the alternatives presented are $0 cost to implement Alternative G1 (No Action), $2.8 million to implement Alternative G2 (ISCO), $3.2 million to implement

Alternative G3 (ISTT), and $6.9 million to implement Alternative G4 (pump and treat). Alternative G3 (ISTT) has the highest capital cost ($1.5 million) followed by Alternative G4 (pump and treat) of $1.2 million and Alternative G2 (ISCO) of $1.2 million.

8.3.2.8 Land Use

The site is presently zoned Light Industry. Alternatives G2, G3 and G4 will likely achieve NYS Class GA GWQS for the source remediation area. There are no potable water supply sources in the vicinity of the site or down gradient and so future restrictions on groundwater use will not have an impact on the existing land use of the site. It is assumed that the dissolved phase plume will naturally attenuate before reaching any potable water supply source that may exist further down gradient of the site.

8.3.3 On-Site Soil Vapor Alternative Comparative Evaluation

8.3.3.1 Overall Protectiveness of Public Health and the Environment

Alternative SV1 is not protective of human health or the environment. Alternatives SV2 and SV3 are protective of human health and the environment, and are expected to achieve soil vapor RAOs within the two on-site buildings. Alternative SV2 includes installation of SSDSs which will reduce exposure of VOCs contaminated soil vapor to occupants inside the buildings. Vapors emitted from the SSDSs may be further treated using GAC prior to emitting to the atmosphere if required to comply with applicable SCGs. Alternative SV3 will effectively extract the VOCs contaminated soil and provide treatment above ground which provides maximum protection of public health and environment. Under Alternative SV3 extracted vapors will be treated with vapor-phase GAC before emitting to the atmosphere.

8.3.3.2 Compliance with SCGs

Alternative SV1 will not achieve compliance with SCGs. Alternatives SV2 will reduce exposure of vapors inside the buildings but will not reduce the concentrations of VOCs in soil vapor. Emissions from the SSDS installed in each building will comply with the State and Federal ambient air quality regulations. Vapors emitted from the SSDSs may be further treated using GAC prior to emitting to the atmosphere if required to comply with applicable SCGs. Alternative

SV3 will reduce the concentrations of VOCs in soil vapor by extraction and treatment to comply with the SCGs.

8.3.3.3 Long Term Effectiveness and Permanence

Alternative SV1 provides no active reduction in contaminant levels or risk and does not provide any long-term effectiveness. SSDSs under Alternative SV2 will be installed in the on-site buildings. The long-term effectiveness and permanence of the SSDS will depend on the routine maintenance and operation of the systems. Periodic repairs and equipment replacement will be necessary for the systems to work effectively. Comparatively, Alternative SV3 will provide maximum long-term effectiveness and permanence because the extracted soil vapor will be treated on-site and VOCs contamination permanently reduced. The long-term effectiveness and permanence of the SVE system will also depend on the routine maintenance and operation of the systems. Periodic repairs and equipment replacement will be necessary for the SVE system to work effectively.

8.3.3.4 Reduction of Toxicity, Mobility or Volume with Treatment

Alternative SV1 will not reduce toxicity, mobility or volume of groundwater contamination. SSDSs under Alternative SV2 will collect soil vapors from beneath the buildings and emit them to the atmosphere. Prior to emitting gases to the atmosphere it may be treated using GAC if required to meet applicable SCGs. As with the SVE system under Alternative SV3, extracted soil vapor will be treated using GAC and spent GAC will be reactivated or destroyed which will permanently destroy VOC contaminants. The relative ability of reducing toxicity, mobility or volume of the contaminated soil vapor is higher for Alternative SV3 than Alternative SV2.

8.3.3.5 Short Term Impacts and Effectiveness

Alternative SV1 creates no short-term impacts to human health or the environment because no action is conducted.

Alternative SV2 will have greater short term impacts to occupants of the building that Alternative SV3 since the system will be installed inside the buildings. Because the system will be installed outside the building under Alternative SV3, short term impacts will disrupt only outside activities performed during construction. Equipment and vehicles located in areas proposed for the location of the treatment building or vacuum well will need to be re-located to allow for system installation. Installation of both systems will generate noise and may generate some dust. Exposure to on-site contaminants is expected to be minimal under both alternatives since direct contact to contaminated groundwater is unlikely since piping for both systems will be installed in the unsaturated zone. However, air monitoring will be conducted to ensure contaminant levels remain below health standards during construction.

8.3.3.6 Implementability

Alternative SV1, No Action, is the easiest alternative to implement since no action will be taken. Alternatives SV2 and SV3 are both commercially available technologies and are normally easy to install and operate. Alternative SV2 will be harder to install compared to Alternative SV3 since installation of the SSDSs will require access inside the buildings and temporarily disrupt ongoing activities at the site Alternative SV3 will be implemented with less disruption since the soil vapor extraction wells for the SVE system will be installed outside of the buildings. Implementation of Alternative SV3 may be impacted due to the existence of underground utilities and drywells which may potentially short circuit the SVE system and reduce the effectiveness of the system.

8.3.3.7 Cost

The cost evaluation of each alternative includes an estimation of capital costs and O&M costs. Tables 25 and 26 include conceptual cost analyses (and assumptions) for the on-site soil vapor alternatives being considered for the site. The costing was based on conceptual remedy assumptions and the information developed for this FS (e.g., site geology; contaminant levels). The costs are presented in present-worth basis for comparison purposes. Table 24 provides a summary of the remedial costs developed for the on-site soil vapor alternatives.

The relative costs of the alternatives presented is a $0 cost to implement the No Action Alternative, SV1; approximately $0.8 million to implement Alternative SV2 (SSDS); approximately $0.7 million to implement Alternative SV3 (SVE System).

8.3.3.8 Land Use

The No Action Alternative, SV1 will result in soil vapor concentrations greater than the NYSDOH air guideline values remaining in place. Over time indoor air concentrations could exceed the NYSDOH air guidelines making it unsafe to continue working inside the building.

Alternatives SV2 and SV3 will reduce the indoor air concentrations and allow for the continued use of those buildings without adverse health affects.

9.0 CERTIFICATION

I Werner Mueller certify that I am currently a NYS registered professional engineer and that this Feasibility Study Report was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10) and that all activities were performed in full accordance with the DER-approved work plan and any DER-approved modifications.

Werner Mueller, P.E., CPM
Contract Manager

10.0 REFERENCES

6 NYCRR Part 375, Environmental Remediation Programs, December 14, 2006.

40 CFR 300.430-National Oil and Hazardous Substances Pollution Contingency Plan

Environmental Conservation Law, Article 27, Title 13, §27-1313 Remedial Programs

HDR, Brandt Airflex Remedial Investigation Report, June 2014.

NYSDEC, DER-10 Technical Guidance for Site Investigation and Remediation, May 3, 2010.

NYSDEC, Division of Water Technical and Operational Guidance Series (1.1.1), Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations, June 1998.

NYSDOH, Guidance for Evaluating Soil Vapor Intrusion in the State of New York, October 2006.

USEPA, Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, October 1988.

Table 1 – Range of VOCs in Soil

Detected Constituents	Concentration Range Detected (mg/kg) Low - High	URUSCO/POGW SCO (mg/kg)	Frequency Exceeding URUSCO and/or POGW SCOs/ Total # of Samples	Commercial/Industrial SCO (mg/kg)	Frequency Exceeding Commercial/Industrial SCOs/Total # of Samples
1,1,1-Trichloroethane	ND - 0.9	0.68	1/11	500/1000	0/11; 0/11
Acetone	ND - 0.052	0.05	1/11	500/1000	0/11; 0/11
Ethylbenzene	ND - 1.2	1.0	1/11	390/780	0/11; 0/11
Isopropylbenzene	ND - 0.77	2.3*	0/11	NA / NA	0/11; 0/11
m,p-Xylene	ND - 2.1	NA	0/11	NA / NA	0/11; 0/11
Methylcyclohexane	ND - 11	NA	NA	NA / NA	0/11; 0/11
o-Xylene	ND - 0.27	NA	0/11	NA / NA	0/11; 0/11
Tetrachloroethene	ND - 1.1	1.3	0/11	150/300	0/11; 0/11
Xylene (Total)	ND - 2.37	0.26/1.6	1/11	500/1000	0/11; 0/11

ND - not detected. NA – not applicable.
* Standard taken from CP-51 Soil Cleanup Guidance.

Table 2 – Range of SVOCs in Soil

Detected Constituents	Concentration Range Detected (mg/kg) Low - High	URUSCO (mg/kg)	Frequency Exceeding URUSCO / Total # of Samples	Commercial/ Industrial SCO (mg/kg)	Frequency Exceeding Commercial/Industrial SCOs/Total # of Samples
Benzo[a]anthracene*	ND - 1.9	1.0	1/11	5.6/11	0/11; 0/11
Benzo[a]pyrene*	ND - 2.2	1.0	1/11	1.0/1.1	1/11; 1/11
Benzo[b]fluoranthene*	ND - 3.5	1.0	1/11	5.6/11	0/11; 0/11
Benzo[g,h,i]perylene*	ND - 1.9	100	0/11	500/1000	0/11; 0/11
Benzo[k]fluoranthene*	ND - 0.92	0.8	1/11	56/110	0/11; 0/11
Bis(2-ethylhexyl)phthalate	ND - 34	NA	0/11	NA/NA	0/11; 0/11
Butylbenzyphthalate	ND - 2.4	NA	0/11	NA/NA	0/11; 0/11
Chrysene*	ND - 2.5	1.0	1/11	56/110	0/11; 0/11
Dibenzo[a,h]anthracene*	ND - 0.67	0.33	1/11	0.56/1.1	1/11; 0/11
Dimethylphthalate	ND - 2.1	NA	0/11	NA/NA	0/11; 0/11
Di-n-butylphthalate	ND - 13	NA	0/11	NA/NA	0/11; 0/11
Fluoranthene*	ND - 4.6	100	0/11	500/1000	0/11; 0/11
Indeno[1,2,3-cd]pyrene*	ND - 1.6	0.5	1/11	5.6/11	0/11; 0/11
Phenanthrene*	ND - 2.3	100	0/11	500/1000	0/11; 0/11
Pyrene*	ND - 4.1	100	0/11	500/1000	0/11; 0/11
Total PAHs	ND - 26.19	NA	0/11	500**/500**	0/11; 0/11

Table 3 – Range of PCBs in Soil

Detected Constituents	Concentration Range Detected (mg/kg) Low - High	URUSCO (mg/kg)	Frequency Exceeding URUSCO / Total # of Samples	Commercial/ Industrial SCO (mg/kg)	Frequency Exceeding Commercial/ Industrial SCOs/Total # of Samples
Aroclor-1248	ND - 2.2	NA	0/11	NA/NA	0/11; 0/11
Aroclor-Total	ND - 2.2	0.10	3/11	1.0/25	1/11; 0/11

Commercial SCO - commercial soil cleanup objectives.
Industrial SCO - industrial soil cleanup objectives.

ND - not detected. NA - not applicable.

Table 4 – Range of Metals in Soil

Detected Constituents	Concentration Range Detected (mg/kg) Low - High	URUSCO/ POERSCO* (mg/kg)	Frequency Exceeding URUSCO and/or POER SCOs/ Total # of Samples	Commercial/ Industrial SCO (mg/kg)	Frequency Exceeding Commercial/Industrial SCOs/Total # of Samples
Mercury	ND - 1.7	0.18	2/11	2.8/5.7	0/11; 0/11
Aluminum	480 - 11,000	10,000*	1/11	NA/NA	0/11; 0/11
Antimony	ND - 20	12*	2/11	NA/NA	0/11; 0/11
Arsenic	ND - 4.3	13	0/11	16/16	0/11; 0/11
Barium	ND - 22	350	0/11	400/10,000	0/11; 0/11
Cadmium	ND - 5.1	2.5	1/11	9.3/60	0/11; 0/11
Calcium	ND - 42,000	NA	0/11	NA/NA	0/11; 0/11
Chromium**	ND - 630	30	4/11	1,500/6,800	0/11; 0/11
Cobalt	ND - 12	20*	0/11	NA/NA	0/11; 0/11
Copper	ND - 1,400	50	4/11	270/10,000	3/11; 0/11
Iron	1,000 - 53,000	NA	0/11	NA/NA	0/11; 0/11
Lead	ND - 120	63	2/11	1,000/3,900	0/11; 0/11
Magnesium	ND - 24,000	NA	0/11	NA/NA	0/11; 0/11
Manganese	ND - 440	1,600	0/11	10,000/10,000	0/11; 0/11
Nickel	ND - 490	30	4/11	310/10,000	2/11; 0/11
Selenium	ND - 8.6	3.9	1/11	1,500/6,800	0/11; 0/11
Silver	ND - 4.7	2.0	2/11	1,500/6,800	0/11; 0/11
Vanadium	ND - 23	39*	0/11	NA/NA	0/11; 0/11
Zinc	ND - 1,200	109	4/11	10,000/10,000	0/11; 0/11
Cyanide	ND - 0.36	NA	0/11	NA	0/11; 0/11

Table 5 – Range of VOCs in Groundwater

Detected Constituents	Concentration Range Detected (µg/L) Low - High	Standard or Criteria (µg/L)	Frequency Exceeding Standard/Total # of Samples
Tetrachloroethene	ND - 10,000	5	27/116
Trichloroethene	ND - 260	5	14/116
cis-1,2-Dichloroethene	ND - 280	5	14/116
1,1,1-Trichloroethane	ND - 39	5	10/116
1,1-Dichloroethene	ND - 20	5	4/116
1,1-Dichloroethane	ND - 5.2	5	1/116
1,1,2-Trichloro-1,2,2-trifluoroethane	ND - 140	5	4/116
Acetone	ND - 17	50	0/116
Methyl tert-butyl ether	ND - 1.1	10	0/116
Chloroform	ND - 1.8	7	0/116
Criteria: Part 703: Surface Water and Groundwater Quality Standards (Class GA). ND - not detected.			

Table 6 – Range of Metals in Groundwater

Detected Constituents	Concentration Range Detected (µg/L) Low - High	Standard or Criteria (µg/L)	Frequency Exceeding Standard/Total # of Samples
Aluminum	ND - 5,200	NA	0/8
Barium	ND - 97	1,000	0/8
Calcium	13,000 - 42,000	NA	0/8
Iron	ND - 7,200	300	2/15
Magnesium	2,000 - 4,000	35,000*	0/8
Manganese	ND - 8,400	300	3/15
Manganese (filtered)	ND - 48	300	0/3
Potassium	ND - 5,500	NA	0/8
Sodium	11,000 - 40,000	20,000	3/8
Zinc	ND - 61	5,000*	0/8

Criteria: Part 703: Surface Water and Groundwater Quality Standards (Class GA). ND - not detected. NA – not available.
*Guidance Value taken from Division of Water Technical and Operational Guidance Series (1.1.1) Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations

Table 7 – Range of Pesticides in Groundwater

Detected Constituents	Concentration Range Detected (µg/L) Low - High	Standard or Criteria (µg/L)	Frequency Exceeding Standard/Total # of Samples
Chlordane	ND - 0.28	0.05	1/8
Dieldrin	ND - 0.31	0.004	1/8
Endrin Ketone	ND - 0.064	5	0/8
Criteria: Part 703: Surface Water and Groundwater Quality Standards (Class GA). ND - not detected.			

Table 8 – Range of VOCs in Groundwater Profiling Results

Detected Constituents	Concentration Range Detected (µg/L) Low - High	Standard or Criteria (µg/L)	Frequency Exceeding Standard/Total # of Samples
Tetrachloroethene	ND - 13,000	5	17/65
Trichloroethene	ND - 6.1	5	1/65
Cis-1,2-Dichloroethene	ND - 1.5	5	0/65
1,1,1-Trichloroethane	ND - 2.7	5	0/65
1,1,2-Trichloro-1,2,2-trifluoroethene	ND - 1.2	NA	0/65
1,2,4-Dichlorobenzene	ND - 3.1	NA	0/65
1,4-Dichlorobenzene	ND - 1.5	3	0/65
Toluene	ND - 1.6	5	0/65

Criteria: Part 703: Surface Water and Groundwater Quality Standards (Class GA). ND - not detected.

Table 9 – Range of SVOCs in Groundwater Profiling Results

Detected Constituents	Concentration Range Detected (µg/L) Low - High	Standard or Criteria (µg/L)	Frequency Exceeding Standard/Total # of Samples
Bis(2-ethylhexyl)phthalate	ND - 3.2	5	0/4
Criteria: Part 703: Surface Water and Groundwater Quality Standards (Class GA). ND - not detected.			

Table 10 – Range of Metals in Groundwater Profiling Results

Detected Constituents	Concentration Range Detected (µg/L) Low - High	Standard or Criteria (µg/L)	Frequency Exceeding Standard/Total # of Samples
Aluminum	240 - 3,900	NA	0/4
Calcium	15,000 - 37,000	NA	0/4
Chromium	ND - 70	50	1/4
Iron	4,600 - 21,000	300	4/4
Lead	ND - 10	25	0/4
Magnesium	ND - 4,300	NA	0/4
Manganese	68 - 380	300	1/4
Sodium	12,000 - 19,000	20,000	0/4
Zinc	ND - 82	NA	0/4
Criteria: Part 703: Surface Water and Groundwater Quality Standards (Class GA). ND - not detected. NA - not available.			

Table 11 – Range of VOCs in Subslab Soil Vapor

Detected Constituents	Concentration Range Detected ($\mu g/m^3$) Low - High	Subslab Guideline Value ($\mu g/m^3$)	Frequency Exceeding Standard/Total # of Samples
Tetrachloroethene	ND - 1,300,000	1,000	16/19
Trichloroethene	ND - 4,900	250	4/19
1,1,1-Trichloroethane	ND - 6,300	1,000	1/19
1,1-Dichloroethane	ND - 86	NA	0/19
1,2,4-Trimethylbenzene	ND - 56	NA	0/19
1,2-Dichloroethane	ND - 2.1	NA	0/19
1,3,5-Trimethylbenzene	ND - 20	NA	0/19
1,4-Dichlorobenzene	ND - 1.5	NA	0/19
2,2,4-Trimethylpentane	ND - 1.8	NA	0/19
4-Ethyltoluene	ND - 31	NA	0/19
Acetone	ND - 210	NA	0/19
Benzene	ND - 23	NA	0/19
Carbon disulfide	ND - 44	NA	0/19
Carbon tetrachloride	ND - 1.9	250	0/19
Chloroform	ND - 250	NA	0/19
cis-1,2-Dichloroethene	ND - 190	NA	0/19
Cyclohexane	ND - 17	NA	0/19
Ethyl acetate	ND - 18	NA	0/19
Ethylbenzene	ND - 9.3	NA	0/19
Freon 11	1.4 - 14	NA	0/19
Freon 113	ND - 3.1	NA	0/19
Freon 12	ND - 5.9	NA	0/19
Heptane	ND - 16	NA	0/19
Hexane	ND - 11	NA	0/19
Isopropanol	ND - 44	NA	0/19
m,p-Xylene	0.71 - 31	NA	0/19

Table 11 – Range of VOCs in Subslab Soil Vapor

Detected Constituents	Concentration Range Detected ($\mu g/m^3$) Low - High	Subslab Guideline Value ($\mu g/m^3$)	Frequency Exceeding Standard/Total # of Samples
Methyl Ethyl Ketone	ND - 12	NA	0/19
Methyl Isobutyl Ketone	ND - 1.1	NA	0/19
Methylene chloride	ND - 50	NA	0/19
o-Xylene	ND - 15	NA	0/19
Toluene	1.5 - 71	NA	0/19
trans-1,2-Dichloroethene	ND - 240	NA	0/19

Criteria: No criteria are available for subslab soil vapor.
ND - not detected. NA - not available.
Subslab guideline value taken from NYSDOH matrices 1 & 2 in the Guidance for Evaluating Soil Vapor Intrusion in the State of New York

Table 12 – Range of VOCs in Indoor (Ambient) Air

Detected Constituents	Concentration Range Detected ($\mu g/m^3$) Low - High	Indoor Air Guideline Value ($\mu g/m^3$)	Frequency Exceeding Standard/Total # of Samples
Tetrachloroethene	ND - 80	30	3/15
Trichloroethene	ND - 0.76	5	0/15
1,1,1-Trichloroethane	ND - 1.3	NA	0/15
1,2,4-Trimethylbenzene	ND - 12	NA	0/15
1,3,5-Trimethylbenzene	ND - 5.5	NA	0/15
2,2,4-Trimethylpentane	ND - 1.2	NA	0/15
4-Ethyltoluene	ND - 7.2	NA	0/15
Acetone	13 - 320	NA	0/15
Benzene	0.39 - 2	NA	0/15
Carbon disulfide	ND - 0.38	NA	0/15
Carbon tetrachloride	ND - 0.38	NA	0/15
Cyclohexane	ND - 13	NA	0/15
Ethyl acetate	ND - 97	NA	0/15
Ethylbenzene	ND - 2.1	NA	0/15
Freon 11	0.97 - 2	NA	0/15
Freon 12	1.7 - 2.7	NA	0/15
Heptane	ND - 55	NA	0/15
Hexane	ND - 4.1	NA	0/15
Isopropanol	ND - 140	NA	0/15
m,p-Xylene	0.71 - 19	NA	0/15
Methyl Ethyl Ketone	ND - 2.8	NA	0/15

Table 12 – Range of VOCs in Indoor (Ambient) Air

Detected Constituents	Concentration Range Detected (µg/m³) Low - High	Indoor Air Guideline Value (µg/m³)	Frequency Exceeding Standard/Total # of Samples
Methyl Isobutyl Ketone	ND - 1.9	NA	0/15
Methylene chloride	0.42 - 7	60	0/15
o-Xylene	ND - 2.3	NA	0/15
Toluene	2.4 - 140	NA	0/15
Criteria: NYS Dept. of Health indoor air guideline values. Applies to indoor/ambient air samples only.			
ND - not detected. NA - not available.			
*Chemicals used indoors at this location assumed to have contributed to indoor air result.			

Table 13 – Summary of Qualitative Human Health Exposure Assessment

Environmental Media & Exposure Route	**Human Exposure Assessment**
Direct contact with surface soils (and incidental ingestion)	Surface soil above the unrestricted use SCOs was identified in the washout area north of building 937. However because of the nature of the use (industrial) the potential for direct contact with surface soils by workers is not of concern because soil contaminants are less than industrial use SCOs.
Direct contact with subsurface soils (and incidental ingestion)	People are not coming into contact because contaminated subsurface soils are covered with pavement and building foundations and known contaminated soil is at least 15 feet bgs. People can come into contact if they complete ground-intrusive work or utility work at the site in the vicinity of existing drywells 8, 9, and 11 that requires excavation to 15 feet bgs.
Ingestion of groundwater	Contaminated groundwater is not being used for drinking water, as the area is served by the public water supply. There are no known potable or irrigation water supply wells in the area of groundwater contamination.
Direct contact with groundwater	Contaminated groundwater is not being used for drinking water, as the area is served by the public water supply. There are no known potable or irrigation water supply wells in the area of groundwater contamination. Groundwater contamination is between 25 to 130 feet bgs, so direct contact during ground-intrusive work is unlikely.
Inhalation of air (exposures related to soil vapor intrusion)	Exposures to contaminated soil vapor may occur if soil vapor migrates through cracks or other openings in the building floor or foundation. A soil vapor intrusion evaluation was conducted as part of the RI. Based on matrices in NYSDOH Vapor Intrusion Guidance mitigation systems should be installed at both buildings on site and at the neighboring building at 931 Conklin Street.

Table 14 – General Response Actions

General Response Actions	Media	Area /Volume	Identified Use of Area	Presumptive Remedy
No Action - included as a basis for comparison with the active soil remediation technologies. If no action is taken, the contaminants will remain in place and the RAOs will not be met.	Soil	340 square feet / 130 cubic yards	Industrial	No
Institutional Controls - Restricting the site to industrial use through institutional controls (deed restrictions, environmental easements) would likely not interfere with current site operations (zoned for industrial use) and would reduce the volume of soil requiring active remediation.	Soil	340 square feet / 130 cubic yards	Industrial	No
Containment – The in-place containment of contaminated soils may be accomplished through capping. The contaminated soil area is already capped by concrete and asphalt pavement. The cap prevents direct contact with impacted soils; however, it does not eliminate sources of groundwater contamination or address soil vapor intrusion.	Soil	340 square feet / 130 cubic yards	Industrial	No
Removal – Excavation and off-site disposal will permanently remove soil contaminants from the site. Soil excavation may be accomplished using conventional earthmoving equipment. Disposal options for excavated soils include transport and disposal to an off-site landfill or treatment facility.	Soil	340 square feet / 130 cubic yards	Industrial	**Yes**
Treatment – Treatment of contaminants can be achieved either in-situ or ex-situ and includes several type of technologies that encompass biological, thermal, physical, and chemical treatment approaches.	Soil	340 square feet / 130 cubic yards	Industrial	**Yes (for thermal and physical only)**
No Action – The no action option is included as a basis for comparison with the active groundwater remediation technologies.	Ground water	550 square feet /164,560 gallons	Industrial	No
Institutional Controls – Effective in ensuring that on-site contaminated groundwater continues to not be used for a potable or process water uses. Groundwater use at the site has *already* been restricted through deed restrictions for both properties.	Ground water	550 square feet /164,560 gallons	Industrial	No
Containment – The contaminated groundwater area is already capped by buildings and pavement. Existing stormwater drywells currently provide a pathway of contaminant migration to groundwater so the cap is ineffective as a method of minimizing infiltration.	Ground water	550 square feet /164,560 gallons	Industrial	No
Collection/Treatment/Disposal – Collection is an effective technology for hydraulic control and/or removal of groundwater contamination. Various technologies are available for treating organic contaminants in collected groundwater. On-site and off-site treatment/disposal options are available for the collected groundwater.	Ground water	550 square feet /164,560 gallons	Industrial	**Yes**
In-situ Treatment – Several types of technologies may be applicable for the in-situ treatment of groundwater, and include including biological, physical and chemical treatment.	Ground water	550 square feet /164,560 gallons	Industrial	**Yes (for thermal and physical only)**

Table 15 – Identification and Screening of Technologies – Soil

				Overall Cost and Performance						Treatment Effectiveness							
	Presumptive Remedy	Established Technology	Complexity	O&M	Capital	Reliability/ Maintainability	Cost	Time	Availability	VOCs	Product (NAPL)	CVOCs	SVOCs	Inorganics	Implementable at Site	Retained for Alternative Evaluation	Reason(s)
Institutional Controls	No	Yes	Low	Low	Low	Medium	Low	High	High	Not Effective	Not Effective	Not Effective	Not Effective	Not Effective	Yes	**Yes**	Typically used in conjunction with other technologies.
Containment																	Impacted areas are limited to existing drywells used to manage storm water runoff from the Site. Capping these areas would require the installation of new systems to manage storm water runoff. Capping was not retained because no impact to groundwater was identified for contaminants in soil and soil meets industrial use SCOs and is therefore protective of health for the intended use of the site without requiring an engineering control such as a cap.
Capping System	No	Yes	Low	Medium	Low	Medium	Low		High	Effective	Not Effective	Effective	Effective	Effective	Yes	**No**	
Cap Enhancements/ Alternatives	No	Yes	Low-Medium	Medium-High	Low	Medium	Low	Low but long-term inspection & maintenance	High	Effective	Effective	Effective	Effective	Effective	No	No	
In-Situ Biological Treatment																	Soil contamination is inorganic and not effectively treated by these technologies.
Bioventing	No	Yes	Medium	Low	Low	Medium	Low	Medium	High	Effective	Limited	Limited	Limited	Not Effective	No	No	
Enhanced Bioremediation	Yes*	Yes	Medium	Low	Medium	Medium	Low	Medium	High	Effective	Limited	Effective	Limited	Not Effective	No	No	
Phytoremediation	No	Yes	Medium	Low	Low	Low	Low	High	Medium	Limited	Not Effective	Limited	Limited	Limited	No	No	
In-Situ Physical/Chemical Treatment																	Soil contamination is inorganic and not effectively treated by these technologies.
Chemical Oxidation (ISCO)	No	Yes	Medium	Low	Medium	Medium	Medium	Low	High	Effective	Effective	Effective	Limited	Not Effective	No	No	
Electrokinetic Separation	No	Yes	High	High	Medium	Medium	High	Medium	Medium	Limited	Not Effective	Limited	Limited	Effective	No	No	
Soil Flushing	No	Yes	High	Low	Medium	Medium	Medium	Medium	High	Effective	Effective	Effective	Limited	Effective	No	No	
Soil Vapor Extraction	Yes	Yes	Medium	Medium	Medium	High	Low	Medium	High	Effective	Limited	Effective	Limited	Not Effective	No	**No**	
Solidification/ Stabilization	No	Yes	Medium	Medium	Medium-High	High	Medium-High	Low	High	Limited	Not Effective	Limited	Limited	Effective	No	No	
In-Situ Thermal Treatment																	Soil contamination is inorganic and not effectively treated by these technologies.
ISTT	No	Yes	High	High	High	High	Medium	Low	Medium	Effective	Limited	Effective	Effective	Not Effective	No	**No**	
Ex-Situ Biological Treatment (assuming removal by excavation)																	Implementation of ex situ technologies requires a portion of the site to be dedicated for a moderate to long-term timeframe to the treatment and monitoring of excavated soils. Based on the industrial use of the site, small size (2.0± acres including buildings), and very limited exterior area available, ex situ technologies do not appear to be compatible for the site. Therefore, ex situ technologies have been screened out and will not be evaluated further.
Biopiles	No	Yes	Low	Low	Low	High	Low	Medium-High	High	Effective	Limited	Effective	Limited	Not Effective	No	No	
Composting	No	Yes	Low	Low	Low	Medium	Low	Medium-High	High	Limited	Limited	Limited	Limited	Not Effective	No	No	
Landfarming	No	Yes	Low	Low-Medium	Low	High	Low	Medium-High	High	Limited	Limited	Limited	Effective	Not Effective	No	No	
Slurry Phase Biological Treatment	No	Yes	High	High	High	Medium	Medium	Medium	High	Limited	Limited	Effective	Effective	Not Effective	No	No	

Table 15 – Identification and Screening of Technologies – Soil

	Presumptive Remedy	Established Technology	Complexity	Overall Cost and Performance					Availability	Treatment Effectiveness					Implementable at Site	Retained for Alternative Evaluation	Reason(s)
				O&M	Capital	Reliability/ Maintainability	Cost	Time		VOCs	Product (NAPL)	CVOCs	SVOCs	Inorganics			
Ex-Situ Physical/Chemical Treatment (assuming excavation and/or treatment)																	Implementation of ex situ technologies requires a portion of the site to be dedicated for a moderate to long-term timeframe to the treatment and monitoring of excavated soils. Based on the industrial use of the site, small size (2.0+ acres including buildings), and very limited exterior area available, ex situ technologies do not appear to be compatible for the site. Therefore, ex situ technologies have been screened out and will not be evaluated further.
Chemical Extraction	No	Yes	High	High	High	Medium	Medium	Medium	High	Limited	Limited	Limited	Effective	Effective	No	No	
Chemical Reduction /Oxidation	No	Yes	Medium	Medium	High	High	Medium	Low	High	Limited	Limited	Limited	Limited	Effective	No	No	
Dehalogenation	No	Yes	Medium	High	High	Low	High	Medium	Medium	Not Effective	Not Effective	Effective	Not Effective	Not Effective	No	No	
Separation	No	Yes	Medium	High	Medium	High	Medium	Low	High	Limited	Limited	Limited	Limited	Limited	No	No	
Soil Washing	No	Yes	High	High	High	High	Medium	Low	High	Limited	Limited	Limited	Limited	Limited	No	No	
Solidification/Stabilization	No	Yes	Low	Medium	High	High	Low	Low	High	Not Effective	Not Effective	Not Effective	Limited	Effective	No	No	
Ex-Situ Thermal Treatment (assuming removal by excavation)																	Implementation of ex situ technologies requires a portion of the site to be dedicated for a moderate to long-term timeframe to the treatment and monitoring of excavated soils. Based on the industrial use of the site, small size (2.0+ acres including buildings), and very limited exterior area available, ex situ technologies do not appear to be compatible for the site. Therefore, on-site ex situ technologies have been screened out and will not be evaluated further.
Hot Gas Decontamination	No	No	Low	High	High	High	Low	Low	Medium	Not Demonstrated	Not Effective	Not Demonstrated	Not Demonstrated	Not Demonstrated	No	No	
Incineration	Yes	Yes	Low	High	High	Medium	High	Low	High	Effective	Limited	Effective	Effective	Not Effective	No	No	
Pyrolysis	No	Yes	Medium	High	High	Low	High	Low	High	Limited	Not Effective	Limited	Effective	Not Effective	No	No	
Thermal Desorption	Yes	Yes	Medium	High	High	Medium	Medium-High	Low	High	Effective	Limited	Effective	Effective	Not Effective	No	No	
Removal/Excavation, Off-Site Disposal	Yes	Yes	Low	Low	Low-Medium	High	Medium	Low	High	Effective	Effective	Effective	Effective	Effective	Yes	**YES**	This alternative involves removing all or a significant portion of the contaminated soil and disposing of in a permitted landfill. It meets the RAOs and is often a fast and cost-effective remedy.

O&M – relative overall cost and performance of operation and maintenance. Capital – relative overall cost and performance of capital investment. Adapted from Federal Remediation Technologies Roundtable Technology Screening Matrix, 2007. www.frtr.gov.
*Presumptive remedy only for petroleum hydrocarbons

Table 16 – Identification and Screening of Technologies – Groundwater

	Presumptive Remedy	Established Technology	Complexity	Overall Cost and Performance: O&M	Capital	Reliability/ Maintain-ability	Cost	Time	Availability	Treatment Effectiveness: VOCs	CVOCs	SVOCs	Inorganics	Implementable at Site	Retained for Alternative Evaluation	Reason(s)
Containment																Groundwater contamination is too deep for the use of physical barriers. Deep well injection can't be used because of the sole source aquifer designation on Long Island.
Physical Barriers	No	Yes	Low	Medium	High	High	Medium-High	Medium-High	High	Effective	Effective	Effective	Effective	No	No	
Deep Well Injection	No	Yes	Low	Low	Low	Medium	Low	High	High	Limited	Limited	Limited	Limited	No	No	
In-Situ Biological Treatment																Biological treatment is less proven than other technologies for CVOCs. Bioremediation is a Presumptive Remedy only for petroleum hydrocarbons. Evidence of natural subsurface processes that reduce contamination is lacking at the site, thus Bioremediation and Monitored Natural Attenuation is not retained. However, Long Term Monitoring will be utilized in conjunction with other technologies. Phytoremediation has limited effectiveness for VOC treatment and is not implementable at the site.
Enhanced Bioremediation	*Yes	Yes	Low-Medium	Medium-High	Medium	Medium	Low	Medium-High	High	Effective	Effective	Effective	Not Effective	Yes	**No**	
Monitored Natural Attenuation/ LTM	No	Yes	Low	High	Medium	Medium	Low	Medium-High	High	Effective	Limited	Limited	Not Effective	Yes	**YES** (LTM only)	
Phytoremediation	No	Yes	Low	Low	Low	Low	Low	High	Medium	Limited	Limited	Limited	Limited	No	No	
In-Situ Physical/Chemical Treatment																
Air Sparging	Yes	Yes	Low	Low	Low-Medium	High	Low	Low-Medium	High	Effective	Effective	Limited	Not Effective	Yes	No	Air sparging was determined to not be appropriate due to existence of underground utilities and depth of contamination which will make capture of vapors for treatment and implementation difficult.
Chemical Oxidation (ISCO)	Yes	Yes	Medium	Low	Medium	Medium	Medium-High	Low	High	Effective	Effective	Limited	Not Effective	Yes	**YES**	ISCO is a presumptive remedy that is very effective for the treatment of VOCs in groundwater.
Directional Wells (enhancement)	No	Yes	Low-Medium	Medium	High	Medium	Medium	Medium	Medium	Limited	Limited	Limited	Limited	No	No	Directional wells are not implementable due to the existing buildings and structures which limit space available for installation.
Thermal Treatment	No	Yes	High	High	High	Medium	Medium-High	Low-Medium	Medium	Effective	Effective	Effective	Not Effective	Yes	Yes	Thermal treatment is an effective remedy for treating VOCs in a short time period. Although the depth of contamination and hydraulic conductivity of the Site may make implementation challenging, this alternative has been retained.
In-Well Air Stripping	Yes	Yes	Medium	Medium	High	Medium	Medium	High	Low	Effective	Effective	Limited	Not Effective	Yes	No	In-well air stripping is a group of proprietary technologies that limits competitive bidding. The depth of contamination further limits the in-well stripping technologies that will be effective at this Site and the existence of clay/silt lenses further reduces treatment efficiency. It is also more costly than equally effective technologies.
Passive/Reactive Treatment Walls	No	Yes	Medium	Medium	High	Medium-High	Medium-High	Medium-High	Medium	Effective	Effective	Effective	Limited	No	No	Groundwater contamination is too deep for the use of passive or reactive treatment walls.
Ex-Situ Biological Treatment																The small size of the site limits implementation of ex situ technologies that requires a portion of the site to be dedicated for a moderate to long-term timeframe to treatment.
Bioreactors	No	Yes	Low-Medium	Medium	High	Medium	Low	Medium	High	Effective	Effective	Limited	Not Effective	No	No	
Constructed Wetlands	No	Yes	Low-Medium	Medium	High	Medium-High	Medium	Medium-High	Medium	Limited	Limited	Limited	Effective	No	No	

Table 16 – Identification and Screening of Technologies – Groundwater (continued)

	Presumptive Remedy	Established Technology	Complexity	Overall Cost and Performance: O&M	Overall Cost and Performance: Capital	Overall Cost and Performance: Reliability/ Maintain-ability	Overall Cost and Performance: Cost	Overall Cost and Performance: Time	Availability	Treatment Effectiveness: VOCs	Treatment Effectiveness: CVOCs	Treatment Effectiveness: SVOCs	Treatment Effectiveness: Inorganics	Implementable at Site	Retained for Alternative Evaluation	Reason(s)
Ex-Situ Physical/Chemical Treatment (assuming groundwater extraction)																
Granulated Activated Carbon (GAC)	Yes	Yes	Low	Medium-High	Medium	High	Low-Medium	Medium-High	High	Effective	Effective	Effective	Not Effective	Yes	YES	GAC and air stripping are technologies that are used as part of a pump and treat system. Together these are retained for further analysis. Advanced oxidation processes such as ultraviolet light have high energy requirements and are more costly relative to other equally effective technologies. Ion exchange and precipitation/coagulation/ flocculation are not effective for VOC contamination. *GAC is a form of separation that has been retained for further analysis. Sprinkler irrigation requires vegetated open land and is therefore not applicable.
Air Stripping	Yes	Yes	Medium	Medium-High	Medium	High	Medium	High	High	Effective	Effective	Not Effective	Not Effective	Yes	YES	
Groundwater Pumping/Pump & Treat	Yes	Yes	Medium-High	High	Medium-High	High	Medium-High	Medium-High	High	Effective	Effective	Limited	Effective	Yes	YES	
Advanced Oxidation Processes	No	Yes	Medium	High	High	Medium	High	Medium-High	High	Effective	Effective	Effective	Not Effective	Yes	No	
Discharge/Disposal																
Disposal of treated groundwater to surface water, sanitary sewer or POTW	NA	Yes	Low	Low	Low	High	Low	NA	High	Effective	Effective	Effective	Effective	Yes	YES	In conjunction with other treatment technologies.

O&M – relative overall cost and performance of operation and maintenance. Capital – relative overall cost and performance of capital investment. Adapted from Federal Remediation Technologies Roundtable Technology Screening Matrix, 2007. www.frtr.gov.

*Presumptive remedy only for petroleum hydrocarbons

Table 17 – Evaluation of Soil Alternatives

Alt. No.	Alternative Name	Overall Protection of Public Health and the Environment	Compliance with SCGs	Long Term Effectiveness and Permanence	Reduction of Toxicity, mobility or Volume of Contamination thru Treatment	Short Term Impact and Effectiveness	Implementability	Cost Effectiveness		Land Use Criteria
S1	**No Action**	- Will not meet any of the RAOs for the site.	- Will not comply with SCGs.	- Contaminants remain in the environment and may transform into other compounds. - Magnitude of remaining risks will be unchanged.	- Does not reduce toxicity, mobility or volume of contamination present in the site soils.	- Does not result in disruption of site operations or pose a short term threat to public health or the environment. - No remedial timeframe is associated with this alternative.	- No technical or administrative difficulties or constraints.	Capital Cost: O&M Present Worth Cost: Average Annual Site Management Cost: Periodic Present Worth Cost: Total Present Worth Cost:	$0 $0 $0 $0 $0	- Will not comply with SCGs. Not sufficient for the current, intended and reasonably anticipated future use of the site which is industrial.
S2	**Institutional Controls**	- Minimizes contact with metals contaminated soil by restricting future development of the Site to industrial uses.	-Remaining soil contamination will meet the industrial use SCOs and will therefore be compliant with applicable SCGs. -Based on groundwater samples contaminants in soil do not appear to have impacted groundwater quality at the Site.	-Effectiveness and permanence is dependent on the enforcement of institutional controls by regulating agencies. -Site inspections would be required to verify compliance with environmental easement. Cost estimate assumes inspections every 5 years.	-Does not reduce the toxicity, mobility, or volume of contamination present in the site soils.	-Does not result in disruption of site operations or pose short term risks to public health or the environment. - Remedial timeframe to execute the environmental easement is 1-2 months.	-No technical or administrative difficulties or constraints.	Capital Cost: Average Annual Site Management Cost: O&M Present Worth Cost: Periodic Present Worth Cost: Total Present Worth Cost:	$36,000 $0 $0 $7,000 $43,000	- Will comply with applicable SCGs and will prevent direct contact with contaminated soils beyond the intended industrial use. Sufficient for the current, intended and reasonably anticipated future use of the site which is industrial.

Table 17 – Evaluation of Soil Alternatives

Alt. No.	Alternative Name	Overall Protection of Public Health and the Environment	Compliance with SCGs	Long Term Effectiveness and Permanence	Reduction of Toxicity, mobility or Volume of Contamination thru Treatment	Short Term Impact and Effectiveness	Implementability	Cost Effectiveness		Land Use Criteria
S3	**Excavation and Off-Site Disposal**	- Permanently removes contaminated soil from the site to provide a high degree of protection of public health and the environment.	-Soil will meet the unrestricted use SCOs. -Impacted soils removed from the site will be transported off site to a permitted disposal facility and will meet all applicable State, Federal and local laws governing waste disposal.	-Contaminated soil will be permanently removed from the site.	-Reduces the toxicity, mobility and volume of contaminants from the site. -The actual toxicity and volume will ultimately remain unchanged in the landfill, but the mobility will decrease.	- Temporary disruption to current site operations during excavation. - Will generate noise and traffic during construction. - Remedial timeframe less than 6 months which includes preparation of work plans and actual construction time. Construction time frame is estimated to be 1 to 2 months.	-Generally easy to implement. Shoring and bracing may be needed to prevent collapse of dry wells during excavation.	Capital Cost: Average Annual Site Management Cost: O&M Present Worth Cost: Periodic Present Worth Cost: Total Present Worth Cost:	$164,000 $0 $0 $0 $164,000	-No restrictions on land use will be required under this alternative.

Table 18 - Cost Estimate for Alternative S2

Alternative S2

Institutional Controls

COST ESTIMATE SUMMARY

Site: Brandt Airflex Site (#152183)
Location: East Farmingdale, Suffolk County, New York
Phase: Feasibility Study (-30% - +50%)
Base Year: 2014
Date: October 14, 2014

Description: Alternative S2 consists of restricting the use of the property to Industrial.

Item No.	Description	Quantity	Unit	Unit Cost	Total	Notes
CAPITAL COSTS:						
1	**Institutional Controls**					
1.1	Deed Restriction	1	LS	$ 5,000	$ 5,000	metes & bounds survey and filing
1.2	Prepare Site Management Plan	1	LS	$ 20,000	$ 20,000	
	Sub-Total				**$ 25,000**	
	Contingency	25%			$ 6,000	10% scope + 15% bid
	Sub-Total				**$ 31,000**	
	Project Management				$ 5,000	
	Sub-Total				**$ 5,000**	
	TOTAL CAPITAL COST				**$ 36,000**	
ANNUAL O&M COST:						
1	**Site Management**					
1.1	No Annual O&M Costs	0	LS	$ -	$ -	
	Sub-Total				**$ -**	
	Sub-Total				**$ -**	
	Contingency	15%			$ -	
	Sub-Total				**$ -**	
	Project Management				$ -	
	TOTAL ANNUAL O&M COST				**$ -**	

PERIODIC COSTS:

Item No.	Description	Year	Quantity	Unit	Unit Cost	Total	Notes
1	**Periodic Costs**						
1.1	Deed Restriction Certification & Site Inspection	5	1	LS	$ 1,600	$ 1,600	
	Sub-Total					**$ 1,600**	

PRESENT VALUE ANALYSIS: Rate of Return: 5% Interest Rate: 3%

Item No.	Cost Type	Year	Total Cost	Present Value	Notes
1	**Capital Cost**	0		**$ 36,000**	
2	**Annual O&M Cost**				
2.1	O&M	1-30	0	$ -	
	Sub-Total			**$ -**	
3	**Periodic Costs**				
3.1	Year 5	5	1,600	$ 1,453	
3.2	Year 10	10	1,600	$ 1,320	
3.3	Year 15	15	1,600	$ 1,199	
3.4	Year 20	20	1,600	$ 1,089	
3.5	Year 25	25	1,600	$ 989	
3.6	Year 30	30	1,600	$ 899	
	Sub-Total			**$ 7,000**	
	TOTAL PRESENT VALUE OF ALTERNATIVE			**$ 43,000**	

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Table 19 - Cost Estimate for Alternative S3

Alternative S3

Excavation and Off-Site Disposal

COST ESTIMATE SUMMARY

Site: Brandt Airflex Site (#152183)
Location: East Farmingdale, Suffolk County, New York
Phase: Feasibility Study (-30% - +50%)
Base Year: 2014
Date: October 14, 2014

Description: Alternative S3 consists of excavating impacted soils/sludge from 3 dry wells and the washout area.

Item No.	Description	Quantity	Unit	Unit Cost	Total	Notes
CAPITAL COSTS:						
1	**Drywell Excavation**					
1.1	Remedial Action Work Plan/Permitting	1	LS	$ 15,000	$ 15,000	RAWP, PAMP, CPP
1.2	Submittals/Implementation Plans	1	LS	$ 10,000	$ 10,000	HASP, shop dwgs and work plans
1.3	Construction Equipment Mob/Demob	1	LS	$ 6,000	$ 6,000	
1.4	Excavation	130	CY	$ 15	$ 1,950	Excavate sludge from drywells
1.5	Sheeting / Shoring	1	LS	$ 5,000	$ 5,000	
1.6	Stockpile Area	1	LS	$ 500	$ 500	
1.7	Vacuum Truck	3	Day	$ 1,775	$ 5,325	
1.8	Water Disposal	10,000	Gallon	$ 0.85	$ 8,500	
1.9	Transportation & Disposal	195	Ton	$ 90	$ 17,550	Trucking and Landfill Tipping fees
1.10	Post Excavation Sampling	4	EA	$ 250	$ 1,000	Metals & SVOCs analysis - inc. collection & shipping
1.11	Waste Characterization Sampling	2	EA	$ 450	$ 900	TCLP, inc. collection & shipping
1.12	Perimeter Air monitoring	1	Week	$ 1,200	$ 1,200	Tripod station with Dust and PID monitors.
1.13	H&S Monitoring	1	Week	$ 300	$ 300	Meters for monitoring work zone.
1.14	PPE and Field Supplies	1	LS	$ 1,000	$ 1,000	Boots, glasses, hard hat, gloves, etc.
1.15	Post Construction Submittals/Report	1	LS	$ 25,000	$ 25,000	Manifests, asbuilts, warranties,
	Sub-Total				**$ 99,225**	
	Sub-Total				**$ 99,225**	Sub-Total All Construction Costs.
	Contingency	25%			$ 25,000	10% scope + 15% bid
	Sub-Total				**$ 124,225**	
	Project Management				$ 10,000	
	Remedial Design				$ 20,000	
	Construction Management				$ 10,000	
	Sub-Total				**$ 40,000**	
	TOTAL CAPITAL COST				**$ 164,000**	
ANNUAL O&M COST:						
1	**Annual Operations & Maintenance**					
1.1	No O&M Costs	0	LS	$ -	$ -	
	Sub-Total				**$ -**	
	Sub-Total				**$ -**	
	Contingency	15%			$ -	
	Sub-Total				**$ -**	
	Project Management				$ -	
	Technical Support				$ -	
	TOTAL ANNUAL O&M COST				**$ -**	

PERIODIC COSTS:

Item No.	Description	Year	Quantity	Unit	Unit Cost	Total	Notes
1	**Periodic Costs**						
1.1	No Periodic Costs	5	0	EA	$ -	$ -	
	Sub-Total					**$ -**	

Table 19 - Cost Estimate for Alternative S3

Alternative S3

Excavation and Off-Site Disposal

COST ESTIMATE SUMMARY

Site:	Brandt Airflex Site (#152183)	**Description:**	Alternative S3 consists of excavating impacted soils/sludge from 3 dry wells and the washout area.
Location:	East Farmingdale, Suffolk County, New York		
Phase:	Feasibility Study (-30% - +50%)		
Base Year:	2014		
Date:	October 14, 2014		

Item No.	Description	Quantity	Unit	Unit Cost	Total	Notes

PRESENT VALUE ANALYSIS: Rate of Return: 5% Interest Rate: 3%

Item No.	Cost Type	Year	Total Cost	Present Value	Notes
1	**Capital Cost**	0		**$ 164,000**	
2	**Annual O&M Cost**				
2.1	O&M	1-30	0	$ -	
	Sub-Total			**$ -**	
3	**Periodic Costs**				
3.1	Year 5	5	0	$ -	
3.2	Year 10	10	0	$ -	
3.3	Year 15	15	0	$ -	
3.4	Year 20	20	0	$ -	
3.5	Year 25	25	0	$ -	
3.6	Year 30	30	0	$ -	
	Sub-Total			**$ -**	
	TOTAL PRESENT VALUE OF ALTERNATIVE			**$ 164,000**	

Table 20 – Evaluation of Groundwater and Off-Site Soil Vapor Alternatives

Alt. No.	Alternative Name	Overall Protectiveness of Public Health and the Environment	Compliance with SCGs	Long Term Effectiveness and Permanence	Reduction of Toxicity, mobility or Volume of Contamination Thru Treatment	Short Term Impact and Effectiveness	Implementability	Cost Effectiveness		Land Use Criteria
G1	**No Action**	- Will not meet any of the RAOs for the site.	- Will not meet SCGs.	- Contaminants remain in the environment. - Magnitude of remaining risks will be unchanged.	- Does not reduce toxicity, mobility or volume of contamination present at the site.	- Does not result in disruption of site operations or pose a short term threat to public health or the environment. - No remedial timeframe is associated with this alternative.	- No technical or administrative difficulties or constraints.	Capital Cost: Average Annual Site Management Cost: O&M Present Worth Cost: Periodic Present Worth Cost: Total Present Worth Cost:	$0 $0 $0 $0 $0	- Will not comply with SCGs. -Will not restore groundwater quality and does not provide any restrictions to prevent use of groundwater at the site.
G2	**In-Situ Chemical Oxidation** **Long Term Monitoring** **Off-Site SSDS**	- Will result in a reduction of VOC concentrations in a sole-source aquifer. -Off-Site SSDS will minimize exposure to vapor phase CVOCs from contaminated groundwater by eliminating vapor accumulating beneath the building.	- Will result in a reduction of VOC concentrations, achieving the groundwater SCGs within the treatment area. -Will require UIC permit. -Will need to comply with EPCRA depending on quantities of chemicals used on site. -Areas outside treatment zone will take longer to meet SCGs. Estimated time frame of 30 years was used for these areas. -Emissions from the Off-Site SSDS will comply with Federal and State air regulations.	- Permanent reduction of groundwater contaminants from active groundwater remediation in the source area. - May require multiple injections to achieve long term effectiveness. - After removing the source, areas outside the treatment zone will naturally degrade and attenuate over a long period of time to eventually meet SCGs. -Off-Site SSDS will require routine maintenance to maintain effectiveness.	- Will reduce the volume of VOCs in groundwater on-site in the source area. - Active treatment in the source area and site boundary will reduce the volume of contaminated groundwater migrating off-site. -Off-Site SSDS will reduce the toxicity, mobility or volume of contaminated vapor present under the building.	- Will disrupt site operations during installation of wells and during injections (1-2 months to install and inject first round; 2 weeks for second injection event). Equipment and vehicles in the vicinity of the source area will need to be temporarily located during these activities. -Handling, storage and use of chemicals will require proper PPE and training. - Will generate noise and traffic during construction. - Remedial time frame – 1-2 years. -LTM time frame – 30 years -Off-Site SSDS time frame – 30 years.	- Installation is similar to monitoring wells. - Concerns with transport, storage and handling the oxidizing agent in the field	Capital Cost: Weighted Average Annual Site Management Cost: O&M Present Worth Cost: Periodic Present Worth Cost: Total Present Worth Cost:	$1, 177,000 $67,000 $1,558,000 $80,000 $2,815,000	- Will comply with applicable SCGs. -Will restrict use of groundwater as a potable water supply source until SCGs are met. -Will eventually restore groundwater quality of the site.

Table 20 – Evaluation of Groundwater and Off-Site Soil Vapor Alternatives

Alt. No.	Alternative Name	Overall Protectiveness of Public Health and the Environment	Compliance with SCGs	Long Term Effectiveness and Permanence	Reduction of Toxicity, mobility or Volume of Contamination Thru Treatment	Short Term Impact and Effectiveness	Implementability	Cost Effectiveness		Land Use Criteria
G3	**In-Situ Thermal Treatment** **Long Term Monitoring** **Off-Site SSDS**	- Will result in a reduction of VOC concentrations in a sole source aquifer. - Off-Site SSDS will minimize exposure to vapor phase CVOCs from contaminated groundwater by eliminating vapor accumulating beneath the building.	- Will result in a reduction of VOC concentrations achieving the groundwater SCGs within the source area. -Will need to comply with OSHA standards for working with electrical voltages. -Areas outside treatment zone will take longer to meet SCGs. Estimated time frame of 30 years was used for these areas. -Emissions from the Off-Site SSDS will comply with Federal and State air regulations.	- Permanent reduction of groundwater contaminants from active groundwater remediation in the source area. - After removing the source, areas outside the treatment zone will naturally degrade and attenuate over a long period of time to eventually meet SCGs. -Off-Site SSDS will require routine maintenance to maintain effectiveness.	- Will reduce the volume of VOCs in groundwater on-site in the source area. - Active treatment in the source area and site boundary will reduce the volume of contaminated groundwater migrating off-site. -Off-Site SSDS will reduce the toxicity, mobility or volume of contaminated vapor present under the building.	- Will temporarily disrupt site operations during installation (2-3 months assumed to install). - Will generate noise and traffic during construction. - Dust control and health and safety plan measures will be needed. - Remedial time frame – 6 -12 months. -LTM time frame – 30 years -Off-Site SSDS time frame – 30 years.	- Installation is similar to monitoring wells. - Survey for underground utilities will need to be completed prior to implementation. -Building will need to be surveyed for cracks and sealed as necessary to eliminate any preferential pathways that would short circuit the vacuum system and cause exposure of vapors to building occupants. -Will require PDI to determine whether subsurface characteristics are viable for implementation of remedy.	Capital Cost: Weighted Average Annual Site Management Cost: O&M Present Worth Cost: Periodic Present Worth Cost: Total Present Worth Cost:	$1469,000 $68,000 $1, 586,000 $100,000 $3,155,000	- Will comply with applicable SCGs. Will restrict use of groundwater as a potable water supply source until SCGs are met. -Will eventually restore groundwater quality of the site.

Table 20 – Evaluation of Groundwater and Off-Site Soil Vapor Alternatives

Alt. No.	Alternative Name	Overall Protectiveness of Public Health and the Environment	Compliance with SCGs	Long Term Effectiveness and Permanence	Reduction of Toxicity, mobility or Volume of Contamination Thru Treatment	Short Term Impact and Effectiveness	Implementability	Cost Effectiveness		Land Use Criteria
G4	**Pump and Treat** **Long Term Monitoring** **SSDS**	- Will result in a reduction of VOC concentrations in a sole source aquifer. - Off-Site SSDS will minimize exposure to vapor phase CVOCs from contaminated groundwater by eliminating vapor accumulating beneath the building.	- Will result in a reduction of VOC concentrations achieving the groundwater SCGs within the source area over a longer time frame, 30 years was assumed. -Areas outside source area will take longer to meet SCGs. Estimated time frame of 30 years was used for these areas. -Emissions from the Off-Site SSDS will comply with Federal and State air regulations.	- Permanent reduction of groundwater contaminants from active groundwater remediation in source area. -Will require routine maintenance and repair to maintain effectiveness. - After removing the source, areas outside the treatment zone will naturally degrade and attenuate over a long period of time to eventually meet SCGs. -Off-Site SSDS will require routine maintenance to maintain effectiveness.	- Will reduce the volume of VOCs in groundwater on-site in the source area. - Will establish hydraulic control in the source area to minimize off-site migration of the plume. -Off-Site SSDS will reduce the toxicity, mobility or volume of contaminated vapor present under the Off-Site building.	- Can be implemented with some temporary disruption of current site operations during construction of the pump and treat system (2-3 months to install). - Will generate minimal noise and traffic during construction. - Dust control and health and safety plan measures will be needed. - Remedial timeframe – 30 years. -LTM time frame – 30 years -Off-Site SSDS time frame – 30 years.	- Requires limited excavation for construction. - Minimal technical or administrative difficulties or constraints.	Capital Cost: Weighted Average Annual Site Management Cost: O&M Present Worth Cost: Periodic Present Worth Cost: Total Present Worth Cost:	$1,180,000 $247,000 $5,602,000 $143,000 $6,925000	- Will comply with applicable SCGs. Will restrict use of groundwater as a potable water supply source until SCGs are met. -Will eventually restore groundwater quality of the site.

Table 21 - Cost Estimate for Alternative G2

Alternative G2

In-Situ Chemical Oxidation with LTM

COST ESTIMATE SUMMARY

Site: Brandt Airflex Site (#152183)
Location: East Farmingdale, Suffolk County, New York
Phase: Feasibility Study (-30% - +50%)
Base Year: 2014
Date: October 14, 2014

Description: Alternative G2 consists of implementing In-Situ Chemical Oxidation in the source area. Long-term monitoring will be implemented outside of the source remediation area. A SSDS will be installed inside the building at 931 Conklin Street.

Item No.	Description	Quantity	Unit	Unit Cost	Total	Notes
CAPITAL COSTS:						
1	**Sub-Slab Depressurization System Installation**					
1.1	Connectivity Testing	1	LS	$ 5,000	$ 5,000	Pilot Study to optimize extraction points
1.2	Mobilization	1	LS	$ 2,000	$ 2,000	
1.3	Transmission Piping	400	LF	$ 15	$ 6,000	Includes pipe, grout, pipe supports, valves etc.
1.4	Blowers and Accessories	1	EA	$ 1,500	$ 1,500	Includes blower, moisture separator, filters, muffler, valves, manual
1.5	Equipment Enclosures	1	EA	$ 12,000	$ 12,000	includes 72"x96" fiberglass shelter, delivery to site and construction
1.6	Power Service	1	LS	$ 5,000	$ 5,000	
1.7	Electrical Controls	1	LS	$ 10,000	$ 10,000	
1.8	System Installation	1	LS	$ 10,000	$ 10,000	labor to install system including extraction points, enclosure, piping,
1.9	System Startup	1	LS	$ 5,000	$ 5,000	
1.10	Permits	1	LS	$ 5,000	$ 5,000	
1.11	Reporting, Documentation and Surveying	1	LS	$ 5,000	$ 5,000	
1.12	IDW - Drum Disposal	1	EA	$ 250	$ 250	assumes disposal of 1 drum, nonhazardous, includes delivery of
	Sub-Total				**$ 66,750**	
2	**Pre-Design Investigation**					
2.1	Investigation Work Plan	1	LS	$ 25,000	$ 25,000	Sampling Plan, QAPP, HASP
2.2	Well Driller Mob/Demob	1	LS	$ 6,000	$ 6,000	
2.3	Monitoring Well Installation	6	EA	$ 9,200	$ 55,200	2-inch diameter; 130 ft deep, PVC riser, and screen and development; 3 for LTM and 3 for monitoring TMT efficiency
2.4	Flush-mount curb box with inner locking cap	6	EA	$ 275	$ 1,650	For monitoring wells
2.5	Auger borings for soil chemical/geotechnical samples	3	EA	$ 5,200	$ 15,600	for geochemical/geotechnical analysis
2.6	IDW- monitoring wells	1	LS	$ 8,000	$ 8,000	
2.7	Water Level Measurements/Transducers	1	LS	$ 6,000	$ 6,000	
2.8	Groundwater Sampling (Baseline) and data evaluation	18	EA	$ 1,000	$ 18,000	Sampling 15 monitoring wells; 20% QC samples; includes sampling labor, and analysis for VOCs, TOC, ORP, etc.
2.9	Geochemical analysis	6	EA	$ 550	$ 3,300	1 deep and 1 shallow sample from 3 locations
2.10	Geotechnical Analysis	3	EA	$ 300	$ 900	grain size, porosity, density, etc.
2.11	Pre-Design Report	1	LS	$ 30,000	$ 30,000	
2.12	Permits	1	LS	$ 5,000	$ 5,000	UIC, drilling permits
	Sub-Total				**$ 174,650**	
3	**Construction Submittals**					
3.1	Submittals/Implementation Plans	1	LS	$ 50,000	$ 50,000	
3.2	Site Survey	1	LS	$ 5,000	$ 5,000	includes well survey
	Sub-Total				**$ 55,000**	
4	**Pilot Test for ISCO**					
4.1	Mob/Demob- Drilling subcontractor	1	LS	$ 6,000	$ 6,000	Hollow stem auger rig, decon pad, water truck for decon
4.2	Mob/Demob- Injection subcontractor	1	LS	$ 5,500	$ 5,500	Equipment for pilot test
4.3	Nested Well Installation	1	EA	$ 20,000	$ 20,000	Four 1-inch diameter wells installed in 10-inch borehole; ss screens and casing
4.4	Injection Substrate Material	4	EA	$ 3,394	$ 13,576	1,234 gallons per injection well
4.5	Injection Labor and Equipment	1	DAY	$ 4,000	$ 4,000	Labor and equipment for 1, 3man crew + per diem
4.6	Water truck	1	DAY	$ 450	$ 450	2,000 -gal non-potable water
4.7	Temporary water storage tank	1	DAY	$ 30	$ 30	5,000 gal poly
4.8	Delivery fee of truck and tank	2	EA	$ 700	$ 1,400	includes drop off and pick up
4.9	IDW-nested wells	1	LS	$ 2,000	$ 2,000	Includes soil cuttings from installation and water disposal from development of nested wells and decon water
4.10	Pilot Study Sampling	25	EA	$ 600	$ 15,000	Collect 7 samples @ 3 MWs, includes sample collection and VOCs analysis and water chemistry, 20% QC samples
4.11	Data Reduction, Evaluation, Reporting	1	LS	$ 30,000	$ 30,000	
4.12	Surface Repair- Asphalt	1	SY	$ 40	$ 36	8 sf area per well installation
4.13	Flush-mount curb box with inner locking cap	1	EA	$ 1,500	$ 1,500	For nested injection wells
	Sub-Total				**$ 99,492**	
5	**Full Scale Injection Well Installation**					
5.1	Mob/Demob- Drilling subcontractor	1	LS	$ 6,000	$ 6,000	Hollow stem auger rig, decon pad, water truck for decon
5.2	Nested Well Installation	3	EA	$ 20,000	$ 60,000	Four 1-inch diameter wells installed in 10-inch borehole; ss screens and casing
5.3	IDW- nested wells	1	LS	$ 6,000	$ 6,000	Includes soil cuttings from installation and water disposal from development of nested wells and decon water
5.4	Surface Repair- Asphalt	3	SY	$ 40	$ 107	8 sf area per well installation
5.5	Flush-mount curb box with inner locking cap	3	EA	$ 1,500	$ 4,500	For nested injection wells
5.6	Waste characterization testing	1	EA	$ 750	$ 750	
	Sub-Total				**$ 77,357**	
6	**Initial Injection Event**					
6.1	Mob/Demob- Injection subcontractor	1	LS	$ 24,000	$ 24,000	Full scale equipment
6.2	Injection Substrate Material	16	EA	$ 3,394	$ 54,305	1,234 gallons per injection well
6.3	Injection Labor and Equipment	4	DAY	$ 4,000	$ 16,000	Labor and equipment for 1 crew + per diem
6.4	Water Truck	4	DAY	$ 450	$ 1,800	2,000 -gal non-potable water
6.5	Temporary water storage tank	4	DAY	$ 30	$ 120	5,000 gal poly
6.6	Delivery fee of truck and tank	2	EA	$ 700	$ 1,400	includes drop off and pick up
6.7	Performance Sampling	43	EA	$ 550	$ 23,650	12 samples from 3 wells for VOCs; inc. labor, mobilization, data management and sample analysis + 20% QC samples
	Sub-Total				**$ 121,275**	

Table 21 - Cost Estimate for Alternative G2

Alternative G2

In-Situ Chemical Oxidation with LTM

COST ESTIMATE SUMMARY

Site: Brandt Airflex Site (#152183)
Location: East Farmingdale, Suffolk County, New York
Phase: Feasibility Study (-30% - +50%)
Base Year: 2014
Date: October 14, 2014

Description: Alternative G2 consists of implementing In-Situ Chemical Oxidation in the source area. Long-term monitoring will be implemented outside of the source remediation area. A SSDS will be installed inside the building at 931 Conklin Street.

Item No.		Description	Quantity	Unit	Unit Cost	Total	Notes
7		**Second Injection Event**					
	7.1	Mob/Demob- Injection subcontractor	1	LS	$ 24,000	$24,000	
	7.2	Injection Substrate Material	16	EA	$ 3,394	$54,305	
	7.3	Injection Labor and Equipment	4	DAY	$ 4,000	$16,000	
	7.4	Water Truck	4	DAY	$ 450	$1,800	
	7.5	Temporary water storage tank	4	DAY	$ 30	$120	
	7.6	Delivery fee of truck and tank	2	EA	$ 700	$1,400	
	7.7	Performance Sampling	32	EA	$ 550	$17,600	9 samples from 3 wells for VOCs; inc. labor, mobilization, data management and sample analysis + 20% QC samples
		Sub-Total				**$ 115,225**	
8		**Reporting and Institutional Controls**					
	8.1	Remedial Action Report	1	LS	$ 30,000	$ 30,000	
	8.2	Preparation of Site Management Plan	1	LS	$ 20,000	$ 20,000	
		Sub-Total				**$ 50,000**	
		Sub-Total				**$ 759,748**	Sub-Total All Construction Costs.
		Contingency	25%			$ 190,000	10% scope + 15% bid.
		Sub-Total				**$ 949,748**	
		Project Management	5%			$ 47,000	
		Remedial Design	8%			$ 76,000	
		Construction Management	6%			$ 57,000	
		Construction Oversight	5%			$ 47,000	
		TOTAL CAPITAL COST				**$ 1,177,000**	

ANNUAL O&M COSTS:

Item No.		Description	Quantity	Unit	Unit Cost	Total	Notes
1		**LTM and Institutional Controls - Year 1**					
	1.1	Maintain Institutional Controls	1	LS	$ 5,000	$ 5,000	
	1.2	Groundwater Sampling	144	EA	$ 500	$ 72,000	Monthly sampling of 12 wells
	1.3	Groundwater Sample Laboratory Analysis	173	EA	$ 100	$ 17,300	Sampling 12 wells monthly for Total VOCs analysis + 20% QC samples.
	1.4	Data Reduction, Evaluation and Reporting	12	EA	$ 1,500	$ 18,000	inc. submission of EDDs to state
	1.5	Annual Report	1	EA	$ 24,000	$ 24,000	Includes periodic report
		Sub-Total				**$ 136,300**	
2		**SSDS O&M - Year 1**					
	2.1	Quarterly Inspections	1	LS	$ 3,000	$ 3,000	
	2.2	Annual Sampling Event	1	LS	$ 2,500	$ 2,500	
	2.3	Annual Report	1	LS	$ 3,000	$ 3,000	
	2.4	Electrical Usage	30,000	kW-hr	$ 0.18	$ 5,400	
	2.5	Repair and Maintenance	1	LS	$ 1,000	$ 1,000	
		Sub-Total				**$ 14,900**	
		Sub-Total				**$ 151,200**	
		Contingency	15%			$ 22,680	
		Sub-Total				**$ 173,880**	
		TOTAL ANNUAL O&M COST (Year 1)				**$ 173,880**	
3		**LTM and Institutional Controls - Years 2 to 4**					
	3.1	Maintain Institutional Controls	1	LS	$ 5,000	$ 5,000	
	3.2	Groundwater Sampling	48	EA	$ 500	$ 24,000	Quarterly sampling of 12 wells
	3.3	Groundwater Sample Laboratory Analysis	58	EA	$ 100	$ 5,800	Sampling 12 wells quarterly for VOCs analysis + 20% QC samples.
	3.4	Data Reduction, Evaluation and Reporting	4	EA	$ 1,500	$ 6,000	
	3.5	Annual Report	1	EA	$ 24,000	$ 24,000	Includes periodic report
		Sub-Total				**$ 64,800**	
4		**SSDS O&M - Years 2 to 4**					
	4.1	Quarterly Inspections	1	LS	$ 3,000	$ 3,000	
	4.2	Annual Sampling Event	1	LS	$ 2,500	$ 2,500	
	4.3	Annual Report	1	LS	$ 3,000	$ 3,000	
	4.4	Electrical Usage	30,000	kW-hr	$ 0.18	$ 5,400	
	4.5	Repair and Maintenance	1	LS	$ 500	$ 500	
		Sub-Total				**$ 14,400**	
		Sub-Total				**$ 79,200**	
		Contingency	15%			$ 11,880	
		Sub-Total				**$ 91,080**	
		TOTAL ANNUAL O&M COST (Years 2-4)				**$ 91,080**	
5		**LTM and Institutional Controls - Year 5 to 30**					
	5.1	Maintain Institutional Controls	1	LS	$ 5,000	$ 5,000	
	5.2	Groundwater Sampling	12	EA	$ 500	$ 6,000	Annual sampling of 12 wells
	5.3	Groundwater Sample Laboratory Analysis	14	EA	$ 100	$ 1,400	Sampling 12 wells annually for Total VOCs analysis + 20% QC samples.
	5.4	Data Reduction, Evaluation and Reporting	1	EA	$ 1,500	$ 1,500	
	5.5	Annual Report	1	EA	$ 24,000	$ 24,000	Includes periodic report
		Sub-Total				**$ 37,900**	

Table 21 - Cost Estimate for Alternative G2

Alternative G2

In-Situ Chemical Oxidation with LTM

COST ESTIMATE SUMMARY

Site: Brandt Airflex Site (#152183)
Location: East Farmingdale, Suffolk County, New York
Phase: Feasibility Study (-30% - +50%)
Base Year: 2014
Date: October 14, 2014

Description: Alternative G2 consists of implementing In-Situ Chemical Oxidation in the source area. Long-term monitoring will be implemented outside of the source remediation area. A SSDS will be installed inside the building at 931 Conklin Street.

Item No.		Description	Quantity	Unit	Unit Cost	Total	Notes
6		**SSDS O&M - Year 5 to 30**					
	6.1	Quarterly Inspections	1	LS	$ 3,000	$ 3,000	
	6.2	Annual Sampling Event	1	LS	$ 2,500	$ 2,500	
	6.3	Annual Report	1	LS	$ 3,000	$ 3,000	
	6.4	Electrical Usage	30,000	kW-hr	$ 0.18	$ 5,400	
	6.5	Repair and Maintenance	1	LS	$ 500	$ 500	
		Sub-Total				**$ 14,400**	
		Sub-Total				**$ 52,300**	
		Contingency	15%			$ 7,845	
		Sub-Total				**$ 60,145**	
		TOTAL ANNUAL O&M COST (Years 5-30)				**$ 60,145**	

PERIODIC COSTS:

Item No.		Description	Year	Quantity	Unit	Unit Cost	Total	Notes
1		**System Decommissioning**						
	1.1	Injection Well Abandonment	2	4	EA	$ 4,000	$ 16,000	Drilling subcontractor, abandonment of injection wells
	1.2	Performance Well Abandonment	2	3	EA	$ 1,500	$ 4,500	Drilling subcontractor, abandonment of performance wells
	1.3	Permitting and Reporting	2	1	LS	$ 20,000	$ 20,000	
		Sub-Total					**$ 40,500**	
2		**Site Close Out**						
	2.1	Monitoring Well Abandonment	30	12	EA	$ 1,500	$ 18,000	Drilling subcontractor, abandonment of monitoring wells
	2.2	Decommission SSDS	30	1	LS	$ 5,000	$ 5,000	
	2.3	Final Closure Report	30	1	LS	$ 50,000	$ 50,000	
		Sub-Total					**$ 73,000**	

PRESENT VALUE ANALYSIS: Rate of Return: 5% Interest Rate: 3%

Item No.			Year	Total Cost	Present Value	Notes
1		**Capital Cost**	0		**$ 1,177,000**	
2		**Annual O&M Cost**				
	2.1	Year 1	1	$ 173,880	$ 170,568	
	2.2	Years 2 to 4	2 to 4	$ 91,080	$ 257,954	
	2.3	Years 5 to 30	5 to 30	$ 60,145	$ 1,128,547	
		Sub-Total			**$ 1,558,000**	
3		**Periodic Costs**				
	3.1	Year 3	2	$ 40,500	$ 38,972	
	3.2	Year 30	30	$ 73,000	$ 40,998	
		Sub-Total			**$ 80,000**	
		TOTAL PRESENT VALUE OF ALTERNATIVE			**$ 2,815,000**	

Table 22- Cost Estimate for Alternative G3

Alternative G3

In-Situ Thermal Treatment with LTM

COST ESTIMATE SUMMARY

Site: Brandt Airflex Site (#152183)
Location: East Farmingdale, Suffolk County, New York
Phase: Feasibility Study (-30% - +50%)
Base Year: 2014
Date: August 1, 2014

Description: Alternative G3 consists of implementing In-Situ Thermal Treatment in the source area. Long-term monitoring will be implemented outside of the source remediation area. A SSDS will be installed inside the building at 931 Conklin Street.

Item No.	Description	Quantity	Unit	Unit Cost	Total	Notes
CAPITAL COSTS:						
1	**Sub-Slab Depressurization System Installation**					
1.1	Connectivity Testing	1	LS	$ 5,000	$ 5,000	Pilot Study to optimize extraction points
1.2	Mobilization	1	LS	$ 2,000	$ 2,000	
1.3	Transmission Piping	400	LF	$ 15	$ 6,000	Includes pipe, grout, pipe supports, valves etc.
1.4	Blowers and Accessories	1	EA	$ 1,500	$ 1,500	Includes blower, moisture separator, filters, muffler, valves,
1.5	Equipment Enclosures	1	EA	$ 12,000	$ 12,000	includes 72"x96" fiberglass shelter, delivery to site and
1.6	Power Service	1	LS	$ 5,000	$ 5,000	
1.7	Electrical Controls	1	LS	$ 10,000	$ 10,000	
1.8	System Installation	1	LS	$ 10,000	$ 10,000	labor to install system including extraction points, enclosure,
1.9	System Startup	1	LS	$ 5,000	$ 5,000	
1.10	Permits	1	LS	$ 5,000	$ 5,000	
1.11	Reporting, Documentation and Surveying	1	LS	$ 5,000	$ 5,000	
1.12	IDW - Drum Disposal	1	EA	$ 250	$ 250	assumes disposal of 1 drum, nonhazardous, includes delivery of
	Sub-Total				**$ 66,750**	
2	**Pre-Design Investigation**					
2.1	Investigation Work Plan	1	LS	$ 25,000	$ 25,000	Sampling Plan, QAPP, HASP
2.2	Well Driller Mob/Demob	1	LS	$ 6,000	$ 6,000	
2.3	Monitoring Well Installation	6	EA	$ 10,000	$ 60,000	2-inch diameter; 130 ft deep, SS riser, and screen and development;
2.4	Flush-mount curb box with inner locking cap	6	EA	$ 275	$ 1,650	For monitoring wells
2.5	Auger borings for soil chemical/geotechnical samples	3	EA	$ 5,200	$ 15,600	for geochemical/geotechnical analysis
2.6	Water Level Measurements/Transducers	1	LS	$ 6,000	$ 6,000	
2.7	IDW- monitoring wells	1	LS	$ 8,000	$ 8,000	
2.8	Groundwater Sampling (Baseline) and data evaluation	18	EA	$ 1,000	$ 18,000	Sampling 15 monitoring wells; 20% QC samples; includes sampling, and analysis for VOCs, TOC, ORP, etc
2.9	Geotechnical Analysis	2	EA	$ 300	$ 600	grain size, porosity, density, etc.
2.10	Pre-Design Report	1	LS	$ 30,000	$ 30,000	
2.11	Permits	1	LS	$ 5,000	$ 5,000	
	Sub-Total				**$ 175,850**	
3	**SVE Pilot Test**					
3.1	Well Driller Mob/Demob	1	LS	$ 7,000	$ 7,000	
3.2	Soil Vapor Extraction Well	1	EA	$ 1,500	$ 1,500	Drilling, construction and development. 4-inch diameter; SS casing; 20 ft depth.
3.3	Pressure Well Installation	3	EA	$ 800	$ 2,400	1-inch diameter; 20 ft deep, PVC riser, and screen and development;
3.4	Vapor Treatment Skid	1	LS	$ 15,000	$ 15,000	Includes trailer mount set up, blower, carbon disposal and labor.
3.5	Oversight	1	LS	$ 5,000	$ 5,000	3 day pilot test, for one person oversight for 12 hours/day.
3.6	Data Reduction, Evaluation, Reporting	1	LS	$ 15,000	$ 15,000	
3.7	IDW - Drum Disposal	1	EA	$ 250	$ 250	assumes disposal of 1 drum, nonhazardous, includes delivery of clean drum to site
3.8	Waste characterization testing	1	EA	$ 750	$ 750	
	Sub-Total				**$ 46,900**	
4	**Construction Submittals**					
4.1	Submittals/Implementation Plans	1	LS	$ 50,000	$ 50,000	
4.2	Site Survey	1	LS	$ 5,000	$ 5,000	includes well survey
	Sub-Total				**$ 55,000**	
5	**In-Situ Thermal Treatment**					
5.1	Mobilization/Demobilization	1	LS	$ 20,000	$ 20,000	
5.2	Drilling Mob/Demob	1	LS	$ 6,000	$ 6,000	Hollow stem auger rig, decon pad, water truck for decon
5.3	Abandon Existing Monitoring Well	3	EA	$ 1,500	$ 4,500	
5.4	Abandon Triplet Monitoring Well	2	EA	$ 4,000	$ 8,000	
5.5	Install Electrode	10	EA	$ 20,000	$ 200,000	130 ft; 4" sch. 40 steel in 10" borehole
5.6	Install Vacuum Wells	10	EA	$ 2,500	$ 25,000	4" sch. 40 steel; 20 ft deep hollow stem auger
5.7	Drill Cutting Disposal	1	LS	$ 10,000	$ 10,000	
5.8	Electrical Usage	1	LS	$ 50,000	$ 50,000	
5.9	Power Supply and Instrumentation Controls	1	LS	$ 100,000	$ 100,000	
5.10	SVE Equipment/Components	1	LS	$ 80,000	$ 80,000	Includes equipment.
5.11	System Installation & Start up	1	LS	$ 40,000	$ 40,000	
5.12	Permitting	1	LS	$ 10,000	$ 10,000	
	Sub-Total				**$ 553,500**	
6	**Reporting and Institutional Controls**					
6.1	Remedial Action Report	1	LS	$ 30,000	$ 30,000	
6.2	Preparation of Site Management Plan	1	LS	$ 20,000	$ 20,000	
	Sub-Total				**$ 50,000**	

Table 22- Cost Estimate for Alternative G3

Alternative G3

In-Situ Thermal Treatment with LTM

COST ESTIMATE SUMMARY

Site: Brandt Airflex Site (#152183)
Location: East Farmingdale, Suffolk County, New York
Phase: Feasibility Study (-30% - +50%)
Base Year: 2014
Date: August 1, 2014

Description: Alternative G3 consists of implementing In-Situ Thermal Treatment in the source area. Long-term monitoring will be implemented outside of the source remediation area. A SSDS will be installed inside the building at 931 Conklin Street.

Item No.	Description	Quantity	Unit	Unit Cost	Total	Notes
	Sub-Total				**$ 948,000**	Sub-Total All Construction Costs.
	Contingency	25%			$ 237,000	10% scope + 15% bid.
	Sub-Total				**$ 1,185,000**	
	Project Management	5%			$ 59,000	
	Remedial Design	8%			$ 95,000	
	Construction Management	6%			$ 71,000	
	Construction Oversight	5%			$ 59,000	
	TOTAL CAPITAL COST				**$ 1,469,000**	

ANNUAL O&M COST:

Item No.	Description	Quantity	Unit	Unit Cost	Total	Notes
1	**In-Situ Thermal Treatment System O&M - Year 1**					
1.1	Air Sampling and Analysis (TO-15 Analysis)	11	EA	$ 300	$ 3,300	collect samples monthly from VGAC influent, between units, effluent for 3 mo. + 20% QC samples; inc. labor and analysis
1.2	Water Condensate Samples	3	EA	$ 500	$ 1,500	Monthly samples of condensate water for 3 month operation
1.3	Water Disposal	3	MO	$ 800	$ 2,400	dispose water off site; 3 month operation
1.4	Plant Operator	120	HR	$ 80	$ 9,600	10 hr/week; 12 weeks/yr - 3 month operation.
1.5	Groundwater Sampling	12	EA	$ 500	$ 6,000	Weekly sampling of 3 wells for one month
1.6	Groundwater Sample Laboratory Analysis	14	EA	$ 100	$ 1,400	Sampling 3 wells weekly for one month for Total VOCs analysis + 20% QC samples.
1.7	Data Reduction, Evaluation and Reporting	1	EA	$ 1,500	$ 1,500	inc. submission of EDDs to state
	Sub-Total				**$ 25,700**	
2	**LTM and Institutional Controls - Year 1**					
2.1	Maintain Institutional Controls	1	LS	$ 5,000	$ 5,000	
2.2	Groundwater Sampling	144	EA	$ 500	$ 72,000	Monthly sampling of 12 wells
2.3	Groundwater Sample Laboratory Analysis	173	EA	$ 100	$ 17,300	Sampling 12 wells monthly for Total VOCs analysis + 20% QC samples.
2.4	Data Reduction, Evaluation and Reporting	12	EA	$ 1,500	$ 18,000	inc. submission of EDDs to state
2.5	Annual Report	1	EA	$ 24,000	$ 24,000	Includes periodic report
	Sub-Total				**$ 136,300**	
3	**SSDS O&M - Year 1**					
3.1	Quarterly Inspections	1	LS	$ 3,000	$ 3,000	
3.2	Annual Sampling Event	1	LS	$ 2,500	$ 2,500	
3.3	Annual Report	1	LS	$ 3,000	$ 3,000	
3.4	Electrical Usage	30,000	kW-hr	$ 0.18	$ 5,400	
3.5	Repair and Maintenance	1	LS	$ 500	$ 500	
	Sub-Total				**$ 14,400**	
	Sub-Total				**$ 176,400**	
	Contingency	15%			$ 26,000	
	Sub-Total				**$ 202,400**	
	TOTAL ANNUAL O&M COST (Year 1)				**$ 202,400**	
6	**LTM and Institutional Controls - Years 2 to 4**					
6.1	Maintain Institutional Controls	1	LS	$ 5,000	$ 5,000	
6.2	Groundwater Sampling	48	EA	$ 500	$ 24,000	Quarterly sampling of 12 wells
6.3	Groundwater Sample Laboratory Analysis	58	EA	$ 100	$ 5,800	Sampling 12 wells quarterly for VOCs analysis + 20% QC samples.
6.4	Data Reduction, Evaluation and Reporting	4	EA	$ 1,500	$ 6,000	
6.5	Annual Report	1	EA	$ 24,000	$ 24,000	Includes periodic report
	Sub-Total				**$ 64,800**	
7	**SSDS O&M - Years 2 to 4**					
7.1	Quarterly Inspections	1	LS	$ 3,000	$ 3,000	
7.2	Annual Sampling Event	1	LS	$ 2,500	$ 2,500	
7.3	Annual Report	1	LS	$ 3,000	$ 3,000	
7.4	Electrical Usage	30,000	kW-hr	$ 0.18	$ 5,400	
7.5	Repair and Maintenance	1	LS	$ 500	$ 500	
	Sub-Total				**$ 14,400**	
	Sub-Total				**$ 79,200**	
	Contingency	15%			$ 11,880	
	Sub-Total				**$ 91,080**	
	TOTAL ANNUAL O&M COST (Years 2-4)				**$ 91,080**	
8	**LTM and Institutional Controls - Year 5 to 30**					
8.1	Maintain Institutional Controls	1	LS	$ 5,000	$ 5,000	
8.2	Groundwater Sampling	12	EA	$ 500	$ 6,000	Annual sampling of 12 wells
8.3	Groundwater Sample Laboratory Analysis	14	EA	$ 100	$ 1,400	Sampling 12 wells annually for Total VOCs analysis + 20% QC samples.
8.4	Data Reduction, Evaluation and Reporting	1	EA	$ 1,500	$ 1,500	
8.5	Annual Report	1	EA	$ 24,000	$ 24,000	Includes periodic report
	Sub-Total				**$ 37,900**	

Table 22- Cost Estimate for Alternative G3

Alternative G3

In-Situ Thermal Treatment with LTM

COST ESTIMATE SUMMARY

Site: Brandt Airflex Site (#152183)
Location: East Farmingdale, Suffolk County, New York
Phase: Feasibility Study (-30% - +50%)
Base Year: 2014
Date: August 1, 2014

Description: Alternative G3 consists of implementing In-Situ Thermal Treatment in the source area. Long-term monitoring will be implemented outside of the source remediation area. A SSDS will be installed inside the building at 931 Conklin Street.

Item No.	Description	Quantity	Unit	Unit Cost	Total	Notes
9	**SSDS O&M - Year 5 to 30**					
9.1	Quarterly Inspections	1	LS	$ 3,000	$ 3,000	
9.2	Annual Sampling Event	1	LS	$ 2,500	$ 2,500	
9.3	Annual Report	1	LS	$ 3,000	$ 3,000	
9.4	Electrical Usage	30,000	kW-hr	$ 0.18	$ 5,400	
9.5	Repair and Maintenance	1	LS	$ 500	$ 500	
	Sub-Total				**$ 14,400**	
	Sub-Total				**$ 52,300**	
	Contingency	15%			$ 7,845	
	Sub-Total				**$ 60,145**	
	TOTAL ANNUAL O&M COST (Years 5-30)				**$ 60,145**	

Item No.	Description	Year	Quantity	Unit	Unit Cost	Total	Notes
1	**System Decommissioning**						
1.1	Well Abandonment	1	23	EA	$ 1,500	$ 34,500	abandon in place using grout electrodes, vacuum wells, and monitoring wells
1.2	Demobilize Treatment Plant	1	1	LS	$ 30,000	$ 30,000	Decommission plant
1.3	Permitting and Reporting	1	1	LS	$ 20,000	$ 20,000	
	Sub-Total					**$ 84,500**	
2	**Site Close Out**						
2.1	Monitoring Well Abandonment	30	12	EA	$ 1,500	$ 18,000	Drilling subcontractor, abandonment of monitoring wells
2.2	Decommission SSDS	30	1	LS	$ 5,000	$ 5,000	
2.3	Final Closure Report	30	1	LS	$ 50,000	$ 50,000	
	Sub-Total					**$ 73,000**	

PRESENT VALUE ANALYSIS: Rate of Return: 5% Interest Rate: 3%

Item No.	Cost Type	Year	Total Cost	Present Value	Notes
1	**Capital Cost**	0		**$ 1,469,000**	
2	**Annual O&M Cost**				
2.1	Year 1	1	$ 202,400	$ 198,545	
2.3	Years 2 to 4	2 to 4	$ 91,080	$ 257,954	
2.4	Years 5 to 30	5 to 30	$ 60,145	$ 1,128,547	
	Sub-Total			**$ 1,586,000**	
3	**Periodic Costs**				
3.1	Year 1	1	$ 84,500	$ 82,890	
3.2	Year 30	30	$ 73,000	$ 16,891	
	Sub-Total			**$ 100,000**	
	TOTAL PRESENT VALUE OF ALTERNATIVE			**$ 3,155,000**	

Table 23- Cost Estimate for Alternative G4

Alternative G4

Pump and Treat with LTM

COST ESTIMATE SUMMARY

Site: Brandt Airflex Site (#152183)
Location: East Farmingdale, Suffolk County, New York
Phase: Feasibility Study (-30% - +50%)
Base Year: 2014
Date: October 14, 2014

Description: Alternative G4 consists of implementing groundwater extraction and ex situ treatment in the source area. Long-term monitoring will be implemented outside of the source remediation area. A SSDS will be installed inside the building at 931 Conklin Street.

Item No.	Description	Quantity	Unit	Unit Cost	Total	Notes
CAPITAL COSTS:						
1	**Sub-Slab Depressurization System Installation**					
1.1	Connectivity Testing	1	LS	$ 5,000	$ 5,000	Pilot Study to optimize extraction points
1.2	Mobilization	1	LS	$ 2,000	$ 2,000	
1.3	Transmission Piping	400	LF	$ 15	$ 6,000	Includes pipe, grout, pipe supports, valves etc.
1.4	Blowers and Accessories	1	EA	$ 1,500	$ 1,500	Includes blower, moisture separator, filters, muffler, valves, manual pump drain.
1.5	Equipment Enclosures	1	EA	$ 12,000	$ 12,000	includes 72"x96" fiberglass shelter, delivery to site and construction of concrete pad
1.6	Power Service	1	LS	$ 5,000	$ 5,000	
1.7	Electrical Controls	1	LS	$ 10,000	$ 10,000	
1.8	System Installation	1	LS	$ 10,000	$ 10,000	labor to install system including extraction points, enclosure, piping, etc.
1.9	System Startup	1	LS	$ 5,000	$ 5,000	
1.10	Permits	1	LS	$ 5,000	$ 5,000	
1.11	Reporting, Documentation and Surveying	1	LS	$ 5,000	$ 5,000	
1.12	IDW - Drum Disposal	1	EA	$ 250	$ 250	assumes disposal of 1 drum, nonhazardous, includes delivery of clean drum to site
	Sub-Total				**$ 66,750**	
2	**Pre-Design Investigation**					
2.1	Investigation Work Plan	1	LS	$ 25,000	$ 25,000	Sampling Plan, QAPP, HASP
2.2	Well Driller Mob/Demob	1	LS	$ 6,000	$ 6,000	
2.3	Monitoring Well Installation	6	EA	$ 9,200	$ 55,200	2-inch diameter; 130 ft deep, PVC riser, and screen and development;
2.4	Flush-mount curb box with inner locking cap	6	EA	$ 275.00	$ 1,650	For monitoring wells
2.5	IDW- monitoring wells	1	LS	$ 8,000	$ 8,000	
2.6	Extraction Well Installation - Deep	1	EA	$ 17,308	$ 17,308	6-inch diameter to 60 ft bgs, stainless steel casing & 50 ft stainless
2.7	Well Vault	1	EA	$ 2,500	$ 2,500	For extraction wells, 12"x12"x12"
2.8	IDW-extraction wells	1	LS	$ 10,000	$ 10,000	Soil cuttings and wastewater from well installations, steam cleaning
2.9	Surface Repair- Asphalt	1	SY	$ 40	$ 40	9 sf area per well installation
2.10	Decon/ well development	1	EA	$ 4,500	$ 4,500	
2.11	Aquifer Pump Test	1	LS	$ 30,000	$ 30,000	Labor, materials and equipment to complete pump test
2.12	Water Level Measurements/Transducers	1	LS	$ 6,000	$ 6,000	
2.13	Groundwater Sampling (Baseline) and data evaluation	18	EA	$ 1,000	$ 18,000	Sampling 15 monitoring wells; 3 QC samples; includes sampling, and analysis for VOCs, TOC, ORP, etc
2.14	Pre-Design Report	1	LS	$ 30,000	$ 30,000	
2.15	Permits	1	LS	$ 5,000	$ 5,000	
	Sub-Total				**$ 219,198**	
3	**Construction Submittals**					
3.1	Submittals/Implementation Plans	1	LS	$ 25,000	$ 25,000	
3.2	Site Survey	1	LS	$ 5,000	$ 5,000	includes well survey
	Sub-Total				**$ 30,000**	
4	**EW Drilling and Installation - Pump and Treat**					
4.1	Well Driller Mob/Demob	1	LS	$ 6,000	$ 6,000	well rig, water truck, decon pad
4.2	Extraction Well Installation - Shallow	1	EA	$ 12,800	$ 12,800	6-inch diameter to 60 ft bgs, stainless steel casing & 50 ft stainless steel screen
4.3	Decon/ well development	1	EA	$ 4,500	$ 4,500	
4.4	Pump Installation and Testing	1	EA	$ 6,300	$ 6,300	includes drawdown testing
4.5	Extraction Well Pump, and Transducer	1	EA	$ 6,000	$ 6,000	
4.6	Well Vault	1	EA	$ 2,500	$ 2,500	For extraction wells, 12"x12"x12"
4.7	IDW-extraction wells	1	LS	$ 10,000	$ 10,000	Soil cuttings and wastewater from well installations, steam cleaning and well development.
4.8	Surface Repair- Asphalt	1	SY	$ 40	$ 40	9 sf area per well installation
	Sub-Total				**$ 48,140**	
5	**Conveyance Piping**					
5.1	EW Trenching and piping	50	LF	$ 50	$ 2,500	2-inch PVC transmission pipe to building
5.2	Effluent Discharge Pipe and trenching	20	LF	$ 60	$ 1,200	4-inch PVC discharge pipe to Drywells
5.3	Surface Restoration	31	SY	$ 40	$ 1,244	with asphalt
5.4	Backfill	13	CY	$ 30	$ 389	includes placement and compaction
5.5	Electrical	50	LF	$ 2	$ 100	from EW to PLC
5.6	Soil Disposal	39	Tons	$ 100	$ 3,889	5 ft deep x 2 feet wide by total length x 1.5 tons/CY.
5.7	Asphalt and concrete disposal	20	LF	$ 16	$ 320	From any trenching or saw cut work
	Sub-Total				**$ 9,642**	
6	**Treatment System**					
6.1	Air Stripper Skid System with vapor GAC	1	LS	$ 40,000	$ 40,000	5 trays low profile stripper @350 cfm, blower, discharge pump, 2- 1,500 lb GAC vessels with reactivated carbon
6.2	Liquid GAC Polisher	1	LS	$ 20,000	$ 20,000	2 - 1,000 lb GAC vessels with carbon
6.3	Discharge pump	1	LS	$ 10,000	$ 10,000	
6.4	Bag Filter Skid System	1	LS	$ 16,000	$ 16,000	2" duplex bag filter system
6.5	Interconnecting pipes and valves	1	LS	$ 10,000	$ 10,000	
6.6	Instrumentation and Controls	1	LS	$ 20,000	$ 20,000	PLC and autodialer
	Sub-Total				**$ 116,000**	

Table 23- Cost Estimate for Alternative G4

Alternative G4

Pump and Treat with LTM

COST ESTIMATE SUMMARY

Site: Brandt Airflex Site (#152183)
Location: East Farmingdale, Suffolk County, New York
Phase: Feasibility Study (-30% - +50%)
Base Year: 2014
Date: October 14, 2014

Description: Alternative G4 consists of implementing groundwater extraction and ex situ treatment in the source area. Long-term monitoring will be implemented outside of the source remediation area. A SSDS will be installed inside the building at 931 Conklin Street.

Item No.		Description	Quantity	Unit	Unit Cost	Total	Notes
7		**Treatment Plant Building**					
	7.1	Concrete Foundation with 6" slab	1	LS	$ 20,000	$ 20,000	Assume 1,200 sq ft building footprint
	7.2	Concrete and Soil Testing	1	LS	$ 5,000	$ 5,000	
	7.3	Site Preparation	1,200	SF	$ 35	$ 42,000	Includes silt fence and temporary fence around building footprint
	7.4	Pre-engineered Steel Building	1	LS	$ 60,000	$ 60,000	Includes garage door and service door
	7.5	Electrical Power and Lighting	1	LS	$ 15,000	$ 15,000	
	7.6	HVAC system	1	LS	$ 5,000	$ 5,000	
		Sub-Total				**$ 147,000**	
8		**System Start-up Testing**					
	8.1	System Start-up	1	LS	$ 25,000	$ 25,000	includes initial testing period and sampling
		Sub-Total				**$ 25,000**	
9		**Re-injection System**					
	9.1	Infiltration Wells	2	EA	$ 15,000	$ 30,000	12-ft diameter, ea. 15-ft deep, inc installation
	9.2	Soil Disposal	188	Tons	$ 100	$ 18,800	1.5 tons/CY.
		Sub-Total				**$ 48,800**	
10		**Reporting and Institutional Controls**					
	10.1	Remedial Action Report	1	LS	$ 30,000	$ 30,000	
	10.2	Preparation of Site Management Plan	1	LS	$ 20,000	$ 20,000	
		Sub-Total				**$ 50,000**	
		Sub-Total				**$ 760,530**	Sub-Total All Construction Costs.
		Contingency	25%			$ 190,000	10% scope + 15% bid.
		Sub-Total				**$ 950,530**	
		Project Management	5%			$ 48,000	
		Remedial Design	8%			$ 76,000	
		Construction Management	6%			$ 57,000	
		Construction Oversight	5%			$ 48,000	
		TOTAL CAPITAL COST				**$ 1,180,000**	

ANNUAL O&M COSTS:

Item No.		Description	Quantity	Unit	Unit Cost	Total	Notes
1		**Operations Cost - Year 1**					
	1.1	Electrical Usage	52,560	KW-Hr	$ 0.15	$ 7,884	
	1.2	Vapor Carbon Change out	1	EA	$ 7,000	$ 7,000	Assume carbon change out every year; includes equipment & labor
	1.3	Carbon characterization testing	2	EA	$ 400	$ 800	
	1.4	Liquid Carbon Change out	1	EA	$ 8,000	$ 8,000	Assume once every year, inc. labor and equipment
	1.5	Plant Operator	520	HR	$ 80	$ 41,600	10 hr/week; 52 weeks/yr
	1.6	Project Management	1	LS	$ 20,000	$ 20,000	
	1.7	Technical Support	1	LS	$ 20,000	$ 20,000	
		Sub-Total				**$ 105,284**	
2		**Performance Monitoring - Year 1**					
	2.1	Performance Sampling and Analysis (labor and equipment)	72	EA	$ 600	$ 43,200	2 extraction wells + combined influent + AS effluent + BF effluent for VOCs+ metals analysis, 20% QC samples
	2.2	Air Sampling and Analysis (TO-15 Analysis)	43	EA	$ 300	$ 12,900	1 influent, 1 between lead/lag, 1 effluent, monthly, TO15 analysis only, 20% QC samples
	2.3	Monthly Reporting	12	EA	$ 1,500	$ 18,000	
		Sub-Total				**$ 74,100**	
3		**LTM and Institutional Controls - Year 1**					
	3.1	Maintain Institutional Controls	1	LS	$ 5,000	$ 5,000	
	3.2	Groundwater Sampling	144	EA	$ 500	$ 72,000	Monthly sampling of 12 wells
	3.3	Groundwater Sample Laboratory Analysis	173	EA	$ 100	$ 17,300	Sampling 12 wells monthly for Total VOCs analysis + 20% QC
	3.4	Data Reduction, Evaluation and Reporting	12	EA	$ 1,500	$ 18,000	inc. submission of EDDs to state
	3.5	Annual Report	1	EA	$ 24,000	$ 24,000	Includes periodic report
		Sub-Total				**$ 136,300**	
4		**SSDS O&M - Year 1**					
	4.1	Quarterly Inspections	1	LS	$ 3,000	$ 3,000	
	4.2	Annual Sampling Event	1	LS	$ 2,500	$ 2,500	
	4.3	Annual Report	1	LS	$ 3,000	$ 3,000	
	4.4	Electrical Usage	30,000	kW-hr	$ 0.18	$ 5,400	
	4.5	Repair and Maintenance	1	LS	$ 500	$ 500	
		Sub-Total				**$ 14,400**	
		Sub-Total				**$ 330,084**	
		Contingency	15%			$ 50,000	
		Sub-Total				**$ 380,084**	
		TOTAL ANNUAL OPERATIONS & PERFORMANCE MONITORING COST (Year 1)				**$ 380,084**	
5		**Operations Cost - Years 2 to 4**					
	5.1	Electrical Usage	52,560	KW-Hr	$ 0.15	$ 7,884	
	5.2	Vapor Carbon Change out	1	EA	$ 7,000	$ 7,000	Assume carbon change out every year; includes equipment & labor
	5.3	Liquid Carbon Change out	1	EA	$ 8,000	$ 8,000	Assume once every year, inc. labor and equipment
	5.4	Plant Operator	520	HR	$ 80	$ 41,600	10 hr/week; 52 weeks/yr
	5.5	Technical Support	1	LS	$ 20,000	$ 20,000	
		Sub-Total				**$ 84,484**	

Table 23- Cost Estimate for Alternative G4

Alternative G4

Pump and Treat with LTM

COST ESTIMATE SUMMARY

Site: Brandt Airflex Site (#152183)
Location: East Farmingdale, Suffolk County, New York
Phase: Feasibility Study (-30% - +50%)
Base Year: 2014
Date: October 14, 2014

Description: Alternative G4 consists of implementing groundwater extraction and ex situ treatment in the source area. Long-term monitoring will be implemented outside of the source remediation area. A SSDS will be installed inside the building at 931 Conklin Street.

Item No.		Description	Quantity	Unit	Unit Cost	Total	Notes
6		**Performance Monitoring - Years 2 to 4**					
	6.1	Performance Sampling and Analysis (labor and equipment)	72	EA	$ 100	$ 7,200	2 extraction wells + combined influent + AS effluent + BF effluent for
	6.2	Air Sampling and Analysis (TO-15 Analysis)	43	EA	$ 300	$ 12,900	1 influent, 1 between lead/lag, 1 effluent, monthly, TO15 analysis only,
	6.3	Monthly Reporting	12	EA	$ 1,500	$ 18,000	
		Sub-Total				**$ 38,100**	
7		**LTM and Institutional Controls - Years 2 to 4**					
	7.1	Maintain Institutional Controls	1	LS	$ 5,000	$ 5,000	
	7.2	Groundwater Sampling	48	EA	$ 500	$ 24,000	Quarterly sampling of 12 wells
	7.3	Groundwater Sample Laboratory Analysis	58	EA	$ 100	$ 5,800	Sampling 12 wells quarterly for VOCs analysis + 20% QC samples.
	7.4	Data Reduction, Evaluation and Reporting	4	EA	$ 1,500	$ 6,000	
	7.5	Annual Report	1	EA	$ 24,000	$ 24,000	Includes periodic report
		Sub-Total				**$ 64,800**	
8		**SSDS O&M - Years 2 to 4**					
	8.1	Quarterly Inspections	1	LS	$ 3,000	$ 3,000	
	8.2	Annual Sampling Event	1	LS	$ 2,500	$ 2,500	
	8.3	Annual Report	1	LS	$ 3,000	$ 3,000	
	8.4	Electrical Usage	30,000	kW-hr	$ 0.18	$ 5,400	
	8.5	Repair and Maintenance	1	LS	$ 500	$ 500	
		Sub-Total				**$ 14,400**	
	Sub-Total					**$ 201,784**	
		Contingency	15%			$ 30,000	
	Sub-Total					**$ 231,784**	
	TOTAL ANNUAL O&M COST (Years 2 to 4)					**$ 231,784**	
9		**Operations Cost - Years 5 to 20**					
	9.1	Electrical Usage	52,560	KW-Hr	$ 0.15	$ 7,884	
	9.2	Vapor Carbon Change out	1	EA	$ 7,000	$ 7,000	Assume carbon change out every year; includes equipment & labor
	9.3	Carbon characterization testing	2	EA	$ 385	$ 770	
	9.4	Liquid Carbon Change out	1	EA	$ 8,000	$ 8,000	Assume once every year, inc. labor and equipment
	9.5	Plant Operator	520	HR	$ 80	$ 41,600	10 hr/week; 52 weeks/yr
	9.6	Technical Support	1	LS	$ 20,000	$ 20,000	
		Sub-Total				**$ 85,254**	
10		**Performance Monitoring - Years 5 to 20**					
	10.1	Performance Sampling and Analysis (labor and equipment)	72	EA	$ 600	$ 43,200	2 extraction wells + combined influent + AS effluent + BF effluent for
	10.2	Air Sampling and Analysis (TO-15 Analysis)	43	EA	$ 300	$ 12,900	1 influent, 1 between lead/lag, 1 effluent, monthly, TO15 analysis only,
	10.3	Monthly Reporting	12	EA	$ 1,500	$ 18,000	
		Sub-Total				**$ 74,100**	
11		**LTM and Institutional Controls - Year 5 to 20**					
	11.1	Maintain Institutional Controls	1	LS	$ 5,000	$ 5,000	
	11.2	Groundwater Sampling	12	EA	$ 500	$ 6,000	Annual sampling of 12 wells
	11.3	Groundwater Sample Laboratory Analysis	14	EA	$ 100	$ 1,400	Sampling 12 wells annually for Total VOCs analysis + 20% QC samples.
	11.4	Data Reduction, Evaluation and Reporting	1	EA	$ 1,500	$ 1,500	
	11.5	Annual Report	1	EA	$ 24,000	$ 24,000	Includes periodic report
		Sub-Total				**$ 37,900**	
12		**SSDS O&M - Year 5 to 20**					
	12.1	Quarterly Inspections	1	LS	$ 3,000	$ 3,000	
	12.2	Annual Sampling Event	1	LS	$ 2,500	$ 2,500	
	12.3	Annual Report	1	LS	$ 3,000	$ 3,000	
	12.4	Electrical Usage	30,000	kW-hr	$ 0.18	$ 5,400	
	12.5	Repair and Maintenance	1	LS	$ 500	$ 500	
		Sub-Total				**$ 14,400**	
	Sub-Total					**$ 211,654**	
		Contingency	15%			$ 32,000	
	Sub-Total					**$ 243,654**	
	TOTAL ANNUAL O&M COST (Years 5-20)					**$ 243,654**	
13		**LTM and Institutional Controls - Year 21 to 30**					
	13.1	Maintain Institutional Controls	1	LS	$ 5,000	$ 5,000	
	13.2	Groundwater Sampling	12	EA	$ 500	$ 6,000	Annual sampling of 12 wells
	13.3	Groundwater Sample Laboratory Analysis	14	EA	$ 100	$ 1,400	Sampling 12 wells annually for Total VOCs analysis + 20% QC samples.
	13.4	Data Reduction, Evaluation and Reporting	1	EA	$ 1,500	$ 1,500	
	13.5	Annual Report	1	EA	$ 24,000	$ 24,000	Includes periodic report
		Sub-Total				**$ 37,900**	
14		**SSDS O&M - Year 21 to 30**					
	14.1	Quarterly Inspections	1	LS	$ 3,000	$ 3,000	
	14.2	Annual Sampling Event	1	LS	$ 2,500	$ 2,500	
	14.3	Annual Report	1	LS	$ 3,000	$ 3,000	
	14.4	Electrical Usage	30,000	kW-hr	$ 0.18	$ 5,400	
	14.5	Repair and Maintenance	1	LS	$ 500	$ 500	
		Sub-Total				**$ 14,400**	
	Sub-Total					**$ 52,300**	
		Contingency	15%			$ 8,000	
	Sub-Total					**$ 60,300**	
	TOTAL ANNUAL O&M COST (Years 21 to 30)					**$ 60,300**	

Table 23- Cost Estimate for Alternative G4

Alternative G4

Pump and Treat with LTM

COST ESTIMATE SUMMARY

Site: Brandt Airflex Site (#152183)
Location: East Farmingdale, Suffolk County, New York
Phase: Feasibility Study (-30% - +50%)
Base Year: 2014
Date: October 14, 2014

Description: Alternative G4 consists of implementing groundwater extraction and ex situ treatment in the source area. Long-term monitoring will be implemented outside of the source remediation area. A SSDS will be installed inside the building at 931 Conklin Street.

Item No.	Description	Quantity	Unit	Unit Cost	Total	Notes

PERIODIC COSTS:

Item No.	Description	Year	Quantity	Unit	Unit Cost	Total	Notes
1	**Periodic Maintenance**						
1.1	Equipment Replacement/Repair	5	1	LS	$ 5,000	$ 5,000	Every 5 years through year 30
	Sub-Total					**$ 5,000**	
2	**System Decommissioning**						
2.1	Demobilize Treatment System	21	1	LS	$ 50,000	$ 50,000	
2.2	Well Abandonment	21	1	LS	$ 10,000	$ 10,000	Abandon drywells, extraction wells
2.3	Performance Well Abandonment	21	3	EA	$ 1,500	$ 4,500	Drilling subcontractor, abandonment of performance wells
2.4	Treatment System Piping	21	1	LS	$ 5,000	$ 5,000	
2.5	Permitting and Reporting	21	1	LS	$ 20,000	$ 20,000	
	Sub-Total					**$ 89,500**	
3	**Site Close Out**						
3.1	Monitoring Well Abandonment	30	12	EA	$ 1,500	$ 18,000	Drilling subcontractor, abandonment of monitoring wells
3.2	Decommission SSDS	30	1	LS	$ 5,000	$ 5,000	
3.3	Final Closure Report	30	1	LS	$ 50,000	$ 50,000	
	Sub-Total					**$ 73,000**	

PRESENT VALUE ANALYSIS: Rate of Return: 5% Interest Rate: 3%

Item No.		Year	Total Cost	Present Value	Notes
1	**Capital Cost**	0		**$ 1,180,000**	
2	**Annual O&M Cost**				
2.1	Year 1	1	$ 380,084	$ 372,844	
2.2	Years 2 to 4	2 to 4	$ 231,784	$ 656,451	
2.3	Years 5 to 20	5 to 20	$ 243,654	$ 3,077,499	
2.4	Years 21 to 30	21 to 30	$ 60,300	$ 1,494,370	
	Sub-Total			**$ 5,602,000**	
3	**Periodic Costs**				
3.1	Year 5	5	$ 5,000	$ 4,542	
3.2	Year 10	10	$ 5,000	$ 4,125	
3.3	Year 15	15	$ 5,000	$ 3,747	
3.4	Year 20	20	$ 5,000	$ 3,404	
3.5	Year 21	21	$ 89,500	$ 32,125	
3.6	Year 25	25	$ 5,000	$ 3,091	
3.7	Year 30	30	$ 162,500	$ 91,262	
	Sub-Total			**$ 143,000**	
	TOTAL PRESENT VALUE OF ALTERNATIVE			**$ 6,925,000**	

Table 24 – Evaluation of On-Site Soil Vapor Alternatives

Alt. No.	Alternative Name	Overall Protectiveness of Public Health and the Environment	Compliance with SCGs	Long Term Effectiveness and Permanence	Reduction of Toxicity, mobility or Volume of Contamination Thru Treatment	Short Term Impact and Effectiveness	Implementability	Cost Effectiveness		Land Use Criteria
SV1	**No Action**	- Will not meet any of the RAOs for the site.	- Will not meet SCGs.	- Contaminants remain in the environment. - Magnitude of remaining risks will be unchanged.	- Does not reduce toxicity, mobility or volume of contamination present at the site.	- Does not result in disruption of site operations or pose a short term threat to public health or the environment. - No remedial timeframe is associated with this alternative.	- No technical or administrative difficulties or constraints.	Capital Cost: Average Annual Site Management Cost: O&M Present Worth Cost: Periodic Present Worth Cost: Total Present Worth Cost:	$0 $0 $0 $0 $0	- Will not comply with SCGs. -Will not restore groundwater quality and does not provide any restrictions to prevent use of groundwater at the site.
SV2	**SSDS**	- SSDS will minimize exposure to vapor phase CVOCs from contaminated groundwater by eliminating vapor accumulating beneath the buildings.	-Emissions from the Off-Site SSDS will comply with Federal and State air regulations. -Indoor air quality will comply with NYSDOH guidelines.	- SSDS will require routine maintenance to maintain effectiveness.	- SSDS will reduce the toxicity, mobility or volume of contaminated vapor present under the buildings.	- Will disrupt site operations during installation of the SSDS inside the buildings (1-2 months to install). Install will consist of extraction points through building slab and piping to convey vapors to the atmosphere. - Will generate noise and construction. - Remedial time frame – 30 years.	-Installation may be difficult due to existing equipment and ongoing industrial activities conducted inside the building.	Capital Cost: Weighted Average Annual Site Management Cost: O&M Present Worth Cost: Periodic Present Worth Cost: Total Present Worth Cost:	$254,000 $23,000 $527,000 $4,000 $785,000	- Will prevent contaminated soil vapor from entering the buildings allowing for their continued use without adverse health affects.

Table 24 – Evaluation of On-Site Soil Vapor Alternatives

Alt. No.	Alternative Name	Overall Protectiveness of Public Health and the Environment	Compliance with SCGs	Long Term Effectiveness and Permanence	Reduction of Toxicity, mobility or Volume of Contamination Thru Treatment	Short Term Impact and Effectiveness	Implementability	Cost Effectiveness		Land Use Criteria
SV3	**SVE**	- SVE will minimize exposure to vapor phase CVOCs from contaminated groundwater by eliminating vapor accumulating beneath the buildings.	-Emissions from the SVE will comply with Federal and State air regulations. -Indoor air quality will comply with NYSDOH guidelines.	-SVE will require routine maintenance and repairs to maintain effectiveness.	-SVE will reduce the toxicity, mobility or volume of contaminated vapor present under the buildings. -Vapors will be treated with vapor phase GAC.	- Will temporarily disrupt site operations during installation (2-3 months assumed to install). Install will require pipe trenching and construction of a treatment building. - Will generate noise and traffic during construction. - Dust control and health and safety plan measures will be needed. - Remedial time frame – 3 years.	- Survey for underground utilities will need to be completed prior to implementation to ensure short circuiting of the SVE system will not occur. -Building will need to be surveyed for cracks and sealed as necessary to eliminate any preferential pathways that would short circuit the SVE system. -Will require PDI to determine achievable radius of influence.	Capital Cost: Weighted Average Annual Site Management Cost: O&M Present Worth Cost: Periodic Present Worth Cost: Total Present Worth Cost:	$525,000 $48,000 $0 $7,000 $663,000	- Will prevent contaminated soil vapor from entering the buildings allowing for their continued use without adverse health affects.

Table 25 - Cost Estimate for Alternative SV2

Alternative SV2

Sub Slab Depressurization System

COST ESTIMATE SUMMARY

Site: Brandt Airflex Site (#152183)
Location: East Farmingdale, Suffolk County, New York
Phase: Feasibility Study (-30% - +50%)
Base Year: 2014
Date: August 1, 2014

Description: Install a sub slab depressurization system to mitigate vapor intrusion into existing on-site buildings.

Item No.	Description	Quantity	Unit	Unit Cost	Total	Notes
CAPITAL COSTS:						
1	**Sub-Slab Depressurization System Installation**					For both buildings
1.1	Connectivity Testing	1	LS	$ 10,000	$ 10,000	Pilot Study to optimize extraction points/2 tests - 1 per building
1.2	Mobilization	1	LS	$ 2,000	$ 2,000	
1.3	Transmission Piping	1,300	LF	$ 15	$ 19,500	Includes pipe, grout, pipe supports, valves etc.
1.4	Blowers and Accessories	2	EA	$ 3,000	$ 6,000	Includes blower, moisture separator, filters, muffler, valves, manual pump drain.
1.5	Equipment Enclosures	2	EA	$ 12,000	$ 24,000	includes 72"x96" fiberglass shelter, delivery to site and construction of concrete pad
1.6	Power Service	1	LS	$ 10,000	$ 10,000	
1.7	Electrical Controls	1	LS	$ 10,000	$ 10,000	
1.8	System Installation	1	LS	$ 20,000	$ 20,000	labor to install both systems including extraction points, enclosure, piping, etc.
1.9	System Startup	1	LS	$ 10,000	$ 10,000	
1.10	Permits	1	LS	$ 10,000	$ 10,000	
1.11	Reporting, Documentation and Surveying	1	LS	$ 10,000	$ 10,000	
1.12	IDW - Drum Disposal	2	EA	$ 250	$ 500	assumes disposal of 2 drums, nonhazardous, includes delivery of clean drums to site
	Sub-Total				**$ 132,000**	
2	**Reporting and Institutional Controls**					
2.1	Remedial Action Report	1	LS	$ 30,000	$ 30,000	
2.2	Preparation of Site Management Plan	1	LS	$ 10,000	$ 10,000	
	Sub-Total				**$ 40,000**	
	Sub-Total				**$ 172,000**	Sub-Total All Construction Costs.
	Contingency	25%			$ 43,000	10% scope + 15% bid
	Sub-Total				**$ 215,000**	
	Project Management	5%			$ 11,000	
	Remedial Design	8%			$ 17,000	
	Construction Oversight	5%			$ 11,000	
	TOTAL CAPITAL COST				**$ 254,000**	

ANNUAL O&M COST:

Item No.	Description	Quantity	Unit	Unit Cost	Total	Notes
1	**SSDS O&M**					
1.1	Quarterly Inspections	1	LS	$ 3,000	$ 3,000	
1.2	Annual Sampling Event	1	LS	$ 2,500	$ 2,500	
1.3	Annual Report	1	LS	$ 3,000	$ 3,000	
1.4	Electrical Usage	60,000	kW-hr	$ 0.18	$ 10,800	
1.5	Repair and Maintenance	1	LS	$ 1,000	$ 1,000	
	Sub-Total				**$ 20,300**	
	Sub-Total				**$ 20,300**	
	Contingency	15%			$ 3,000	
	Sub-Total				**$ 23,300**	
	TOTAL ANNUAL O&M COST				**$ 23,300**	

Table 25 - Cost Estimate for Alternative SV2

Alternative SV2

Sub Slab Depressurization System

COST ESTIMATE SUMMARY

Site: Brandt Airflex Site (#152183)
Location: East Farmingdale, Suffolk County, New York
Phase: Feasibility Study (-30% - +50%)
Base Year: 2014
Date: August 1, 2014

Description: Install a sub slab depressurization system to mitigate vapor intrusion into existing on-site buildings.

Item No.	Description	Quantity	Unit	Unit Cost	Total	Notes

PERIODIC COSTS:

Item No.	Description	Year	Quantity	Unit	Unit Cost	Total	Notes
1	**Equipment Replacement SSDS**						
1.1	Equipment Replacement/Repair	5	1	LS	$ 800	$ 800	Every 5 years through year 30
	Sub-Total					**$ 800**	

PRESENT VALUE ANALYSIS: Rate of Return: 5% Interest Rate: 3%

Item No.	Cost Type	Year	Total Cost	Present Value	Notes
1	**Capital Cost**	0		**$ 254,000**	
2	**Annual O&M Cost**				
2.1	Years 1 to 30	1-30	23,300	$ 526,100	
	Sub-Total			**$ 527,000**	
3	**Periodic Costs**				
3.1	Year 5	5	800	$ 727	
3.2	Year 10	10	800	$ 660	
3.3	Year 15	15	800	$ 600	
3.4	Year 20	20	800	$ 545	
3.5	Year 25	25	800	$ 495	
3.6	Year 30	30	800	$ 449	
	Sub-Total			**$ 4,000**	
	TOTAL PRESENT VALUE OF ALTERNATIVE			**$ 785,000**	

Table 26 - Cost Estimate for Alternative SV3

Alternative SV3

Soil Vapor Extraction System

COST ESTIMATE SUMMARY

Site:	Brandt Airflex Site (#152183)	**Description:**	Install a soil vapor extraction system to mitigate vapor intrusion into existing on site buildings
Location:	East Farmingdale, Suffolk County, New York		
Phase:	Feasibility Study (-30% - +50%)		
Base Year:	2014		
Date:	October 14, 2014		

Item No.	Description	Quantity	Unit	Unit Cost	Total	Notes
CAPITAL COSTS:						
1	**Soil Vapor Extraction System Installation**					For both buildings
1.1	Pilot Testing	1	LS	$ 30,000	$ 30,000	Pilot Study to determine radius of influence and blower capacity needed
1.2	Driller Mobilization	1	LS	$ 50,000	$ 50,000	Hollow stem auger rig, decon pad, water truck for decon
1.3	SVE Well Installation	5	EA	$ 2,100	$ 10,500	
1.4	Transmission Piping	605	LF	$ 50	$ 30,250	2-inch PVC transmission pipe to building; incl. labor, equip, pipe bedding, etc.
1.5	Blower and Treatment Equipment	1	LS	$ 80,000	$ 80,000	Includes blower, moisture separator, filters, muffler, valves, manual pump drain, vapor GAC.
1.6	Treatment Building Construction	900	SF	$ 80	$ 72,000	includes foundation, electric, construction, site work, HVAC
1.7	Power Service	1	LS	$ 10,000	$ 10,000	
1.8	System Startup	1	LS	$ 10,000	$ 10,000	
1.9	Permits	1	LS	$ 10,000	$ 10,000	
1.10	Reporting, Documentation and Surveying	1	LS	$ 10,000	$ 10,000	
1.11	IDW Disposal	1	LS	$ 3,000	$ 3,000	
	Sub-Total				**$ 315,750**	
2	**Reporting and Institutional Controls**					
2.1	Remedial Action Report	1	LS	$ 30,000	$ 30,000	
2.2	Preparation of Site Management Plan	1	LS	$ 10,000	$ 10,000	
	Sub-Total				**$ 40,000**	
	Sub-Total				**$ 355,750**	Sub-Total All Construction Costs.
	Contingency	25%			$ 89,000	10% scope + 15% bid
	Sub-Total				**$ 444,750**	
	Project Management	5%			$ 22,000	
	Remedial Design	8%			$ 36,000	
	Construction Oversight	5%			$ 22,000	
	TOTAL CAPITAL COST				**$ 525,000**	

ANNUAL O&M COST:

Item No.	Description	Quantity	Unit	Unit Cost	Total	Notes
1	**Annual Operations and Sampling - SVE**					
1.1	Air Sampling and Analysis (TO-15 Analysis)	43	EA	$ 300	$ 12,900	collect samples monthly from VGAC influent, between units, effluent + 20% QC samples
1.2	Performance Air Monitoring	14	EA	$ 300	$ 4,200	Collect quarterly indoor air samples. 3 samples total + 20% QC
1.3	Quarterly Inspections	1	LS	$ 3,000	$ 3,000	
1.4	Annual Report	1	LS	$ 3,000	$ 3,000	
1.5	Electrical Usage	98,000	kW-hr	$ 0.18	$ 17,640	
1.6	Repair and Maintenance	1	LS	$ 1,000	$ 1,000	
	Sub-Total				**$ 41,740**	
	Sub-Total				**$ 41,740**	
	Contingency	15%			$ 6,000	
	Sub-Total				**$ 47,740**	
	TOTAL ANNUAL O&M COST				**$ 47,740**	

Table 26 - Cost Estimate for Alternative SV3

Alternative SV3

Soil Vapor Extraction System

COST ESTIMATE SUMMARY

Site: Brandt Airflex Site (#152183)
Location: East Farmingdale, Suffolk County, New York
Phase: Feasibility Study (-30% - +50%)
Base Year: 2014
Date: October 14, 2014

Description: Install a soil vapor extraction system to mitigate vapor intrusion into existing on site buildings

Item No.	Description	Quantity	Unit	Unit Cost	Total	Notes

PERIODIC COSTS:

Item No.	Description	Year	Quantity	Unit	Unit Cost	Total	Notes
1	**No Periodic Costs**						
1.1	No Periodic Costs	-	0	-	$ -	$ -	
	Sub-Total					**$ -**	

PRESENT VALUE ANALYSIS: Rate of Return: 5% Interest Rate: 3%

Item No.	Cost Type	Year	Total Cost	Present Value	Notes
1	**Capital Cost**	0		**$ 525,000**	
2	**Annual O&M Cost**				
2.1	O&M	1-3	47,740	$ 137,900	
	Sub-Total			**$ 138,000**	
3	**Periodic Costs**				
3.1	No Periodic Costs	-	0	$ -	
	Sub-Total			**$ -**	
	TOTAL PRESENT VALUE OF ALTERNATIVE			**$ 663,000**	

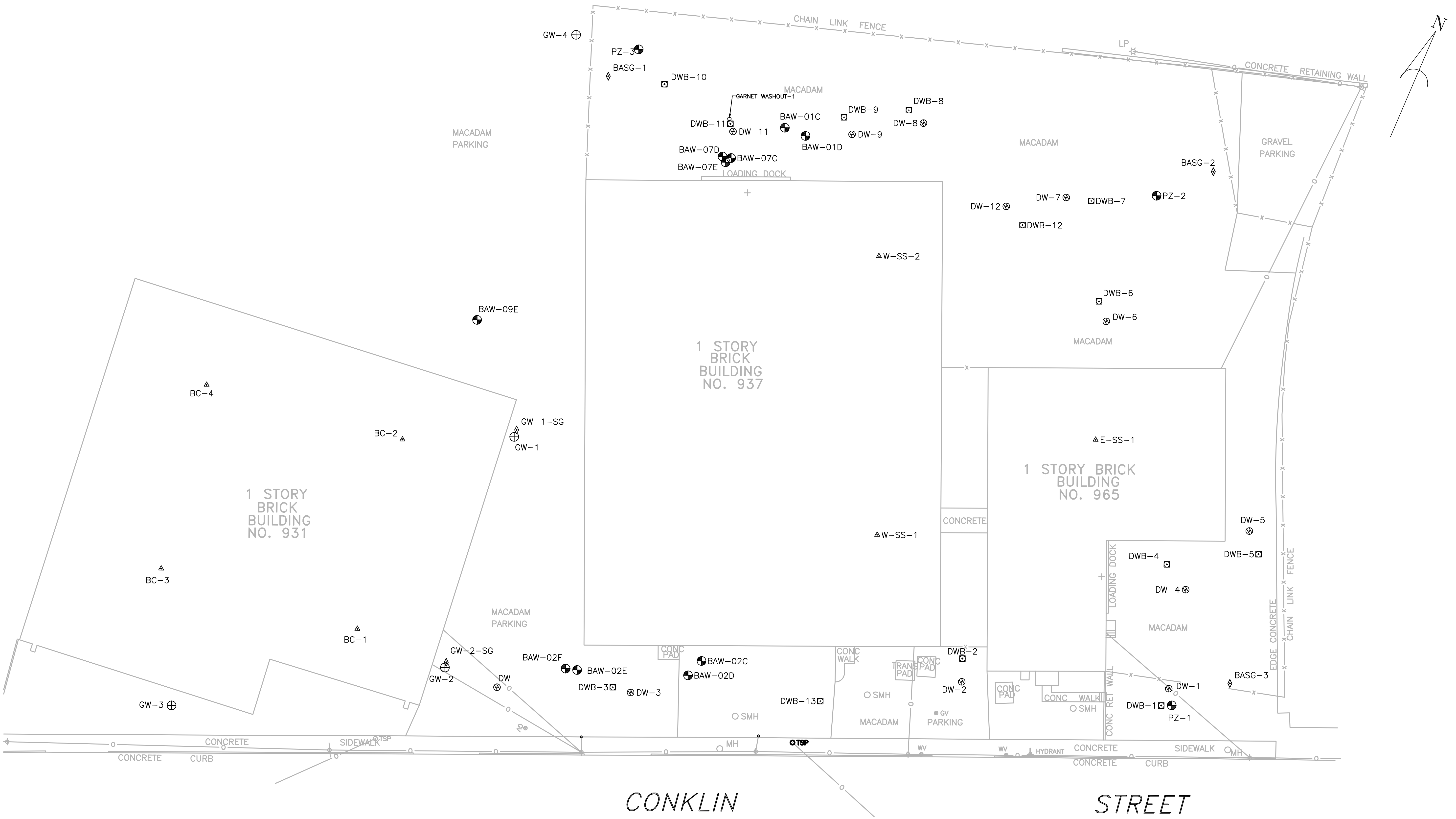
Brandt Airflex (NYSDEC Site # 152183)
937 & 965 Conklin Street
East Farmingdale, New York

DATE
1/18/2011

Site Location Map

FIGURE
1

\\Prl-srv3\gis_projects\202315_NEW YORK STATE DEPT OF ENVIRONMENTAL CON\0147462_NYSDECESWA11BRANDT AIRFLEXRIFS\GIS\map_docs\mxd\Fig1_Site_Location_011911.mxd



LEGEND

- GROUNDWATER PROFILE SAMPLE LOCATION
- DRYWELL
- MONITORING WELL
- SUB SLAB SOIL SAMPLE LOCATION
- SOIL GAS SAMPLE LOCATION
- CHAIN LINK FENCE
- OVERHEAD WIRE
- BUILDING
- LIGHT POLE

GRAPHIC SCALE

40 0 40 80

(IN FEET)
1 inch = 40 ft.

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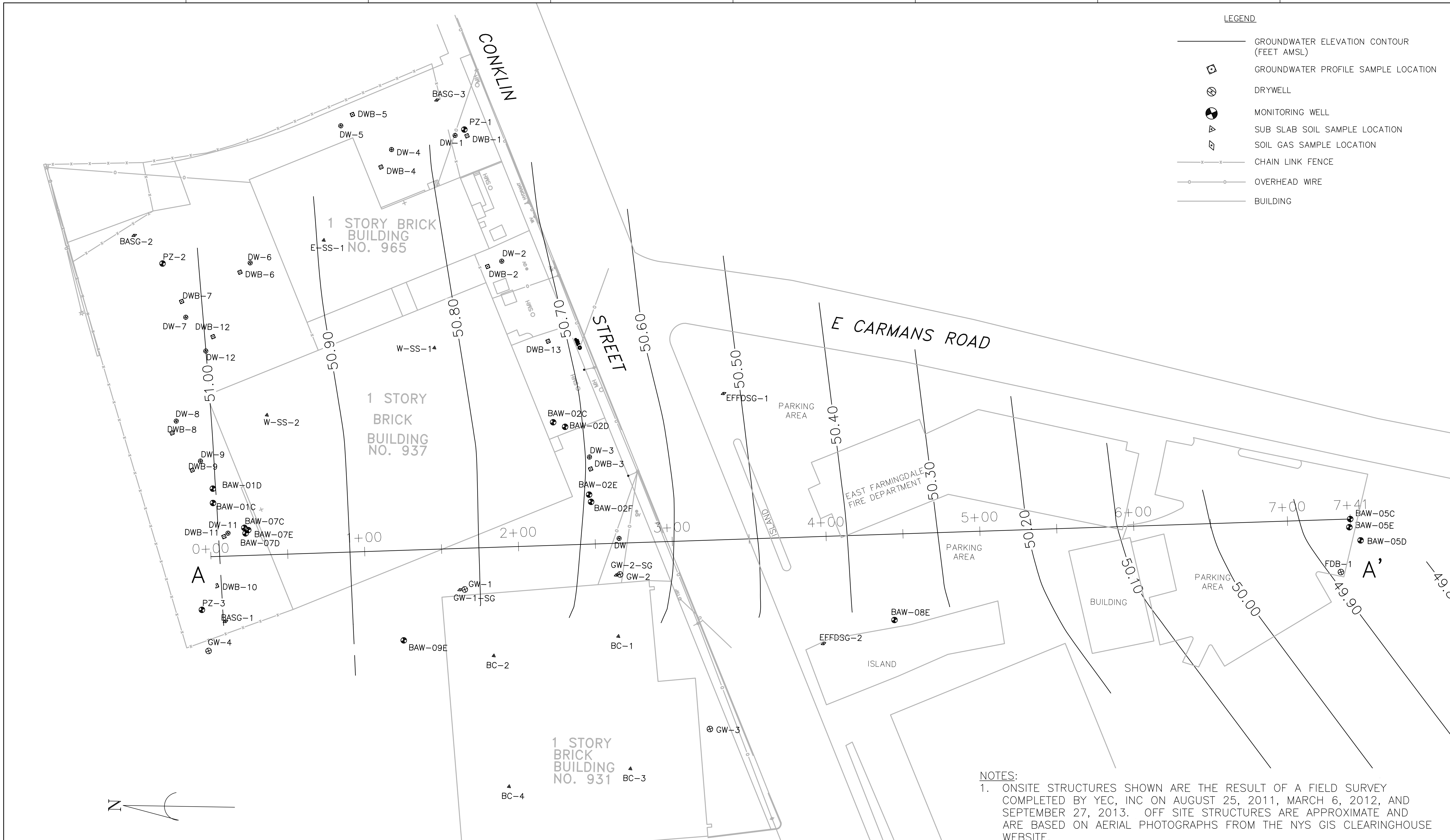
SITE MAP
BRANDT AIRFLEX
NYSDEC SITE NO. 152183
EAST FARMINGDALE, NEW YORK

DATE
DECEMBER 2014

FIGURE
2



NOTES:
1. ONSITE STRUCTURES SHOWN ARE THE RESULT OF A FIELD SURVEY COMPLETED BY YEC, INC ON AUGUST 25, 2011, MARCH 6, 2012, AND SEPTEMBER 27, 2013. OFF SITE STRUCTURES ARE APPROXIMATE AND ARE BASED ON AERIAL PHOTOGRAPHS FROM THE NYS GIS CLEARINGHOUSE WEBSITE.

GRAPHIC SCALE
60 0 60 120
(IN FEET)
1 inch = 60 ft.

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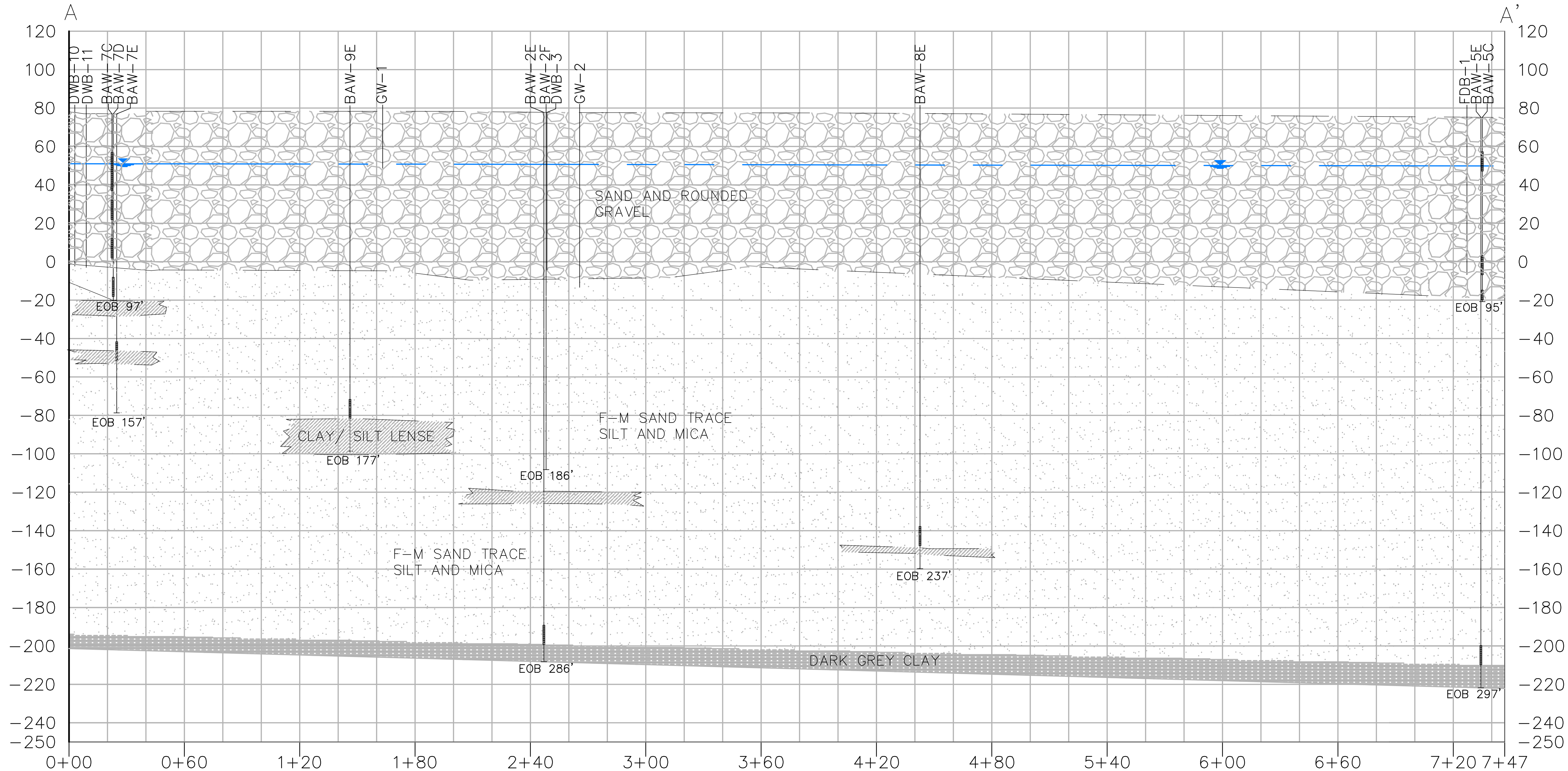
GROUNDWATER CONTOURS
SECTION A – A' PLAN VIEW
BRANDT AIRFLEX
NYSDEC SITE NO. 152183
EAST FARMINGDALE, NEW YORK

DATE
DECEMBER 2014

FIGURE
3



LEGEND:

- SAND AND ROUNDED GRAVEL
- F-M SAND TRACE SILT AND MICA
- CLAY/SILT
- DARK GREY CLAY
- WELL SCREEN
- GROUNDWATER TABLE
- EOB END OF BORING

GRAPHIC SCALE

60 0 60 120

(IN FEET)
1 inch = 60 ft.

NOTES:
1. GEOLOGIC CROSS SECTION IS BASED ON BORINGS COMPLETED BY HDR FROM 2011 TO 2013.

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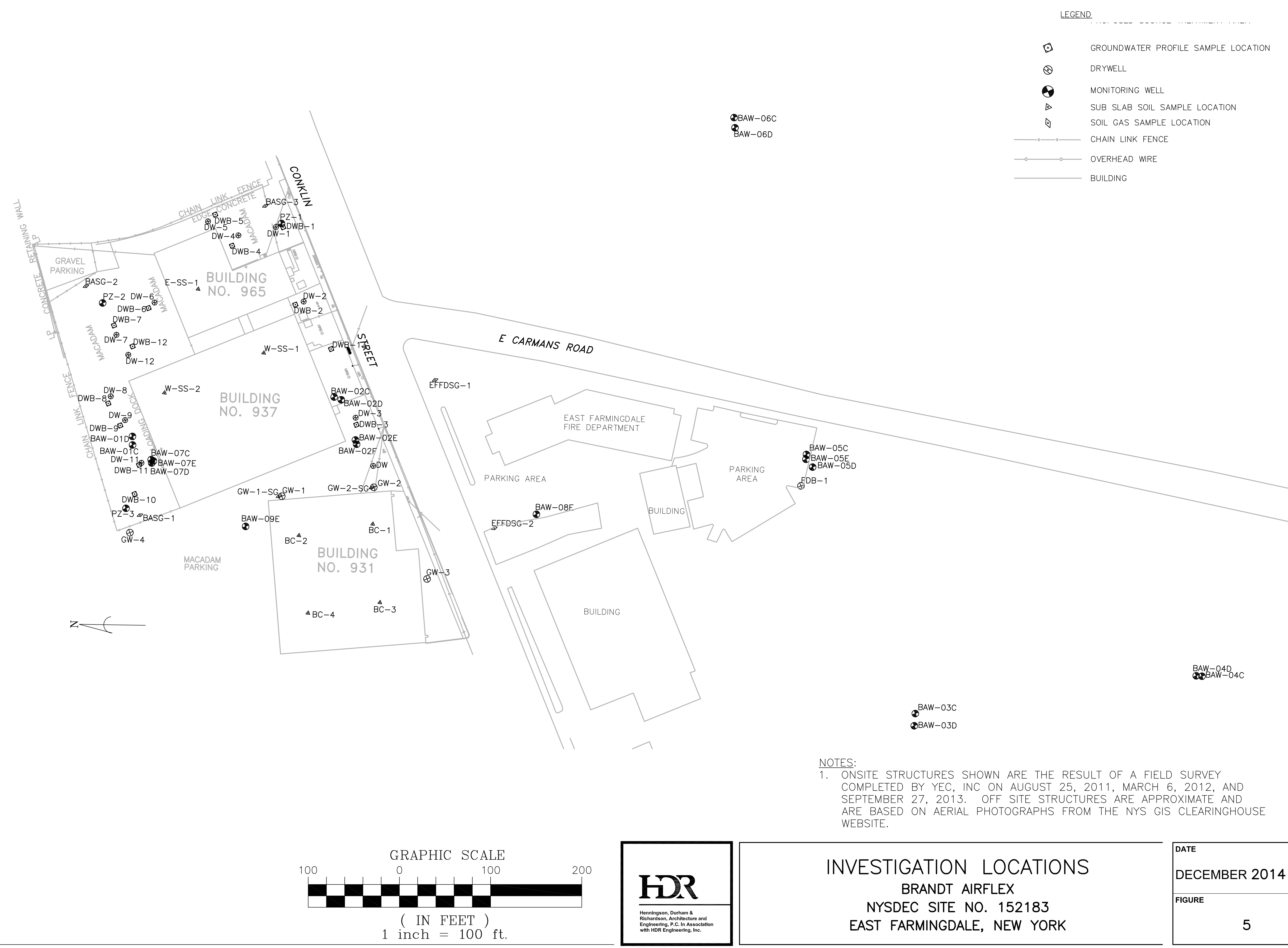
GEOLOGICAL CROSS SECTION A – A'

BRANDT AIRFLEX
NYSDEC SITE NO. 152183
EAST FARMINGDALE, NEW YORK

DATE	FIGURE
DECEMBER 2014	4



NOTES:

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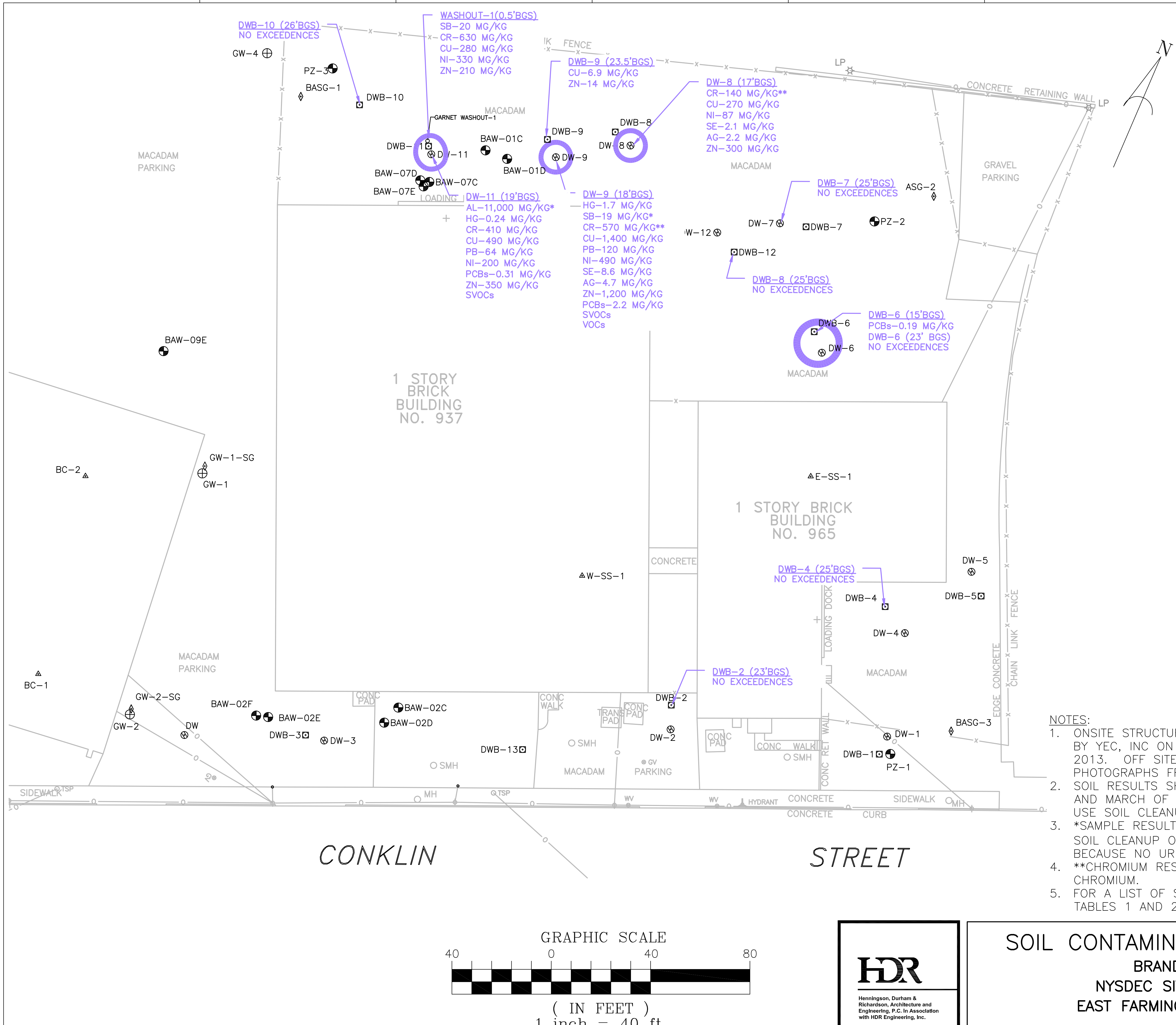
INVESTIGATION LOCATIONS

BRANDT AIRFLEX
NYSDEC SITE NO. 152183
EAST FARMINGDALE, NEW YORK

DATE
DECEMBER 2014

FIGURE
5



LEGEND

	GROUNDWATER CONTOUR
	EXTENT OF SOIL CONTAMINATION
DWB-8 (25'BGS) NO EXCEEDENCES	CHEMICAL CONCENTRATIONS IN SOIL
	GROUNDWATER PROFILE SAMPLE LOCATION
	DRYWELL
	MONITORING WELL
	SUB SLAB SOIL SAMPLE LOCATION
	CHAIN LINK FENCE
	OVERHEAD WIRE
	BUILDING
AL	ALUMINUM
HG	MERCURY
SB	ANTIMONY
CR	CHROMIUM
CU	COPPER
LB	LEAD
NI	NICKEL
SE	SELENIUM
AG	SILVER
ZN	ZINC
PCBs	POLYCHLORINATED BIPHENYLS
SVOCs	SEMI-VOLATILE ORGANIC COMPOUNDS
VOCs	VOLATILE ORGANIC COMPOUNDS
MG/KG	MILLIGRAMS PER KILOGRAM
BGS	BELOW GROUND SURFACE
URU SCOs	UNRESTRICTED USE SOIL CLEANUP OBJECTIVES

NOTES:

1. ONSITE STRUCTURES SHOWN ARE THE RESULT OF A FIELD SURVEY COMPLETED BY YEC, INC ON AUGUST 25, 2011, MARCH 6, 2012, AND SEPTEMBER 27, 2013. OFF SITE STRUCTURES ARE APPROXIMATE AND ARE BASED ON AERIAL PHOTOGRAPHS FROM THE NYS GIS CLEARINGHOUSE WEBSITE.
2. SOIL RESULTS SHOWN ARE FROM SAMPLES COLLECTED BY HDR IN FEBRUARY AND MARCH OF 2011. ONLY CONCENTRATIONS EXCEEDING THE UNRESTRICTED USE SOIL CLEANUP OBJECTIVES ARE SHOWN.
3. *SAMPLE RESULTS WERE COMPARED TO THE PROTECTION OF GROUNDWATER SOIL CLEANUP OBJECTIVE PUBLISHED IN NYSDEC'S GUIDANCE DOCUMENT CP-51 BECAUSE NO URU SCO HAS BEEN ESTABLISHED.
4. **CHROMIUM RESULTS WERE COMPARED TO THE RESULT FOR TRIVALENT CHROMIUM.
5. FOR A LIST OF SVOCs AND VOCs EXCEEDING THE URU SCOs REFER TO TABLES 1 AND 2 OF THE FS REPORT.

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SOIL CONTAMINATED ABOVE SCOs

BRANDT AIRFLEX

NYSDEC SITE NO. 152183

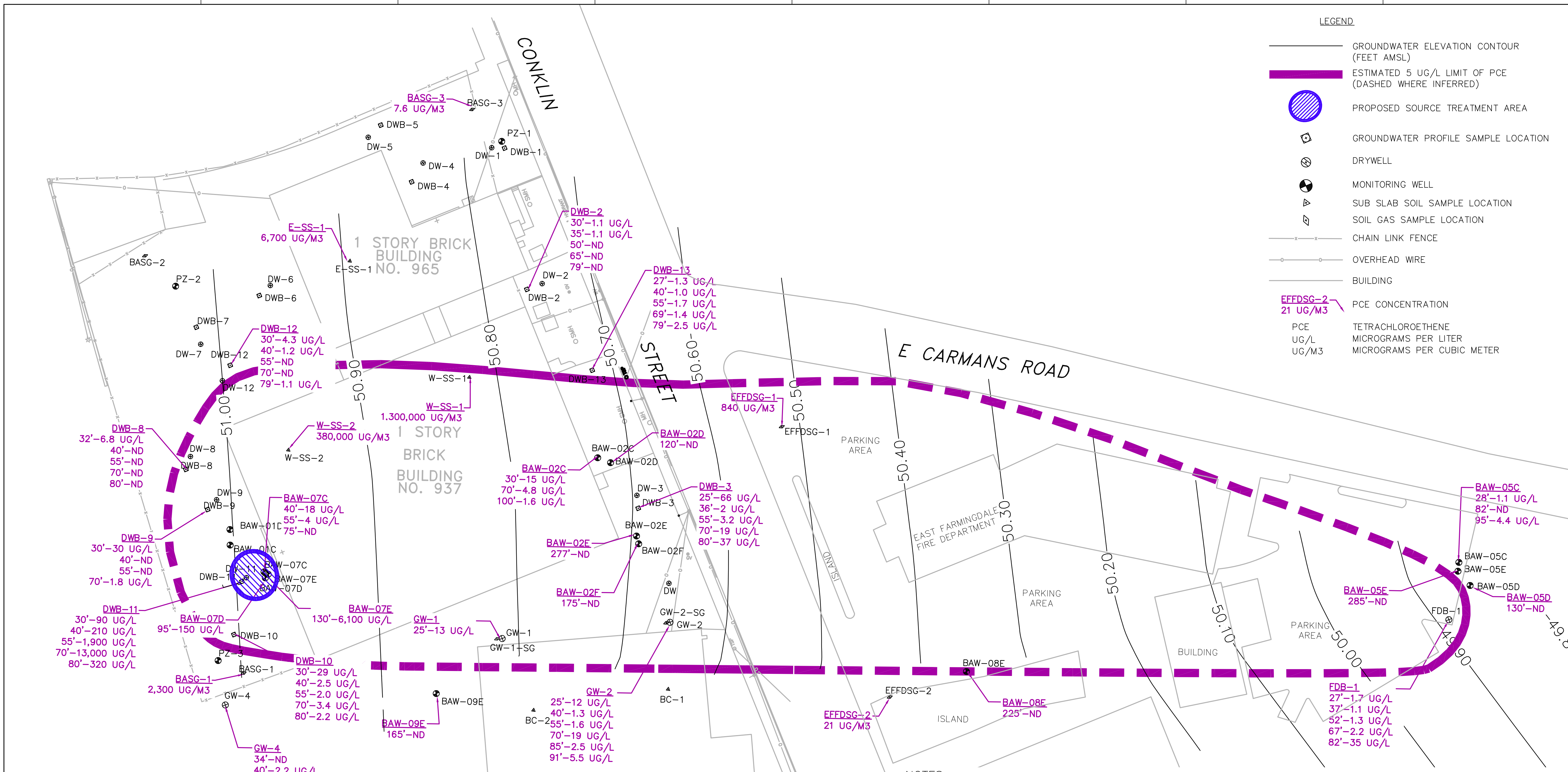
EAST FARMINGDALE, NEW YORK

DATE

DECEMBER 2014

FIGURE

6



NOTES:

1. ONSITE STRUCTURES SHOWN ARE THE RESULT OF A FIELD SURVEY COMPLETED BY YEC, INC ON AUGUST 25, 2011, MARCH 6, 2012, AND SEPTEMBER 27, 2013. OFF SITE STRUCTURES ARE APPROXIMATE AND ARE BASED ON AERIAL PHOTOGRAPHS FROM THE NYS GIS CLEARINGHOUSE WEBSITE.
2. SOIL GAS RESULTS SHOWN ARE FROM SAMPLES COLLECTED BY HDR IN NOVEMBER 2013.
3. GROUNDWATER SAMPLE RESULTS SHOWN ARE FROM SAMPLES COLLECTED BY HDR IN NOVEMBER 2013.
4. GROUNDWATER PROFILING RESULTS SHOWN ARE FROM SAMPLES COLLECTED BY HDR IN FEBRUARY 2011.
5. THE SOURCE REMEDIATION AREA IS SUBJECT TO CHANGE AND MAY BE REFINED DURING THE PRE-DESIGN INVESTIGATION PRIOR TO IMPLEMENTING A REMEDY.
6. ISO-CONCENTRATION LINES DEPICT CONTAMINANT CONCENTRATIONS AT VARIABLE DEPTHS PROJECTED TO THE GROUNDWATER SURFACE.

GRAPHIC SCALE

60 0 60 120

(IN FEET)
1 inch = 60 ft.

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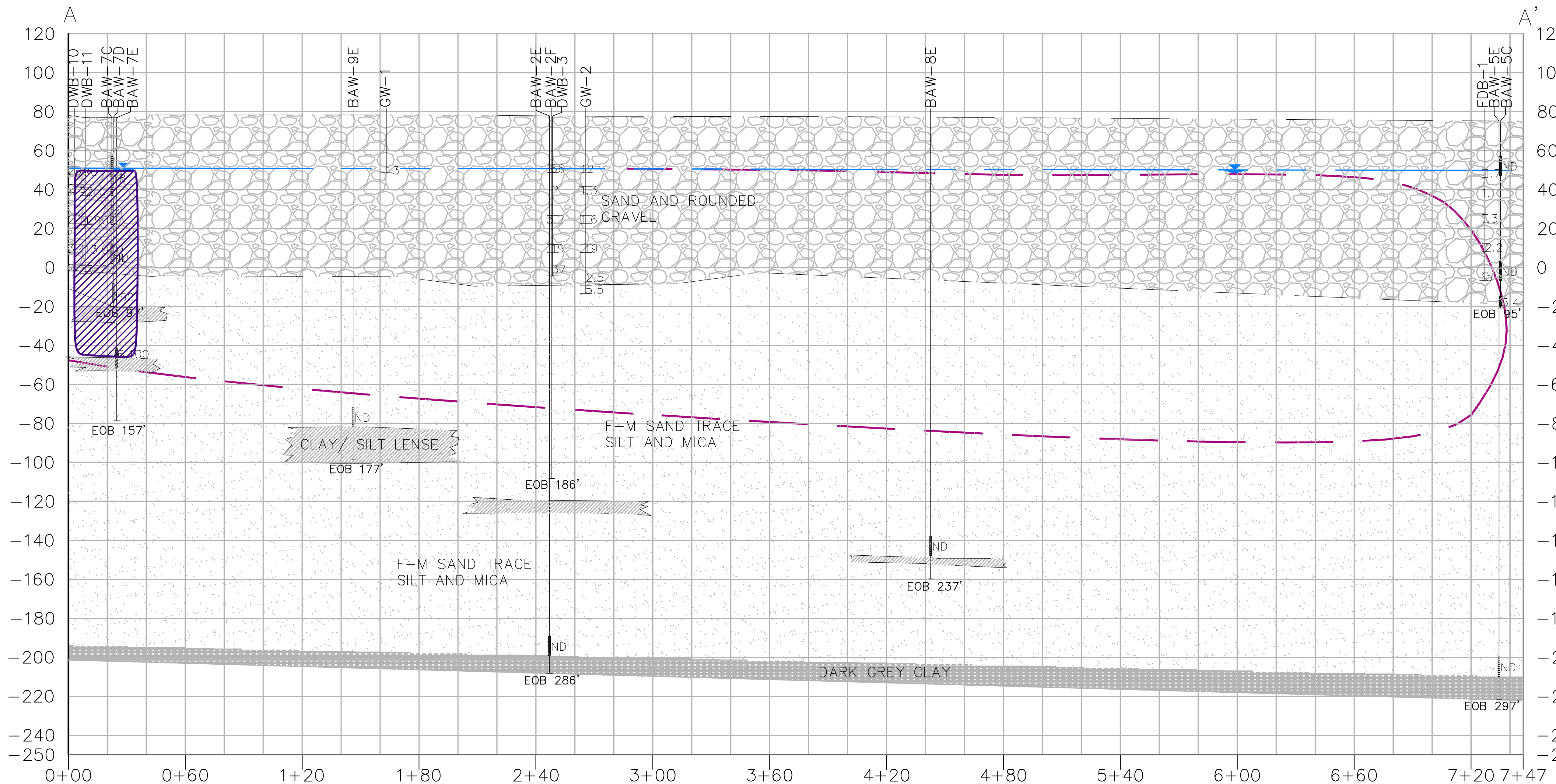
SUMMARY OF GROUNDWATER PCE ANALYTICAL RESULTS

BRANDT AIRFLEX
NYSDEC SITE NO. 152183
EAST FARMINGDALE, NEW YORK

DATE: DECEMBER 2014

FIGURE: 7



LEGEND:

- SAND AND ROUNDED GRAVEL
- F-M SAND TRACE SILT AND MICA
- CLAY/SILT
- DARK GREY CLAY
- WELL SCREEN
- GROUNDWATER TABLE
- EOB END OF BORING
- ESTIMATED 5 UG/L LIMIT OF PCE (DASHED WHERE INFERRED)
- PROPOSED SOURCE TREATMENT AREA

GRAPHIC SCALE

60 0 60 120

(IN FEET)
1 inch = 60 ft.

NOTES:

1. SAMPLE CONCENTRATIONS ARE FOR PCE AND ARE REPORTED IN UG/L
2. GROUNDWATER PROFILING SAMPLES WERE COLLECTED BY HDR IN FEBRUARY AND MARCH OF 2011.
3. GROUNDWATER SAMPLE RESULTS ARE FROM SAMPLES COLLECTED BY HDR IN SEPTEMBER AND NOVEMBER OF 2013.
4. THE PROPOSED SOURCE REMEDIATION AREA MAY NEED TO BE REFINED DURING THE PRE-DESIGN INVESTIGATION PHASE.

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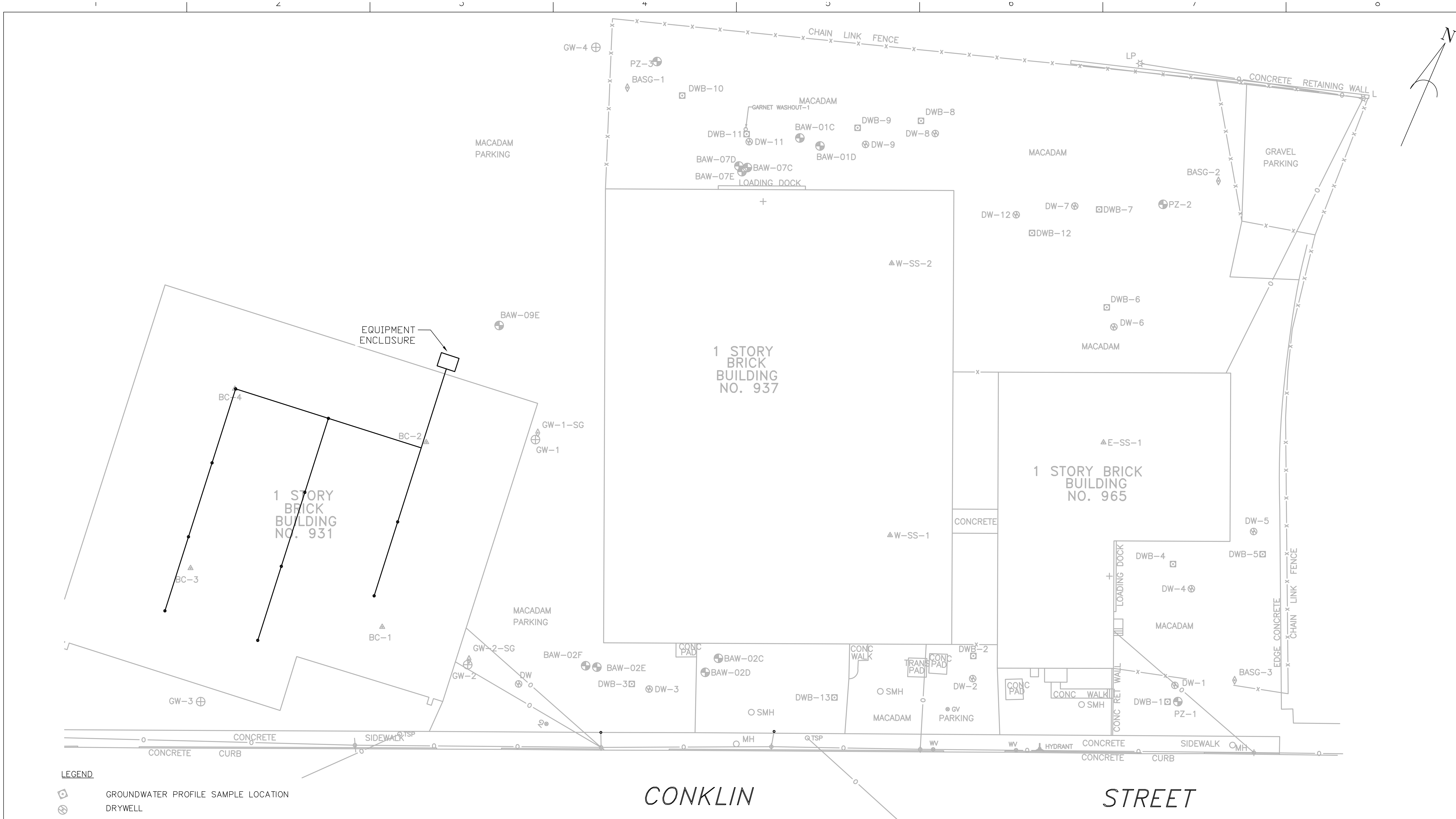
VERTICAL EXTENT OF PCE CONTAMINATION

BRANDT AIRFLEX
NYSDEC SITE NO. 152183
EAST FARMINGDALE, NEW YORK

DATE
DECEMBER 2014

FIGURE
8



NOTES:

1. LAYOUT IS CONCEPTUAL AND THE FINAL NUMBER AND LOCATION OF EXTRACTION POINTS WILL BE DETERMINED DURING THE REMEDIAL DESIGN.

LEGEND

- GROUNDWATER PROFILE SAMPLE LOCATION
- DRYWELL
- MONITORING WELL
- SUB SLAB SOIL SAMPLE LOCATION
- SOIL GAS SAMPLE LOCATION
- CHAIN LINK FENCE
- OVERHEAD WIRE
- BUILDING
- LIGHT POLE
- EXTRACTION POINT
- HEADER PIPE
- EQUIPMENT ENCLOSURE

GRAPHIC SCALE

40 0 40 80

(IN FEET)
1 inch = 40 ft.

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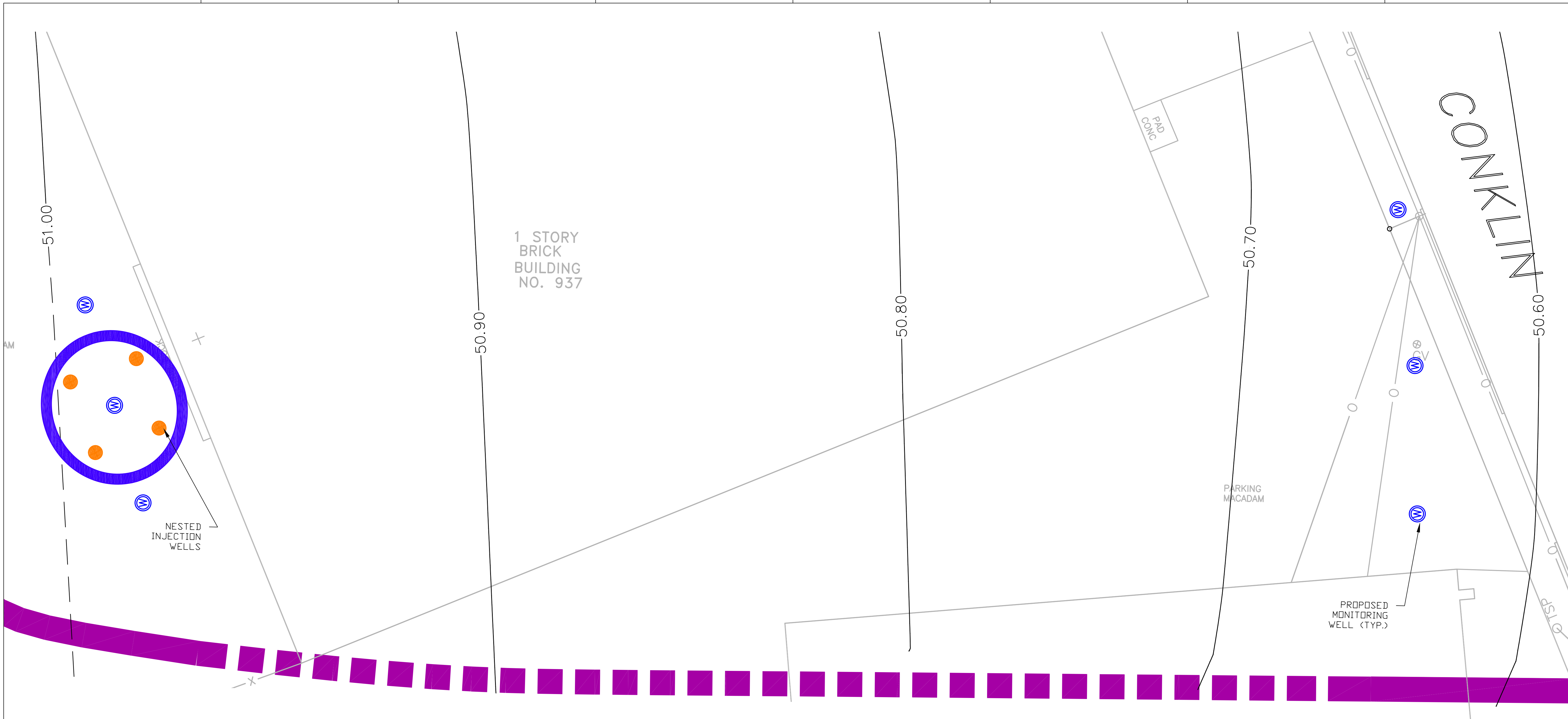
OFF-SITE SUB-SLAB DEPRESSURIZATION SYSTEM LAYOUT

BRANDT AIRFLEX
NYSDEC SITE NO. 152183
EAST FARMINGDALE, NEW YORK

DATE	DECEMBER 2014
FIGURE	9



LEGEND

- GROUNDWATER ELEVATION CONTOUR (FEET AMSL) (DASHED WHERE INFERRED)
- ESTIMATED 5 UG/L LIMIT OF PCE (DASHED WHERE INFERRED)
- PROPOSED SOURCE TREATMENT AREA
- CHAIN LINK FENCE
- OVERHEAD WIRE
- BUILDING
- NESTED INJECTION POINTS (4 WELLS PER POINT)
- PROPOSED PERFORMANCE MONITORING WELL

NOTES:

1. ONSITE STRUCTURES SHOWN ARE THE RESULT OF A FIELD SURVEY COMPLETED BY YEC, INC ON AUGUST 25, 2011, MARCH 6, 2012, AND SEPTEMBER 27, 2013. OFF SITE STRUCTURES ARE APPROXIMATE AND ARE BASED ON AERIAL PHOTOGRAPHS FROM THE NYS GIS CLEARINGHOUSE WEBSITE.
2. ALTERNATIVE INCLUDES THE INSTALLATION OF INJECTION WELLS AT FOUR DEPTHS TO TREAT THE FULL DEPTH OF CONTAMINATION.
3. LAYOUT IS CONCEPTUAL AND FINAL NUMBER OF WELLS AND LOCATIONS WILL BE DETERMINED DURING THE REMEDIAL DESIGN.
4. SCREEN LOCATIONS FOR NESTED WELLS WILL BE SHALLOW (30–50' BGS), INTERMEDIATE (55–75' BGS), DEEP (810–100' BGS), AND VERY DEEP (105–125' BGS)

GRAPHIC SCALE

20 0 20 40

(IN FEET)
1 inch = 20 ft.

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ALTERNATIVE G2
IN SITU CHEMICAL OXIDATION
NYSDEC SITE NO. 152183
EAST FARMINGDALE, NEW YORK

DATE
DECEMBER 2014

FIGURE
10

LEGEND

- GROUNDWATER ELEVATION CONTOUR (FEET AMSL) (DASHED WHERE INFERRED)
- ESTIMATED 5 UG/L LIMIT OF PCE (DASHED WHERE INFERRED)
- PROPOSED SOURCE TREATMENT AREA
- CHAIN LINK FENCE
- OVERHEAD WIRE
- BUILDING
- ELECTRODES
- PROPOSED PERFORMANCE MONITORING WELL
- ELECTRIC PIPING
- SVE VACUUM TRANSMISSION PIPING

GRAPHIC SCALE

30 0 30 60

(IN FEET)
1 inch = 30 ft.

NOTES:
1. ONSITE STRUCTURES SHOWN ARE THE RESULT OF A FIELD SURVEY COMPLETED BY YEC, INC ON AUGUST 25, 2011, MARCH 6, 2012, AND SEPTEMBER 27, 2013. OFF SITE STRUCTURES ARE APPROXIMATE AND ARE BASED ON AERIAL PHOTOGRAPHS FROM THE NYS GIS CLEARINGHOUSE WEBSITE.
2. ALTERNATIVE CONSISTS OF IN SITU THERMAL TREATMENT WITH CO-LOCATED SOIL VAPOR EXTRACTION WELLS.
3. LAYOUT IS CONCEPTUAL AND FINAL NUMBER AND LOCATION OF VACUUM WELLS AND ELECTRODES WILL BE DETERMINED DURING THE REMEDIAL DESIGN.

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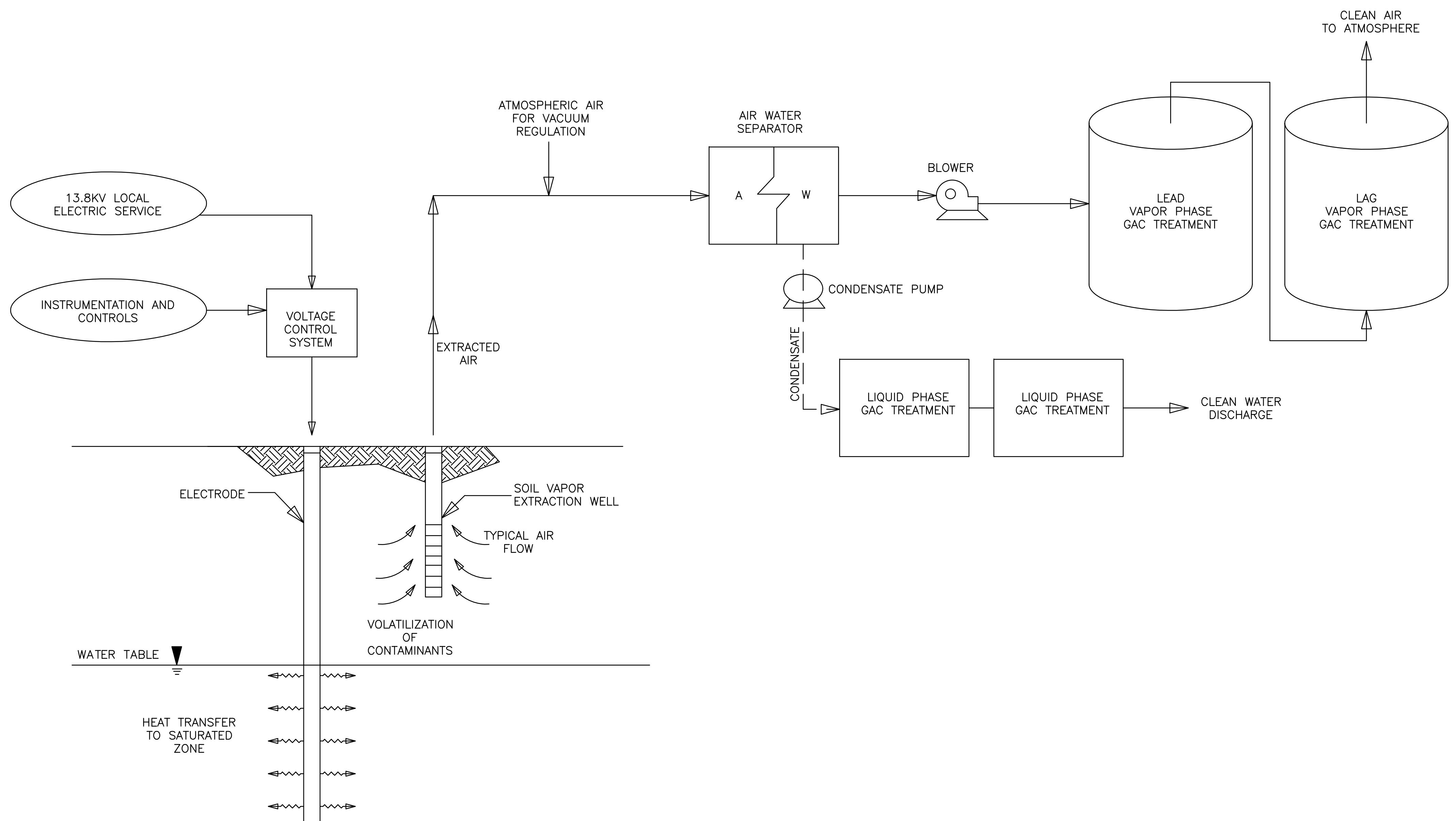
ALTERNATIVE G3
IN SITU THERMAL TREATMENT
BRANDT AIRFLEX
NYSDEC SITE NO. 152183
EAST FARMINGDALE, NEW YORK

DATE
DECEMBER 2014

FIGURE
11



TYPICAL IN-SITU THERMAL REMEDIATION TREATMENT PROCESS DIAGRAM

SCALE: NOT TO SCALE

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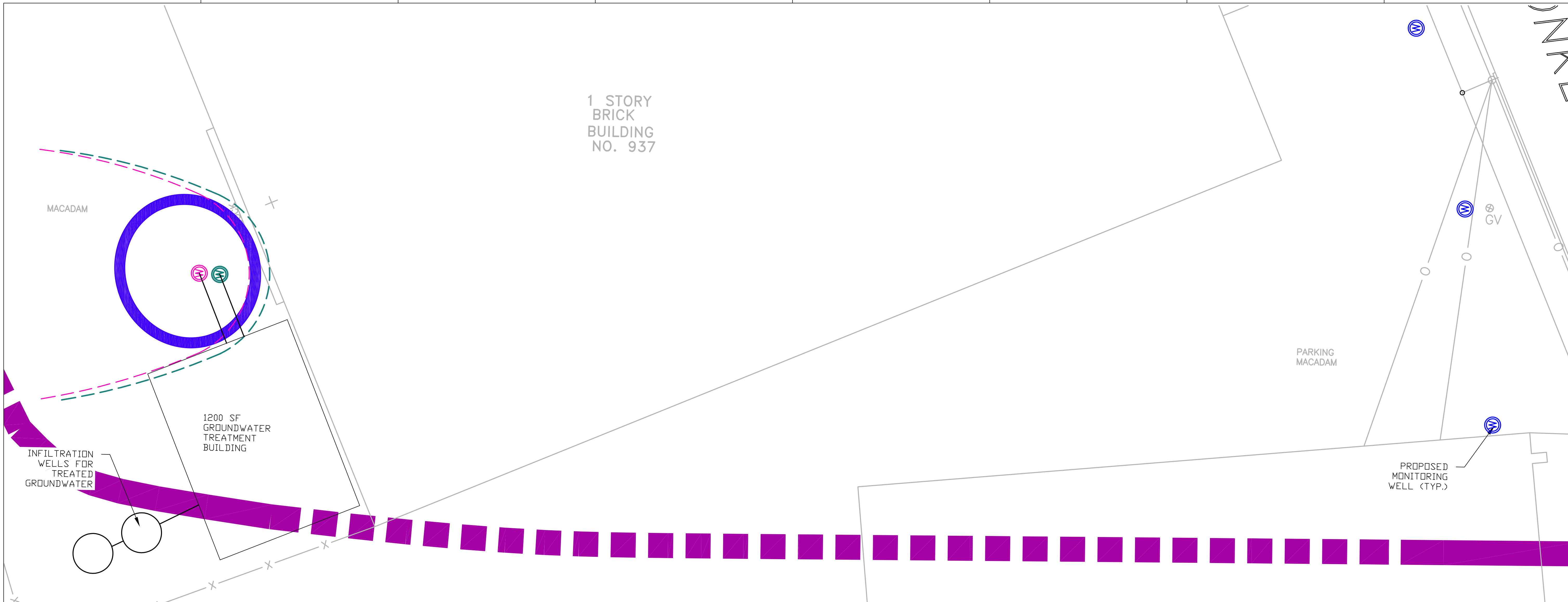
IN–SITU THERMAL TREATMENT SYSTEM
PROCESS FLOW DIAGRAM
BRANDT AIRFLEX
NYSDEC SITE NO. 152183
EAST FARMINGDALE, NEW YORK

DATE	DECEMBER 2014
FIGURE	12



LEGEND

- GROUNDWATER ELEVATION CONTOUR (FEET AMSL) (DASHED WHERE INFERRED)
- ESTIMATED 5 UG/L LIMIT OF PCE (DASHED WHERE INFERRED)
- PROPOSED SOURCE TREATMENT AREA
- CHAIN LINK FENCE
- OVERHEAD WIRE
- BUILDING
- SHALLOW PUMPING WELL WITH CAPTURE ZONE (30–70'BGS)
- DEEP PUMPING WELL WITH CAPTURE ZONE (85–125' BGS)
- TRANSMISSION PIPE
- PROPOSED PERFORMANCE MONITORING WELL
- PROPOSED DRYWELL

GRAPHIC SCALE

30 0 30 60

(IN FEET)
1 inch = 30 ft.

NOTES:

1. ONSITE STRUCTURES SHOWN ARE THE RESULT OF A FIELD SURVEY COMPLETED BY YEC, INC ON AUGUST 25, 2011, MARCH 6, 2012, AND SEPTEMBER 27, 2013. OFF SITE STRUCTURES ARE APPROXIMATE AND ARE BASED ON AERIAL PHOTOGRAPHS FROM THE NYS GIS CLEARINGHOUSE WEBSITE.
2. ALTERNATIVE CONSISTS OF PUMP AND TREAT USING SHALLOW AND DEEP WELLS FOR THE SOURCE AREA.
3. LAYOUT IS CONCEPTUAL AND THE NUMBER, LOCATION AND PUMPING RATES FOR WELLS WILL BE DETERMINED DURING THE REMEDIAL DESIGN.

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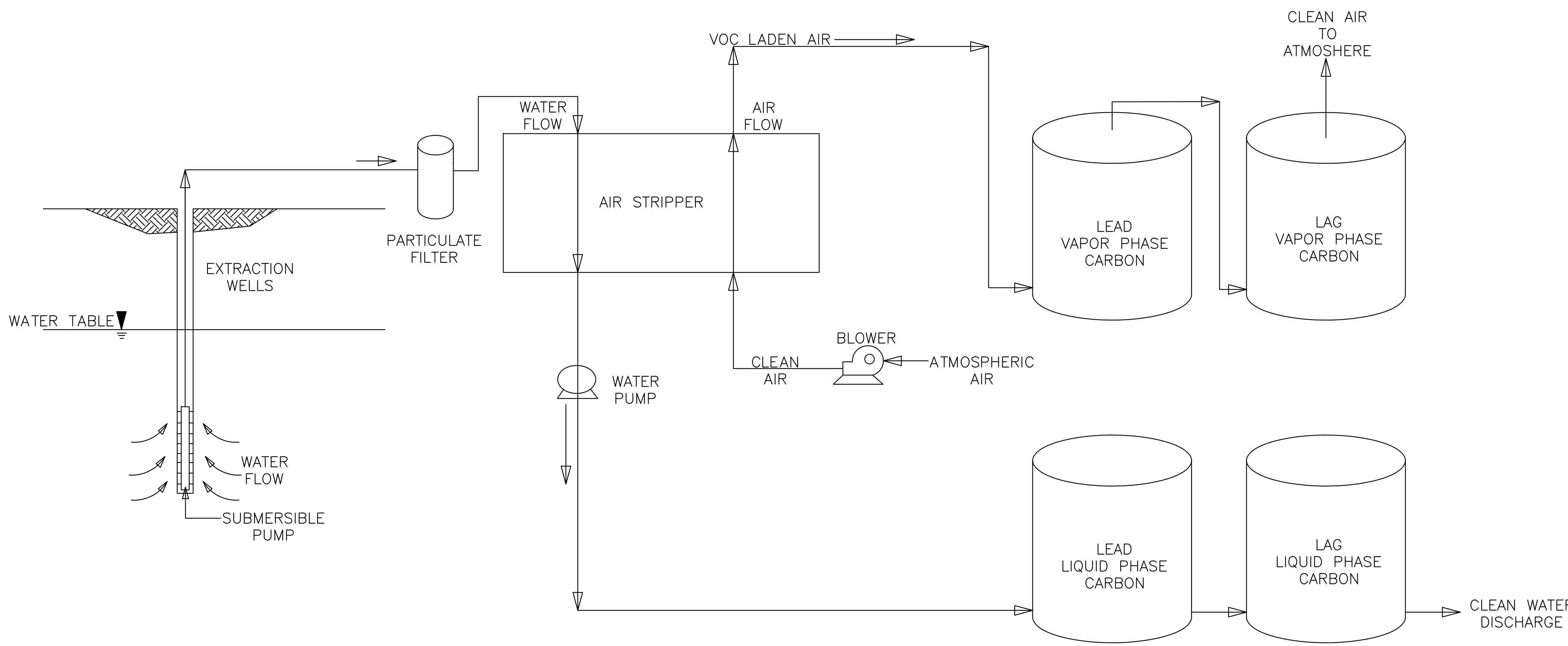
ALTERNATIVE G4
PUMP AND TREAT
BRANDT AIRFLEX
NYSDEC SITE NO. 152183
EAST FARMINGDALE, NEW YORK

DATE
DECEMBER 2014

FIGURE
13



TYPICAL GROUNDWATER TREATMENT SYSTEM PROCESS SCHEMATIC

SCALE: NOT TO SCALE

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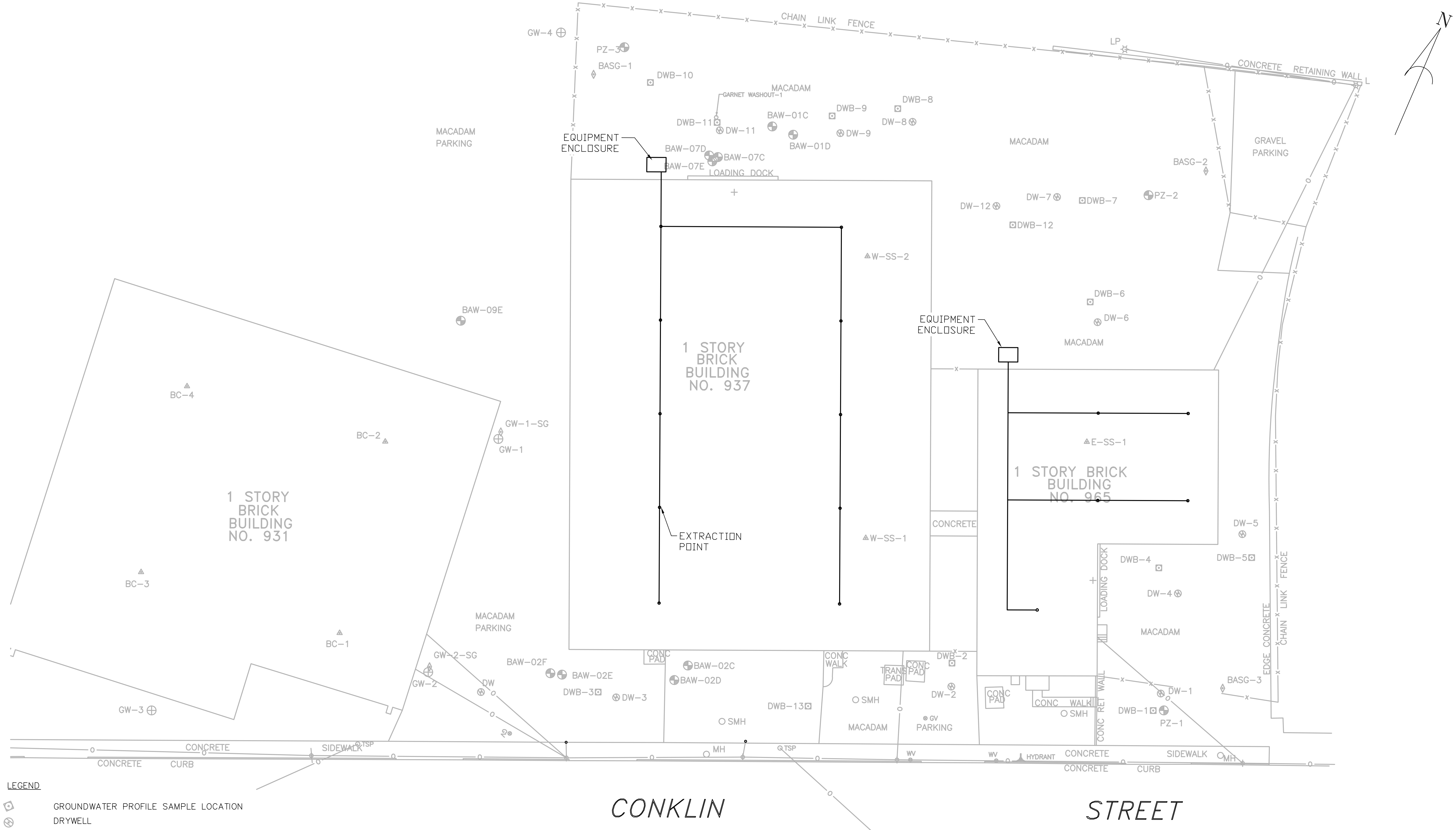
GROUNDWATER TREATMENT SYSTEM
PROCESS FLOW DIAGRAM
BRANDT AIRFLEX
NYSDEC SITE NO. 152183
EAST FARMINGDALE, NEW YORK

DATE
DECEMBER 2014

FIGURE
14



LEGEND

- GROUNDWATER PROFILE SAMPLE LOCATION
- DRYWELL
- MONITORING WELL
- SUB SLAB SOIL SAMPLE LOCATION
- SOIL GAS SAMPLE LOCATION
- CHAIN LINK FENCE
- OVERHEAD WIRE
- BUILDING
- LIGHT POLE
- EXTRACTION POINT
- HEADER PIPE
- EQUIPMENT ENCLOSURE

GRAPHIC SCALE

40 0 40 80

(IN FEET)
1 inch = 40 ft.

NOTES:
1. LAYOUT IS CONCEPTUAL AND THE FINAL NUMBER AND LOCATION OF EXTRACTION POINTS WILL BE DETERMINED DURING THE REMEDIAL DESIGN.

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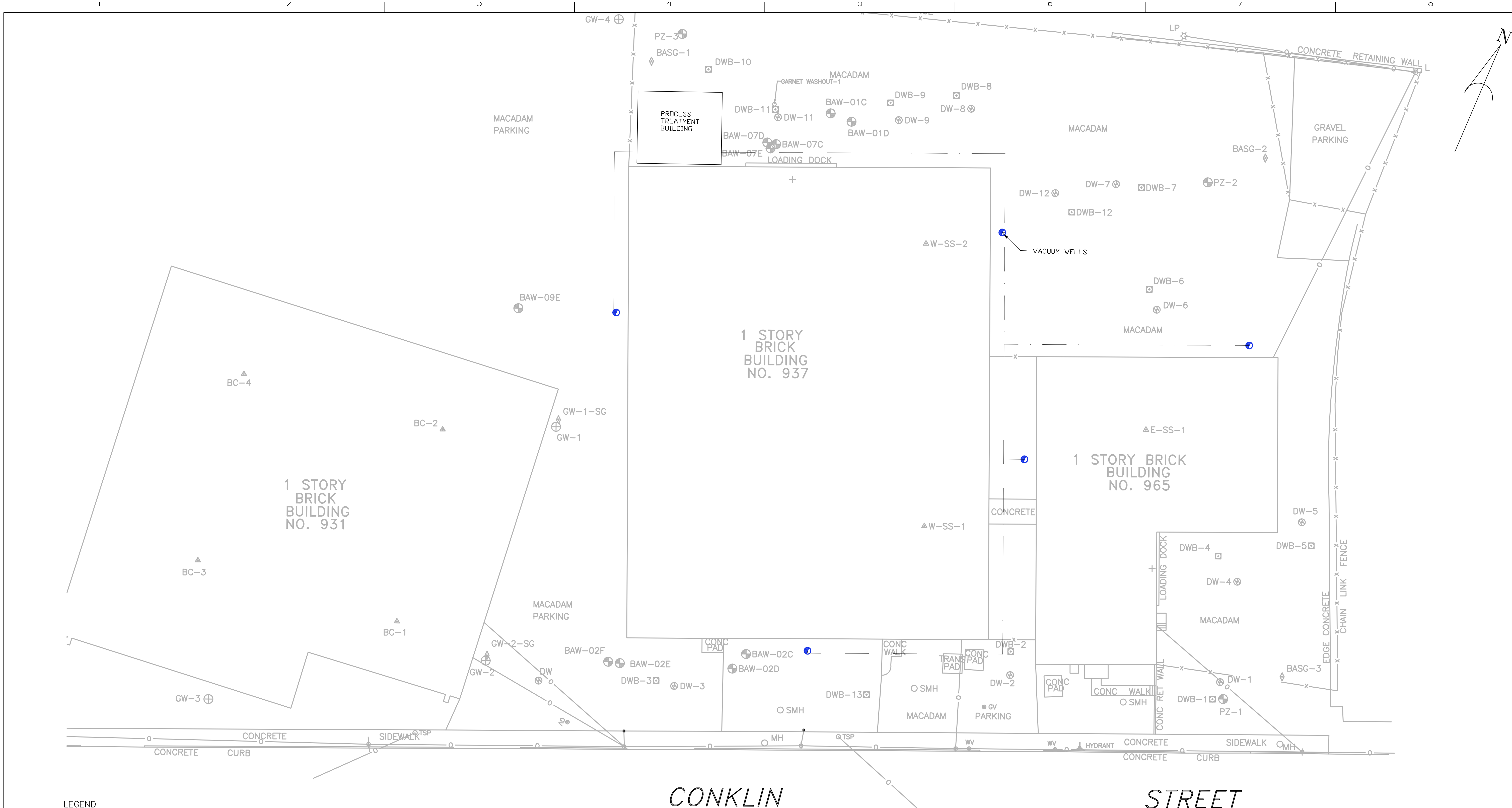
ON-SITE SUB-SLAB DEPRESSURIZATION SYSTEM LAYOUT
BRANDT AIRFLEX
NYSDEC SITE NO. 152183
EAST FARMINGDALE, NEW YORK

DATE	DECEMBER 2014
FIGURE	15



LEGEND

- GROUNDWATER PROFILE SAMPLE LOCATION
- DRYWELL
- MONITORING WELL
- SUB SLAB SOIL SAMPLE LOCATION
- SOIL GAS SAMPLE LOCATION
- CHAIN LINK FENCE
- OVERHEAD WIRE
- BUILDING
- LIGHT POLE
- VACUUM WELLS
- VACUUM TRANSMISSION PIPING

NOTES:

1. LAYOUT IS CONCEPTUAL AND THE FINAL NUMBER AND LOCATION OF VAPOR EXTRACTION WELLS WILL BE DETERMINED DURING THE REMEDIAL DESIGN. RADIUS OF INFLUENCE WAS CALCULATED TO BE 100 FEET IN THE UPPER SAND AND GRAVEL AQUIFER USING A BLOWER CAPACITY OF 150 CFM.
2. SOIL VAPOR EXTRACTION WELLS WERE ASSUMED TO HAVE 5 FEET SCREEN AND DEPTH OF 10 FEET BELOW GROUND SURFACE.

GRAPHIC SCALE

40 0 40 80

(IN FEET)
1 inch = 40 ft.

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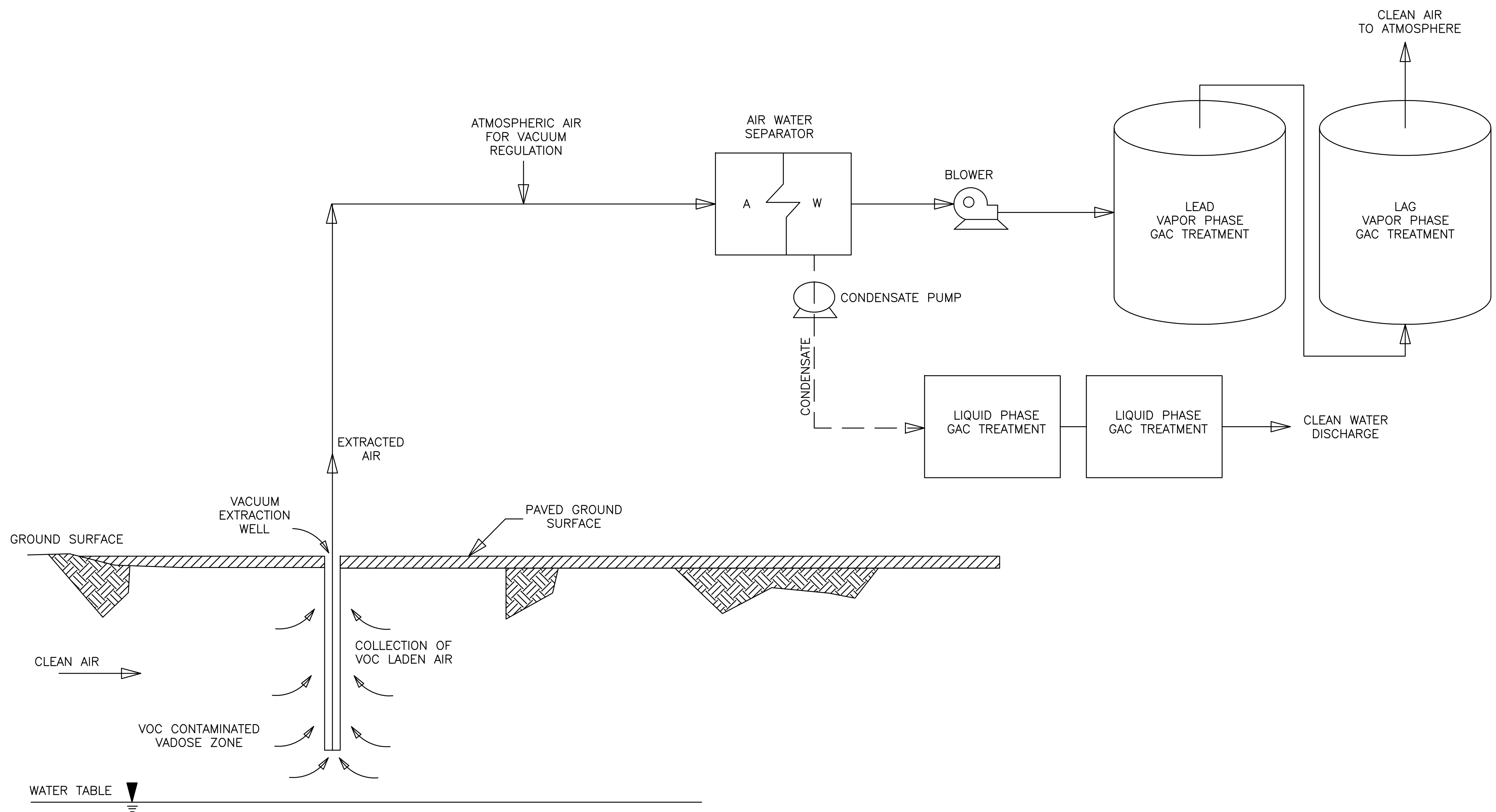
SOIL VAPOR EXTRACTION SYSTEM LAYOUT
BRANDT AIRFLEX
NYSDEC SITE NO. 152183
EAST FARMINGDALE, NEW YORK

DATE	DECEMBER 2014
FIGURE	16



TYPICAL SOIL VAPOR EXTRACTION SYSTEM

SCALE: NOT TO SCALE

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SOIL VAPOR EXTRACTION TREATMENT SYSTEM PROCESS FLOW DIAGRAM
BRANDT AIRFLEX
NYSDEC SITE NO. 152183
EAST FARMINGDALE, NEW YORK

DATE
DECEMBER 2014

FIGURE
17