de maximis, inc.

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November 23, 2011

Via electronic and U.S Mail

Brian Davidson
Division of Environmental Remediation
Remedial Bureau B
New York State DEC
625 Broadway, 12th Floor
Albany, New York, 12233-7016

Reference: **Review Avenue Development Sites (RAD I and RAD II)**
Long Island City, Queens, New York
Remedial Action Work Plan November 2011

Dear Mr. Davidson:

On behalf of Cresswood Environmental Consultants, LLC, we are pleased to provide the attached Remedial Action Work Plan (RWP) for the Review Avenue Development Sites identified as:

Review Avenue Development I
37-30 Review Avenue
Long Island City, Queens, New York
BCP #C241089

Review Avenue Development II
37-80 Review Avenue
Long Island City, Queens, New York
BCP #C241005

This RWP has been prepared in accordance with DER-10 Technical Guidance for Site Investigation and Remediation and Subpart 375.3 Brownfield Cleanup Program (BCP) Regulations.

Should you have any questions or comments regarding the Remedial Action Work Plan or any other aspect of this project, please do not hesitate to contact me at (610) 435-1151.

Sincerely,

de maximis, inc.

R. Craig Coslett
Project Coordinator

Attachment
CC: Stephanie Selmer, New York Department of Health
David Kushner, Cresswood Environmental Consultants
Robert Stetkar, Golder Associates

File: 3216.05/2011 RA Work Plan Cover.doc

REPORT

REMEDIAL ACTION WORKPLAN

Review Avenue Development

Long Island City, Queens, New York

Review Avenue Development I
37-30 Review Avenue
(BCA # 241089)

Review Avenue Development II
37-80 Review Avenue
(BCA # 241005)

Submitted To: New York State Department of Environmental Conservation
Division of Environmental Remediation
625 Broadway, 12th Floor
Albany, NY 12233-7016

Submitted By: Golder Associates Inc.
744 Broad Street, 25th Floor
Newark, NJ 07102 USA

Distribution:

1 Copy	New York State Department of Environmental Conservation
1 Copy	New York State Department of Health
1 Copy	Cresswood Environmental Consultants, LLC
2 Copies	*de maximis, inc.*
2 Copies	Golder Associates Inc.

November 2011 **023-6151-002**

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CERTIFICATION STATEMENT

I, Gary P. Hurta Jr., P.E., certify that I am currently a NYS registered professional engineer and that this Remedial Action Work Plan 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).

Warning: It is a violation of New York State Education Law Section 7209 for any person to alter any document that bears the seal of a professional engineer, unless the person is acting under the direction of a licensed professional engineer. If altered, the altering person shall comply with all requirements of New York State Education Law Section 7209.

EXECUTIVE SUMMARY

Introduction

This summary provides an overview of the remedial action workplan (RWP) proposed by Cresswood Environmental Consultants, LLC (Volunteer) to satisfy the requirements of the Record of Decision (ROD) for the Review Avenue Development II property (RAD II property). The RAD II property is located at 37-80 Review Avenue in Long Island City, New York. The ROD was issued by the New York State Department of Environmental Conservation (NYSDEC) on February 9, 2007 (NYSDEC, 2007). This RWP is also intended to satisfy the requirements of the Decision Document (DD) to be issued by NYSDEC for the Review Avenue Development I property (RAD I property) located at 37-30 Review Avenue in Long Island City, New York.

The RWP was prepared by Golder Associates Inc. (Golder) on behalf of the Volunteer in accordance with the *DER-10 Technical Guidance for Site Investigation and Remediation* (DER-10) (NYSDEC, 2010) and Subpart 375.3 Brownfield Cleanup Program (BCP) Regulations (NYSDEC, 2006a). The RAD II property entered the BCP in October 2005 as site C241005 (NYSDEC, 2005a). The Review Avenue Development I property (RAD I property) bordering RAD II and addressed in the ROD entered the BCP in December 2005 as site C241089 (NYSDEC, 2005b).

The RWP describes the approach to implementing the selected remedy in the ROD at the RAD I and RAD II properties to address soil, groundwater and soil vapor impacted by volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), metals, PCBs and light non-aqueous phase liquids (LNAPL).

Background

RAD II, previously referred to as the Quanta Resources Site, and RAD I, previously referred to as the North Capasso Property, are situated in a highly industrialized area of Long Island City, Queens, New York. An alley (Preston Street) runs between the two properties from Review Avenue to the LIRR tracks. The two properties are bounded on the northeast by Review Avenue, on the southwest by the Southern Line of the Long Island Railroad (LIRR), on the southeast by the property formally occupied by Phoenix Beverages and on the northwest by Allied Extruders, a plastics manufacturing company. RAD II consists of approximately 1.7 acres. This property was used for a variety of industrial purposes, including refining and later recycling of crankcase oil, between the late 19th century and 1981. The structures previously existing on the property (buildings, tanks, containment areas) were demolished and removed in 2008 as an interim remedial action. Below-grade foundation structures, concrete pads, sumps and vaults and debris piles scattered throughout the RAD II property were also removed during the interim action. The RAD II property is currently leased by the Volunteer to an equipment rental company for storage and parking of equipment and vehicles.

RAD I consists of approximately 2.7 acres. This property was used for a variety of commercial and industrial purposes between at least 1898 and the present, including commercial vehicle and heavy equipment maintenance. The property is paved and contains one five-story brick building (Building No. 1), which is currently used as a warehouse and automotive repair business, and one three-story brick building (Building No. 2), which is currently occupied with multiple industrial and commercial uses. Portions of the RAD I property are used for parking and equipment storage. RAD I is currently used by two tenants for vehicle parking, equipment storage and an automotive repair business.

Prior investigations conducted at RAD II were summarized in the Remedial Investigation (RI) Report submitted to NYSDEC in June 2005 (Golder 2005a). Golder subsequently submitted a Feasibility Study (FS) report to NYSDEC in July 2005 (Golder 2005b). The FS presented remediation goals and an evaluation of alternative methods for LNAPL extraction and other remedy components to achieve those goals. The remedy selected by NYSDEC in the ROD was Alternative F from the FS, which includes using a combination of technologies to extract LNAPL in a timeframe that will support redevelopment of the RAD I and RAD II properties. The ROD maintained flexibility in the selection of the technologies and the areas where they would be applied. The ROD noted that the final combination of LNAPL extraction technologies would be based on the results of pilot testing of the technologies to address the large variations in the LNAPL viscosity. The pilot testing program has been completed, and the results are provided in Appendix B in this RWP.

The ROD also required that additional “data gap” investigations be performed to expand prior remedial investigations that identified the presence of elevated concentrations of constituents in soil vapor above the LNAPL. These investigations would further evaluate the potential risk for human exposure to soil vapors on or adjacent to the RAD II property, which would also be considered during the final selection of the LNAPL extraction technologies. The results of soil vapor investigations performed by Geosyntec Inc. on behalf of the Volunteer were submitted in reports issued to NYSDEC and the New York State Department of Health (NYSDOH) (Geosyntec 2008, 2010a, 2010b). The results of those investigations are summarized in Section 3.4 in this report as they relate to the proposed remedy.

The nature and extent of soil, groundwater and LNAPL contamination found during investigations completed at and around the site, including those completed after the ROD was issued, are summarized in this RWP for reference in connection with the proposed remedy design.

The selected cleanup track for the site as specified in the ROD is Track 4 – Restricted Use, consistent with development plans for RAD I and RAD II properties and zoning. The development plans for RAD I include modifications of the existing buildings to meet occupancy needs. RAD II development plans are limited to parking, which will include regrading, asphalt pavement (an upgrade to the interim crushed

stone/concrete surface currently being used), possible limited landscaping, and improved stormwater management.

Overview of Proposed Remedial Actions

The remediation goals for the site stipulated by the ROD are to eliminate or reduce to the extent practicable:

- the presence of LNAPL as a potential source of soil, groundwater and soil gas contamination;
- potential further migration of LNAPL that could result in soil, groundwater or soil gas contamination;
- exposures of persons at or around the site to VOCs or exceedance of the lower explosive level (LEL) in soil vapor;
- the potential for ingestion/direct contact with contaminated soil; and
- the release of contaminants from the urban soil and LNAPL into groundwater that may create exceedances of groundwater quality standards over time.

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

- ambient groundwater quality standards and
- regulatory standards, criteria and guidelines (SCGs) for soil.

Two elements of the selected remedy in the ROD, demolition and proper disposal of onsite building and tanks have been completed as an interim remedial action as approved by NYSDEC. These elements are addressed in other reports. The remaining remedial action elements included in the ROD as proposed in the RWP are summarized below and described in further detail in the RWP.

Urban Fill / Soil

The remedy for RAD II to address residual contamination in soil and urban fill is to cover (cap) the property using materials consistent with development plans. The cap on RAD II will primarily consist of asphalt pavement at least 6 inches thick, or a 2-foot clean soil cover for vegetated landscape areas. The boundary between the lower contaminated materials and the clean soil cover cap will be identified with a geotextile marker layer, and restrictions identified in the deed will prohibit disturbance of the capped materials without NYSDEC notification, and handling of materials in accordance with a soil reuse plan approved by NYSDEC.

The cap is intended to be protective of human health by restricting direct contact with any compounds that exceed NYSDEC SCGs. The final design of the RAD II cap and stormwater runoff management will be addressed in the more detailed designs that will be prepared for permits and construction contracting. The final site management plan addressing remedy post-construction activities and environmental

easement/institutional controls incorporating “as-built” cap limits will be addressed in the Construction Completion and Final Engineering reports. An interim site management plan addressing site activities on RAD I and RAD II during remedy construction is provided in Section 6.3 in this RWP.

The majority of RAD I property is currently paved. Consistent with the ROD, the RWP does not require installation of a cap on RAD I as a remedy element. However, restoration of the existing asphalt on RAD I that will be disturbed during construction of the LNAPL extraction remedy element will be part of the remedial activities.

Groundwater

The remedial action selected in the ROD for groundwater requires institutional controls that restrict the use of untreated groundwater beneath the site as a source of potable water. The ROD also requires a long term monitoring program to monitor the effectiveness of the LNAPL recovery system. Recent groundwater monitoring determined that there has been some natural improvement in groundwater quality beneath the site since the RI. No constituent concentrations in groundwater beneath the site currently exceed the groundwater quality standards applicable to ambient groundwater, unless those constituents already exceeded those standards upgradient from the site.

LNAPL

The ROD identified area-wide LNAPL recovery via a combination of single-phase (skimmer), vacuum-enhanced (VER) and localized soil heating LNAPL recovery methods as the selected approach to remediate LNAPL at RAD II and RAD I (identified as Alternative F in the FS). Based on subsequent correspondences and discussions with NYSDEC regarding the favorable results from the VER pilot testing and concerns with soil heating, the soil heating component of the remediation strategy will not be implemented. The soil heating infrastructure previously installed for localized pilot testing that cannot be utilized during VER implementation will be removed to avoid interference with the cap and stormwater management remedy element.

The proposed full-scale LNAPL recovery system will consist of both VER and pneumatically-powered skimmer wells to collect LNAPL throughout RAD II and portions of RAD I. The area selected for VER recovery represents the portion of the site (i.e., approximately two-thirds of RAD II and a smaller portion of RAD I bordering RADII) with the highest viscosities, moderate to high specific free-product volumes, and where the recovered LNAPL has been extrapolated from prior data to contain PCB concentrations in excess of 50 ppm. LNAPL with known PCB concentrations near or above 50 ppm (i.e., PCB liquids). LNAPL classified as PCB liquid will be segregated from LNAPL with PCBs less than 50 ppm. The area selected for skimmer pump recovery represents the portion of the site where the LNAPL was determined to have low to moderate viscosities and specific free-product volumes. The LNAPL recovered by skimmer wells is also expected to contain PCB concentration less than 50 ppm.

The northern portion of RAD I has been interpreted to not contain LNAPL based on the RI. Therefore, LNAPL recovery wells are not proposed on the northern portion of RAD I, which is consistent with the ROD.

While LNAPL extracted with skimmer wells will only manage LNAPL as a single phase, LNAPL extracted by VER will also extract soil vapor and groundwater. The LNAPL remedy element includes construction of an LNAPL recovery and treatment building on the RAD II property near Review Avenue. The system/building has been sized to house the various processing and treatment components needed to manage LNAPL, soil vapor and groundwater extracted from the wells. The conceptual process flow diagram for these components is further described in this document. Electric power infrastructure installed to perform the pilot testing will be adapted to power the full-scale LNAPL remediation system.

While the level of detail for the LNAPL well extraction and piping system presented in the RWP is sufficient to advance to the construction phase, further design development is needed for the cap, the treatment building, and also connections with the sanitary wastewater utility for discharge of pretreated groundwater extracted during VER. Further design of these LNAPL components will be addressed in permit applications that will be submitted to State and local authorities. The construction of the LNAPL system may be phased to begin installation of permitted components in coordination with ongoing site uses while the permit approval process is proceeding on other components.

The ROD requires that the operation of the LNAPL remediation element continue until the remedial objectives are achieved, or until NYSDEC determines that continued operation is technically impracticable or infeasible. After the first year of operation of the area-wide system (as defined by the anniversary date of the Construction Completion/Final Engineering Report submittal to NYSDEC), the Volunteer will provide a progress report to NYSDEC. This report will provide a record of the performance metrics for the LNAPL remediation system listed in Section 5.6 of the RWP and the operation efficiency of the system. Data collected during the first year operation will be used to model LNAPL mobility using the methods presented in the RI and FS, and will document improvements that have been recognized during the first year of operation. The report will propose for NYSDEC review either continued operation, with operational adjustments if appropriate, or termination of the operation if “asymptotic” recovery has occurred and remedial objectives have been achieved.

Soil Vapor

The remediation goal in the ROD addressing soil vapor is to protect against exposures of persons at or around the site. The results of soil vapor investigations on both the RAD I and RAD II properties did not identify a threat for migration of soil vapor laterally from the limits of LNAPL on RAD I and RAD II. These studies indicated that the vertically-upward migration of soil vapor from LNAPL is affected by several factors including the volatility of the COIs, local variations in the porosity of the urban fill, and the air

permeability of the surface cover (e.g., pavement on RAD I, soil/crushed concrete surfacing on RAD II, or existing concrete slabs in buildings on RAD I) Based on unremediated conditions and current building conditions and use on RAD I, NYSDEC and NYSDOH have required a sub-slab soil vapor assessment for Building 2 to evaluate the potential for exposures to soil vapor, and has determined that such an assessment is not required for Building 1 under its current use. The assessment for Building 2, and any need to mitigate soil vapor risks, will be addressed separately from LNAPL recovery and is being addressed with NYSDEC and NYSDOH separately from this RWP.

Schedule

A detailed project schedule has been prepared that outlines project milestones in 2011 and 2012 in order to receive a certification of completion in December 2012. It is anticipated that implementation of certain components of the RWP would begin approximately one month after NYSDEC RWP approval, and installation of some components might begin before RWP approval. The schedule for the complete RWP execution depends on the timing of permits and approvals. Permit applications and communications with NYC Bureau of Water and Sewer Operations, NYSDEC permitting bureaus, and the NYC Department of Buildings are expected to proceed concurrently with NYSDEC review of this RWP.

Table of Contents

List of Tables

List of Figures

List of Appendices

1.0 INTRODUCTION

This Remedial Action Workplan (RWP) was prepared by Golder Associates Inc. (Golder), on behalf of Cresswood Environmental Consultants, LLC (Volunteer), to satisfy the requirements of the Record of Decision (ROD) issued by the New York State Department of Environmental Conservation (NYSDEC) for the Review Avenue Development II property (RAD II property) located at 37-80 Review Avenue in Long Island City, New York, dated February 9, 2007 (NYSDEC, 2007)[1].

The RWP was prepared in accordance with the *DER-10 Technical Guidance for Site Investigation and Remediation* (DER-10) (NYSDEC, 2010) and Subpart 375.3 Brownfield Cleanup Program (BCP) Regulations (NYSDEC, 2006a). The Review Avenue Development I property (RAD I property) entered the BCP in December 2005 as site C241089 (NYSDEC, 2005b), and the RAD II property entered the BCP in October 2005 as site C241005 (NYSDEC, 2005a).

This RWP addresses implementation of remedies at the RAD I and RAD II properties (collectively referred to as the site) to address soil, groundwater and soil vapor impacted by volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), metals, PCBs and light non-aqueous phase liquids (LNAPL) as identified in the ROD. Section 8 of the ROD presents a summary of the selected remedy addressed by this RWP. The components of the selected remedy, and the section of the RWP where each is addressed, are summarized below:

1. "*A remedial design program will be implemented to provide the details necessary for the construction, operation, maintenance, and monitoring of the remedial program.*" Details of completed remedial design activities are provided in Sections 4.0 and 5.0 and Figures 10 through 16. Plans for future detailed design needed for permits and construction of some remedy components are included in Section 7.0.

2. *"Construction of an area wide LNAPL recovery system using a combination of single-phase, vacuum enhanced recovery and localized soil heating methods."* The proposed configuration and combination of VER and single-phase recovery technologies based on completed pilot testing are presented in Figures 10 and described in Section 5.4. The results of pilot testing required by the ROD to determine an effective configuration of the recovery system to accommodate redevelopment are provided in Appendix B and reviewed in Section 4.

3. *"The buildings and tanks on site will be demolished, removed, and the demolition debris properly disposed."* This element of the remedy has been completed on the RAD II property as an Interim Remedial Measure and is referenced in Section 2.1.

[1] This RWP is also intended to satisfy the requirements of the Decision Document (DD) to be issued by NYSDEC for the Review Avenue Development I property (RAD I property) located at 37-30 Review Avenue in Long Island City, New York.

4. *"The site will be covered by a paving system at least 6 inches in thickness. A 2 foot soil cover will be constructed over all vegetated areas (if any) to prevent exposure to contaminated soils"* This remedy component is presented in Figures 15 and 16 and described in Section 5.2.

5. *"Development of a site management plan to: (a) address residual contaminated soils that may remain on site or off site during future redevelopment. The plan will require soil characterization and, where applicable, disposal/reuse in accordance with NYSDEC regulations; (b) evaluate the potential for vapor intrusion for any buildings developed on the Quanta Resources site, including provision for mitigation of any impacts were warranted; (c) identify any use restrictions; and (d) provide for the operation and maintenance of the components of the remedy."* This element of the remedy is addressed in Section 6.3.

6. *"Imposition of an institutional control in the form of an environmental easement that will (a) require compliance with the approved site management plan; (b) limit the use and development of the property to commercial or industrial uses only; (c) restrict the use of groundwater as a source of potable water, without necessary water quality treatment as determined by NYSDOH; and (d) require the property owner to complete and submit to the NYSDEC periodic certifications."* This element of the remedy will be addressed after approval of the Site Management Plan (SMP), and will include an environmental easement granted by the property owner for the residual contamination that will remain in soil, groundwater and soil vapor addressed by the environmental controls presented in this RWP.

7. *Periodic submittals provided by the property owner that verify that the institution and engineering controls are still in place, allow NYSDEC access to the site and certify nothing has occurred that will impair ability of the control to protect public health or the environment, or constitute a violation or failure to comply with the site management plan.* This element of the remedy is a component that will be addressed by the property owner in the future after the remedy described herein is implemented. The periodic submittals will be described further in the SMP.

8. *"Since the remedy may result in some untreated hazardous waste remaining at the Quanta Resources site, a long term monitoring program will be instituted. This program will allow the effectiveness of the area wide LNAPL recovery system to be monitored and will be a component of the operation, maintenance, and monitoring for the property."* This element of the remedy is discussed in Section 5.3. A monitoring plan for LNAPL and groundwater is provided in Appendix E and will be a component of the SMP.

9. *"An investigation of the potential for soil vapor intrusion off-site will be completed during the remedial design phase."* This element of the remedy was addressed by a series of soil vapor

investigations that were provided in separate reports submitted to NYSDEC and the New York State Department of Health (NYSDOH). The results of these investigations are summarized in Section 3.4, and the recommended actions based on these investigations are provided in Section 5.5.

The ROD required that a Data Gap Investigation be conducted to investigate soil vapor conditions on RAD I. The results of this investigation are addressed in item 9 above. The ROD further required that an Interim Remedial Measure be conducted involving removal of underground storage tanks and contaminated soil on RAD I. These activities have been completed, were reported previously to NYSDEC (ELM, 2007), and determined to be acceptable by NYSDEC on January 31, 2007.

In addition to activities conducted pursuant to the ROD, a groundwater sampling event and monitoring well inspection were completed in April 2011, and a boundary and topographic survey was completed in July 2011. The groundwater sampling results are summarized in Table 2 and Figure 5. Figure 3 depicts the existing site conditions and topography determined by the recent survey.

This RWP also includes the following components as outlined in the DER-10 and BCP regulations documents:

- Section 2.0 provides a summary of the history and current conditions at the RAD I and RAD II properties; a summary of previous investigations; and plans for site development, including the cleanup track to be used for remediation of the site.
- Section 3.0 summarizes from the Remedial Investigation Report (Golder, 2005a) the nature and extent of soil, groundwater, and soil vapor contamination at the RAD I and RAD II properties that are addressed by the remedy proposed in this RWP. The nature and extent of the contamination determined during the prior remedial investigations are also illustrated in Figures 5 through 9 for reference.
- Section 6.0 presents additional elements of the remedial action workplan required by DER-10: a project health and safety plan; a community air monitoring plan, and plans for operating and maintaining the LNAPL recovery system;
- Section 7 presents the anticipated schedule leading to the completion of remedy construction and the beginning of operation and maintenance, and
- Section 8.0 contains the list of references used in the RWP.

2.0 BACKGROUND

2.1 General Site Conditions

RAD II, previously referred to as the Quanta Resources Site, is located at 37-80 Review Avenue. RAD I, previously referred to as the North Capasso Property, is located at 37-30 Review Avenue and borders RAD II. RAD I and RAD II are situated in a highly industrialized area of Long Island City, Queens, New York (Figure 1). An alley (Preston Street) extends between the two properties from Review Avenue to the Long Island Railroad (LIRR) tracks.

The two properties are bounded on the northeast by Review Avenue, on the southwest by the Southern Line of the LIRR, on the southeast by the property formally occupied by Phoenix Beverages and on the northwest by Allied Extruders, a plastics manufacturing company. Further to the east and northeast, across Review Avenue, is Calvary Cemetery, which covers roughly 175 acres and extends approximately 3,000 feet along Review Avenue. Further to the southwest, across the LIRR tracks, is the South Capasso property, see Figure 2. The site's current surface conditions, property boundaries and easements based on a recently completed survey are shown in Figure 3.

2.1.1 RAD II

RAD II, designated Block 312, Lot 69 on a Long Island City tax map, consists of approximately 1.7 acres. This property was used for a variety of industrial purposes, primarily oil refining and re-refining of used crankcase oil, between the late 19th century and 1981. The structures previously existing on the property for industrial uses (buildings, above-ground storage tanks (ASTs), containment areas) have been demolished since the property was abandoned in 1981. Most recently, in 2008, as an interim remedial action, the remaining building and 14 remaining empty and decontaminated steel ASTs were demolished and removed from the site along with some below-grade foundation structures, concrete pads, sumps and vaults. Debris piles throughout the site were also removed. A summary of the demolition activities has been provided to NYSDEC in a construction completion report (CCR) prepared by the current project coordinator, de maximis, inc (de maximis, September 2011). The CCR provides additional information on the disposal of building and AST demolition debris from RAD II. Following the demolition activities, the RAD II property was rough graded by the Volunteer with crushed stone and recycled crushed concrete.

Infrastructure was also installed in preparation for potential implementation of a pilot test examining ground heating as a potential LNAPL extraction enhancement technology. This included an electrical service connection with the Consolidated Edison electrical service utility in the east corner of RAD II abutting Review Avenue, and a pole-mounted electrical transmission line. The electrical transmission line provides service to a transformer. The transformer and the previously planned ground heating pilot area

is enclosed in a fence located near the west boundary of RAD II. The electrical service connection is active, and can be utilized and adapted to service the proposed remediation.

In April 2011 a well inspection program and a groundwater sampling event were conducted by Golder. The well inspection could not locate eight LNAPL monitoring wells installed during the prior remedial investigations, and these wells are presumed to have been destroyed during interim remedial action demolition activities. These wells included: GAL-01, GAL-01R, GAL-02, GAL-03, GAL-05, GAL-16, GAL-19 and GAL-20. In July 2008, after completion of demolition, wells GAL-02 and GAL-16 were replaced with wells GAL-02R and GAL-16R. Furthermore, three new LNAPL monitoring wells were installed within the former area of the demolished building and above-ground storage tanks (wells GAL-29, GAL-30 and GAL-31). The destroyed wells are no longer shown on the site plans, and the new and replacement wells are now shown. The logs for the new and replacement wells, as well as other wells installed after the ROD in connection with the LNAPL pilot tests proposed to be used in the future remediation efforts are provided in Appendix A. The recently completed survey included well reference elevations and locations, which are absent from the logs but are available upon request.

During the groundwater sampling event, deep groundwater monitoring wells GAGW-02, GAGW-03 and GAGW-05 were not sampled. This was because of a large silt accumulation in GAGW-02 and GAGW-03, and a sheen and petroleum-like odor observed in GAGW-05, indicating that GAGW-05 may have been compromised. Damage to the surface casing at MW-1 located near the north corner of the RAD II property also was observed. As described in Appendix E, well GAGW-05 will be closed and abandoned prior to beginning remediation. Other wells shown on the existing conditions plan on Figure 3 but not shown on LNAPL remediation or Groundwater Monitoring plans shown on Figure 10 and in Appendix E will be closed using procedures described in Appendix E.

The RAD II property is surrounded by a 10-12 foot high corrugated steel fence with locking gates. It is currently leased by the Volunteer to an equipment rental company, Angel Aerial Corporation (Angel Aerial), for storage and parking of equipment and vehicles. This use occupies variable amounts of the ground surface on the RAD II property. The most recent site survey completed in July 2011 identified a storage shed and various pieces of construction equipment near the southwest property boundary as shown in Figure 3. Remediation plans and construction will coordinate with the current use of the RAD II property for temporary storage and parking.

Infrastructure installed for the 2008 VER LNAPL Recovery pilot study is located in a fenced area of approximately 3,700 square feet near the southern corner of the property where LNAPL recovery wells will be installed in accordance with the ROD (shown on Figure 3). The remnant pilot study area also occupies space set aside for future stormwater management systems (see Figure 15). LNAPL monitoring and extraction wells and electric service connections proposed for reuse during full-scale remedy

implementation will be preserved. Other remnant components associated with ground heating that will interfere with cap and stormwater management construction will be removed during the early stage of remedy construction,

2.1.2 RAD I

RAD I, designated Block 312, Lot 41 on a Long Island City tax map, consists of approximately 2.7 acres. This property was used for a variety of commercial and industrial purposes between at least 1898 and the present, including commercial vehicle and heavy equipment maintenance. The property is paved and contains one five-story brick building (Building No. 1), which is currently used as a warehouse and automotive repair business, and one three-story brick building (Building No. 2), which is currently occupied with multiple industrial and commercial uses. Additional areas of the site are used for parking. Four formerly utilized USTs, a concrete trench and a sump were removed in May 2006. The Final Report for the UST and Sump Removal Interim Remedial Measure (IRM) (ELM 2007) was submitted to the NYSDEC in January 2007 and was approved on January 31, 2007. A chain link fence surrounds portions of the site. The property currently has two tenants, Angel Aerial and CAS Industries. Angel Aerial uses the fenced portions of the property for vehicle parking and stores equipment and supplies in Buildings No. 1 and No. 2. Building No. 2 is shared with CAS Industries, which operates an automotive repair business in the southern portion of the building.

An April 2011 well inspection found all fifteen wells installed during prior remedial investigations on RAD I, and ten of the wells were inspected. The five wells not inspected (GAL-12, MW-1, MW-2, MW-4R and MW-10) were not accessible to Golder due to ongoing operations during the site visit. Significant damage was noted at LNAPL monitoring well GAL-11. The flush-mount cover, concrete pad, and plug were missing; the PVC well riser pipe was exposed, and probing indicated that several feet of material (dirt, gravel) has accumulated at the bottom of the well. A temporary repair was made by installing a new expandable well cap in the exposed PVC well. The site survey completed in July 2011 identified that the area southwest of Building No. 1 between the building and the off-site railroad tracks was cleared subsequent to the ROD and graded with crushed stone to allow for parking and storage, as shown in the site plan in Figure 3. Easements located on the property are noted on Figure 3.

2.2 Previous Investigations Conducted

Historic remedial, geologic and hydrogeologic investigations conducted at RAD II were summarized in the Remedial Investigation (RI) Report submitted to NYSDEC in June 2005 (Golder 2005a). The report summarized historical operations conducted at the site and adjacent properties, which included investigations and removal actions conducted by NYSDEC and the New York City Department of Environmental Protection (NYCDEP) after the RAD II property was abandoned in 1981 (CH2M Hill 1982 and OHM 1983). Other activities included a Phase II remedial investigation conducted by Lawler,

Matusky & Skelly Engineers (LMS 1990), Phase I and Phase II remedial investigations conducted in 1990 and 1992 by Environmental Resource Management (ERM, 1990 and 1992) and Phase I and Phase II remedial investigations conducted in 2003 and 2004 by Golder. Site sampling results collected by Golder during the RI investigation were presented in the RI Report and used to develop a conceptual site model.

Golder subsequently submitted a Feasibility Study (FS) report to NYSDEC in July 2005 (Golder 2005b). It provided additional information on LNAPL characteristics and mobility, and the results of pilot testing of single phase LNAPL removal at two locations on the RAD II property: GAL-02 (the highest of three viscosity areas on the site), and GAL-07 (the intermediate viscosity area). The FS also presented the results of human health and environmental exposure assessments performed by Golder that were used to develop remediation objectives. The results of the investigations, exposure assessment, remediation objectives and evaluation of alternatives for recovery of LNAPL were evaluated in the NYSDEC February 2007 ROD, leading to the selection of Alternative F for LNAPL recovery. The nature and extent of contamination found during investigations completed at and around the site, including those completed after the ROD was issued, are summarized in subsequent sections of this report. Figures 4 through 9 summarize the nature and extent of constituents in soil and groundwater discussed in ROD. The nature and extent of constituents in subsurface soil vapor on the site relative to New York State Department of Health (NYSDOH) screening objectives are summarized in Section 3.4 and are addressed by the remedy described in this RWP.

In summary, after the ROD was issued by NYSDEC, soil samples, site groundwater samples and site LNAPL samples were collected and analyzed; soil vapor investigations were conducted on the RAD I and RAD II properties, and two Vacuum Enhanced Recovery pilot tests were conducted in the highest and intermediate LNAPL viscosity zones on the RAD I and RAD II properties. These new data have lead to the configuration of the area-wide LNAPL recovery system presented in this RWP, which complies with the requirements of the selected remedy (Alternative F) described in the ROD.

2.3 Site Development Plans

The current development plans for the site do not include constructing any new buildings on RAD I. They only include modifications of existing building interiors to meet current occupancy needs. RAD II development plans are limited to asphalt-paved parking, limited landscaping, and improved stormwater management. No buildings are planned to be constructed on RAD II except for a pre-engineered building to support LNAPL recovery remedy.

The remedy described in this RWP contains features and design provisions that will allow the remedy to operate and function under the variety of alterations that are being considered by the Volunteer. The

selected cleanup track for the site as specified in the ROD is Track 4 – Restricted Use, consistent with development plans for RAD I and RAD II properties and zoning.

3.0 SUMMARY OF NATURE AND EXTENT OF IMPACTED SOIL, GROUNDWATER AND SOIL VAPOR

3.1 Soil

3.1.1 RAD II

Soil samples collected as part of the RI investigation were analyzed for VOCs, SVOCs including polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenols (PCBs) and metals. Soil sampling results were compared during the RI to the NYSDEC recommended soil objectives outlined in the New York Technical Assistance and Guidance Memorandum (TAGM) 4046 as summarized below.

Subsequent to the 2007 ROD, NYSDEC issued new soil cleanup guidance in 6 NYCRR Part 375-6.8(b) and CP-51 (October 21, 2010) which replaced TAGM 4046. CP-51 does not require changing previous remedies selected based on comparisons with TAGM 4046, except as required by DER-2. DER-2 contains provisions for revising a remedy if compliance with updated/new cleanup objectives would cause a fundamental change to the scope, performance or cost of the remedy as required to protect public health and the environment.

For some compounds of interest (COIs) in soil at the site, the more recent soil cleanup objectives impose quantitative objectives that did not exist in TAGM 4046. For other COIs, the more recent objectives are less stringent or more stringent than TAGM 4046. However, despite these changes, the interpreted extent of soil at RAD II exceeding the more recent soil cleanup objectives is not different than the extents shown in Figures 6 through 9 and summarized below relative to the TAGM 4046 objectives. Therefore, the RWP has retained reference to TAGM 4046 objectives consistent with the ROD and the previously selected remedy.

Eleven VOCs were detected in subsurface soil samples above soil objectives values that are based on protection of groundwater as shown in Figure 7. However, none of the VOCs detected exceeded guidance values based on the United States Environmental Protection Agency (USEPA) human health based criteria. Five PAHs in surface soil samples and eleven SVOCs in subsurface samples were detected above the soil objectives as shown in Figures 6 and 8.

Total PCBs exceeded the soil objective in one surface sample and one subsurface soil sample. However, the detected concentrations of PCBs do not pose a significant threat to human health or the environment, and do not prohibit non-residential use of the property as allowed by federal PCB regulations provided that institutional controls and a protective cover/cap is utilized.

Seven metals in surface soil samples and thirteen metals in subsurface soil samples exceeded the soil objectives as shown in Figures 6 and 9.

Based on the following rationale, the exceedances listed above do not interfere with development plans for the site because:

- The soil objectives listed in the RI Report are based on restoration of site conditions to background, and not directly based on groundwater or human health protections. As stated in the ROD, urban fill is distributed ubiquitously across the site and adjacent properties and so the objective of restoration of background is unrealistic.
- The site is not designated for residential use and a protective cap is included as part of the site redevelopment plan. The cap will be protective of human health by restricting direct contact with compounds that exceed the soil objectives. The Site Management Plan (SMP) will identify provisions for handling and management of the capped soils that will allow subsurface excavations for utility or foundation construction without exposing construction workers or site occupants to unacceptable levels of site constituents.
- As supported by the ROD, although several chemicals in the urban fill/soil samples were above the soil objectives based on groundwater protection, the urban fill/soil to groundwater leaching pathway is not expected to pose a significant threat to groundwater given the presence of LNAPL overlying the aquifer in the vicinity of the site, and the small impacts to groundwater quality beneath the site that have occurred prior to remediation.

Additional soil samples were collected on the RAD II property during installation of LNAPL monitoring wells GAL-29 through GAL-31 described in the June 2008 LNAPL Recovery Pilot Study Work Plan. These wells were installed on July 17, 2008 and sampled at various intervals for gasoline range organics (GRO) and diesel range organics (DRO). GRO and DRO was tested in soil at these locations to compare petroleum contamination levels beneath the former area of the demolished buildings and above-ground storage tanks with the extensive data from borings and samples surrounding that area collected prior to demolition completed during the interim remedial measure. Results are summarized in Table 1, where the results of soil samples collected from borings SB-29, SB-30 and SB-31 (performed at wells GAL-29, GAL-30 and GAL-31, respectively) are summarized. These well locations are shown on Figure 3. Boring logs also containing well construction details are provided in Appendix A. The following summarizes observations made regarding the July 2008 soil analytical results:

- Generally GRO concentrations decreased from shallow to deeper intervals.
- Generally DRO concentrations increased from shallow to deeper intervals.
- Soil collected from three sample locations exhibited a range of GRO and DRO concentrations with the highest GRO concentration detected in SB-30 at a depth of 10.5-11.5 feet below ground surface (bgs) and the highest DRO concentration detected in SB-31 at a depth of 22-23 feet bgs.
- The new data were consistent with the data collected prior to the ROD, and did not reflect a concentrated source of petroleum contamination originating from this area. The results from these borings do not affect the remedy approach required for soil identified in the ROD (i.e., capping with pavement or clean soil).

3.1.2 RAD I

The majority of RAD I property is currently paved. Urban fill/soil investigations were only required by NYSDEC on the RAD II property, and not on the RAD I property. Residual contaminated surface or

subsurface soils that may be above the soil objectives are likely within the vertical and lateral limits of the residual LNAPL that may remain after the implementation of the area-wide LNAPL recovery remedy presented in the ROD.

Soil sampling was conducted on the RAD I property in connection with UST, concrete trench and sump removals from the property and the IRM report (ELM 2007) was approved by NYSDEC on January 31, 2007. Any residual contamination remaining after this IRM is restricted from human exposure by the existing surface soil and pavement materials. The ROD does not require installation of a new cap on RAD I. Institutional controls addressing any future excavations extending into the LNAPL-impacted soils on the RAD I property after LNAPL remediation is completed will be addressed in the SMP.

3.2 Groundwater

3.2.1 Background Deep Groundwater

Groundwater samples were collected during the RI investigation and in April 2011 from background deep groundwater monitoring well GAGW-04D, located upgradient of RAD II near Calvary Cemetery. These samples were analyzed for VOCs, SVOCs, PCBs, metals and general chemistry parameters. The results were compared to the (Technical and Operational Guidance Series) TOGS 1.1.1 Groundwater (Class GA) standards for drinking water, and the TOGS 1.1.1 SD standards for saline water.

Groundwater sampling results from August 2004 and April 2011 are summarized in Tables 2A through 2E and Figure 5. In 2004 or 2011 iron, magnesium, sodium and benzo(a)anthracene were detected in background monitoring well GAGW-04D above the TOGS 1.1.1 Class GA standard. Furthermore, copper, and hexachlorobenzene were detected above the TOGS 1.1.1 SD standard for saline water in background monitoring well GAGW-04D. Therefore, groundwater upgradient from the site does not meet either drinking water or saline water standards that have been referenced during prior groundwater investigations. These standards are also referenced in the ROD.

The following summarizes April 2011 groundwater quality compared with the TOGS 1.1.1 GA drinking water standard for reference, and provides a comparison with the 2004 groundwater sampling data:

- Benzo(a)anthracene was detected at a concentration of 0.031 ppb, above the TOGS 1.1.1 standard of 0.002 ppb; prior sampling events did not detect this parameter.
- Iron and sodium were detected at concentrations lower than those detected in 2004.
- Manganese was detected at a concentration greater than that detected in 2004.

Since the analytes listed above were detected in background groundwater, detections at the site of these analytes may be due to, or at least partially attributable to, local background concentrations. Furthermore, the ROD states that metals detected at the site are naturally occurring.

In addition to groundwater concentrations historically detected in monitoring well GAGW-04D, the ROD states that xylene and MTBE have been detected in upgradient groundwater samples along Review Avenue. The ROD did not attribute the presence of MTBE groundwater concentrations at the site to the past waste oil recycling activities on the RAD II property and also stated that MTBE and TCE were detected in groundwater both upgradient and down gradient of the site.

Because groundwater quality at the site has been affected by upgradient sources and background concentrations, and groundwater at the site and in the vicinity of the site will not be used as drinking water as acknowledged in Section 5.1.2 in the ROD, the groundwater criteria most applicable to site is the TOGS 1.1.1 SD standards for protection of aesthetic quality for saline surface water. However, constituent concentrations detected in groundwater have been and will continue to be compared with the TOGS 1.1.1 GA standards for drinking water for reference, as well as the applicable TOGS 1.1.1 SD standards.

3.2.2 RAD II

Groundwater samples were collected from deep groundwater monitoring wells GAGW-01, GAGW-02, GAGW-03 and GAGW-05 and shallow groundwater monitoring well GAGW-06I in August 2004 as part of the RI investigation. Groundwater samples were also collected from GAGW-01 and GAGW-06I in April 2011. Samples were analyzed for VOCs, SVOCs, PCBs, metals and natural attenuation parameters.

No constituents in groundwater at the RAD II property were detected above the applicable TOGS 1.1.1 Class SD standards, either during the RI or during the April 2011 sampling event.

During the RI investigation, six VOCs, five SVOCs and four metals were detected in groundwater at concentrations above the TOGS 1.1.1 Class GA standard examined for reference but not applicable as a groundwater remediation objective. Groundwater sampling results from both the RI investigation and the April 2011 groundwater sampling event are summarized in Tables 2A through 2E and Figure 5.

Sampling results obtained in April 2011 from monitoring wells GAGW-01 and GAGW-06I indicated comparable results or improvements in groundwater quality since the RI, as described below:

- Benzene was detected at a concentration of 2.2 µg/L (ppb), above the TOGS 1.1.1 GA standard of 1 ppb, in monitoring well GAGW-06I. This concentration is only approximately 1 ppb higher than the benzene concentration of 1.1 ppb detected in this well in 2004.
- MTBE was detected at a concentration of 14 ppb, above the TOGS 1.1.1 GA standard of 10 ppb, in monitoring well GAGW-06I. The MTBE concentration in this well decreased from 32 ppb detected in 2004.
- Benzo(a)anthracene was detected at concentrations of 0.065 and 0.061 ppb, above the TOGS 1.1.1 GA standard of 0.002 ppb, in monitoring wells GAGW-01 and GAGW-06I,

respectively. Prior sampling events did not detect this parameter. However, in April 2011, it was also detected in background groundwater monitoring well GAGW-04D.

- Iron was detected at a concentration lower than that detected in 2004 in monitoring well GAGW-01 and was detected at a concentration higher than that detected in 2004 in monitoring well GAGW-06I.
- Sodium and magnesium exceeded the TOGS 1.1.1 GA standard in monitoring well GAGW-01 at concentrations comparable to those detected in 2004.
- Manganese exceeded the TOGS 1.1.1 GA standard in monitoring well GAGW-06, at a concentration comparable to that detected in 2004.
- Groundwater concentrations of MTBE in GAGW-01 and VC and sodium in GAGW-06I, which exceeded the TOGS 1.1.1 GA standard in 2004, were not detected at concentrations exceeding the TOGS 1.1.1 GA standard in 2011.

During the April 2011 sampling event, groundwater monitoring wells GAGW-02, GAGW-03 and GAGW-05 were not sampled due to issues described in Section 2.1.1.

3.2.3 RAD I

Groundwater samples were collected from deep groundwater monitoring wells GAGW-07 and GAGW-08 in August 2004 as part of the RI investigation, and in April 2011. Samples were analyzed for VOCs, SVOCs, PCBs, metals and natural attenuation parameters.

Except for copper and hexachlorobenzene, no constituents in groundwater on the RAD I property were detected above the applicable TOGS 1.1.1 Class SD standards either during the RI or during the April 2011 sampling event. The concentration of copper detected above the TOGS 1.1.1 SD standard at GAGW-08 in April 2011 was lower than the upgradient concentration of copper detected in GAGW-04D. Also, the concentrations of hexachlorobenzene detected at GAGW-07 and GAGW-08 in April 2011 were lower than the upgradient concentration detected in GAGW-04D. LNAPL at the site has not been identified as a source of copper or hexachlorobenzene in groundwater.

During the RI investigation, two VOCs, and three metals (iron, magnesium and sodium), were detected in groundwater above the TOGS 1.1.1 Class GA standards for drinking water, examined for reference but are not applicable as a ground water remediation objective. Groundwater sampling results from both the RI investigation and the April 2011 groundwater sampling event are summarized in Tables 2A through 2E and Figure 5.

Sampling results obtained in April 2011 from monitoring wells GAGW-07 and GAGW-08 indicated some improvements in groundwater quality for some constituents since the RI as described below:

- MTBE was detected at concentrations of 33 and 30 ppb in the sample and the field duplicate collected from monitoring well GAGW-08, a decrease from the MTBE concentration of 240 ppb detected in this well in 2004.

- Benzo(a)anthracene was detected at concentrations of 0.026 ppb and 0.032 ppb, above the TOGS 1.1.1 GA standard of 0.002 ppb, in monitoring wells GAGW-07 and GAGW-08, respectively. Benzo(a)anthracene was not detected in groundwater samples collected in 2004. Prior sampling events did not detect this parameter. However, in April 2011, it was also detected in background groundwater monitoring well GAGW-04D.
- Iron was detected at concentrations lower than those detected in 2004.
- Magnesium and sodium exceeded the TOGS 1.1.1 GA standard at concentrations greater than those detected in 2004, which also was noted to have increased in background groundwater monitoring well GAGW-04D.
- Groundwater concentrations of TCE, which exceeded the TOGS 1.1.1 GA standard in 2004, were not detected at concentrations exceeding the TOGS 1.1.1 GA standard in 2011.

3.3 LNAPL

During RI activities, LNAPL samples were collected throughout the site and analyzed for various parameters as summarized in Table 3. LNAPL viscosities and specific free product volume differ in different areas of the RAD I and RAD II properties. Based on these viscosity differences, three conceptual site LNAPL viscosity zones were identified and presented in the ROD. LNAPL viscosity ranges decrease from Zone 1 to Zone 3 as shown in Figure 10. The specific LNAPL (free product) volume at each LNAPL monitoring well (i.e., the total volume of LNAPL per unit area) was also calculated by Golder in the RI (Appendix L, Golder, 2005a) and the FS (Figure 16, Golder, 2005b). Figure 16 from the FS is also provided in Appendix B, because the specific LNAPL volume was a factor considered during the selection of the LNAPL extraction technology configuration presented in Figure 10 and described in Section 5 of this RWP.

It is noted that the specific LNAPL (free product) volume represents the total of both mobile (i.e. recoverable) and residual (i.e., immobile and largely unrecoverable) LNAPL. Modeling of LNAPL mobility performed using physical parameters collected during the RI and FS calculated that at least 25% of the total LNAPL volume (reflected by the specific LNAPL (free product) volume) is residual and unrecoverable using any of the technologies. However, areas with larger specific LNAPL volumes generally contain larger amounts of recoverable LNAPL, with higher viscosities of LNAPL requiring higher energies to extract LNAPL from soil pore spaces.

LNAPL samples from GAL 01/01R, GAL-02 and GAL-03 that exhibited PCB concentrations above 50 mg/kg (ppm) are located within Zone 1, and have been conservatively extrapolated to occur in Zone 2 on the RAD I and RAD II properties within approximately 50 feet of Zone 1. These levels of PCBs and LNAPL extracted from this area will be classified as PCB liquids with concentrations greater than 50 mg/L and will require separate extraction, handling, storage and disposal for treatment by incineration as required under the federal Toxic Substances Control Act (TSCA) regulations at 40CFR part 761.60(a). LNAPL measured at monitoring wells elsewhere on the site outside of Zone 1 exhibited a maximum PCB

concentration of 34 ppm. Therefore, this LNAPL will be extracted and handled separately and will not require incineration or be subject to TSCA regulations for PCB liquids. Additional information explaining how this data and the LNAPL zones were used to develop the site remedy is provided in Section 5.4. LNAPL sampling activities conducted since the ROD was issued are described in Sections 3.3.1 and 3.3.2. Additionally, comparisons of apparent LNAPL thicknesses measured between 2004 and 2011 are provided in these sections.

3.3.1 RAD II

LNAPL monitoring wells GAL-29 through GAL-31 and vacuum enhanced recovery (VER) well VER-2 were installed on RAD II in conjunction with the pilot study activities discussed in Section 4.0. The locations of these wells are shown on Figure 3. LNAPL in these wells was sampled in 2008 and analyzed for viscosity, density, surface tension and interfacial tension. A summary of the LNAPL physical property data collected from RAD II, including comparison with data presented in the RI report, is provided in Table 3. The LNAPL viscosities measured in these wells were consistent with the range of viscosities in Zone 2.

LNAPL apparent thickness measurements were recorded on July 24 and August 31, 2004, June 20, 2008, August 7, 2008, and April 14 and 27, 2011 and are presented in Table 4A. General observations made by comparing apparent thickness and viscosity measurements over time are:

- LNAPL thickness in LNAPL monitoring wells measured in 2008 differed from those measured in 2004 by less than one foot, and generally showed a small decrease in thickness over time with a maximum apparent thickness of about 7 feet detected in 2008 (OW-1 located in Zone 1). Apparent LNAPL thickness has varied in wells among various sampling events and is affected by fluctuations in groundwater level. Therefore, consistent with the findings of the RI and FS, LNAPL on site has remained stagnant over the 7 year period of monitoring.
- It appears that the LNAPL plume gradient on RAD II has remained stable or slightly decreased during the approximately seven years since the RI. This supports the finding in the RI that the driving force for LNAPL migration is continuing to dissipate naturally.
- It appears that the LNAPL viscosity in the southern part of RAD II near the pilot test location (well VER-2) measured after the pilot test is even higher (170 cSt) than the maximum viscosity in LNAPL Recovery Zone 1 (120 cSt) presented in the FS and referenced in the ROD. VER-2 was also installed in the area containing larger apparent thicknesses of LNAPL in Zone 1. Testing during the RI had detected a large range of viscosities in Zone 1, and the viscosity at VER-2 only increases the range previously detected. Because the LNAPL conductivity and migration velocity is inversely proportional to the viscosity, the LNAPL flow velocity in Zone 1 near VER-2 is even lower than the very low velocity of less than 0.1 ft/yr calculated for this Zone in the RI.

Additional information regarding LNAPL characteristics and recoverability on RAD II is provided in Section 4.0.

3.3.2 RAD I

LNAPL was sampled in VER-1 in 2008 and analyzed for viscosity. VER-1 was installed in conjunction with the pilot study activities discussed in Section 4.0 LNAPL was also sampled in well GAL-21 in 2008 and analyzed for viscosity. A summary of the LNAPL physical property data collected from RAD I, including data presented in the RI report, is provided in Table 3.

LNAPL apparent thickness measurements were recorded on July 24 and August 31, 2004, June 20, 2008, August 7, 2008, and April 14 and 27, 2011 and are presented in Table BE. General observations made by comparing apparent thickness and viscosity measurements over time are:

- LNAPL thickness in RAD I monitoring wells measured after the RI were generally within 0.2 feet of that measured during the RI, with a maximum apparent thickness in the monitoring wells of about 4 feet. The VER-1 pilot test well appears to have been installed in the thicker area of LNAPL on RAD I.
- The LNAPL viscosity measured in the VER pilot test area on RAD I after the pilot test (48 cSt) is in the viscosity range in LNAPL Recovery Zone 2 presented in the FS and referenced in the ROD.
- It appears that the LNAPL plume on RAD I has remained stagnant during the approximately seven year span since the RI, and the specific LNAPL (free product)volumes, conductivity and flow velocity calculated in the RI have not changed significantly.

Additional information regarding LNAPL characteristics and recoverability on RAD I is provided in Section 4.0.

3.4 Soil Vapor

3.4.1 RAD II

The selected remedy in the ROD required investigation of the potential soil vapor pathway on the unpaved RAD II property. It also required evaluating the potential for soil vapor intrusion offsite, including a study performed on the adjacent (off-site) former Phoenix Beverage property. These two soil vapor investigations summarized below.

A soil vapor survey was performed in October 2008 by Geosyntec Consultants, Inc. (Geosyntec) on the RAD II property. The results were reported in a document titled Phase I Soil Vapor Investigation Report (Geosyntec 2008), which was submitted to NYSDEC. The major findings of this report were:

- The COIs in soil vapor samples exceeded conservative residential screening levels used for the study.
- COIs were substantially lower in samples collected along the Phoenix Beverages property boundary compared with those collected near the Preston Street boundary of the RAD II property.

Geosyntec conducted the Phase II investigation in December 2009 on the adjacent Phoenix Beverage Property. The results of soil vapor samples collected from paved locations outside of the building on that property were reported in a document titled Phase IIA Soil Vapor Investigation Report (Geosyntec 2010a), which was submitted to NYSDEC and NYSDOH.

The Phase IIA report concluded that concentrations of COIs were below the USEPA Generic Screening Levels (10^{-4} risk) with the exception of benzene, 1,3,5-trimethylbenzene (TMB) and 1,2,4-TMB in sampling location SV-22, and naphthalene in SV-20. However, the report stated that the attenuation factors used to derive the soil vapor screening levels are highly conservative for the site conditions. The report also noted differences between the COIs detected on RAD II and on the Phoenix Beverages properties, which indicated that soil vapor beneath the RAD II property is not migrating off-site to the Phoenix Beverages property. The report also identified the potential that sources outside of the RAD II property may be responsible for the soil vapor COIs detected in soil vapor on the Phoenix Beverages property.

Because of elevated concentrations of methane detected on the Phoenix Beverages property, an indoor screening study was performed and found no evidence of migration of soil vapors containing methane into the building on the Phoenix Beverages property.

3.4.2 RAD I

As stated above, the ROD required a soil vapor intrusion study (Data Gap Investigation) on the RAD I property. This Data Gap Investigation was performed by Geosyntec in October 2010 to investigate baseline soil vapor conditions on the RAD I property and assess the potential for soil vapor intrusion concerns within buildings existing on the RAD I property. This investigation is summarized below.

The soil vapor survey collected baseline soil vapor conditions beneath the RAD I parcel at 10 paved locations outside of the existing building perimeters. The results were reported in a document titled Review Avenue Development I Property Soil Vapor Investigation Report (Geosyntec 2010b).

The soil vapor survey detected methane and concentrations of several VOCs in soil gas at the sample locations. The VOC concentrations in shallow soil vapor were generally lower than the concentrations measured in deeper soil vapor samples collected a short distance above the top of the LNAPL layer. The report concluded that despite RAD I being covered with a lower permeability pavement, concentrations of COIs measured along the boundary of the RAD I property were substantially lower than concentrations previously measured on the unpaved RAD II property. The report indicated that elevated concentrations of COIs in soil vapor on the RAD II parcel have limited affect on the RAD I parcel (i.e., soil vapor is not migrating from RAD II to RAD I). Instead, the source of soil vapor on RAD I is likely the LNAPL located typically 15 to 20 feet below the pavement surface. Although methane at levels of concern was measured

in 16 of the 20 soil vapor samples, methane was not detected in indoor air during an indoor screening study by Geosyntec, with the exception of methane detected at levels below concern associated with the sewer system in Building No. 2.

After review of the Geosyntec reports, NYSDOH requested a sub-slab soil vapor investigation in Building No. 2 on the RAD I property in a March 8, 2011 letter. NYSDOH noted detection of vinyl chloride and trichloroethene in soil vapor at levels of concern near the buildings. NYSDOH did not require indoor air sampling in Building No. 2, as numerous chemicals are used during daily activities inside the building. NYSDOH indicated that unless current activities in Building No. 2 change, indoor air sampling at Building No. 2 will not be required. NYSDOH also determined that a sub-slab soil vapor investigation was not necessary at Building 1, based on current ventilation conditions and activities in this building.

3.4.3 RAD I – Building No. 2

The vapor intrusion (VI) investigation was conducted on July 28, 2011 per the NYSDOH March 2011 request. Work was conducted in general accordance with the NYSDOH Guidance for Evaluating Soil Vapor Intrusion in the State of New York, dated October 2006, and Golder's Vapor Intrusion Sampling Plan letter dated June 24, 2011 and submitted to NYSDEC and NYSDOH.

Three soil vapor samples were collected in the basement of the Building No. 2. The results of this investigation were provided to NYSDOH and NYSDEC on September 27, 2011.

4.0 SUMMARY OF LNAPL PILOT STUDY ACTIVITIES

The LNAPL plume at the site exhibits varying physical and chemical properties that affect its mobility and recoverability. A conceptual site model that divides the site into three zones based on LNAPL viscosity data and specific free-product volume collected from site LNAPL monitoring wells was presented in the ROD. Zone 1 on RAD II exhibited the highest LNAPL viscosity and largest specific free product volume. Zones 2 and 3 exhibited progressively lower LNAPL viscosities and specific free product volumes. Each zone has different characteristics that affect the recoverability of LNAPL using single or multiple phase technologies. Generally, the viscosity of LNAPL on the RAD I property is less than that measured on the RAD II property, with the viscosity increasing towards Zone 1 to the south.

Due to the various viscosities and soil conditions, pilot studies were conducted to determine the effectiveness of the alternative technologies being considered in the remedy selected in the ROD, so that the configuration and combination of the technologies could be determined for this RWP to achieve the objectives associated with LNAPL remediation. Pilot studies were performed for single-phase (in-well skimmer), and multi-phase (vacuum enhanced recovery or "VER") LNAPL recovery. Furthermore, plans were developed to include examining whether ground heating could efficiently reduce LNAPL viscosity and enhance the speed of LNAPL recovery without exacerbating soil vapor conditions.

As noted in the RI and FS reports, two skimmer tests were completed in 2004, and the results were presented in those reports. Section 4.1 below summarizes the skimmer pilot test results. In 2008, two VER LNAPL recovery pilot tests were conducted, and the results were discussed with NYSDEC in December 2010. Section 4.3 presents the results and a summary of findings for the two VER tests, and Appendix B contains data on LNAPL recovery and VER operation collected during the two VER tests. Although infrastructure was installed for the pilot-level examination of ground heating as a further enhancement for LNAPL recovery (Test C), the performance of this test was abandoned because of soil vapor conditions in the highest viscosity zone where ground heating was being considered. The circumstances leading to the abandonment of Test C are described in Section 4.4.

4.1 Single Phase LNAPL Recovery

An LNAPL pilot test was conducted on RAD II in LNAPL monitoring well GAL-07 in March 2004 to assess the recoverability of intermediate-viscosity LNAPL (45 cST, within the range of Zone 2). A second pilot test was conducted on RAD II in June and July 2004 at GAL-02, where LNAPL viscosity (118 cST) was measured to be near the upper range for Zone 1. The pilot tests indicated that a pneumatically operated specific-gravity skimmer pump operated in a passive recovery mode can recover LNAPL from both Viscosity Zone 1 and Viscosity Zone 2. The pilot test at GAL-07 was conducted for an approximately 5-week period and recovered 1,300 gallons of LNAPL. The pilot test at GAL-02 was conducted for an approximately 2-week period and recovered 200 gallons of LNAPL. Observation wells were not installed

for the test GAL-02, and therefore the zone of influence for skimming in Viscosity Zone 1 was not assessed. Observation wells were installed up to about 9 feet from the skimmer well for the test performed at GAL-07. A draw down of 1 foot was measured during the test in the furthest observation well, resulting in a conservative estimate of the radius of influence for skimming recovery at the upper range of viscosity in Zone 2 of about 15 feet. The rate of recovery measured at the end of the two-week pilot test in the higher viscosity Zone 1 LNAPL at GAL-02 was about 10 gallons per day (GPD), compared with a sustained recovery rate of 25 GPD at the end of the 5-week pilot test in LNAPL at the upper range of Zone 2 viscosity.

Based on LNAPL analytical results and the single-phase recovery pilot studies conducted in 2004, the ROD concluded that a large portion of the LNAPL volume onsite occurs as non-recoverable residual LNAPL trapped in the soil pore spaces. The majority of the LNAPL mass was considered to be stable and naturally contained due to the high viscosities, low LNAPL gradients, and the groundwater mound located down gradient of the RAD II property at the South Capasso property.

4.2 Dual Phase LNAPL Recovery

A dual phase LNAPL recovery pilot testing program examining vacuum-enhanced recovery (VER) technology was initiated in 2008, after the submission and NYSDEC approval of the June 2008 LNAPL Recovery Pilot Study Work Plan. This work plan proposed three LNAPL pilot tests to examine the radius of influence (ROI), vacuum requirements, and the air, groundwater (drawn up into the suction tube as a by-product of LNAPL removal) and LNAPL extraction rates for comparison with the single phase extraction technology. The pilot testing would also provide data necessary for the design of a full-scale VER multi-phase extraction system (including requirements for handling vapor and groundwater also extracted with the LNAPL).

The three pilot tests described in the Work Plan are summarized below.

- Pilot Test A – Vacuum enhanced recovery test conducted on the paved RAD I property in the vicinity of LNAPL monitoring wells GAL-11 and GAL-21, where the viscosity of the LNAPL is at the upper end of the range of viscosity in Zone 2 and the specific free product volume is relatively large in comparison with other portions of the RAD I property.
- Pilot Test B – Vacuum enhanced recovery test conducted on the unpaved RAD II property in the vicinity of LNAPL monitoring wells GAL-16 and GAL-2, where LNAPL viscosity is at the upper range of viscosity in Zone 1, and the specific free product volume is large in comparison with other portions of the RAD II property.
- Pilot Test C – Vacuum enhanced recovery test with thermal enhancement in the same VER well as Pilot Test B, to evaluate if soil-heating is needed to enhance VER in LNAPL Zone 1 and can be performed without increasing the risk for soil vapor impacts.

Consistent with the approved pilot study work plan, one VER well (VER-2), one LNAPL monitoring well (PSMW-2), seven thermal enhancement wells (TE-1 through TE-7), four vapor and temperature monitoring probes (MP-1 through MP-4), and three vapor monitoring probes (VMP-1 through VMP-3) were installed on RAD II. One VER well (VER-1) and one LNAPL monitoring well (PSMW-1) were installed on RAD I.

4.3 Test A and B Summary

4.3.1 Test B Summary

Due to coordination issues associated with the RAD I site, the first test conducted was Pilot Test B, which was performed on RAD II from August 26, 2008 through August 29, 2008. The results of the pilot test are summarized below.

Pilot Test B was conducted in two phases: Phase 1 – Step Tests and Phase 2 – Longer Duration Test. During Phase I, different system configurations were assessed to determine the optimal configuration for Phase 2. Analysis from the field data from Pilot Test B showed the following:

1. The LNAPL volume extracted during the test was calculated based on the ratio of oil to water extracted from the high viscosity LNAPL in the Test B area (Appendix B, Figure 1B). The estimated sustained LNAPL extraction rate with adjustment to reduce the volume of groundwater extracted with the LNAPL was 29 GPD, or 0.02 gallon per minute (GPM). This was a significant improvement over the sustained extraction rate of 10 GPD encountered in the single phase pilot test in the same area of the site, especially when considering that the LNAPL viscosity extracted during the VER test was more than 40% higher than the LNAPL viscosity extracted with the single phase skimmer well.

2. The average groundwater extraction rate during the longer-duration test was 1.5 GPM. Adjustment of the suction tube as a result of step testing resulted in a groundwater extraction rate that was lower than the rate of 3 GPM estimated in the FS. The total volume of groundwater extracted (including during the step-tests phase) was 4,165 gallons (Appendix B, Figure 3B).

3. The highest ratio of oil to water extracted during the test was 1.7%, and the mean ratio maintained during the longer-duration test was 1.25%. The highest oil-to-water ratio (i.e., most efficient operation setting during the test) was obtained by applying a vacuum pressure at the liquid-ring pump at 25 inches mercury (25" Hg) with a drop tube depth of 16’-11" below the test reference measuring point (BMP), and a groundwater extraction rate of 1.4 GPM.

4. The vacuum head at the liquid-ring pump was maintained at approximately 26” Hg and the resulting vacuum head at VER-2 (annulus) was 8.5 inches water (8.5" H2O) (Appendix B, Figure

2B). The pressure measured at VER-2 reflects a moderately permeable soil formation in the vicinity where the higher viscosity LNAPL was extracted during Test B. Based on the results from the step-tests, it appears that using a larger liquid-ring pump to impose a higher vacuum pressure would not obtain an appreciable increase in vacuum head at VER-2 (i.e., a larger pump than that used for the pilot test will likely not improve results at the full scale).

5. The vacuum head measured at monitoring wells surrounding VER-2 exhibited a rapid decrease of vacuum head with increased distance away from the extraction point/VER-2 (Appendix B, Figure 4B). The radius of vacuum influence (the pneumatic ROI, which Golder evaluated to be the distance at which the vacuum head is higher than 0.5" H2O), was approximately 20 feet during the longer-term test. The pneumatic ROI indicates that soil vapors under unpaved ground conditions are captured within 20 feet of the extraction point. It is expected that the pneumatic, ROI in Zone 1, and consequently the LNAPL extraction ROI in Zone 1, would be much larger under a paved surface condition as observed in Test A reviewed below.

6. The use of a standard oil/water separator, followed by use of modified-organic clay to polish the water after separation, was found to be inefficient. This is especially important for operation in Zone 1, where the LNAPL is classified as a PCB liquid and solid wastes generated from treatment of the liquid may also require disposal at a TSCA or RCRA permitted facility. The process of vacuum extraction emulsifies the oil/water mixture, requiring increased detention time and efforts for the extracted liquid to separate into two phases. This finding both during Test B and Test A has lead to the use of larger tanks and other measures incorporated into the treatment approach described in Section 5.4.4

4.3.2 Test A Summary

Prior to the commencement of Pilot Test A, the VER system was rinsed with potable water to remove PCB liquid residues. After rinsing, the VER system was connected to recovery well VER-1, and the modified-organic clay and the granulated activated carbon used in the groundwater pretreatment system for Test B was replaced with new material. Pilot Test A was conducted September 3, 2008 through September 6, 2008. Step and Longer Duration Tests were conducted during Pilot Test A in a manner similar to Pilot Test B. The field data from Pilot Test A indicated the following:

1. The LNAPL volume extracted during the test was evaluated based on the ratio of oil to water observed during the test (Appendix B, Figure 1A). The sustained LNAPL extraction rate was 48 GPD, or 0.03 GPM. As expected for the lower viscosity LNAPL located in Zone 2, application of VER in Zone 2 extracted LNAPL at a rate higher than in Zone 1.

2. The mean groundwater extraction rate maintained during the long-duration test was 0.93 GPM. The total volume of water extracted (including during the step-tests phase) was 2,401 gallons. This indicates that extraction of the lower-viscosity LNAPL in Zone 2 can be performed with a smaller quantity of extracted groundwater compared with Zone 1.

3. The highest ratio of oil to water observed during the test was 3.1%, and the mean ratio maintained during the long-duration test was 2.2%. The highest oil-to-water ratio was obtained by applying a vacuum head at the liquid-ring pump at 19 "Hg with a drop tube depth of 13'-3" BMP and a groundwater extraction rate of 1.2 GPM. During the longer-duration test, it was possible to operate the system with a groundwater extraction rate of about 1 GPM. This is a relatively small increase of the oil to water ratio for VER extraction from Zone 2 compared with Zone 1.

4. The vacuum head at the liquid-ring pump was maintained at approximately 20 "Hg and the resulting vacuum head measured at VER-1 was 6 "H2O. The vacuum head measured at VER-1 reflects a moderately permeable soil formation (which was also the case for the soil formation tested at RAD II).

5. Vacuum head measured at the monitoring wells surrounding VER-1 confirmed a decrease of the vacuum head with increasing distance from VER-1 (Appendix B, Figure 4A). However, the pneumatic ROI for Test A at RAD I was about 50 feet, which is much larger than the pneumatic ROI at RAD II. This was attributed to pavement cover at the Test A location facilitating the propagation of the vacuum beneath the pavement a larger distance from the extraction point. The pavement cover planned to contain soils at RAD II is expected to increase the pneumatic ROI at RAD II to a level comparable to that measured during Test A at RAD I.

4.3.3 Test A & B Findings

The VER pilot test indicated that VER was successful in recovering the higher viscosity LNAPL. The VER recovery rate for LNAPL with viscosity 170 cST of 29 GPD exceeded the recovery rate of single phase extraction of 25 GPD in LNAPL with viscosity 45 cST. Furthermore, the ROI for VER in an unpaved area for LNAPL with viscosity 170 cST (Zone 1) after 1 day of operation (20 feet) was larger than the ROI measured during more than one month of single phase extraction with viscosity 45 cST (Zone 2). Although the VER operation was adjusted to improve on the oil to water ratio estimated in the RI, VER was still a relatively inefficient method, considering that the optimum oil to water ratio in the extracted liquid was about 1% to 2%. Extracted groundwater impacted by emulsification is a costly waste by-product requiring treatment before disposal (groundwater extraction is not required in the remedy selected in the ROD). An important finding was that LNAPL with a viscosity of 170 cSt was still recoverable at a

rate comparable to single phase extraction of LNAPL with viscosity more than three times lower. Additional findings from the VER test data presented herein, are:

- The measured pneumatic ROIs and LNAPL capture ROIs were within the ranges predicted in the Feasibility Study Report (Golder Associates, July 2005). However, the LNAPL capture ROI did not appear to be significantly affected by the large LNAPL viscosity differences between the intermediate and highest viscosity zones. Therefore, ground heating to reduce LNAPL viscosity from the Zone 1 to Zone 2 condition would not likely increase the LNAPL capture ROI. Instead, paving the currently unpaved surface on RAD II will have the biggest impact on improving the efficiency of VER.
- The actual rate of groundwater capture during pilot testing at both RAD I and RAD II was less than the 3 GPM predicted in the FS Report, However, notable volumes of wastewater will still be generated by VER application due to the extraction oil to water ratio of about 1% to 2%. Area-wide application of VER would generate extremely large volumes of groundwater requiring a large treatment plant and appropriately sized infrastructure able to convey 1 GPM to 2 GPM generated from each VER extraction well.
- The pretreatment systems implemented during pilot testing for treating groundwater were capable of treating water to non-detect levels for volatile organic chemicals and semi-volatile organic chemicals. A lesser level of treatment than granular activated carbon polishing may be possible for acceptance of discharge to the POTW. However, the method for standard oil-water separation followed by organic clay polishing used during the pilot test is too inefficient for use at the full-scale, due to the projected generation of large volumes of solid waste treatment residuals requiring disposal as a TSCA-regulated waste for LNAPL classified as a PCB liquid. The design of extracted liquids treatment includes provisions for a more cost-efficient approach for oil-water separation than used during the pilot tests.

Field data collected during the tests is provided in Appendix B. Appendix B also contains Figure 1 showing the Pilot Test area, Table 1B and Figures 1B through 4B associated with Pilot Test B, and Table 1A and Figures 1A through 4A associated with Pilot Test A. Appendix B also includes Figure 16 from the FS, which shows the specific free product volume calculated for LNAPL monitoring wells.

4.4 Test C Summary and Proposal to Cancel Ground Heating Pilot Testing

Test C was scheduled to be performed on the RAD II property shortly after Tests A and B. However, Test C was postponed indefinitely when soil vapor readings collected by Geosyntec in October 2008 unexpectedly discovered soil vapor levels in the Test C area that were already at elevated concentrations before ground heating. These levels related both to specific volatile organic chemical constituents, as well as potentially explosive methane levels.

Compared with the vapor monitoring safeguards to protect against the possible generation of elevated soil vapor concentrations as a result of ground heating, pre-heating soil vapor levels were already at levels requiring shut-down of ground heating for concerns of unacceptable deterioration of soil vapor quality. As indicated in the ROD, soil heating would be considered only if needed to overcome potential technical limitations for implementing VER in high viscosity areas, or possibly to reduce recovery

completion time-frames to accommodate redevelopment schedules. Ground heating would also not be considered if it increased the potential for short-term migration of either LNAPL or constituents of interest in either the aqueous or air phases.

On November 22, 2010, NYSDEC (NYSDEC, 2010c) recommended suspending Test C and proceeding with the completion of a remedial action work plan/remedial design without ground heating pilot testing. NYSDEC recommendation to suspend Test C was due primarily to the promising results of Tests A & B, and also consideration of NYSDEC's guidance document DER-32, Green Remediation. Therefore, it is proposed that ground heating pilot testing plans be cancelled, and ground heating pilot test infrastructure that cannot be used for VER extraction be removed for the following reasons:

- VER has been demonstrated to be effective in extracting the highest viscosity LNAPL without ground heating;
- Ground heating would not likely increase the capture efficiency of VER. Pavement proposed to address soil contamination will be much more effective in improving VER efficiency;
- VER and single phase applications have been developed to coordinate with development use (parking) in the areas where it will be applied during the expected duration of implementation. Ground heating would not likely reduce this timeframe.
- Ground heating poses a strong risk for degradation of existing soil vapor concentrations. Although elevated concentrations have been detected on RAD II, soil vapor investigations have determined that the soil vapor levels are not migrating off-site. Ground heating would likely increase the flux of COIs entering into soil vapor and disturb the current equilibrium, increasing the risk for off-site migration.

The data collected from Pilot Tests A and B, and pilot testing of single phase extraction during the RI, have been used to develop the recommended combination and configuration of technologies proposed for LNAPL extraction described in Section 5.

5.0 DESCRIPTION OF REMEDIAL ACTION

5.1 Summary of Remedial Action Objectives

The remediation goals for the site stipulated by the ROD are to eliminate or reduce to the extent practicable:

- the presence of LNAPL as a potential source of soil, groundwater and soil gas contamination;
- potential further migration of LNAPL that could result in soil, groundwater or soil gas contamination;
- exposures of persons at or around the site to VOCs or exceedance of the lower explosive level (LEL) in soil vapor;
- the potential for ingestion/direct contact with contaminated soil; and
- the release of contaminants from the urban soil and LNAPL into groundwater that may create exceedances of groundwater quality standards over time.

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

- ambient groundwater quality standards and
- SCGs for soil.

As discussed in Section 1, the ROD presents a summary of the selected remedy. Two elements of the selected remedy, demolition and proper disposal of onsite building and tanks (Element No. 3), and investigation of the potential for offsite soil vapor intrusion (Element No. 9) have been completed as discussed in earlier sections of the RWP, with the results submitted in separate reports. The following sections of the RWP discuss the remaining remedial action elements proposed for the site in further detail.

5.2 Urban Fill / Soil

5.2.1 RAD II Cover

Section 3.1 reviews soil concentrations that were detected above TAGM 4046 soil objectives established during the RI and summarized in the ROD. As presented in the ROD, a selected remedy for RAD II is to cover (cap) the property by either a paving system at least 6 inches thick, or a 2-foot clean soil cover for vegetated areas. The cap is intended to be protective of human health by restricting direct contact with compounds that exceed the soil objectives for restricted use found in Subpart 375.6 Remedial Program Soil Cleanup Objectives (NYSDEC(b)).

As discussed in Section 2, the current development plans for the RAD II property is a parking lot. Therefore, the proposed cap is an asphalt pavement system as depicted in Figures 15 and 16. The minimum pavement system will be 6 inches in thickness and will designed and constructed to

accommodate medium volume/commercial traffic and associated vehicle loads following applicable pavement design guidelines.

Figures 15 and 16 depict conceptual site grades and stormwater management and pavement details. The subgrade for the new cap will be graded to slope from the front of the property (Review Avenue) to the rear using the existing crushed concrete and stone surface materials. The current conceptual plan reflects the general existing slope of the crushed concrete and stone surface, with cuts and fills below and above the existing surface grade within 1 to 2 feet. The final design of the cap will refine these grades with the intention of balancing the cuts and fills to reduce or eliminate the import of new fill or removal of existing material. This may involve minor adjustments (typically less than two feet) from the top of remediation cap contours shown on Figure 15.

The final surface of the urban fill in any unpaved landscaped areas will be identified with a geotextile marker layer as shown on Detail 2 on Figure 16 and as required by the ROD. To support medium volume use typical of a commercial property, it is expected that a 6-inch thick layer of clean imported crushed aggregate consistent with local pavement standards for medium volume pavements will be placed atop the regraded and compacted urban fill subgrade surface, prior to construction of the pavement, as shown on Detail 1 on Figure 16.

Stormwater runoff from the paved cap surface will be collected in an underground detention chamber located in the southwest portion of the site, with the accumulated water pumped via an underground force main to the municipal storm water system pipeline located along Review Avenue. The electric submersible pump and controls will be designed to operate in an atmosphere where soil vapor levels might accumulate above 20% of the lower explosive limit. Alternatively, the chamber may be equipped with safeguards to protect against soil vapor intrusion from the underlying LNAPL. The preferred approach will be determined during design considering safety, long-term maintenance and cost. The sizes, elevations and locations of the stormwater management piping, chamber and tank details will be determined during design and application for stormwater discharge permits from the local permitting authorities. Other details such as landscaping and electrical lighting will be resolved during the permitting phase of the design as referenced in the schedule (Figure 17).

The final design and constructed limits of the RAD II cap will be addressed in the final Site Management Plan (SMP) and environmental easement/institutional controls addressing future activities after completion of remedy construction. This would be prepared with the Remedial Action Construction (RA) Completion Report issued after completion of cap construction (see Figure 17). The Interim Site Management Plan provided in Section 6.3 addresses requirements for management of contaminated soil disturbed during remedy and development construction activities prior to the issuance of the RA Completion Report

5.2.2 RAD I

The majority of the RAD I property is currently paved. As discussed in Section 3.1.2, urban fill/soil investigations were only required for the RAD II/former Quanta Resources property, and not the RAD I property. Any near surface contamination in urban fill soils that may be above the applicable soil cleanup objectives will also likely overlie the limits of the residual LNAPL area on RAD I that will be addressed by the LNAPL recovery remedy element. The current depth below ground surface to the top of the LNAPL-impacted portion of the subsurface soil is approximately 15 to 20 feet below the ground surface on RAD I. During LNAPL recovery well construction of RAD I, this depth will be refined using visual methods, and the final Site Management Plan will reference an environmental easement on RAD I addressing excavations that might encounter LNAPL-impacted soils. Consistent with the ROD, the RWP does not require installation of a cap on RAD I as a remedy element. However damage to the existing asphalt during construction of LNAPL remediation elements will be repaired as part of remedial activities.

5.3 Groundwater Long-Term Monitoring

5.3.1 RAD II

The remedial action selected in the ROD for groundwater requires institutional controls that restrict the use of untreated groundwater as a source of potable water, and a long term monitoring program to monitor the effectiveness of the LNAPL recovery system.

As stated in the ROD, a remediation goal is to attain to the extent practicable ambient groundwater quality standards. The ambient groundwater quality standard is the TOGS 1.1.1 SD standard, and this is being achieved even in the site's unremediated condition for site-related constituents (exceedances of copper and hexachlorobenzene appear to be related to upgradient, off-site conditions). Appendix E presents a program for aqueous phase groundwater quality monitoring. This program includes monitoring of deeper groundwater monitoring wells installed during the RI (see wells identified in the table and figure provided in Appendix E). Existing wells that will be used for groundwater monitoring during remediation on the RAD I and RAD II properties will be redeveloped when appropriate.

Wells on RAD II that are not proposed for inclusion in future monitoring will be grouted and sealed consistent with NYSDEC guidelines. During the remedial action, shallow excavations will be performed to expose the well riser pipes at the locations of the eight LNAPL monitoring wells that appear to have been damaged during the interim remedial actions (see Section 2.1.1), and measures will be taken to grout and seal the remaining well casings. Two monitoring wells proposed to be used for groundwater quality monitoring during the remedy implementation are located downgradient from RAD II. Access was not obtained to sample these wells during the April 2011 monitoring event. When access is obtained, the conditions of these wells will be examined, the wells will be sampled and the results will be reported to

NYSDEC in a letter. If necessary, well development or repair will be performed to allow these wells to be utilized during future monitoring.

The need for continuing groundwater monitoring after substantial completion of LNAPL extraction will be addressed in subsequent monitoring reports, based on data collected during the remediation period.

5.3.2 RAD I

The groundwater monitoring program during LNAPL remediation will include one well (GAGW-08) on RAD I, located within the Preston Street access roadway easement. This well will be preserved during any development changes planned for the access roadway, or moved by the Volunteer outside of the access road improvements limits. Use of this well is included in the groundwater monitoring plan included in Appendix E.

5.4 LNAPL Recovery

The ROD identified area-wide LNAPL recovery via a combination of single-phase (skimmer), vacuum-enhanced recovery (VER) and possibly localized soil heating LNAPL recovery methods as the appropriate strategy to implement at RAD II (identified as Alternative F in the FS). Based on subsequent correspondences and discussions with NYSDEC regarding the favorable results from the VER pilot test, and concerns with soil heating, the soil heating component of the remediation strategy will not be implemented. Soil heating infrastructure that cannot be utilized during VER implementation will be removed to avoid interference with the cap and stormwater management features shown on Figures 15 and 16 (see also Section 4.4). The proposed full-scale LNAPL recovery system will consist of VER and skimmer wells to collect LNAPL throughout RAD II and portions of RAD I.

A conceptual site model that divides the site into three zones based on LNAPL viscosity data and specific free-product volume[2] collected from site LNAPL monitoring wells was presented in the ROD with Zones 1 through 3 reflecting decreasing LNAPL viscosities and specific free product volume. Each zone has different characteristics that affect the recoverability of LNAPL using single or multiple phase technologies, and the layout, design, and operation of the LNAPL recovery system in each zone. A description of each LNAPL recovery zone is presented below.

- LNAPL Recovery Zone 1 (Zone 1) – This zone includes the area having the highest measured LNAPL viscosities (measured between approximately 45 and 170 cSt), and specific free-product volumes with an average of approximately 0.87 cubic feet of LNAPL per square foot of LNAPL-impacted site area. This occurs within the lower, southwestern portion of the RAD II property and a small portion of the adjacent RAD I property as shown on Figure 10. LNAPL sampled from this zone has also been found or conservatively extrapolated to contain PCB concentrations greater than 50 ppm,

[2] The specific free-product volume can be viewed to represent the approximate volume of LNAPL in cubic feet within a 1-foot by 1-foot area around a monitoring well. This total volume comprises a non-mobile portion (residual phase) that is bound within the soil matrix and a potentially mobile portion (free phase).

classifying the LNAPL as a PCB liquid. The boundary of this zone is approximate and was interpolated from data collected at the LNAPL ("GAL") monitoring wells.

- LNAPL Recovery Zone 2 (Zone 2) – This zone includes areas having moderate viscosities (ranging from approximately 30 to 50 cSt), and specific free-product volumes with an average of approximately 0.33 cubic feet of LNAPL per square foot of LNAPL-impacted area. This zone generally covers the remainder of the RAD II property and the southern portion of the RAD I property as shown on Figure 10. LNAPL recovered from this zone is expected to have PCB concentrations less than 50 ppm, based on previous monitoring data.
- LNAPL Recovery Zone 3 (Zone 3) – This zone includes areas having low viscosity (ranging from approximately 20 to 30 cSt), and specific free-product volumes with an average of approximately 0.09 cubic feet per foot of LNAPL-impacted area. This zone generally covers the central portion of the RAD I property as shown on Figure 10. LNAPL recovered from this zone is expected to have PCB concentration less than 50 ppm, based on previous monitoring data.

The proposed remedial action for LNAPL recovery includes installation of VER wells in Zone 1, VER and single-phase (skimmer) recovery wells in Zone 2, and skimmer wells in Zone 3. The main purpose of utilizing two types of recovery wells is to recover LNAPL area-wide to the extent practical, and support achieving the remediation goals listed in Section 5.1 above together with the other remedy elements. The limits of utilizing the VER technology also considered the desire to limit the volume of groundwater extracted by VER application that would require separation, treatment and disposal to the POTW, in recognition of conserving resources while still maintaining environmental responsiveness. The layout and details of the active VER and single phase applications and infrastructure are shown on Figures 10, 12 and 13. Provisions for using selected LNAPL extraction wells as part of post-remediation monitoring would be addressed in the RA Completion Report (see Figure 17 and Section 6.4).

The following subsections discuss the specific remedial action for LNAPL recovery on RAD I and RAD II and provide information on the proposed LNAPL recovery systems on each of the properties.

5.4.1 RAD II

LNAPL recovery on RAD II will utilize VER and skimmer pump technologies as generally depicted on Figure 10. Twenty (20) VER wells will be installed in Zone 1 and the portion of Zone 2 adjacent to Zone 1 on RAD II. LNAPL beneath the remaining portion of Zone 2 on RAD II will be addressed utilizing twelve (12) skimmer wells. Although the pilot test results indicate that skimmer wells are capable of recovering LNAPL with viscosities over 100 cSt as found in Zone 1, the proposed pneumatically-powered skimmer technology will be used to extract LNAPL in viscosity ranges consistent with Zone 3 and the middle to lower viscosity range in Zone 2.

The area selected for VER recovery represents the portion of the site with the highest viscosities and moderate to high specific free-product volumes. This area is also where the recovered LNAPL has been extrapolated from prior data to potentially contain PCB concentrations in excess of 50 ppm, which will

require separate handling and disposal from LNAPL beneath the remainder of the site. LNAPL with known PCB concentrations near or above 50 ppm (i.e., PCB liquids) will be segregated from LNAPL with PCBs less than 50 ppm. In accordance with TSCA, off-site disposal of the LNAPL PCB liquids will require incineration, while LNAPL with concentrations of PCBs less than 50 ppm may be disposed or recycled using less expensive methods. It is important to note that in paved areas, the pneumatic ROI for VER recovery of LNAPL and soil gas is expected to extend an estimated 50 feet beyond the outer rows of VER wells.

The area selected for skimmer pump recovery represents the portion of the site where the LNAPL was determined to have low to moderate viscosities and specific free-product volumes, and where the recovered LNAPL is expected to contain PCB concentration less than 50 ppm.

The VER extraction wells will discharge the extracted mixture of LNAPL, groundwater and soil gas using a network of pipes connecting the wells as generally shown schematically on Figure 10 and Figure 13. The piping will connect to the VER control system, and separate LNAPL separation/management and groundwater and soil vapor management systems at the LNAPL recovery and groundwater treatment building that will be located in the eastern part of RAD II fronting Review Avenue. The handling and management of extracted LNAPL, soil vapor and groundwater are addressed in Section 5.4.4.

Piping connecting single phase extraction wells (compressed air powering the pumps and piping conveying extracted LNAPL) to controls within the proposed treatment building will be separate from the VER piping and LNAPL management systems.

The specific routes and depths of the piping will be determined during further design coordination with development planning. These will be determined during the final design of the LNAPL extraction and conveyance system.

Due to the favorable VER pilot test results, the VER technology will be employed to the extent practical without applying localized soil heating. The decision to remove soil heating as a potential technology is consistent with the ROD for the reasons stated in Section 4.4. It is also consistent with NYSDEC's Green Remediation guidance document DER-31. The proposed remedial action includes removing the seven soil heaters (temperature elements), monitoring devices and controls during remedial construction activities. The determination of the practical time limits for employing the VER and single phase technologies on an area-wide basis is addressed in Section 5.6.

5.4.2 RAD I

LNAPL recovery on RAD I will primarily consist of utilizing the pneumatically-powered skimmer pump technology where shown on Figure 10. Twenty-six (26) skimmer wells will be installed in a portion of

Zone 2, and in Zone 3 on RAD I. The area selected for skimmer wells represents the portion of the site with low to moderate viscosities, low to moderate specific free-product volumes, and where the recovered LNAPL is expected to contain PCB concentration less than 50 ppm which will not require special handling and disposal. Ten (10) VER wells will be installed on RAD I. The piping systems for the single phase and VER extraction systems on RAD I will be separated as indicated above for RAD II. However, LNAPL, groundwater and soil vapor extracted by VER wells on RAD I will be interconnected with the piping for VER wells on RAD II, and will be managed and treated together with RAD II materials in the treatment building located on RAD II. The depth of the pipelines crossing the Preston Street easement will be addressed during the final design of the LNAPL conveyance system.

The portion of the RAD I located north of Zone 3 has been extrapolated to not contain LNAPL as provided for in the ROD, and therefore recovery wells are not proposed on RAD I beyond the estimated limits of Zone 3. It is important to note that the ROI of the skimmer wells in this lower viscosity zone is likely to be larger than the approximately 15-ft ROI measured during pilot testing of single-phase recovery.

5.4.3 Adjacent Property Expansion (Phoenix Beverage)

As shown on Figure 16 in Appendix B, which is taken from the FS (Golder, 2005b), the remedial investigation completed for RAD II indicated the presence of LNAPL in wells installed on the Phoenix Beverage Property located adjacent to the RAD II property. The Remedial Investigation Report (Golder, 2005a) concluded that lateral migration from RAD II onto the Phoenix Beverage Property is expected to be limited. It may be beneficial to extend the LNAPL extraction onto the Phoenix Beverage Property to facilitate LNAPL recovery. This could be accomplished by installing VER wells on the Phoenix Property directly, and managing the extracted LNAPL with the proposed storage and treatment system planned on RAD II. Expansion of the LNAPL extraction system onto the Phoenix Beverage Property, however, would require access onto the Phoenix Beverage Property. Also, further analysis of the LNAPL extracted from that property would be needed to identify any potential impacts that LNAPL and extracted water would have on the treatment system under design.

5.4.4 LNAPL Recovery Systems

5.4.4.1 VER System

VER involves the application of a high vacuum and air flow rates, through a subsurface extraction well, to enhance the recovery of LNAPL. Soil vapor, LNAPL and groundwater (inadvertently) are extracted via a common vacuum/blower system, where they are separated for treatment and disposal. As a result of the vacuum enhanced LNAPL recovery using VER, a wider radius of influence can be achieved, and the well spacing can be consequently larger in higher viscosity LNAPL areas relative to Single-Phase LNAPL Recovery Wells, as confirmed during pilot testing.

Estimated radius of influences (ROI) up to 25 feet were observed on the unpaved RAD II property, and ROIs up to 60 feet were observed on the paved RAD I property during the pilot studies. The proposed spacing between VER wells of 50 feet includes overlapping of ROIs of the wells, especially after constructing the pavement cap on RAD II. The schedule shown on Figure 17 indicates that the extraction wells and piping would be installed prior to grading and paving of RAD II. The well heads will be protected with precast concrete man-ways that will be constructed so the top elevation of the man-way can be adjusted to match the final pavement elevation. The piping depth will be selected so that it is below the limits of grading (cuts and fills) that will be needed for cap construction. The piping will be designed so that it will not be damaged by the weight and vibration of equipment that will be used for construction of the final cap, and the vehicles traversing the surfaces of RAD I and RAD II.

In the interior of the site, the spacing of the wells will vary from 50 feet to a maximum spacing of 100 feet depending on site constraints and requirements. For example, it may be necessary to adjust well locations shown on Figure 10 to allow construction of subsurface stormwater management infrastructure on RAD II. It is proposed that such changes to well alignments be documented in further permitting and construction record documents, but changes in VER well spacing will not require prior review with NYSDEC provided that the spacing needed to avoid planned or existing infrastructure does not exceed 100 feet.

All VER wells will be drilled using a conventional hollow-stem auger drilling techniques similar to those used to install the successful pilot test wells. The wells will be constructed using 4-inch diameter, or larger, PVC well screen and riser pipe, in accordance with standard well installation practices (silica sand filter pack with appropriate seals). The screen will extend from below the LNAPL/groundwater interface to above the LNAPL capillary fringe. Figure 13 provides a schematic of a typical VER well. An adjustable-length drop suction tube would be initially positioned directly above the LNAPL/groundwater interface and a vacuum applied to promote recovery. Vacuum enhanced pumping creates a cone of reduced pressure (vacuum) around the well, resulting in a pressure induced gradient from the relatively higher pressure areas in the formation beyond the well to the lower pressure inside the well. When the LNAPL level declines in the well below the top of the screen, the drop tube draws in soil vapor (vapor extraction) and promotes air movement and aerobic biodegradation processes (bioventing) in the vadose zone.

When the developed vacuum creates a slight localized rise or mounding in the shallow groundwater-table elevation, the drop tube inadvertently collects some groundwater. The drop tube elevation can be adjusted during operation to reduce groundwater withdrawal, and vapor extraction rates also can be controlled by adjusting the vacuum and air flow rates. Groundwater extraction is not required (or intended) for effective operation of a VER system. However, some groundwater removal is inevitable, particularly in higher permeability materials where vacuum and air flow rates can be high. As determined during pilot testing, the optimum oil to groundwater recovery ratio to obtain the design ROI was about

1.5% to 3%, resulting in groundwater extraction rates of between 1 GPM and 1.5 GPM at each operating VER well. However, it is expected that the oil to groundwater extraction ratio will decrease with time as the system extracts the more mobile LNAPL in the highly variable LNAPL mass, and encounters reduced efficiency when extracting less mobile LNAPL. This behavior will be addressed during the evaluation of the practical application of VER (see Section 5.6).

A liquid ring vacuum pump(s) or alternative high-vacuum blowers and associated control systems will be used to impart the required vacuums and draw the required air flows across the installed recovery wells. Extracted vapors will be separated from the liquids and treated using vapor phase activated carbon. Other vapor phase treatment processes may be needed as determined during detailed design and permitting. Treatment will be performed as necessary to comply with applicable air emissions permit requirements.

Extracted liquids will be separated prior to groundwater treatment. Extracted groundwater will be pretreated to the extent necessary, prior to disposal via a piped connection to the publicly-owned treatment works (POTW) operated by NYCDEP via the subsurface municipal sewer utility adjacent to the site. Recovered product would be collected in aboveground storage tanks for subsequent characterization and off-site disposal as described above. A schematic layout and conceptual process diagram for a VER blower and multi-phase treatment system is provided on Figure 14.

The operation of the VER extraction wells will be “pulsed.” Pulsing will be controlled automatically, with initial pulsing cycling the operation of the wells in 10-well zones every 4 to 6 hours. The capacity of groundwater pretreatment operations in the treatment building and discharge quantities being conveyed to the municipal system will be planned accordingly. It is expected that one third of the installed 30 VER wells will be operated at any given time. Pulsing of the system as planned will optimize system performance, provided sufficient equilibration periods and control groundwater removal rates. Such pulsing allows for changes in LNAPL levels within the ROI, and repeated extraction and resaturation of LNAPL-impacted soil, which will improve the efficiency of LNAPL removal. The designed overlapping of well ROIs (i.e., spacing for an ROI of 25 feet instead of greater than 50 feet expected below pavement as demonstrated during the pilot test), combined with pulsing, has been proposed to reduce the duration of VER operation and groundwater extraction. ”Fine tuning” of VER system operation including pulsing frequency, suction tube adjustment and other operation parameters to optimize initial performance will occur during an initial three week start-up period provided for in the schedule shown in Figure 17. It is likely that pulsing frequency will be changed along with readjustment of vacuum applications during continued full-scale operation, within the flexibility accommodated in the VER system as proposed herein. Monitoring of system operation parameters, potential adjustments, and documentation of system operation area are outlined in Section 6.4. Section 6.4 also addresses monitoring of treatment and discharge of groundwater and soil vapors that are by-product wastes of VER LNAPL extraction.

5.4.4.2 Single-phase LNAPL Recovery

The proposed use of specific gravity skimmers and pneumatically-driven product recovery pumps installed in recovery wells is based on well accepted and conventional technologies. Pilot testing conducted during the RI demonstrated site-specific effectiveness for intermediate (and therefore also lower) LNAPL viscosities, and provided the data and information necessary to complete a final design and establish operating requirements for the subsurface conditions tested.

Skimmer wells are proposed to be installed in the portions of Zone 2 where LNAPL viscosities were measured to be generally in the middle to lower range of viscosities in that Zone. The measured LNAPL viscosities from Zone 3, where skimmer wells are also proposed to be placed, are between approximately 20 and 30 cSt, well below the viscosity (45 cST) where single phase extraction was indicated to operate efficiently during the RI pilot test. As discussed in Section 4.0, LNAPL recovered from monitoring well GAL-07 (45 cSt) indicated an ROI of approximately 15 feet. However, ROIs in Zone 3 and portions of Zone 2 are expected to be larger because of lower viscosities. Therefore, the typical 50-ft spacing between wells reflects an ROI of 25 feet.

Skimmer wells will be drilled using a conventional hollow-stem auger drilling techniques and constructed using 4-inch diameter, or larger, PVC well screen and riser pipe, in accordance with standard well installation practices (silica sand filter pack with appropriate seals). Pneumatic specific gravity skimmer pumps, driven by a common compressor(s) located in the treatment building on RAD II, would be installed in each well to remove free LNAPL entering the well. LNAPL flow into the single-phase recovery wells is induced by the local gradient between the lowered LNAPL in the extraction well and the higher LNAPL immediately outside of the well. The cone of depression created by the skimmer wells will draw mobile LNAPL toward the wells within the ROI. The skimmer pumps are designed to pump only LNAPL, thereby eliminating the need for groundwater handling and/or treatment systems.

Routine monitoring of system performance will be carried out throughout system operations, and is outlined in Section 6.4.

5.4.5 Pretreatment and Disposal of Groundwater Separated from Extracted LNAPL

Figure 10 shows an LNAPL Recovery and Groundwater Treatment Building (recovery and treatment building) in the east corner of the RAD II property near Review Avenue. The purpose of this building is to house the aboveground equipment necessary for site-wide LNAPL recovery. Based on conceptual engineering, the approximate footprint of the building is 40 feet wide by 100 feet long. The recovery and treatment building will be a pre-engineered metal building constructed on a concrete slab. The exterior walls of the building will be light gauge steel panels. The interior of the building will be insulated and heated, include a hazardous classified area and a non-classified area to segregate the process equipment that generates or stores flammable liquids or gases (e.g. LNAPL/water separator) from

equipment or areas that will not process flammable liquids or gases (e.g. air compressor or a parts room). The building will be constructed in accordance with national, state and local requirements, including the New York City Construction Codes[3] and New York City Fire Code[4]. The recovered LNAPL product, TSCA and non-TSCA regulated, will be stored in separate aboveground steel tanks located outside of the main building, in a secondary containment area.

Figure 14 depicts a conceptual process flow diagram (PFD) for VER recovery, separation, LNAPL storage, vapor management and groundwater treatment. The VER process will include a separator tank between the air (gas)-liquid separator and the LNAPL/separator assembly. The tank will be sized to provide for a minimum of 20 minutes of hold time, include an internal heating coil to warm the liquid to improve the efficiency of separation of the emulsified liquid, and gravity flow into an oil-water separator assembly. The LNAPL accumulated in the separator assembly will be transferred to the aboveground steel tank located in the secondary containment area and stored separate from the LNAPL product recovered by the pneumatic skimmer pumps. The accumulated water from the separator assembly will be pretreated and discharged to a sanitary sewer system that drains to the Bowery Bay Water Pollution Control Plant (WPCP) operated under permit by NYCDEP.

The effluent limitation criteria for discharging groundwater into a sanitary sewer system is found in Table A (Limitations for Effluent to Sanitary or Combined Sewers) included in the Wastewater Quality Control Application (form WQ-D-001, Rev. 4-6-10). Based on Table A's criteria, and the site's groundwater quality, the recovered groundwater will need to be pretreated to address VOCs, total suspended solids, non-polar materials and PCBs prior to discharge. Additional pretreatment criteria can be imposed by NYCDEP based upon its review of the completed Wastewater Quality Control Application.

5.4.6 LNAPL Temporary Storage and Disposal

The site-wide LNAPL recovery will include separate storage and handling systems to segregate the TSCA regulated material recovered from the VER wells from the non-TSCA material recovered from the skimmer wells. Two aboveground steel tanks, installed outside of the recovery and treatment building, will be located within a secondary containment area covered by a canopy to reduce the accumulation of rainwater. The tanks will be constructed, installed and tested in accordance with NYC Fire and Building code requirements.

Each tank will be equipped with a level gauge, level sensors to indicate high level and high-high level conditions, vacuum and pressure relief devices, vents and means for transferring the tank's contents to a

[3]The New York City Construction Codes consist of four technical volumes – the New York City Building Code (BC), Plumbing Code (PC), Mechanical Code (MC) and the Fuel Gas Code (FGC) – and one administrative volume – the Administrative Code (Title 28), which contains permitting, licensing, fees and other provisions that apply universally to the four technical volumes.

[4]The New York City Fire Code, based on the International Fire Code published by the International Code Council, with amendments reflecting the specific requirements unique to the city.

DOT-approved tanker truck for transportation to an approved disposal or recycling facility. Each level sensor will be integrated to the control system to notify the Contractor implementing the recovery system when a tank has reached a high, or high-high level condition. A high-high level condition will also shutdown the associated LNAPL recovery system (i.e. VER or skimmer system) to address a potential overfill condition. The procedure for empting an LNAPL storage tank to a tanker truck will be a manual process and require Contractor involvement and oversight.

In accordance with TSCA regulations, off-site disposal of the LNAPL PCB liquids will require incineration, while LNAPL with concentrations of PCBs < 50 ppm may be disposed or recycled using less expensive methods.

5.5 Soil Vapor

The remediation goal in the ROD addressing soil vapor is to protect against exposures of persons at or around the site. The results of soil vapor investigations on both the RAD I and RAD II properties did not identify a threat for migration of soil vapor laterally from the limits of LNAPL. These studies indicated that the vertically-upward migration of soil vapor from LNAPL is affected by several factors including the volatility of the COIs, local variations in the porosity of the urban fill, and the air permeability of the surface cover (e.g., pavement on RAD I, temporary soil/crushed concrete surfacing on RAD II, or existing concrete slabs in buildings on RAD I). At locations where differences in COI concentrations were examined with increasing distance from the LNAPL surface (located typically 15 to 20 feet bgs), many COI concentrations were found to attenuate with increasing distance from the LNAPL, while others did not attenuate closer to the ground surface.

Based on unremediated conditions, and current building conditions and use on RAD I, NYSDEC and NYSDOH has required a sub-slab soil vapor assessment for Building 2. NYSDEC and NYSDOH have determined that such an assessment is not required for Building 1 at this time. The assessment for Building 2 is being addressed with NYSDEC and NYSDOH separately from this RWP.

Therefore, the remedy approach for addressing soil vapor is to assess the location and development-specific exposures to potential on-site receptors based on the soil vapor conditions existing at the time of exposure. Mitigation measures will be taken associated with the specific building conditions to protect against exposure to unacceptable levels of VOCs and methane gas. Mitigation measures will consist of engineering controls such as soil vapor barriers and sub-slab depressurization measures for existing or potential new buildings on the RAD I property. Institutional controls/environmental restrictions will be used on the RAD II property, where development plans are limited to a parking lot.

The interim Site Management Plan in Section 6 addresses safeguards that will be required to protect workers during intrusive subsurface remediation or development work on RAD I or RAD II involving

excavations or underground utility structures extending more than two-foot below the existing ground surface. These will include engineering controls involving vapor barriers or ventilation, and/or work procedures and equipment protecting worker safety in potentially flammable atmospheres in subsurface space.

The final Site Management Plan (SMP) that will be submitted with the proposal to terminate area-wide LNAPL recovery (see Section 5.6) will update the interim Site Management Plan included in Section 6. The updated SMP will be based on soil vapor conditions existing at the time area-wide LNAPL extraction is proposed to be terminated, and will address procedures for the use of engineering and institutional controls to address potential future on-site exposures to soil vapors associated with residual LNAPL.

5.6 LNAPL Recovery Endpoints

The implementation of the remedial action described above will address the remediation objectives and the recovery of LNAPL required for the remedy selected in the ROD. During pilot testing, the recovery rate for intermediate viscosity LNAPL using a single phase recovery well was about 25 GPD after about one month of operation, and the initial recovery rate from a VER well within the high to medium viscosity range tested was about 30 GPD to 50 GPD, depending on viscosity. Based on the combination of systems proposed in this RWP, approximately 950 GPD would be extracted initially from the proposed number of skimmer wells, and approximately 300 to 500 GPD would be extracted initially by the pulsed VER wells. Allowing for a 90% operating efficiency to include occasional shut-down for normal maintenance, the technology combination and layout proposed in this RWP is expected to initially remove LNAPL consistent with the predictions referenced in the ROD for Alternative F.

However, it is expected that the LNAPL recovery rates measured during pilot testing for both single phase and VER technologies will decrease during the progress of recovery. This is because the most mobile LNAPL will be extracted initially, and the less mobile LNAPL will exhibit a lower extraction efficiency. While the ROD speculates that an asymptotic extraction rate signaling the termination of active LNAPL recovery may be realized after two years, the actual time when an asymptotic rate will be encountered cannot be predicted with accuracy at this time. Therefore, it is proposed that the “asymptotic” rate of LNAPL recovery be determined during system operation. This “asymptotic” rate would be the rate at which further operation of the area-wide application would no longer be practical, and at which further operation would be terminated provided that the other remedial objectives in the ROD have been achieved.

At the time the Contractor implementing the recovery system believes an asymptotic recovery rate has been achieved, the LNAPL recovery operation results will be submitted with a proposal to NYSDEC for “shut-down” approval. Important to the determination of shut-down is the protection against further migration of LNAPL, protection against exposures of persons to soil gas generated by the LNAPL, and

protection against release of contaminants from LNAPL into groundwater that would degrade groundwater below the ambient (upgradient) quality standards.

It is important to note that under current conditions prior to beginning area-wide LNAPL extraction:

- Soil vapor has not been found to migrate off-site from the RAD II property, and either existing or new buildings constructed over the LNAPL being remediated can be protected, if necessary, by sub-slab depressurization methods;
- Groundwater is not being impacted by existing LNAPL to worse than upgradient ambient water quality;
- Evaluation of the existing LNAPL during the FS and subsequent pilot testing found that the LNAPL mass is stable and not migrating (see Section 5.4 in the ROD).

During area-wide LNAPL recovery, the performance of the LNAPL recovery system will be evaluated, and adjustments may be made to optimize LNAPL recovery. Periodically, performance characteristics (metrics) will be evaluated to determine the LNAPL recovery system's overall performance and if remedial objectives (i.e. goals) have been achieved, or if the system has reached the practical limits (i.e. asymptotic conditions) to effectively recovery LNAPL in a sustainable manner. The performance metrics to be tracked will include:

- Vacuum pressures and air flow rates at VER well heads
- Drop tube depths and adjustments
- Total LNAPL gallons recovered (separately for single phase and VER systems)
- Total groundwater extraction quantity and rates
- LNAPL/water recovery ratio
- Vapor recovery rates
- Decline curve analysis (LNAPL/time)
- Trend analysis groundwater extraction
- Unit cost/gallon LNAPL recovered
- Electrical power consumption /LNAPL recovered
- Levels and properties of LNAPL as reflected by LNAPL monitoring at preserved "GAL" wells described in Appendix E and shown on Figure 10, including plotting changes in apparent thickness over time

The collected data will be used to update the calculation of specific LNAPL free product volume during the progress of remediation at each monitoring well, and to determine asymptotic conditions appropriate for NYSDEC shut-down approval.

When the performance metrics indicate that area-wide LNAPL recovery is achieving the stated objectives, and has reached asymptotic conditions, the Volunteer will propose to NYSDEC that active area-wide recovery be terminated. The LNAPL recovery and monitoring wells and underground conveyance lines

utilized during the area-wide LNAPL recovery will be abandoned following appropriate agency guidance documents (e.g. NYSDEC CP-43: Groundwater Monitoring Well Decommissioning Policy). The proposal for terminating area-wide LNAPL recovery will also include the procedure for dismantling and removing remediation structures, including the treatment building, storage tanks, subsurface conveyance piping and extraction wells that will not be used for future monitoring. The schedule and procedures for decommissioning the area-wide recovery infrastructure will consider future site development requirements.

After the first year of operation of the area-wide system (as defined by the anniversary date of Final Engineering Report submittal to NYSDEC), the Volunteer will provide a progress report to NYSDEC. This report will provide a record of the performance metrics listed above, the operation efficiency of the system, changes to operations that occurred during the first year to improve efficiency, and groundwater extraction quantities and trends. Data collected during the first year operation at extraction and monitoring wells will be used to model LNAPL mobility using the methods presented in the RI and FS, and will document improvements that have been recognized during the first year of operation. The report will propose for the following 6-month period one of the following alternatives:

- Continued operation for the following 6-month period at the same parameters and settings, or
- Modified operation to improve efficiency within the design and permit capacities of the constructed system for vacuum levels, groundwater extraction quantities and treatment, and vapor extraction and treatment, or
- Termination of the system if “asymptotic” recovery has occurred based on plotted trends, and if the remedy objectives have been achieved.

After the first year progress report, subsequent reports would be prepared and submitted at 6-month intervals, with operation of the area-wide system being terminated after two years of operation if remedial objectives associated with protection against human exposures and protection against off-site migration are satisfied at that time.

5.7 Permitting/Approvals Requirements

The following is a list of permits or approvals that will be required prior to construction of the various remedy components associated with LNAPL extraction, collection, by-product treatment and discharge, and the cap construction on RAD II:

- SPDES General Permit GP-02-01 from NYSDEC for Stormwater Discharges from Construction Activities;
- NYC Bureau of Water and Sewer Operations approvals for water quality and quantity for discharge of pretreated groundwater separated from LNAPL to the local combined sewer POTW (Bowery Bay Water Pollution Control Plant);

- Sewer connection permit for discharge of paved cap runoff to the combined sewer;
- Permits from NYC Fire Department for above-ground storage tanks (ASTs) for temporary storage of separated LNAPL (separate tanks for VER and single phase well networks);
- Air Emissions Permit for discharge of treated soil vapor from the VER system from NYCDEP;
- Construction, plumbing and electrical permits for the LNAPL Recovery and Groundwater Treatment Building from the NYC Department of Buildings office covering Long Island City.

The coordination of permit applications and approvals with the proposed project schedule is addressed in Figure 17. Soil erosion and sediment control features will be implemented during each stage of the remedy following guidelines and procedures required by the local conservation district. This will include such measures as staked silt fencing at the limits of ground disturbance; catch basin inlet protections; stabilized construction entrances to protect against tracking soil on vehicle tires outside of the work areas; dust controls, and other temporary controls preventing transport of soil or sediment from work areas during expected storm events. The local authorities require submittal of a soil erosion and sediment control plan for approval when the disturbance exceeds the threshold size. The details of the appropriate control features will be included in the submitted plans for approval by the local authorities.

6.0 ADDITIONAL REMEDIAL ACTION COMPONENTS

6.1 Health and Safety Plan

A site-specific HASP prepared for personnel involved with monitoring remedial activities, sampling, and quality assurance is included in Appendix C. This HASP has been prepared in accordance with most recently adopted and applicable general industry (29CFR 1910) and construction (20CFR 1926) standards of the Federal Occupational Safety and Health Administration (OSHA), U.S. Department of Labor, as well as other applicable Federal, State, or local applicable statutes or regulations. It provides general health and safety information to others who may be involved with the implementation of the Remedial Action. However, this HASP does not suffice as the remedy or development contractors' construction HASPs. It only provides information for reference in those HASPs.

Contractor Site-specific HASPs providing Job Safety Analyses reflecting the labor, equipment and means and methods the contractors will use to implement the remedy will be submitted to the Volunteer prior to mobilization to the site for remediation work. The Remediation Contractor's Site-specific HASP will also reflect coordination with on-site activities and operations by tenants not involved in the remediation. Copies of HASPs, prepared by the Remedial Contractor or others, will be provided to the NYSDEC for informational purposes prior to commencement of work, and will be included in the Remediation Construction Completion Report.

The Interim Site Management Plan addresses potential disturbance of contaminated soils by development contractor(s) subsequent to the implementation of the remedy. In summary, disturbance of soils below the as-built elevation of the final pavement cap or geotextile marker layer on RAD II may require health and safety measures to protect construction workers against exposures to contaminated on-site soils. On RAD I, disturbance of soils below the top of the residual LNAPL layer (greater than 15 feet below the ground surface) will also require health and safety measures.

6.2 Community Air Monitoring Plan

A site-specific Community Air Monitoring Plan (CAMP) prepared for personnel involved with monitoring remedial activities, sampling, and quality assurance is included in Appendix D. The CAMP is intended to monitor the effectiveness of fugitive soil vapor or dust emissions control measures utilized during the disturbance of contaminated soils during remediation efforts, and to document the control measures are providing protection against fugitive soil vapor or dust emissions outside of the immediate work areas. Information on air monitoring for worker respiratory protection within the work areas is provided in the HASP.

The Volunteers' Remediation Contractor will implement the CAMP at the site during the construction activities associated with the remedial action outlined in the RWP. The Volunteers will require that the

Remediation Contractor control its activities to protect against excursions from the levels in the CAMP in any areas on the site occupied by on-going uses (e.g., tenant activities on RAD I and temporary parking on RAD II). The Remediation Contractor will be responsible for the implementation of the CAMP and will have direct communication with all Remedial Action subcontractors, the site's tenants, and adjacent property owner (or tenants) as necessary to coordinate its work and protect against migration of fugitive dust or vapors. Soil vapor extracted during VER application will be treated, discharged and monitored as required by the conditions of the air discharge permit.

Based on previous investigations and intrusive activities conducted at the RAD II property, volatile organic compounds (VOCs), methane and particulates have been identified as contaminants of potential concern relevant to the CAMP. Community air monitoring protection levels in the CAMP are consistent with the guidelines in Appendices 1A and 1B in DER-10.

6.3 Interim Site Management Plan During Remedy Construction and Area-wide LNAPL Extraction

6.3.1 General

The ROD requires the development of a Site Management Plan (SMP) to address residual contaminated soils in connection with future site development; evaluating and provisions for mitigating vapor intrusion for any buildings developed on RAD II; use restrictions, if any; and provisions for operation and maintenance of the remedy. DER-10 refers to site management as the last phase of a remedial program which begins with the Certificate of Completion (COC), following issuance of the SMP with the Construction Completion Report (CCR) and the Final Engineering Report (FER).

The purpose of site management is to provide for the safe reuse of properties where contamination will remain in place. DER-10 includes provisions for separate SMPs for the on-site remedial program (i.e., RAD II) and an off-site remedial program (i.e., RAD I). DER-10 also provides for interim site management to address activities occurring before the issuance of the COC. The Volunteer, or its Remediation Contractor, will be responsible for monitoring and documenting that the requirements of the Interim SMP are followed.

This section contains provisions for interim site management separately on the RAD I and RAD II properties while the LNAPL recovery and cap remedy components are being constructed. The interim site management provisions address:

- Protections against exposure of site occupants to residual contaminated soils and LNAPL
- Protections against exposure of site occupants to soil vapors, and
- Controls on site use to avoid conflict with remedy operation and handling of contaminated materials during operation of the LNAPL recovery system.

Contractors responsible for the construction of the remediation activities will be responsible for monitoring that its activities comply with the requirements of the interim SMP, and that its activities are being managed to provide the needed protections during ongoing site use. Weekly (during construction) to monthly (during system operation) progress meetings will be held on-site by the Contractor during remedy system construction and operation to review the effectiveness of its controls, and this will be documented in the meeting minutes prepared after each meeting. The Project Coordinator will be responsible for monitoring that any plans for changes in site activities by the occupants or users of RAD I or RAD II are being communicated with the Remediation Contractor. The Project Coordinator will also be responsible for reviewing the progress meeting minutes and providing monthly progress reports to NYSDEC. The progress reports will address interim site management being performed during construction and the implementation of the proposed LNAPL extraction system and construction of other remedy elements, such as the cap.

The Interim Site Management Plan will be amended to include site management activities during operation and maintenance of the LNAPL recovery system in the Construction Completion Report

The controls and provisions described in the following sections will be coordinated with the implementation of the HASP and the CAMP.

6.3.2 Residual Contaminated Soil and LNAPL

6.3.2.1 RAD II

The following Remedial Action or site development activities that could involve disturbance of contaminated soil or residual LNAPL within the property boundary limits on RAD II, and associated site management controls, are listed below. NYSDEC will be notified by the Project Coordinator two weeks in advance of any planned disturbance either for remediation or development activities on RAD II:

- Trenching or grading below the bottom of the crushed concrete parking
  - Personnel potentially exposed to the contaminated soils will require personal protective equipment and work area monitoring consistent with the requirements of the HASP. Such workers will require HAZMAT training under 29 CFR 1910.120.
  - The activities will require implementation of the CAMP.
  - Exclusion zone taping will be required to demarcate the limits of work disturbing or stockpiling the subsurface contaminated soils, and equipment surfaces contacting the soils will require decontamination before leaving the exclusion zone limits.
  - Erosion and sediment controls will be employed to prevent soil from disturbed contaminated areas from migrating to uncontaminated surfaces being used by site activities occurring during remediation.
  - Contaminated soils/urban fill excavated from RAD II above the top of the LNAPL layer may be reused without sampling and testing for backfilling of excavations and

regrading below the crushed aggregate subbase below pavement or the geotextile marker below landscaping shown respectively in Details 1 and 2 on Figure 16. During the final design of the RAD II remediation cap shown on Figure 15, a drawing will be prepared establishing the final surface elevation of regraded urban fill and existing crushed concrete surface materials within the RAD II property limits, in coordination with development plans. Excess soils that cannot be reused on RAD II below the pavement subbase will be staged atop a polyethylene layer and containment perimeter berm for sampling and characterization. If considered for reuse on another site, the materials shall be sampled at the frequency required in DER-10 Table 5.4(e)10. Samples shall be tested for VOCs, metals, SVOCs and PCBs. If planned for disposal at an off-site permitted landfill/disposal facility, the testing requirements shall be as required by the facility's permit.

- Fill imported from off-site for final vegetated soil cover, crushed aggregate pavement subbase, or piping or stormwater management structure bedding/backfill shall be from a virgin source with testing as required by DER-10 Section 5.4(e)4, with a minimum of two VOC discrete samples and one composite sample for other parameters per source, and a frequency of two VOC discrete samples and one composite for other parameters for every 500 cubic yards of material in addition to the first 100 cubic yards.

- Drilling, or excavation activities extending more than 15 feet below the existing ground surface (bgs) or encountering LNAPL impacted soils above that depth;
  - Personnel potentially exposed to the contaminated soils will require personal protective equipment and work area monitoring consistent with the requirements of the HASP. Such workers will require HAZMAT training under 29 CFR 1910.120.
  - The activities will require implementation of the CAMP.
  - Exclusion zone taping will be required to demarcate the limits of work disturbing or stockpiling the subsurface contaminated soils, and equipment surfaces contacting the soils will require decontamination before leaving the exclusion zone limits.
  - Erosion and sediment controls will be employed to prevent soil from disturbed contaminated areas from migrating to uncontaminated surfaces being used by site activities occurring during remediation.
  - The specified depth for drilling of each LNAPL extraction well will be specified in a schedule that will be incorporated in the construction documents. Drilling will also be monitored by a qualified representative acting on behalf of the Volunteers to identify LNAPL impacted soils. Drilling cuttings from less than 15 feet bgs will be segregated from deeper materials, and soils visually impacted with LNAPL will be managed together with drilling cuttings from beneath 15 feet.
  - Drilling cuttings impacted with LNAPL or from a depth of 15 feet or greater bgs generated from VER wells will be segregated from other wells and managed as PCB bulk remediation waste ≥ 50 mg/kg and NYS hazardous waste and disposed off-site at a hazardous waste or TSCA-permitted landfill. Testing requirements for disposal will be as required by the disposal facility's permit. An anticipated 3 to 4 cubic yards (cy) of such material will be generated, and will be managed in DOT-approved drums or a DOT-approved bulk soil box in a marked staging area on RAD II. Temporary accumulation of the materials on-site will comply with applicable RCRA requirements, and materials will be removed from the site in less than 90-days from the time of generation from drilling. Any tenants using RAD II during remediation will be informed to avoid activities in this area.

- Drill cuttings impacted with LNAPL or from a depth ≥ 15 feet originating from single phase extraction wells (anticipated less than 1 cy) will be staged separately from other materials for off-site disposal as non-hazardous, petroleum contaminated waste. The characterization of these materials will be as required by the off-site disposal facility.
- Drill cuttings originating from a depth of <15 feet bgs from VER and single phase wells (approximately 5 cy) may be reused on-site for fill or grading below the bottom of the current crushed concrete parking surface, or may be disposed off-site at a Subtitle D permitted landfill, with characterization as required by the landfill's permit.
- Any drilling or decontamination fluids contacting LNAPL during VER well installation shall be segregated and managed as potential PCB liquids per the applicable requirements of TSCA regulations, for testing and offsite disposal. Any drilling or decontamination fluids contacting LNAPL during single phase well installation shall be managed as petroleum-contaminated fluids for testing and offsite disposal

6.3.2.2 RAD I

The following Remedial Action or site development activities that could involve disturbance of contaminated soil or residual LNAPL within the property boundary limits on RAD II, and associated site management controls, are listed below. NYSDEC will be notified two weeks in advance of any planned disturbance either for remediation or development activities on RAD I:

- Drilling, or excavation activities extending more than 15 feet below the existing ground surface (bgs) or encountering LNAPL impacted soils above that depth;
  - Personnel potentially exposed to the contaminated soils will require personal protective equipment and work area monitoring consistent with the requirements of the HASP. Such workers will require HAZMAT training under 29 CFR 1910.120.
  - The activities will require implementation of the CAMP.
  - Exclusion zone taping will be required to demarcate the limits of work disturbing or stockpiling the subsurface contaminated soils, and equipment surfaces contacting the soils will require decontamination before leaving the exclusion zone limits.
  - Erosion and sediment controls will be employed to prevent soil from disturbed contaminated areas from migrating to uncontaminated surfaces being used by site activities occurring during remediation.
  - The specified depth for drilling of each LNAPL extraction well will be specified in a schedule that will be incorporated in the construction documents. Drilling will also be monitored by a qualified representative acting on behalf of the Volunteers to identify LNAPL impacted soils. Drilling cuttings from less than 15 feet bgs will be segregated from deeper materials, and soils visually impacted with LNAPL will be managed together with drilling cuttings from beneath 15 feet.
  - Drilling cuttings impacted with LNAPL or from a depth of 15 feet or greater bgs generated from VER wells will be segregated from other wells and managed as PCB bulk remediation waste ≥ 50 mg/kg and NYS hazardous waste and disposed off-site at a hazardous waste or TSCA-permitted landfill. Testing requirements for disposal will be as required by the disposal facility's permit. An anticipated 1 to 2 cubic yards (cy) of such material will be generated, and will be managed in DOT-approved drums or a DOT-approved bulk soil box in a marked staging area on RAD II. Temporary "satellite" accumulation of the materials within drums in the exclusion zones on RAD I will occur while drilling is in progress, and after filling each drum will be transported to

RAD II for further accumulation and staging for off-site disposal in compliance with applicable RCRA requirements, and materials will be removed from the RAD II property in less than 90-days from the time of generation from drilling. Any tenants using RAD I during remediation will be informed to avoid activities in the exclusion zone and satellite accumulation areas. Because tenant activities and uses will be restricted in these areas, the layout and sequence of exclusion areas on RAD I will be reviewed with current RAD I users before the beginning of drilling on RAD I.

- Drill cuttings impacted with LNAPL or from a depth ≥ 15 feet originating from single phase extraction wells (anticipated less than 1 cy) will be staged separately from other materials for off-site disposal as non-hazardous, petroleum contaminated waste. The characterization of these materials will be as required by the off-site disposal facility.
- Drill cuttings originating from a depth of <15 feet bgs from VER and single phase wells (approximately 5 cy) may be reused on-site for fill or grading in unpaved areas if approved by the Volunteers and site tenants, or may be disposed off-site at a Subtitle D permitted (i.e., non-hazardous waste) landfill, with characterization as required by the landfill's permit. Beneficial reuse of these materials at an off-site location will be subject to characterization and other requirements in DER-10 Section 5.4(e)4.
- Any drilling or decontamination fluids contacting LNAPL during VER well installation shall be segregated and managed as potential PCB liquids per the applicable requirements of TSCA regulations, for testing and offsite disposal. Any drilling or decontamination fluids contacting LNAPL during single phase well installation shall be managed as petroleum-contaminated fluids for testing and offsite disposal.

Excess soils obtained from LNAPL extraction piping excavations that cannot be reused on RAD I may be reused on RAD II beneath the final cap based on soil characterization testing complying with DER-10 Section 5.4(e)4. Any contamination levels exceeding the concentrations in RAD II soils as presented in Figures 6 through 9 herein will not allowed to be reused below the final cap on RAD II without prior NYSDEC approval.

6.3.3 Soil Vapor

6.3.3.1 RAD II

The LNAPL Recovery and Groundwater Treatment Building that will be constructed on RAD II to support the LNAPL extraction system will be constructed over a portion of the site where elevated concentrations of VOCs and methane were detected in soil vapor. The floor slab of this building will be underlain by a soil vapor migration barrier (Liquid Boot® manufactured by CETCO or equivalent). Either interior air monitoring will be performed in the building during its use, or a sub-slab venting system will be employed. The determination of which alternative method will be used to address indoor air quality in this temporary building will be addressed during final design of the building. Details on protective measures that will be used to address indoor air quality in this building will be provided to NYSDEC and NYSDOH for approval prior to submittal to the NYC Building Department for obtaining a construction permit.

No other site management plans will be required to address soil vapors on RAD II during the remediation construction period, as no other buildings will be constructed on RAD II. Soil vapors associated with remediation activities are addressed in the HASP and the CAMP.

6.3.3.2 RAD I

The Volunteer is currently evaluating the results of a sub-slab soil vapor investigation at Building No. 2 on RAD I. Any requirements for further investigation, monitoring or the management of potential soil vapors at this Building will be coordinated with NYSDEC and NYSDOH during development of the Decision Document for this property in connection with the Brownfield Remediation Agreement for RAD I. NYSDOH has determined that no further investigation of Building No. 1 is required based on the current uses of the building. The Volunteer will notify NYSDEC and NYSDOH of any changes in the use of Building No. 1 by its existing tenant or new tenants during the period covered by this Interim Site Management Plan, prior to issuance of the Construction Completion Report.

Soil vapors associated with remediation activities are addressed in the HASP and the CAMP.

6.3.4 Site Use Controls

The Volunteer will be responsible for enforcing controls of its tenants and Remediation Contractor to comply with the requirements of the Interim Site Management Plan and RWP. The Volunteer, or its Project Coordinator, will report the status of compliance with the Interim Site Management Plan in routine progress reports that will be submitted to NYSDEC.

6.4 Operation and Maintenance of LNAPL Recovery

The operation and maintenance period for LNAPL recovery will begin after construction completion of the LNAPL extraction and piping system and the LNAPL Recovery and Groundwater Treatment Building. The specific monitoring of LNAPL handling and groundwater pretreatment will depend on the final design and actual equipment that will be employed in the building, and the requirements of the permits outlined in Section 5.7. The performance metrics that will be monitored to evaluate LNAPL recovery are listed in Section 5.6.

The final operation and maintenance (O&M) plan for LNAPL recovery will be provided with the Construction Completion Report based on the supplied and constructed components, and the results of start-up and commissioning that will occur during the 15-day period after system construction. The O&M requirements that will be addressed in the final O&M Plan will include the following:

- VER System
  - Vacuum pressure (vs. atmospheric pressure) and air flow at VER well heads
  - Liquid extraction rate (LNAPL and Water) from each pulse section of VER wells

- Drop tube depth at each well
- Vacuum compressor maintenance

- Single Phase System
  - Pneumatic pressure operating skimmer pumps
  - Inspections of pump operation and periodic maintenance program
- Soil Vapor System
  - Air flow rates at pump inlet, and air treatment inlet
  - Air discharge quality vs. permit requirements
  - Vapor treatment maintenance and media replacement and disposal
- Groundwater Pretreatment System
  - LNAPL/water separation efficiency and detention times
  - Groundwater extraction rate and LNAPL/water ratio
  - Water discharge quality and quantity vs. permit requirements
  - Treatment equipment maintenance and media replacement and disposal
- LNAPL Storage System
  - LNAPL accumulation rate VER (PCB liquids) and storage time measured at holding tank
  - LNAPL accumulation rate single phase and storage time measured at holding tank
  - Maintenance of level indicators and alarms
- LNAPL level monitoring well measurement (see Appendix E)

7.0 SCHEDULE FOR DETAILED REMEDY DESIGN AND CONSTRUCTION

Figure 17 depicts the proposed schedule for execution of the RWP. This schedule provides for the following major steps:

- NYSDEC acceptance of RWP;
- Installation of LNAPL extraction wells and underground conveyance piping;
- Receipt of permits from the NYC Bureau of Water and Sewer Operations, NYSDEC permitting bureaus, and the NYC Department of Buildings;
- Construction of an LNAPL recovery and groundwater treatment building, installation of VER equipment, groundwater pretreatment equipment, air emission treatment equipment, and commissioning and start-up of equipment;
- Installation of a remediation cap on RAD II property;
- Submission of the SMP
- Execution of Easements
- Submission of the Final Engineering Report and Construction Completion Report to document the as-built construction of the remediation elements, the plans for remedy operation and maintenance and evaluation, and incorporate the final SMP and environmental easements.

The schedule for the RWP execution depends on the timing of permits and approvals. Permit applications and communications with NYC Bureau of Water and Sewer Operations, NYSDEC permitting bureaus, and the NYC Department of Buildings are expected to proceed concurrently with NYSDEC review of this RWP. The applications would be modified if necessary based on NYSDEC comments on the RWP. It is anticipated that the Remedial Action construction could be completed in a nine to twelve month timeframe after RWP approval. Delays in receiving permits from the various agencies may result in an extended project timeframe.

Permit level designs for groundwater pretreatment, LNAPL recovery, handling and storage, and air emission treatment based on this RWP are currently being prepared. The installation of LNAPL extraction wells and final design of underground conveyance piping systems is expected to begin prior to NYSDEC approval of the RWP, and approval of the Decision Document for RAD I in connection with the separate Brownfields Agreement for that property. The designs for the recovery and treatment building and associated systems are anticipated to be completed two months after approval of the RWP. The construction of the recovery and treatment building is dependent upon receipt of permit approvals from the NYC Department of Buildings and the NYC Fire Department, and upon NYC Bureau of Water and Sewer Operations approvals for water quality and quantity for discharge of pretreated groundwater separated from LNAPL to the local combined sewer. The final design of the remediation cap and stormwater management control will begin after approval of the RWP. The construction of the cap and

stormwater management controls is contingent upon receiving approval from NYC Bureau of Water and Sewer Operations to accept the site's stormwater.

The schedule presented in Figure 17 was developed with the intention of receiving a Certificate of Completion from NYSDEC for construction and beginning full-scale operation of the LNAPL recovery system before the end of 2012.

8.0 REFERENCES

CH2M Hill, 1982. Engineering Services Report, Quanta Resources Site Cleanup, prepared for the NYCDEP, December 29, 1982.

de maximis, inc. (de maximis, 2011). *Construction Completion Report, Progress Summary, Demolition Submittal,* September, 2011

Environmental Liability Management of New York, L.L.C. (ELM), 2007. *Final Report for Underground Storage Tank (UST) and Sump Removal Interim Remedial Measure (IRM), Review Avenue Development I, 37-30 Review Avenue, Long Island City, New York, BCA #C241089*, January 12, 2007.

Environmental Resources Management-Northeast (ERM), 1990. *Phase I Environmental Assessment, 37-30 Review Avenue, Long Island City, New York,* 1990.

Environmental Resources Management-Northeast, 1992. *Phase II Environmental Assessment, 37-30 Review Avenue, Long Island City, New York,* May, 1992.

Geosyntec Consultants (Geosyntec), 2008. *Phase I Soil Vapor Investigation Report, Review Avenue Development II Property,* November 26, 2008.

Geosyntec Consultants, 2010a. *Phase IA Soil Vapor Investigation Report, Review Avenue Development II Property*, February 9, 2010.

Geosyntec Consultants, 2010b. *Review Avenue Development I Property, Soil Vapor Investigation Report Revised Draft,* December 31, 2010.

Golder Associates Inc. (Golder), 2005a. *Remedial Investigation Report, Quanta Resources Site, Long Island City, New York*, June 2005.

Golder Associates Inc., 2005b. *Feasibility Study Report, Quanta Resources Site, Long Island City, Queens, New York*, July 2005.

Golder Associates Inc., 2008. *LNAPL Recovery Pilot Study Work Plan, Review Avenue Development (RAD) II, Long Island City, Queens, New York*, June 2, 2008.

Golder Associates Inc, 2010. *Revised LNAPL Recovery Pilot Study Work Plan, Review Avenue Development (RAD) II, Long Island City, Queens, New York*, October 4, 2010.

New York State Department of Environmental Conservation (NYSDEC), 2005a, *Brownfield Site Cleanup Agreement, Index #W2-1076-05-09, Site #C241005,* October 2005.

New York State Department of Environmental Conservation, 2005b, *Brownfield Site Cleanup Agreement, Index #W2-1078-05-09, Site #C241089,* December 2005.

New York State Department of Environmental Conservation, 2006a, *Subpart 375-3: Brownfield Cleanup Program,* December 2006.

New York State Department of Environmental Conservation, 2006b, *Subpart 375-6: Remedial Program Soil Cleanup Objectives,* December 2006.

New York State Department of Environmental Conservation, 2007. *Declaration Statement – Record of Decision, Quanta Resources Inactive Hazardous Waste Disposal Site (a.k.a. Review Avenue Development II), Long Island City, Queens, New York, Site No. 2-41-005,* February 2007.

New York State Department of Environmental Conservation, 2010a. *Program Policy DER-10: Technical Guidance for Site Investigation and Remediation,* May 2010.

New York State Department of Environmental Conservation, 2010b. *Regulations, Chapter III-Air Resources, Subpart 201*-3, revised June 8, 2010.

New York State Department of Environmental Conservation, 2010c. Letter to R. Craig Coslett, de maximis, inc., regarding: *Review Avenue Development Sites (RAD I & RAD II)*, November 22, 2010.

TABLES

TABLE 1
SUMMARY OF GASOLINE RANGE AND DIESEL RANGE ORGANICS
REVIEW AVENUE DEVELOPMENT SOIL SAMPLING
37-80 AND 37-30 REVIEW AVENUE
LONG ISLAND CITY, NEW YORK

Sample Point ID:	SB-29				SB-30				SB-31			
Date Sampled:	7/17/2008				7/17/2008				7/17/2008			
Lab ID:	623178				623179				623180			
Depth (feet)	GRO	Quantitation Limit	DRO	Quantitation Limit	GRO	Quantitation Limit	DRO	Quantitation Limit	GRO	Quantitation Limit	DRO	Quantitation Limit
10.5-11.5	-	-	-	-	6800	590	593	39.5	-	-	-	-
11.0-12.0	3700	600	2840	200	-	-	-	-	99	34	301	9.1
15.0-16.0	-	-	-	-	ND	22	375	36.6	-	-	-	-
17.0-18.0	440	110	4990	180	-	-	-	-	-	-	-	-
21.0-22.0	-	-	-	-	240	26	10800	344	-	-	-	-
22.0-23.0	-	-	-	-	-	-	-	-	1600	530	67400	3580
25.0-26.0	100	30	5600	197	200	110	13000	380	170	22	11800	750
27.0-28.0	-	-	-	-	74	11	13800	382	160	22	14900	728
(Duplicate)	-	-	-	-	58	5.5	12300	370	-	-	-	-
31.0-32.0	72	22	7420	374	-	-	-	-	-	-	-	-
33.0-34.0	72	29	6300	194	-	-	-	-	-	-	-	-

Notes:
GRO = gasoline range organics
DRO = diesel range organics
All units are mg/kg.
"-" indicates the depth was not sampled.

TABLE 2A
SUMMARY OF CHEMICAL DETECTIONS
GROUNDWATER SAMPLE ANALYSES
VOLATILE ORGANIC COMPOUNDS
REVIEW AVENUE DEVELOPMENT
LONG ISLAND CITY, NEW YORK

			Sample Point:	GAGW-01			GAGW-01			GAGW-02			FGAGW-02			GAGW-03		
			Date Sampled:	1/9/2004			4/26/2011			1/9/2004			1/9/2004			1/9/2004		
			Lab ID:	493423			460-25807-2			493426			493428			493424		
Parameter	**TOGS 1.1.1 SD Standard (Saline Water)**	**TOGS 1.1.1 GA Standard (Drinking water)**		**Result**	**Qual**	**RL**	**Result**	**Qual**	**RL**	**Result**	**Qual**	**RL**	**Result**	**Qual**	**RL**	**Result**	**Qual**	**RL**
Acetone		50*		-	R	5	-	U	10	-	R	5	-	R	5	-	R	5
Benzene	10	1		-	U	1	-	U	1	-	U	1	-	U	1	-	U	1
Carbon Tetrachloride		5		-	U	2	-	U	1	-	U	2	-	U	2	0.6	JN	2
Chloroethane		5*		-	U	5	-	U	1	-	U	5	-	U	5	-	U	5
Chloroform		7		-	U	5	-	U	1	-	U	5	-	U	5	7.9		5
Cyclohexane				-	U	5	-	U	1	2.4		5	2.6	J	5	-	U	5
1,1-Dichloroethane		5		1	JN	5	0.23	U	1	-	U	5	-	U	5	-	U	5
cis-1,2-Dichloroethene		5		0.7	JN	5	-	U	1	-	U	5	-	U	5	-	U	5
Isopropylbenzene		5		-	U	5	-	U	1	-	U	5	-	U	5	-	U	5
Methyl Cyclohexane				-	U	5	-	U	1	9.6	J	5	9.9	J	5	-	U	5
MTBE		10		170		5	5.4		1	40		5	38		5	1.4	JN	5
Tetrachloroethene	1*	5		-	U	1	-	U	1	-	U	1	-	U	1	-	U	1
Toluene	6,000	5		-	U	5	-	U	1	-	U	5	-	U	5	-	U	5
Trichloroethene	40	5		4.5		1	1.4		1	-	U	1	-	U	1	-	U	1
Trichloroflouromethane		5		-	U	5	-	U	1	-	U	5	-	U	5	-	U	5
Vinyl Chloride		2		-	U	5	-	U	1	-	U	5	-	U	5	-	U	5
Xylene (Total)	170*	5		-	U	5	-	U	3	-	U	5	1.7	JN	5	-	U	5
Total VOCs				176.2			7.03			52			52.2			9.9		

Notes:

All units are µg / L.

TOGS 1.1.1 = New York Division of Water Technical & Operational Guidance Series

"-" indicates that the constituent was not detected as qualified by "U " or "UJ".

RL indicates reporting limit.

J indicates a laboratory approximated value.

N indicates presumptive evidence of a compound

indicates that detected value is greater than the NYS TOGS 1.1.1 SD Standard

Sample point identification number preceded by "F" is a field duplicate.

* Guidance level in TOGS 1.1.1 for SD or GA water classification in absence of a standard

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TABLE 2A
SUMMARY OF CHEMICAL DETECTIONS
GROUNDWATER SAMPLE ANALYSES
VOLATILE ORGANIC COMPOUNDS
REVIEW AVENUE DEVELOPMENT
LONG ISLAND CITY, NEW YORK

			Sample Point:			GAGW-04D			GAGW-04D			GAGW-05			GAGW-06I			FGAGW-06I			GAGW-06I		
			Date Sampled:			8/12/2004			4/27/2011			1/9/2004			8/12/2004			8/12/2004			4/26/2011		
			Lab ID:			554735			460-25836-5			493425			554731			554732			460-25807-4		
Parameter	**TOGS 1.1.1 SD Standard (Saline Water)**	**TOGS 1.1.1 GA Standard (Drinking water)**	**Result**	**Qual**	**RL**	**Result**	**Qual**	**RL**	**Result**	**Qual**	**RL**	**Result**	**Qual**	**RL**	**Result**	**Qual**	**RL**	**Result**	**Qual**	**RL**	**Result**	**Qual**	**RL**
Acetone		50*	-	R	5	-	U	10	-	R	5	34	J	5	29	J	5	-	U	10			
Benzene	10	1	-	U	1	-	U	1	-	U	2	1		1	1.1		1	2.2		1			
Carbon Tetrachloride		5	-	U	2	0.67	J	1	-	U	4	-	UJ	2	-	UJ	2	-	U	1			
Chloroethane		5*	-	U	5	-	U	1	-	U	10	4.9	J	5	4.2	J	5	4.7		1			
Chloroform		7	6.8		5	1.1		1	-	U	10	2.4	J	5	2.7	J	5	-	U	1			
Cyclohexane			-	U	5	-	U	1	-	U	10	15		5	16		5	19		1			
1,1-Dichloroethane		5	-	U	5	-	U	1	-	U	10	1.6	J	5	1.5	J	5	0.43	J	1			
cis-1,2-Dichloroethene		5	-	U	5	-	U	1	-	U	10	5		5	5.1		5	0.94	J	1			
Isopropylbenzene		5	-	U	5	-	U	1	-	U	10	1.2	J	5	1.2	J	5	1.9		1			
Methyl Cyclohexane			-	U	5	-	U	1	-	U	10	28		5	30		5	11		1			
MTBE		10	1	J	5	0.21	J	1	270		10	33		5	32		5	14		1			
Tetrachloroethene	1*	5	-	U	1	3.3		1	-	U	2	-	U	1	-	U	1	-	U	1			
Toluene	6,000	5	0.9	J	5	-	U	1	-	U	10	-	U	5	-	U	5	0.43	J	1			
Trichloroethene	40	5	-	U	1	-	U	1	17		2	-	U	1	-	U	1	-	U	1			
Trichloroflouromethane		5	-	U	5	3.5			-	U	10	-	U	5	-	U	5	-	U	1			
Vinyl Chloride		2	-	U	5	-	U	1	-	U	10	2.1	J	5	2.1	J	5	1.5		1			
Xylene (Total)	170*	5	-	U	5	-	U	3	-	U	10	-	U	5	-	U	5	1.3	J	3			
Total VOCs			8.7			8.78			287			128.2			124.9			57.4					

Notes:

All units are µg / L.

TOGS 1.1.1 = New York Division of Water Technical & Operational Guidance Series

"-" indicates that the constituent was not detected as qualified by "U " or "UJ".

RL indicates reporting limit.

J indicates a laboratory approximated value.

N indicates presumptive evidence of a compound

indicates that detected value is greater than the NYS TOGS 1.1.1 SD Standard

Sample point identification number preceded by "F" is a field duplicate.

* Guidance level in TOGS 1.1.1 for SD or GA water classification in absence of a standard

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TABLE 2A
SUMMARY OF CHEMICAL DETECTIONS
GROUNDWATER SAMPLE ANALYSES
VOLATILE ORGANIC COMPOUNDS
REVIEW AVENUE DEVELOPMENT
LONG ISLAND CITY, NEW YORK

			Sample Point:	GAGW-07			GAGW-07			GAGW-08			GAGW-08			FGAGW-08		
			Date Sampled:	8/12/2004			4/27/2011			8/12/2004			4/27/2011			4/27/2011		
			Lab ID:	554734			460-25836-4			554733			460-25836-2			460-25836-3		
Parameter	**TOGS 1.1.1 SD Standard (Saline Water)**	**TOGS 1.1.1 GA Standard (Drinking water)**		**Result**	**Qual**	**RL**	**Result**	**Qual**	**RL**	**Result**	**Qual**	**RL**	**Result**	**Qual**	**RL**	**Result**	**Qual**	**RL**
Acetone		50*		-	R	5	-	U	10	-	R	5	-	U	10	-	U	10
Benzene	10	1		-	U	2	-	U	1	-	U	2	-	U	1	-	U	1
Carbon Tetrachloride		5		-	U	4	-	U	1	-	U	4	-	U	1	-	U	1
Chloroethane		5*		-	U	10	-	U	1	-	U	10	-	U	1	-	U	1
Chloroform		7		1.7	J	10	0.18	J	1	-	U	10	-	U	1	-	U	1
Cyclohexane				-	U	10	-	U	1	-	U	10	-	U	1	-	U	1
1,1-Dichloroethane		5		-	U	10	0.15	J	1	-	U	10	0.38	J	1	0.33	J	1
cis-1,2-Dichloroethene		5		-	U	10	-	U	1	1	J	10	3.3		1	3		1
Isopropylbenzene		5		-	U	10	-	U	1	-	U	10	-	U	1	-	U	1
Methyl Cyclohexane				-	U	10	-	U	1	-	U	10	-	U	1	-	U	1
MTBE		10		150		10	2.2		1	240		10	33		1	30		1
Tetrachloroethene	1*	5		-	U	2	-	U	1	-	U	2	-	U	1	-	U	1
Toluene	6,000	5		-	U	10	-	U	1	-	U	10	-	U	1	-	U	1
Trichloroethene	40	5		9.3		2	2.9		1	21		2	8.2		1	7.7		1
Trichloroflouromethane		5		-	U	10	-	U	1	-	U	10	-	U	1	-	U	1
Vinyl Chloride		2		-	U	10	-	U	1	-	U	10	-	U	1	-	U	1
Xylene (Total)	170*	5		-	U	10	-	U	3	-	U	10	-	U	3	-	U	3
Total VOCs				161			5.43			262			44.88			41.03		

Notes:

All units are µg / L.

TOGS 1.1.1 = New York Division of Water Technical & Operational Guidance Series

"-" indicates that the constituent was not detected as qualified by "U " or "UJ".

RL indicates reporting limit.

J indicates a laboratory approximated value.

N indicates presumptive evidence of a compound

indicates that detected value is greater than the NYS TOGS 1.1.1 SD Standard

Sample point identification number preceded by "F" is a field duplicate.

* Guidance level in TOGS 1.1.1 for SD or GA water classification in absence of a standard

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TABLE 2A
SUMMARY OF CHEMICAL DETECTIONS
GROUNDWATER SAMPLE ANALYSES
VOLATILE ORGANIC COMPOUNDS
REVIEW AVENUE DEVELOPMENT
LONG ISLAND CITY, NEW YORK

			Sample Point:	GAGW-09S			FGAGW-09S			GAGW-09D		
			Date Sampled:	10/17/2005			10/17/2005			10/17/2005		
			Lab ID:	677998			677997			677996		
Parameter	TOGS 1.1.1 SD Standard (Saline Water)	TOGS 1.1.1 GA Standard (Drinking water)		Result	Qual	RL	Result	Qual	RL	Result	Qual	RL
Acetone		50*		8.2		5	7.4		5	-	U	10
Benzene	10	1		7.8		1	7.6		1	-	U	2
Carbon Tetrachloride		5		-	U	2	-	U	2	-	U	4
Chloroethane		5*		20		5	18		5	-	U	10
Chloroform		7		-	U	5	-	U	5	-	U	10
Cyclohexane				52		5	52		5	-	U	10
1,1-Dichloroethane		5		-	U	5	-	U	5	-	U	10
cis-1,2-Dichloroethene		5		-	U	5	-	U	5	-	U	10
Isopropylbenzene		5		3.1	J	5	3.2	J	5	-	U	10
Methyl Cyclohexane				68		5	68		5	-	U	10
MTBE		10		14		5	14		5	250		10
Tetrachloroethene	1*	5		-	U	1	-	U	1	-	U	2
Toluene	6,000	5		1.4	J	5	1.4	J	5	-	U	10
Trichloroethene	40	5		-	U	1	-	U	1	16		2
Trichloroflouromethane		5		-	U	5	-	U	5	-	U	10
Vinyl Chloride		2		-	U	5	-	U	5	-	U	10
Xylene (Total)	170*	5		3.8	J	5	3.6	J	5	-	U	10
Total VOCs				178.3			175.2			266		

Notes:
All units are µg / L.
TOGS 1.1.1 = New York Division of Water Technical & Operational Guidance Series
"-" indicates that the constituent was not detected as qualified by "U " or "UJ".
RL indicates reporting limit.
J indicates a laboratory approximated value.
N indicates presumptive evidence of a compound
indicates that detected value is greater than the NYS TOGS 1.1.1 SD Standard
Sample point identification number preceded by "F" is a field duplicate.
* Guidance level in TOGS 1.1.1 for SD or GA water classification in absence of a standard

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TABLE 2B
SUMMARY OF CHEMICAL DETECTIONS
GROUNDWATER SAMPLE ANALYSES
SEMI-VOLATILE ORGANIC COMPOUNDS
REVIEW AVENUE DEVELOPMENT
LONG ISLAND CITY, NEW YORK

			Sample Point:	GAGW-01			GAGW-01			GAGW-02			FGAGW-02			GAGW-03		
			Date Sampled:	1/9/2004			4/26/2011			1/9/2004			1/9/2004			1/9/2004		
			Lab ID:	493423			460-25807-2			493426			493428			493424		
Parameter	TOGS 1.1.1 SD Standard (Saline Water)	TOGS 1.1.1 GA Standard (Drinking water)		Result	Qual	RL	Result	Qual	RL	Result	Qual	RL	Result	Qual	RL	Result	Qual	RL
Acenaphthene	60	20		-	U	11	-	U	11	0.7	J	12	0.6	J	11	-	U	10
Anthracene		50		-	U	11	-	U	11	0.6	J	12	0.6	J	11	-	U	10
Benzo(a)anthracene		0.002		-	U	1.1	0.065		0.056	-	U	1.2	-	U	1.1	-	U	1
Benzo(a)pyrene	0.0006+	0.0002**		-	U	1.1	-	U	0.056	-	U	1.2	-	U	1.1	0.3	J	1
Benzo(b)fluoranthene		0.002+		-	U	1.1	-	U	0.056	-	U	1.2	-	U	1.1	0.3	J	1
Benzo(g,h,i)perylene				-	U	11	-	U	11	-	U	12	-	U	11	0.6	J	10
Benzo(k)fluoranthene		0.002+		-	U	1.1	-	U	1.1	-	U	1.2	-	U	1.1	0.4	J	1
bis(2-Ethylhexyl)phthalate		5		-	U	11	-	U	11	-	U	12	-	U	11	3.2	J	10
Chrysene		0.002+		0.3	J	11	-	U	11	-	U	12	-	U	11	-	U	10
Di-n-butylphthalate		50		3	J	11	-	U	11	3.2	J	12	3	J	11	-	U	10
Dibenz(a,h)anthracene				-	U	1.1	-	U	1.1	-	U	1.2	-	U	1.1	0.5	J	1
Fluoranthene		50		0.3	J	11	-	U	11	0.3	J	12	0.3	J	11	-	U	10
Fluorene	23+	50+		-	U	1.1	-	U	11	0.7	J	12	0.6	J	11	-	U	1
Hexachlorobenzene	0.00003	0.04		-	U	1.1	-	U	0.022	-	U	1.2	-	U	1.1	-	U	1
Indeno(1,2,3-cd)pyrene		0.002+		-	U	1.1	-	U	11	-	U	1.2	-	U	1.1	0.3	J	1
2-Methylnaphthalene	38+	5		-	U	1.1	-	U	11	0.9	J	12	0.8	J	11	-	U	1
Naphthalene	140+	10+		-	U	11	-	U	11	-	U	12	-	U	11	-	U	10
Pentachlorophenol		1*		-	U	11	-	U	0.22	-	U	12	-	U	11	-	U	10
Phenanthrene	14+	50+		0.3	J	11	-	U	11	1.6	J	12	1.5	J	11	-	U	10
Pyrene		50+		0.8	J	11	-	U	11	0.8	J	12	0.8	J	11	-	U	10
Total SVOCs				4.7			0.065			8.8			8.2			5.6		

Notes:
All units are µg / L.
TOGS 1.1.1 = New York Division of Water Technical & Operational Guidance Series
"-" indicates that the constituent was not detected as qualified by "U " or "UJ".
RL indicates reporting limit.
J indicates a laboratory approximated value.
indicates that detected value is greater than the NYS TOGS 1.1.1 SD Standard.
* Total phenolic compounds
Sample point identification number preceded by "F" is a field duplicate.
** Practical quantification limit for constituent in water.
+ Guidance level in TOGS 1.1.1 for SD or GA water classification in absence of a standard.

Checked By: JWL 8/11/11

TABLE 2B
SUMMARY OF CHEMICAL DETECTIONS
GROUNDWATER SAMPLE ANALYSES
SEMI-VOLATILE ORGANIC COMPOUNDS
REVIEW AVENUE DEVELOPMENT
LONG ISLAND CITY, NEW YORK

		Sample Point:	GAGW-04D			GAGW-04D			GAGW-05			GAGW-06I			FGAGW-06I			GAGW-06I		
		Date Sampled:	8/12/2004			4/27/2011			1/9/2004			8/12/2004			8/12/2004			4/26/2011		
		Lab ID:	554735			460-25836-5			493425			554731			554732			460-25807-4		
Parameter	TOGS 1.1.1 SD Criteria/ Guidance (Surface Water)	TOGS 1.1.1 GA Criteria (Ground water)	Result	Qual	RL	Result	Qual	RL	Result	Qual	RL	Result	Qual	RL	Result	Qual	RL	Result	Qual	RL
Acenaphthene	NA/60	20	-	U	10	-	U	11	-	U	10	1	J	10	1.4	J	11	-	U	10
Anthracene		50	-	U	10	-	U	11	-	U	10	0.6	J	10	0.8	J	11	-	U	10
Benzo(a)anthracene		0.002	-	U	1	0.031	J	0.053	-	U	1	-	U	1	-	U	1.1	0.061		0.051
Benzo(a)pyrene	NA/0.0006	0.0	-	U	1	-	U	0.053	-	U	1	-	U	1	-	U	1.1	-	U	0.051
Benzo(b)fluoranthene		0.002	-	U	1	-	U	0.053	-	U	1	-	U	1	-	U	1.1	-	U	0.051
Benzo(g,h,i)perylene			-	U	10	-	U	11	-	U	10	-	U	10	-	U	11	-	U	10
Benzo(k)fluoranthene		0.002	-	U	1	-	U	1.1	-	U	1	-	U	1	-	U	1.1	-	U	1
bis(2-Ethylhexyl)phthalate		5	-	U	10	-	U	11	-	U	10	-	U	10	-	U	11	-	U	10
Chrysene		0.002	-	U	10	-	U	11	-	U	10	-	U	10	-	U	11	-	U	10
Di-n-butylphthalate		50	-	U	10	-	U	11	2.2	J	10	-	U	10	-	U	11	-	U	10
Dibenz(a,h)anthracene			-	U	1	-	U	1.1	-	U	1	-	U	1	-	U	1.1	-	U	1
Fluoranthene		50	-	U	10	-	U	11	-	U	10	-	U	10	-	U	11	-	U	10
Fluorene	NA/23	50	-	U	1	-	U	11	-	U	1	0.9	J	10	1.1	J	11	-	U	10
Hexachlorobenzene	0.00003	0.04	-	U	1	0.032	U	0.021	-	U	1	-	U	1	-	U	1.1	-	U	0.02
Indeno(1,2,3-cd)pyrene		0.002	-	U	1	-	U	1.1	-	U	1	-	U	1	-	U	1.1	-	U	1
2-Methylnaphthalene	NA/38		-	U	1	-	U	11	-	U	1	0.2	J	10	-	U	1.1	-	U	10
Naphthalene	NA/140	10	-	U	10	-	U	11	-	U	10	-	U	10	0.4	J	11	-	U	10
Pentachlorophenol		2 *	-	U	10	-	U	0.21	-	U	10	-	U	10	0.2	J	42	-	U	0.2
Phenanthrene	NA/14	50	-	U	10	-	U	11	0.3	J	10	1.9	J	10	2.2	J	11	-	U	10
Pyrene		50	-	U	10	-	U	11	-	U	10	0.4	J	10	0.4	J	11	-	U	10
Total SVOCs			0			0.063			2.5			5			6.5			0.061		

Notes:
All units are µg / L.
TOGS 1.1.1 = New York Division of Water Technical & Operational Guidance Series
"-" indicates that the constituent was not detected as qualified by "U " or "UJ".
RL indicates reporting limit.
J indicates a laboratory approximated value.
indicates that detected value is greater than the NYS TOGS 1.1.1 SD Standard.
* Total phenolic compounds
Sample point identification number preceded by "F" is a field duplicate.
** Practical quantification limit for constituent in water.
+ Guidance level in TOGS 1.1.1 for SD or GA water classification in absence of a standard.

Checked By: JWL 8/11/11

TABLE 2B
SUMMARY OF CHEMICAL DETECTIONS
GROUNDWATER SAMPLE ANALYSES
SEMI-VOLATILE ORGANIC COMPOUNDS
REVIEW AVENUE DEVELOPMENT
LONG ISLAND CITY, NEW YORK

		Sample Point:	GAGW-07			GAGW-07			GAGW-08			GAGW-08			FGAGW-08		
		Date Sampled:	8/12/2004			4/27/2011			8/12/2004			4/27/2011			4/27/2011		
		Lab ID:	554734			460-25836-4			554733			460-25836-2			460-25836-2		
Parameter	**TOGS 1.1.1 SD Criteria/ Guidance (Surface Water)**	**TOGS 1.1.1 GA Criteria (Ground water)**	**Result**	**Qual**	**RL**	**Result**	**Qual**	**RL**	**Result**	**Qual**	**RL**	**Result**	**Qual**	**RL**	**Result**	**Qual**	**RL**
Acenaphthene	NA/60	20	-	U	10	-	U	10	-	U	10	-	U	10	-	U	10
Anthracene		50	-	U	10	-	U	10	-	U	10	-	U	10	-	U	10
Benzo(a)anthracene		0.002				0.026	J	0.051				0.032	J	0.052	-	U	0.051
Benzo(a)pyrene	NA/0.0006	0.0	-	U	1	-	U	0.051	-	U	1	-	U	0.052	-	U	0.051
Benzo(b)fluoranthene		0.002	-	U	1	-	U	0.051	-	U	1	-	U	0.052	-	U	0.051
Benzo(g,h,i)perylene			-	U	10	-	U	10	-	U	10	-	U	10	-	U	10
Benzo(k)fluoranthene		0.002	-	U	1	-	U	1	-	U	1	-	U	1	-	U	1
bis(2-Ethylhexyl)phthalate		5	-	U	10	-	U	10	-	U	10	-	U	10	-	U	10
Chrysene		0.002	-	U	10	-	U	10	-	U	10	-	U	10	-	U	10
Di-n-butylphthalate		50	-	U	10	-	U	10	-	U	10	-	U	10	-	U	10
Dibenz(a,h)anthracene			-	U	1	-	U	1	-	U	1	-	U	1	-	U	1
Fluoranthene		50	-	U	10	-	U	10	-	U	10	-	U	10	-	U	10
Fluorene	NA/23	50	-	U	1	-	U	10	-	U	1	-	U	10	-	U	10
Hexachlorobenzene	0.00003	0.04	-	U	1	0.022	U	0.02	-	U	1	0.026		0.021	0.02		0.2
Indeno(1,2,3-cd)pyrene		0.002	-	U	1	-	U	1	-	U	1	-	U	1	-	U	1
2-Methylnaphthalene	NA/38		-	U	1	-	U	10	-	U	1	-	U	10	-	U	10
Naphthalene	NA/140	10	-	U	10	-	U	10	-	U	10	-	U	10	-	U	10
Pentachlorophenol		2 *	-	U	10	-	U	0.2	-	U	10	-	U	0.21	-	U	0.2
Phenanthrene	NA/14	50	-	U	10	-	U	10	-	U	10	-	U	10	-	U	10
Pyrene		50	-	U	10	-	U	10	-	U	10	-	U	10	-	U	10
Total SVOCs			0			0.048			0			0.058			0.02		

Notes:
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J indicates a laboratory approximated value.
indicates that detected value is greater than the NYS TOGS 1.1.1 SD Standard.
* Total phenolic compounds
Sample point identification number preceded by "F" is a field duplicate.
** Practical quantification limit for constituent in water.
+ Guidance level in TOGS 1.1.1 for SD or GA water classification in absence of a standard.

Checked By: JWL 8/11/11

TABLE 2B
SUMMARY OF CHEMICAL DETECTIONS
GROUNDWATER SAMPLE ANALYSES
SEMI-VOLATILE ORGANIC COMPOUNDS
REVIEW AVENUE DEVELOPMENT
LONG ISLAND CITY, NEW YORK

		Sample Point:	GAGW-09S			FGAGW-09S			GAGW-09D		
		Date Sampled:	10/17/2005			10/17/2005			10/17/2005		
		Lab ID:	677998			677997			677996		
Parameter	TOGS 1.1.1 SD Criteria/ Guidance (Surface Water)	TOGS 1.1.1 GA Criteria (Ground water)	Result	Qual	RL	Result	Qual	RL	Result	Qual	RL
Acenaphthene	NA/60	20	3	J	10	3.3	J	10	-	U	10
Anthracene		50	0.9	J	10	0.9	J	10	-	U	10
Benzo(a)anthracene		0.002	-	U	1	-	U	1	-	U	1
Benzo(a)pyrene	NA/0.0006	0.0	-	U	1	-	U	1	-	U	1
Benzo(b)fluoranthene		0.002	-	U	1	-	U	1	-	U	1
Benzo(g,h,i)perylene			-	U	10	-	U	10	-	U	10
Benzo(k)fluoranthene		0.002	-	U	1	-	U	1	-	U	1
bis(2-Ethylhexyl)phthalate		5	-	U	10	-	U	10	-	U	10
Chrysene		0.002	-	U	10	-	U	10	-	U	10
Di-n-butylphthalate		50	-	U	10	-	U	10	-	U	10
Dibenz(a,h)anthracene			-	U	1	-	U	1	-	U	1
Fluoranthene		50	-	U	10	-	U	10	-	U	10
Fluorene	NA/23	50	2.3	J	10	2.5	J	10	-	U	10
Hexachlorobenzene	0.00003	0.04	-	U	1	-	U	1	-	U	1
Indeno(1,2,3-cd)pyrene		0.002	-	U	1	-	U	1	-	U	1
2-Methylnaphthalene	NA/38		2	J	10	1.9	J	10	-	U	10
Naphthalene	NA/140	10	1.2	J	10	0.9	J	10	-	U	10
Pentachlorophenol		2 *	-	U	42	-	U	40	-	U	42
Phenanthrene	NA/14	50	2.1	J	10	2.4	J	10	-	U	10
Pyrene		50	-	U	10	1.1	J	10	-	U	10
Total SVOCs			11.5			13			0		

Notes:
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RL indicates reporting limit.
J indicates a laboratory approximated value.
indicates that detected value is greater than the NYS TOGS 1.1.1 SD Standard.
* Total phenolic compounds
Sample point identification number preceded by "F" is a field duplicate.
** Practical quantification limit for constituent in water.
+ Guidance level in TOGS 1.1.1 for SD or GA water classification in absence of a standard.

Checked By: JWL 8/11/11

TABLE 2C
SUMMARY OF CHEMICAL DETECTIONS
GROUNDWATER SAMPLE ANALYSES
POLYCHLORINATED BIPHENOLS (PCBs)
REVIEW AVENUE DEVELOPMENT
LONG ISLAND CITY, NEW YORK

			Sample Point:	GAGW-01			GAGW-01			GAGW-02			FGAGW-02			GAGW-03		
			Date Sampled:	1/9/2004			4/26/2011			1/9/2004			1/9/2004			1/9/2004		
			Lab ID:	493423			460-25807-2			493426			493428			493424		
Parameter	TOGS 1.1.1 SD Standard (Saline Water)	TOGS 1.1.1 GA Standard (Drinking water)		Result	Qual	RL	Result	Qual	RL	Result	Qual	RL	Result	Qual	RL	Result	Qual	RL
Aroclor-1016	0.00012*	0.09*		-	U	0.56	-	U	0.51	-	U	0.52	-	U	0.52	-	U	0.5
Aroclor-1221	0.00012*	0.09*		-	U	0.56	-	U	0.51	-	U	0.52	-	U	0.52	-	U	0.5
Aroclor-1232	0.00012*	0.09*		-	U	0.56	-	U	0.51	-	U	0.52	-	U	0.52	-	U	0.5
Aroclor-1242	0.00012*	0.09*		-	U	0.56	-	U	0.51	-	U	0.52	-	U	0.52	-	U	0.5
Aroclor-1248	0.00012*	0.09*		-	U	0.56	-	U	0.51	-	U	0.52	-	U	0.52	-	U	0.5
Aroclor-1254	0.00012*	0.09*		-	U	0.56	-	U	0.51	-	U	0.52	-	U	0.52	-	U	0.5
Aroclor-1260	0.00012*	0.09*		-	U	0.56	-	U	0.51	-	U	0.52	-	U	0.52	-	U	0.5

There were no detections of PCBs

Notes:
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"-" indicates that the constituent was not detected as qualified by "U " or "UJ".
RL indicates reporting limit.
indicates that detected value is greater than the NYS TOGS 1.1.1 SD Standard.
Sample point identification number preceded by "F" is a field duplicate.
* Applies to total PCBs.

Checked By: JWL 8/11/11

TABLE 2C
SUMMARY OF CHEMICAL DETECTIONS
GROUNDWATER SAMPLE ANALYSES
POLYCHLORINATED BIPHENOLS (PCBs)
REVIEW AVENUE DEVELOPMENT
LONG ISLAND CITY, NEW YORK

		Sample Point:	GAGW-04D			GAGW-04D			GAGW-05			GAGW-06I			FGAGW-06I			GAGW-06I		
		Date Sampled:	8/12/2004			4/27/2011			1/9/2004			8/12/2004			8/12/2004			4/26/2011		
		Lab ID:	554735			460-25836-5			493425			554731			554732			460-25807-4		
Parameter	TOGS 1.1.1 SD Standard (Saline Water)	TOGS 1.1.1 GA Standard (Drinking water)	Result	Qual	RL	Result	Qual	RL	Result	Qual	RL	Result	Qual	RL	Result	Qual	RL	Result	Qual	RL
Aroclor-1016	0.00012*	0.09*	-	U	0.5	-	U	0.51	-	U	0.5	-	U	0.5	-	U	0.51	-	U	0.51
Aroclor-1221	0.00012*	0.09*	-	U	0.5	-	U	0.51	-	U	0.5	-	U	0.5	-	U	0.51	-	U	0.51
Aroclor-1232	0.00012*	0.09*	-	U	0.5	-	U	0.51	-	U	0.5	-	U	0.5	-	U	0.51	-	U	0.51
Aroclor-1242	0.00012*	0.09*	-	U	0.5	-	U	0.51	-	U	0.5	-	U	0.5	-	U	0.51	-	U	0.51
Aroclor-1248	0.00012*	0.09*	-	U	0.5	-	U	0.51	-	U	0.5	-	U	0.5	-	U	0.51	-	U	0.51
Aroclor-1254	0.00012*	0.09*	-	U	0.5	-	U	0.51	-	U	0.5	-	U	0.5	-	U	0.51	-	U	0.51
Aroclor-1260	0.00012*	0.09*	-	U	0.5	-	U	0.51	-	U	0.5	-	U	0.5	-	U	0.51	-	U	0.51

There were no detections of PCBs

Notes:
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"-" indicates that the constituent was not detected as qualified by "U " or "UJ".
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indicates that detected value is greater than the NYS TOGS 1.1.1 SD Standard.
Sample point identification number preceded by "F" is a field duplicate.
* Applies to total PCBs.

Checked By: JWL 8/11/11

TABLE 2C
SUMMARY OF CHEMICAL DETECTIONS
GROUNDWATER SAMPLE ANALYSES
POLYCHLORINATED BIPHENOLS (PCBs)
REVIEW AVENUE DEVELOPMENT
LONG ISLAND CITY, NEW YORK

			Sample Point:	GAGW-07			GAGW-07			GAGW-08			GAGW-08			FGAGW-08		
			Date Sampled:	8/12/2004			4/27/2011			8/12/2004			4/27/2011			4/27/2011		
			Lab ID:	554734			460-25836-4			554733			460-25836-2			460-25836-2		
Parameter	**TOGS 1.1.1 SD Standard (Saline Water)**	**TOGS 1.1.1 GA Standard (Drinking water)**		**Result**	**Qual**	**RL**	**Result**	**Qual**	**RL**	**Result**	**Qual**	**RL**	**Result**	**Qual**	**RL**	**Result**	**Qual**	**RL**
Aroclor-1016	0.00012*	0.09*		-	U	0.5	-	U	0.51	-	U	0.5	-	U	0.52	-	U	0.51
Aroclor-1221	0.00012*	0.09*		-	U	0.5	-	U	0.51	-	U	0.5	-	U	0.52	-	U	0.51
Aroclor-1232	0.00012*	0.09*		-	U	0.5	-	U	0.51	-	U	0.5	-	U	0.52	-	U	0.51
Aroclor-1242	0.00012*	0.09*		-	U	0.5	-	U	0.51	-	U	0.5	-	U	0.52	-	U	0.51
Aroclor-1248	0.00012*	0.09*		-	U	0.5	-	U	0.51	-	U	0.5	-	U	0.52	-	U	0.51
Aroclor-1254	0.00012*	0.09*		-	U	0.5	-	U	0.51	-	U	0.5	-	U	0.52	-	U	0.51
Aroclor-1260	0.00012*	0.09*		-	U	0.5	-	U	0.51	-	U	0.5	-	U	0.52	-	U	0.51

There were no detections of PCBs

Notes:
All units are µg / L.
TOGS 1.1.1 = New York Division of Water Technical & Operational Guidance Series
"-" indicates that the constituent was not detected as qualified by "U " or "UJ".
RL indicates reporting limit.
indicates that detected value is greater than the NYS TOGS 1.1.1 SD Standard.
Sample point identification number preceded by "F" is a field duplicate.
* Applies to total PCBs.

Checked By: JWL 8/11/11

TABLE 2C
SUMMARY OF CHEMICAL DETECTIONS
GROUNDWATER SAMPLE ANALYSES
POLYCHLORINATED BIPHENOLS (PCBs)
REVIEW AVENUE DEVELOPMENT
LONG ISLAND CITY, NEW YORK

			Sample Point:	GAGW-09S			FGAGW-09S			GAGW-09D		
			Date Sampled:	10/17/2005			10/17/2005			10/17/2005		
			Lab ID:	677998			677997			677996		
Parameter	TOGS 1.1.1 SD Standard (Saline Water)	TOGS 1.1.1 GA Standard (Drinking water)		Result	Qual	RL	Result	Qual	RL	Result	Qual	RL
Aroclor-1016	0.00012*	0.09*		-	U	0.5	-	U	0.5	-	U	0.5
Aroclor-1221	0.00012*	0.09*		-	U	0.5	-	U	0.5	-	U	0.5
Aroclor-1232	0.00012*	0.09*		-	U	0.5	-	U	0.5	-	U	0.5
Aroclor-1242	0.00012*	0.09*		-	U	0.5	-	U	0.5	-	U	0.5
Aroclor-1248	0.00012*	0.09*		-	U	0.5	-	U	0.5	-	U	0.5
Aroclor-1254	0.00012*	0.09*		-	U	0.5	-	U	0.5	-	U	0.5
Aroclor-1260	0.00012*	0.09*		-	U	0.5	-	U	0.5	-	U	0.5

There were no detections of PCBs

Notes:
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RL indicates reporting limit.
indicates that detected value is greater than the NYS TOGS 1.1.1 SD Standard.
Sample point identification number preceded by "F" is a field duplicate.
* Applies to total PCBs.

Checked By: JWL 8/11/11

TABLE 2D
SUMMARY OF CHEMICAL DETECTIONS
GROUNDWATER SAMPLE ANALYSES
METALS
REVIEW AVENUE DEVELOPMENT
LONG ISLAND CITY, NEW YORK

			Sample Point:	GAGW-01			GAGW-01			GAGW-02			FGAGW-02		
			Date Sampled:	1/9/2004			4/26/2011			1/9/2004			1/9/2004		
			Lab ID:	493423			460-25807-2			493426			493428		
Parameter	TOGS 1.1.1 SD Standard (Saline Water)	TOGS 1.1.1 GA Standard (Drinking water)		Result	Qual	RL	Result	Qual	RL	Result	Qual	RL	Result	Qual	RL
Aluminum				103	B	63	247		50	140	B	63	135	B	63
Arsenic	120	25		7		3	-	U	2.5	-	U	3.2	-	U	3.2
Barium		1,000		60	B	2	82		5	141	B	2	142	B	2
Calcium				19,800		43	195,000		250	147,000		43	146,000		43
Chromium		50		-	U	1.6	-	U	5	-	U	1.6	-	U	1.6
Copper	4.8	200		-	U	3.7	-	U	5	-	U	3.7	-	U	3.7
Iron		300		4,590		39	581		150	464		39	421		39
Lead	204	25		-	U	2.3	1.4	J	1.5	3		2	-	U	2.3
Magnesium		35,000*		66,600		42	65,600		250	46,300		42	46,000		42
Manganese		300		277		1	187		10	753		1	749		1
Nickel	74	100		3	B	2	-	U	5	5	B	2	4	B	2
Potassium				4,850	B	315	5,050		250	2,970	B	315	2,990	B	315
Selenium		10		-	U	4.2	2	J	2.5	-	U	4.2	-	U	4.2
Sodium		20,000		205,000		396	270,000		250	121,000		396	122,000		396
Vanadium				-	U	1.8	4.4	J	5	-	U	1.8	4	B	2
Zinc	95	2,000*		7	B	6	-	U	20	10	B	6	10	B	6

Notes:

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B indicates the analyte was found in the laboratory blank as well as the sample.
indicates that detected value is greater than the NYS TOGS 1.1.1 SD Standard.
* Guidance level in TOGS 1.1.1 for SD or GA water classification in absence of a standard
Sample point identification number preceded by "F" is a field duplicate.

Checked By: JWL 8/11/11

TABLE 2D
SUMMARY OF CHEMICAL DETECTIONS
GROUNDWATER SAMPLE ANALYSES
METALS
REVIEW AVENUE DEVELOPMENT
LONG ISLAND CITY, NEW YORK

			Sample Point:	GAGW-03			GAGW-04D			GAGW-04D			GAGW-05			GAGW-06I		
			Date Sampled:	1/9/2004			8/12/2004			4/27/2011			1/9/2004			8/12/2004		
			Lab ID:	493424			554735			460-25836-5			493425			554731		
Parameter	TOGS 1.1.1 SD Standard (Saline Water)	TOGS 1.1.1 GA Standard (Drinking water)		Result	Qual	RL	Result	Qual	RL	Result	Qual	RL	Result	Qual	RL	Result	Qual	RL
Aluminum				123	B	63	2,140		63	1,350		50	79	B	63	-	U	0.5
Arsenic	120	25		-	U	3.2	-	U	3.2	-	U	2.5	-	U	3.2	-	U	3.2
Barium		1,000		72	B	2	146	B	2	128		5	80	B	2	165	B	2
Calcium				80,400		43	144,000	B	43	162,000		250	189,000		43	56,200		43
Chromium		50		-	U	1.6	7	B	2	18.4		5	-	U	1.6	-	U	1.6
Copper	4.8	200		4	B	4	13	B	4	8.4		5	-	U	3.7	-	U	3.7
Iron		300		266		39	4,370		39	2,820		150	4,600		39	19,200		39
Lead	204	25		-	U	2.3	6		3	4.2		1.5	-	U	2.3	-	U	2.6
Magnesium		35,000*		25,500		42	55,300		42	66,000		250	61,400		42	17,700		42
Manganese		300		104		1	235		1	136		10	807		1	1,110		1
Nickel	74	100		2	B	2	9	B	2	11.9		5	3	B	2	3	B	2
Potassium				3,150	B	315	4,040	B	315	3,760		250	3,440	B	315	7,090		315
Selenium		10		-	U	4.2	-	U	4.2	4.8	U	2.5	-	U	4.2	-	U	2.5
Sodium		20,000		92,800		396	200,000		396	203,000		250	170,000		396	74,300		396
Vanadium				-	U	1.8	2	B	2	-	U	5	-	U	1.8	-	U	2
Zinc	95	2,000*		10	B	6	27	B	6	17.8	J	20	7	B	6	9	B	6

Notes:

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indicates that detected value is greater than the NYS TOGS 1.1.1 SD Standard.
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Sample point identification number preceded by "F" is a field duplicate.

Checked By: JWL 8/11/11

TABLE 2D
SUMMARY OF CHEMICAL DETECTIONS
GROUNDWATER SAMPLE ANALYSES
METALS
REVIEW AVENUE DEVELOPMENT
LONG ISLAND CITY, NEW YORK

			Sample Point:	FGAGW-06I			GAGW-06I			GAGW-07			GAGW-07			GAGW-08			GAGW-08		
			Date Sampled:	8/12/2004			4/26/2011			8/12/2004			4/27/2011			8/12/2004			4/27/2011		
			Lab ID:	554732			460-25807-4			554734			460-25836-4			554733			460-25836-2		
Parameter	**TOGS 1.1.1 SD Standard (Saline Water)**	**TOGS 1.1.1 GA Standard (Drinking water)**		**Result**	**Qual**	**RL**	**Result**	**Qual**	**RL**	**Result**	**Qual**	**RL**	**Result**	**Qual**	**RL**	**Result**	**Qual**	**RL**	**Result**	**Qual**	**RL**
Aluminum				-	U	0.51	160		50	722		63	244		50	-	U	0.5	542		50
Arsenic	120	25		-	U	3.2	4.7		2.5	-	U	3.2	-	U	2.5	-	U	3.2	4.1		2.5
Barium		1,000		153	B	2	200		5	127	B	2	81.7		5	44	B	2	26.7		5
Calcium				50,200		43	101,000		250	148,000		43	156,000		250	196,000		43	200,000		250
Chromium		50		-	U	1.6	-	U	5	4	B	2	-	U	5	-	U	1.6	-	U	5
Copper	4.8	200		-	U	3.7	-	U	5	-	U	3.7	-	U	5	-	U	3.7	7.2		5
Iron		300		16,300		39	30,900		150	1,700		39	333		150	74	B	39	1,210		150
Lead	204	25		-	U	2.6	1.5		1.5	4		3	-	U	1.5	-	U	2.6	2.8		1.5
Magnesium		35,000*		15,900		42	25,300		250	48,000		42	50,000		250	63,100		42	66,400		250
Manganese		300		1,010		1	1,530		10	106		1	42.8		10	207		1	236		10
Nickel	74	100		3	B	2	-	U	5	6	B	2	-	U	5	4	B	2	-	U	5
Potassium				7,400		315	5,200		250	3,850	B	315	3,950		250	4,110	B	315	4,370		250
Selenium		10		-	U	4.2	-	U	2.5	-	U	4.2	4.1		2.5	-	U	4.2	-	U	2.5
Sodium		20,000		81,900		396	17,700		250	145,000		396	189,000		250	213,000		396	263,000		250
Vanadium				-	U	2	-	U	5	-	U	2	-	U	5	-	U	2	-	U	5
Zinc	95	2,000*		10	B	6	37		20	18	B	6	-	U	20	7	B	6	49.6		20

Notes:

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TABLE 2D
SUMMARY OF CHEMICAL DETECTIONS
GROUNDWATER SAMPLE ANALYSES
METALS
REVIEW AVENUE DEVELOPMENT
LONG ISLAND CITY, NEW YORK

			Sample Point:	FGAGW-08			GAGW-09S			FGAGW-09S			GAGW-09D		
			Date Sampled:	4/27/2011			10/172005			10/17/2005			10/17/2005		
			Lab ID:	460-25836-3			677998			677997			677996		
Parameter	**TOGS 1.1.1 SD Standard (Saline Water)**	**TOGS 1.1.1 GA Standard (Drinking water)**		**Result**	**Qual**	**RL**	**Result**	**Qual**	**RL**	**Result**	**Qual**	**RL**	**Result**	**Qual**	**RL**
Aluminum				605		50	3,390		62.6	1,710		62.6	92.7	B	62.6
Arsenic	120	25		4.2		2.5	16.6		3.2	17		3.2	-	U	3.2
Barium		1,000		28.7		5	164	B	1.7	152	B	1.7	92.1	B	1.7
Calcium				200,000		250	67,100		42.5	65,700		42.5	159,000		42.5
Chromium		50		3.8	J	5	6.2	B	1.6	2.1	B	1.6	-	U	1.6
Copper	4.8	200		8		5	9.6	B	3.7	6.6	B	3.7	5.5	B	3.7
Iron		300		1,440		150	28,900		39.2	24,900		39.2	631		39.2
Lead	204	25		3.2		1.5	4.9		2.7	3.7		2.7	-	U	2.7
Magnesium		35,000*		66,200		250	24,900		41.6	23,900		41.6	52,900		41.6
Manganese		300		241		10	1,020		1.2	977		1.2	1,040		1.2
Nickel	74	100		-	U	5	9.8	B	2.4	6.2	B	2.4	4.4	B	2.4
Potassium				4,490		250	19,700		315	18,800		315	4,980	B	315
Selenium		10		1.9	J	2.5	-	U	4.2	-	U	4.2	-	U	4.2
Sodium		20,000		261,000		250	43,400		396	43,200		396	172,000		396
Vanadium				-	U	5	9.8	B	4.7	-		4.7	-	U	4.7
Zinc	95	2,000*		54.8		20	26	B	5.8	21.3	B	5.8	7.9	B	5.8

Notes:

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indicates that detected value is greater than the NYS TOGS 1.1.1 SD Standard.

* Guidance level in TOGS 1.1.1 for SD or GA water classification in absence of a standard

Sample point identification number preceded by "F" is a field duplicate.

TABLE 2E
SUMMARY OF CHEMICAL DETECTIONS
GROUNDWATER SAMPLE ANALYSES
NATURAL ATTENUATION PARAMETERS
REVIEW AVENUE DEVELOPMENT
LONG ISLAND CITY, NEW YORK

			Sample Point:	GAGW-01			GAGW-01			GAGW-02			FGAGW-02			GAGW-03		
			Date Sampled:	1/9/2004			4/26/2011			1/9/2004			1/9/2004			1/9/2004		
			Lab ID:	493423			460-25807-2			493426			493428			493424		
Parameter	Units	TOGS 1.1.1 SD Standard (Saline Water)	TOGS 1.1.1 GA Drinking (Ground water)	Result	Qual	RL	Result	Qual	RL	Result	Qual	RL	Result	Qual	RL	Result	Qual	RL
Alkalinity	mg/L			381		5	374		5	401		5	391		5	258		5
Carbon Dioxide	mg/L			63		5	37.7	HF	5	54.1		5	39.1		5	10		5
Chloride	mg/L		250	500	J	5				262	J	5	263	J	5	100	J	5
Dissolved Organic Carbo	mg/L			-	R	1	1.9		1	-	R	1	-	R	1	-	R	1
Ethane	ng/L			130		5	25		25	350		5	360		5	410		5
Ethene	ng/L			170		5	44		25	58		5	63		5	380		5
Methane	µg/L			8.5		0.015	6		0.1	590		0.02	640		0.02	1.8		0.02
Nitrate	mg/L		10	1.5		0.1	4.8		0.4	4.2		0.1	4.1		0.1	7.9		0.1
Nitrite	mg/L		10															
Sulfate	mg/L		250	186		5	136		25	83		5	82.7		5	101		5
Total Dissolved Solids	mg/L			1,540		10				1,030		10	1,020		10	619		10
Total Organic Carbon	mg/L			-	R	1	1.3		1	-	R	1	-	R	1	-	R	1

Notes:
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Sample point identification number preceded by "F" is a field duplicate.
HF indicates a field parameter with a holding time of 15 minutes

Checked By: JWL 8/11/11

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TABLE 2E
SUMMARY OF CHEMICAL DETECTIONS
GROUNDWATER SAMPLE ANALYSES
NATURAL ATTENUATION PARAMETERS
REVIEW AVENUE DEVELOPMENT
LONG ISLAND CITY, NEW YORK

				Sample Point:	GAGW-04D			GAGW-04D			GAGW-05			GAGW-06I			FGAGW-06I			GAGW-06I		
				Date Sampled:	8/12/2004			4/27/2011			1/9/2004			8/12/2004			8/12/2004			4/26/2011		
				Lab ID:	554735			460-25836-5			493425			554731			554732			460-25807-4		
Parameter	**Units**	**TOGS 1.1.1 SD Standard (Saline Water)**	**TOGS 1.1.1 GA Drinking (Ground water)**		**Result**	**Qual**	**RL**	**Result**	**Qual**	**RL**	**Result**	**Qual**	**RL**	**Result**	**Qual**	**RL**	**Result**	**Qual**	**RL**	**Result**	**Qual**	**RL**
Alkalinity	mg/L				306		5	321		5	350		5	326		5	321		5	449		5
Carbon Dioxide	mg/L				42.3	J	5	34.2	HF	5	40		5	92	J	5	86.5	J	5	259	HF	5
Chloride	mg/L		250		402		5				431	J	5	34.6		5	34.3		5			
Dissolved Organic Carbo	mg/L				2.2		1	1.1		1	-	R	1	6.1		1	5.8		1	1.9		1
Ethane	ng/L				360		5	9.4	J	25	96		5	390		5	510		5	3,100		25
Ethene	ng/L				280		5	130		25	88		5	210		5	280		5	250		25
Methane	µg/L				2.3		0.02	0.45		0.1	1.6		0.02	5,000		0.02	4,800		0.02	14,000		0.1
Nitrate	mg/L		10		6.7		0.1	8.5		0.5	2.9		0.1	-	U	0.1	-	U	0.1	-	U	0.1
Nitrite	mg/L		10					0.03	J	0.1												
Sulfate	mg/L		250		126		5	105	B	25	145		5	53.5		5	58.3		5	-	U	5
Total Dissolved Solids	mg/L				1,070		10				1,290		10	574		10	544		10			
Total Organic Carbon	mg/L				2.3		1	1.2		1	-	R	1	6.0		1	6.3		1	16.9		1

Notes:
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Sample point identification number preceded by "F" is a field duplicate.
HF indicates a field parameter with a holding time of 15 minutes

Checked By: JWL 8/11/11

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TABLE 2E
SUMMARY OF CHEMICAL DETECTIONS
GROUNDWATER SAMPLE ANALYSES
NATURAL ATTENUATION PARAMETERS
REVIEW AVENUE DEVELOPMENT
LONG ISLAND CITY, NEW YORK

			Sample Point:	GAGW-07			GAGW-07			GAGW-08			GAGW-08			FGAGW-08		
			Date Sampled:	8/12/2004			4/27/2011			8/12/2004			4/27/2011			4/27/2011		
			Lab ID:	554734			460-25836-4			554733			460-25836-2			460-25836-3		
Parameter	**Units**	**TOGS 1.1.1 SD Standard (Saline Water)**	**TOGS 1.1.1 GA Drinking (Ground water)**	**Result**	**Qual**	**RL**	**Result**	**Qual**	**RL**	**Result**	**Qual**	**RL**	**Result**	**Qual**	**RL**	**Result**	**Qual**	**RL**
Alkalinity	mg/L			326		5	336		5	372		5	398		5	391		5
Carbon Dioxide	mg/L			35.8	J	5	38.9	HF	5	52.6	J	5	109	HF	5	70.8	HF	5
Chloride	mg/L		250	277		5				452		5						
Dissolved Organic Carbo	mg/L			-	U	1	1.3		1	1.4		1	1.7		1	1.6		1
Ethane	ng/L			160		5	26		25	140		5	19	J	25	21	J	25
Ethene	ng/L			140		5	49		25	66		5	94		25	66		25
Methane	µg/L			3.1		0.015	0.44		0.1	4.2		0.015	2		0.1	1.8		0.1
Nitrate	mg/L		10	6		0.1	7.6		0.1	4.4		0.1	5.2		0.4	5.2		0.4
Nitrite	mg/L		10				0.022	J	0.1				0.052	J	0.1	0.052	J	0.1
Sulfate	mg/L		250	126		5	76	B	20	167		5	132	B	25	130	B	25
Total Dissolved Solids	mg/L			1,304		10				1,890		10						
Total Organic Carbon	mg/L			1.2		1	1.2		1	1.5		1	1.6		1	1.4		1

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Sample point identification number preceded by "F" is a field duplicate.
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Checked By: JWL 8/11/11

TABLE 2E
SUMMARY OF CHEMICAL DETECTIONS
GROUNDWATER SAMPLE ANALYSES
NATURAL ATTENUATION PARAMETERS
REVIEW AVENUE DEVELOPMENT
LONG ISLAND CITY, NEW YORK

			Sample Point:	GAGW-09S			FGAGW-09S			GAGW-09D		
			Date Sampled:	10/17/2005			10/17/2005			10/17/2005		
			Lab ID:	677998			677997			677996		
Parameter	**Units**	**TOGS 1.1.1 SD Standard (Saline Water)**	**TOGS 1.1.1 GA Drinking (Ground water)**	**Result**	**Qual**	**RL**	**Result**	**Qual**	**RL**	**Result**	**Qual**	**RL**
Alkalinity	mg/L			377		5	370		5	368		5
Carbon Dioxide	mg/L											
Chloride	mg/L		250	35.7		5	33.8		5	358		5
Dissolved Organic Carbo	mg/L											
Ethane	ng/L											
Ethene	ng/L											
Methane	µg/L											
Nitrate	mg/L		10	-	U	0.1	-	U	0.1	5.1		0.1
Nitrite	mg/L		10									
Sulfate	mg/L		250	-	U	5	-	U	5	128		5
Total Dissolved Solids	mg/L			383		10	426		10	750		10
Total Organic Carbon	mg/L			13.4		1	13.2		1	1.3		1

Notes:
A blank result box indicates that no data was available for that analyte.
TOGS 1.1.1 = New York Division of Water Technical & Operational Guidance Series
"-" indicates that the constituent was not detected as qualified by "U " or "UJ".
RL indicates reporting limit.
J indicates a laboratory approximated value.
indicates that detected value is greater than the NYS TOGS 1.1.1 SD Standard.
Sample point identification number preceded by "F" is a field duplicate.
HF indicates a field parameter with a holding time of 15 minutes

Checked By: JWL 8/11/11

Golder Associates

TABLE 3
SUMMARY OF PHYSICAL CHARACTERISTICS
LNAPL SAMPLE ANALYSES
REVIEW AVENUE DEVELOPMENT
37-80 AND 37-30 REVIEW AVENUE
LONG ISLAND CITY, NEW YORK

		RAD II WELLS							
Sample Point:		**GAGW-04 ***	**GAL-01**	**GAL-01R**	**(duplicate)**	**GAL-02**	**GAL-03**	**GAL-04**	**GAL-05**
Date Sampled:		12/17/2003	11/18/2003	7/16/2004	7/16/2004	11/18/2003	11/18/2003	11/25/2003	11/19/2003
Lab ID:		488619	481266	547612	547613	481265	481942	483777	481943
Parameter	**Units**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
% Sediments	wt %	10	0.4	0.34	0.8	0.3	0.05	0.2	0.05
% Sulfur	wt %	0.329	0.274	0.323	0.323	0.274	0.416	0.234	0.38
BTU/TOT	BTU/TOT	19155	19457	19416	19421	19586	19305	19377	19411
Flashpoint	deg F	281	201	180	189	280	302	224	277
Interfacial Tension/TOT	dynes/cm	32.55	28.59	12.68	17.85	32.97	31.07	30.5	30.24
Specific Gravity	g/cm^3	0.899	0.885	0.891	0.894	0.899	0.899	0.892	0.897
Surface Tension/TOT	dynes/cm	38	38.5	33	35.5	38	37.5	30.5	38
TOX/TOT	mg/kg	5	321	279.43	223.03	155	23	259	38.72
Viscosity	cSt	41.34	106	82.1	74.15	117.6	51.81	75.9	49.87

		RAD II WELLS							
Sample Point:		**GAL-06**	**GAL-07**	**GAL-07B**	**GAL-08**	**GAL-09**	**GAL-16**	**MW-11**	**MW-15 ***
Date Sampled:		11/17/2003	11/17/2003	11/19/2003	11/25/2003	7/10/2004	7/10/2004	11/20/2003	7/12/2004
Lab ID:		481263	481264	481944	483778	545882	545883	482760	ORGANIC
Parameter	**Units**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
% Sediments	wt %	0.05	0.05	0.2	0.05	-	0.2	0.06	24
% Sulfur	wt %	0.331	0.294	0.29	0.223	0.38	0.342	0.373	0.306
BTU/TOT	BTU/TOT	19326	19391	19327	19343	19250	19307	19375	19242
Flashpoint	deg F	201	275	260	209	219	303	219	288
Interfacial Tension/TOT	dynes/cm	32.94	34.38	29.67	30.5	20.64	20.77	30.3	10.64
Specific Gravity	g/cm^3	0.897	0.903	0.898	0.915	0.898	0.905	0.895	0.898
Surface Tension/TOT	dynes/cm	39	39	38	30.5	36	36.5	30.3	36
TOX/TOT	mg/kg	9.56	34.54	23.17	66.69	7.03	17.89	29.47	13.57
Viscosity	cSt	30.72	45.02	45.91	47.13	34.34	66.15	37.33	41.03

Notes: * - Wells GAGW-04 and MW-15 are located north of the RAD II (aka Quanta) property across from Review Avenue.
"-" indicates analysis was not conducted

TABLE 3
SUMMARY OF PHYSICAL CHARACTERISTICS
LNAPL SAMPLE ANALYSES
REVIEW AVENUE DEVELOPMENT
37-80 AND 37-30 REVIEW AVENUE
LONG ISLAND CITY, NEW YORK

		RAD II WELLS					
Sample Point:		**Sump**	**GAL-29**	**GAL-30**	**GAL-31**	**VER-2**	**GAL-04**
Date Sampled:		1/14/2004	8/7/2008	8/7/2008	8/7/2008	10/29/2008	10/29/2008
Lab ID:		494865	X938-941025	X938-941026	X938-941027	962888	962890
Parameter	**Units**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
% Sediments	wt %	1.2	-	-	-	-	-
% Sulfur	wt %	0.385	-	-	-	-	-
BTU/TOT	BTU/TOT	16278	-	-	-	-	-
Flashpoint	deg F	280	-	-	-	-	-
Interfacial Tension/TOT	dynes/cm	10.68	28.2	28.4	28	-	-
Specific Gravity	g/cm^3	0.9028	0.8965	0.8942	8934	-	-
Surface Tension/TOT	dynes/cm	34	33.7	33	33.2	-	-
TOX/TOT	mg/kg	456.8	-	-	-	-	-
Viscosity	cSt	254.9	49.36	43.71	38.95	170.38	91.12

		RAD I WELLS					
Sample Point:		**GAL-10**	**(duplicate)**	**GAL-11**	**GAL-12**	**GAL-13**	**GAL-18**
Date Sampled:		7/9/2004	7/9/2004	7/9/2004	7/9/2004	7/9/2004	7/16/2004
Lab ID:		545873	545874	545870	545876	545871	547611
Parameter	**Units**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
% Sediments	wt %	1.2	2.4	0.8	0.8	0.2	0.3
% Sulfur	wt %	0.202	0.172	0.255	0.241	0.18	0.281
BTU/TOT	BTU/TOT	19295	19307	19337	19366	19464	19324
Flashpoint	deg F	165	163	178	230	141	155
Interfacial Tension/TOT	dynes/cm	16	19.29	15.78	17.26	17.41	15.97
Specific Gravity	g/cm^3	0.889	0.888	0.875	0.09	0.875	0.892
Surface Tension/TOT	dynes/cm	35.8	34.8	36	35.5	35	34.5
TOX/TOT	mg/kg	37.29	33.43	177.54	74.27	46.95	67.68
Viscosity	cSt	25.43	27.32	50.55	45.93	23.27	27.85

Notes: * - Wells GAGW-04 and MW-15 are located north of the RAD II (aka Quanta) property across from Review Avenue.
"-" indicates analysis was not conducted

TABLE 3
SUMMARY OF PHYSICAL CHARACTERISTICS
LNAPL SAMPLE ANALYSES
REVIEW AVENUE DEVELOPMENT
37-80 AND 37-30 REVIEW AVENUE
LONG ISLAND CITY, NEW YORK

		RAD I WELLS				
	Sample Point:	**MW-4R**	**MW-10**	**MH-Sump**	**VER-1**	**GAL-21**
	Date Sampled:	7/9/2004	7/9/2004	8/13/2004	10/29/2008	10/29/2008
	Lab ID:	545875	545872	554895	962887	962889
Parameter	**Units**	**Result**	**Result**	**Result**	**Result**	**Result**
% Sediments	wt %	0.2	0.4	14	-	-
% Sulfur	wt %	0.232	0.208	0.35	-	-
BTU/TOT	BTU/TOT	19210	19303	16879	-	-
Flashpoint	deg F	229	168	298	-	-
Interfacial Tension/TOT	dynes/cm	16.62	17.09	9.79	-	-
Specific Gravity	g/cm^3	0.9	0.891	0.891	-	-
Surface Tension/TOT	dynes/cm	36	35.5	34	-	-
TOX/TOT	mg/kg	122.34	76.14	83.55	-	-
Viscosity	cSt	54.99	36.8	184.2	48.14	51.53

		PHOENIX BEVERAGES WELLS		
	Sample Point:	**GAL-14**	**GAL-17**	**MW-8**
	Date Sampled:	7/10/2004	7/10/2004	7/10/2004
	Lab ID:	545881	545879	545880
Parameter	**Units**	**Result**	**Result**	**Result**
% Sediments	wt %	0.2	0.4	-
% Sulfur	wt %	0.39	0.444	0.387
BTU/TOT	BTU/TOT	19245	19283	19246
Flashpoint	deg F	294	305	292
Interfacial Tension/TOT	dynes/cm	23.19	23.14	20.76
Specific Gravity	g/cm^3	0.906	0.09	0.905
Surface Tension/TOT	dynes/cm	35.5	36	36
TOX/TOT	mg/kg	-	-	9.27
Viscosity	cSt	49.56	50.12	51.22

Notes: * - Wells GAGW-04 and MW-15 are located north of the RAD II (aka Quanta) property across from Review Avenue.
"-" indicates analysis was not conducted

TABLE 4A
LNAPL AND WATER LEVEL MEASUREMENTS
REVIEW AVENUE DEVELOPMENT II PROPERTY
37-80 AND 37-30 REVIEW AVENUE
LONG ISLAND CITY, NEW YORK

RAD II Property									
Date	**7/24/2004**	**7/24/2004**	**7/24/2004**	**8/31/2004**	**8/31/2004**	**8/31/2004**	**6/20/2008**	**6/20/2008**	**6/20/2008**
Monitoring Point ID	**Depth to LNAPL (feet)**	**Depth to Groundwater (feet)**	**LNAPL Apparent Thickness (feet)**	**Depth to LNAPL (feet)**	**Depth to Groundwater (feet)**	**LNAPL Apparent Thickness (feet)**	**Depth to LNAPL (feet)**	**Depth to Groundwater (feet)**	**LNAPL Apparent Thickness (feet)**
GAL-01	19.10	19.12	**0.02**	19.53	19.62	**0.09**	NM	NM	**NM**
GAL-01R	18.98	23.98	**5.00**	19.36	24.65	**5.29**	NM	NM	**NM**
GAL-02	NM	NM	**NM**	16.61	22.46	**5.85**	NM	NM	**NM**
GAL-02R	NA	NA	**NA**	NA	NA	**NA**	NA	NA	**NA**
GAL-03	22.11	27.73	**5.62**	22.38	28.19	**5.81**	NM	NM	**NM**
GAL-05	22.60	27.66	**5.06**	22.85	27.77	**4.92**	NM	NM	**NM**
GAL-16	17.32	25.06	**7.74**	17.64	25.55	**7.91**	NM	NM	**NM**
GAL-19	NM	NM	**NM**	NM	NM	**NM**	NM	NM	**NM**
GAL-20	NM	NM	**NM**	NM	NM	**NM**	NM	NM	**NM**
MW-11	20.72	24.72	**4.00**	21.06	24.86	**3.8**	NM	NM	**NM**
GAL-04	14.46	18.41	**3.95**	15.14	17.5	**2.36**	14.47	17.12	**2.65**
GAL-06	24.71	26.85	**2.14**	24.96	26.98	**2.02**	24.50	26.08	**1.58**
GAL-07	17.51	23.70	**6.19**	17.88	24.12	**6.24**	17.51	24.32	**6.81**
OW-1	NM	NM	**NM**	NM	NM	**NM**	16.95	24.32	**7.37**
OW-2	NM	NM	**NM**	NM	NM	**NM**	17.40	24.06	**6.66**
GAL-08	18.76	21.70	**2.94**	19	26.1	**7.1**	16.80	18.67	**1.87**
GAL-09	24.40	27.35	**2.95**	24.66	27.55	**2.89**	24.20	26.96	**2.76**
GW-1	NM	NM	**NM**	NM	NM	**NM**	21.53	NA	**NA**
GAL-29	NA	NA	**NA**	NA	NA	**NA**	NA	NA	**NA**
GAL-30	NA	NA	**NA**	NA	NA	**NA**	NA	NA	**NA**

Golder Associates

TABLE 4A
LNAPL AND WATER LEVEL MEASUREMENTS
REVIEW AVENUE DEVELOPMENT II PROPERTY
37-80 AND 37-30 REVIEW AVENUE
LONG ISLAND CITY, NEW YORK

RAD II Property									
Date	**8/7/2008**	**8/7/2008**	**8/7/2008**	**4/14/2011**	**4/14/2011**	**4/14/2011**	**4/27/2011**	**4/27/2011**	**4/27/2011**
Monitoring Point ID	**Depth to LNAPL (feet)**	**Depth to Groundwater (feet)**	**LNAPL Apparent Thickness (feet)**	**Depth to LNAPL (feet)**	**Depth to Groundwater (feet)**	**LNAPL Apparent Thickness (feet)**	**Depth to LNAPL (feet)**	**Depth to Groundwater (feet)**	**LNAPL Apparent Thickness (feet)**
GAL-01	NM	NM	**NM**	Well Missing	Well Missing	**NM**	Well Missing	Well Missing	**NM**
GAL-01R	NM	NM	**NM**	Well Missing	Well Missing	**NM**	Well Missing	Well Missing	**NM**
GAL-02	NM	NM	**NM**	Well Missing	Well Missing	**NM**	Well Missing	Well Missing	**NM**
GAL-02R	14.41	21.00	**6.59**	15.42	18.65	**3.23**	NM	NM	**NM**
GAL-03	NM	NM	**NM**	Well Missing	Well Missing	**NM**	Well Missing	Well Missing	**NM**
GAL-05	NM	NM	**NM**	Well Missing	Well Missing	**NM**	Well Missing	Well Missing	**NM**
GAL-16	NM	NM	**NM**	Well Missing	Well Missing	**NM**	Well Missing	Well Missing	**NM**
GAL-19	NM	NM	**NM**	Well Missing	Well Missing	**NM**	Well Missing	Well Missing	**NM**
GAL-20	NM	NM	**NM**	Well Missing	Well Missing	**NM**	Well Missing	Well Missing	**NM**
MW-11	20.64	24.20	**3.56**	21.79	25.02	**3.23**	NM	NM	**NM**
GAL-04	14.55	17.81	**3.26**	15.90	20.45	**4.55**	NM	NM	**NM**
GAL-06	24.64	26.55	**1.91**	22.90	24.91	**2.01**	NM	NM	**NM**
GAL-07	17.74	23.20	**5.46**	15.25	20.75	**5.50**	NM	NM	**NM**
OW-1	17.10	23.15	**6.05**	15.40	20.95	**5.55**	NM	NM	**NM**
OW-2	17.63	23.97	**6.34**	15.40	20.95	**5.55**	NM	NM	**NM**
GAL-08	17.64	21.52	**3.88**	17.91	21.17	**3.26**	NM	NM	**NM**
GAL-09	24.32	27.18	**2.86**	22.62	25.25	**2.63**	NM	NM	**NM**
GW-1	ND	21.71	**0.00**	22.18	dry	**NA**	NM	NM	**NM**
GAL-29	21.82	25.78	**3.96**	20.55	24.10	**3.55**	NM	NM	**NM**
GAL-30	22.93	26.39	**3.46**	21.55	24.00	**2.45**	NM	NM	**NM**

TABLE 4A
LNAPL AND WATER LEVEL MEASUREMENTS
REVIEW AVENUE DEVELOPMENT II PROPERTY
37-80 AND 37-30 REVIEW AVENUE
LONG ISLAND CITY, NEW YORK

RAD II Property									
Date	**7/24/2004**	**7/24/2004**	**7/24/2004**	**8/31/2004**	**8/31/2004**	**8/31/2004**	**6/20/2008**	**6/20/2008**	**6/20/2008**
Monitoring Point ID	**Depth to LNAPL (feet)**	**Depth to Groundwater (feet)**	**LNAPL Apparent Thickness (feet)**	**Depth to LNAPL (feet)**	**Depth to Groundwater (feet)**	**LNAPL Apparent Thickness (feet)**	**Depth to LNAPL (feet)**	**Depth to Groundwater (feet)**	**LNAPL Thickness (feet)**
GAL-31	NA	NA	**NA**	NA	NA	**NA**	NA	NA	**NA**
VMP-1	NA	NA	**NA**	NA	NA	**NA**	NA	NA	**NA**
VMP-2	NA	NA	**NA**	NA	NA	**NA**	NA	NA	**NA**
VMP-3	NA	NA	**NA**	NA	NA	**NA**	NA	NA	**NA**
GAL-06R	NA	NA	**NA**	NA	NA	**NA**	NA	NA	**NA**
PSMW-2	NA	NA	**NA**	NA	NA	**NA**	NA	NA	**NA**
VER-2	NA	NA	**NA**	NA	NA	**NA**	NA	NA	**NA**
GAGW-01	NM	NM	**NM**	NM	NM	**NM**	ND	18.55	**0.00**
GAGW-02	NM	NM	**NM**	NM	NM	**NM**	ND	16.79	**0.00**
GAGW-03	NM	NM	**NM**	NM	NM	**NM**	ND	22.20	**0.00**
GAGW-05	NM	NM	**NM**	NM	NM	**NM**	ND	15.05	**0.00**
GAGW-06I	NM	NM	**NM**	NM	NM	**NM**	ND	17.82	**0.00**

Notes:

NM = Not Monitored

ND = Not Detected

NA = Not Applicable

Golder Associates

TABLE 4A
LNAPL AND WATER LEVEL MEASUREMENTS
REVIEW AVENUE DEVELOPMENT II PROPERTY
37-80 AND 37-30 REVIEW AVENUE
LONG ISLAND CITY, NEW YORK

RAD II Property									
Date	**8/7/2008**	**8/7/2008**	**8/7/2008**	**4/14/2011**	**4/14/2011**	**4/14/2011**	**4/27/2011**	**4/27/2011**	**4/27/2011**
Monitoring Point ID	**Depth to LNAPL (feet)**	**Depth to Groundwater (feet)**	**LNAPL Apparent Thickness (feet)**	**Depth to LNAPL (feet)**	**Depth to Groundwater (feet)**	**LNAPL Apparent Thickness (feet)**	**Depth to LNAPL (feet)**	**Depth to Groundwater (feet)**	**LNAPL Apparent Thickness (feet)**
GAL-31	20.93	24.61	**3.68**	19.70	22.90	**3.20**	NM	NM	**NM**
VMP-1	12.99	13.51	**0.52**	NM	NM	**NM**	NM	NM	**NM**
VMP-2	NA	dry	**NA**	NM	NM	**NM**	NM	NM	**NM**
VMP-3	NA	dry	**NA**	NM	NM	**NM**	NM	NM	**NM**
GAL-06R	14.94	21.61	**6.67**	NM	NM	**NM**	NM	NM	**NM**
PSMW-2	16.14	21.98	**5.84**	NM	NM	**NM**	NM	NM	**NM**
VER-2	15.76	NM	**NM**	NM	NM	**NM**	NM	NM	**NM**
GAGW-01	ND	18.75	**0.00**	NM	NM	**NM**	ND	15.50	**0.00**
GAGW-02	ND	16.99	**0.00**	NM	NM	**NM**	ND	16.70	**0.00**
GAGW-03	ND	22.39	**0.00**	NM	NM	**NM**	ND	18.35	**0.00**
GAGW-05	ND	15.25	**0.00**	NM	NM	**NM**	ND	16.70	**0.00**
GAGW-06I	ND	18.07	**0.00**	NM	NM	**NM**	ND	19.71	**0.00**

Notes:

NM = Not Monitored

ND = Not Detected

NA = Not Applicable

Golder Associates

TABLE 4B
LNAPL AND WATER LEVEL MEASUREMENTS
REVIEW AVENUE DEVELOPMENT I PROPERTY
37-80 AND 37-30 REVIEW AVENUE
LONG ISLAND CITY, NEW YORK

RAD I Property									
Date	**7/24/2004**	**7/24/2004**	**7/24/2004**	**8/31/2004**	**8/31/2004**	**8/31/2004**	**6/20/2008**	**6/20/2008**	**6/20/2008**
Monitoring Point ID	**Depth to LNAPL (feet)**	**Depth to Groundwater (feet)**	**LNAPL Apparent Thickness (feet)**	**Depth to LNAPL (feet)**	**Depth to Groundwater (feet)**	**LNAPL Apparent Thickness (feet)**	**Depth to LNAPL (feet)**	**Depth to Groundwater (feet)**	**LNAPL Apparent Thickness (feet)**
GAL-10	19.20	20.48	**1.28**	19.66	20.92	**1.26**	19.00	20.31	**1.31**
GAL-11	NM	NM	**NM**	15.08	18.67	**3.59**	14.29	18.00	**3.71**
GAL-12	12.75	16.78	**4.03**	13.20	17.65	**4.45**	12.46	16.65	**4.19**
GAL-13	13.79	15.26	**1.47**	14.35	16.15	**1.80**	13.60	15.41	**1.81**
GAL-18	18.11	20.40	**2.29**	18.64	20.90	**2.26**	17.90	20.10	**2.20**
GAL-21	NM	NM	**NM**	NM	NM	**NM**	NM	NM	**NM**
GAL-22	NM	NM	**NM**	NM	NM	**NM**	16.91	18.56	**1.65**
GAL-23	NM	NM	**NM**	NM	NM	**NM**	13.35	16.19	**2.84**
GAL-24	NM	NM	**NM**	NM	NM	**NM**	NM	NM	**NM**
MW-1	ND	20.05	**0.00**	ND	20.67	**0.00**	ND	20.41	**0.00**
MW-2	ND	12.73	**0.00**	ND	12.72	**0.00**	ND	12.42	**0.00**
MW-4R	11.02	16.65	**5.63**	11.55	16.64	**5.09**	NM	NM	**NM**
MW-10	14.52	17.21	**2.69**	15.08	17.92	**2.84**	14.25	16.70	**2.45**
PSMW-1	NA	NA	**NA**	NA	NA	**NA**	NA	NA	**NA**
VER-1	NA	NA	**NA**	NA	NA	**NA**	NA	NA	**NA**
GAGW-07	NM	NM	**NM**	NM	NM	**NM**	ND	18.06	**0.00**
GAGW-08	NM	NM	**NM**	NM	NM	**NM**	ND	14.97	**0.00**

Notes:
NM = Not Monitored
ND = Not Detected
NA = Not Applicable

Golder Associates

TABLE 4B
LNAPL AND WATER LEVEL MEASUREMENTS
REVIEW AVENUE DEVELOPMENT I PROPERTY
37-80 AND 37-30 REVIEW AVENUE
LONG ISLAND CITY, NEW YORK

RAD I Property									
Date	**8/7/2008**	**8/7/2008**	**8/7/2008**	**4/14/2011**	**4/14/2011**	**4/14/2011**	**4/27/2011**	**4/27/2011**	**4/27/2011**
Monitoring Point ID	**Depth to LNAPL (feet)**	**Depth to Groundwater (feet)**	**LNAPL Apparent Thickness (feet)**	**Depth to LNAPL (feet)**	**Depth to Groundwater (feet)**	**LNAPL Apparent Thickness (feet)**	**Depth to LNAPL (feet)**	**Depth to Groundwater (feet)**	**LNAPL Apparent Thickness (feet)**
GAL-10	NM	NM	**NM**	20.40	21.25	**0.85**	NM	NM	**NM**
GAL-11	14.40	18.48	**4.08**	NM	NM	**NM**	15.65	19.10	**3.45**
GAL-12	12.64	16.80	**4.16**	NM	NM	**NM**	NM	NM	**NM**
GAL-13	NM	NM	**NM**	15.10	17.01	**1.91**	NM	NM	**NM**
GAL-18	18.05	20.18	**2.13**	19.38	21.40	**2.02**	NM	NM	**NM**
GAL-21	13.37	17.25	**3.88**	14.72	18.60	**3.88**	NM	NM	**NM**
GAL-22	NM	NM	**NM**	18.30	19.85	**1.55**	NM	NM	**NM**
GAL-23	NM	NM	**NM**	14.80	17.75	**2.95**	NM	NM	**NM**
GAL-24	NM	NM	**NM**	15.15	16.72	**1.57**	NM	NM	**NM**
MW-1	ND	20.58	**0.00**	NM	NM	**NM**	NM	NM	**NA**
MW-2	NM	NM	**NM**	NM	NM	**NM**	NM	NM	**NA**
MW-4R	NM	NM	**NM**	NM	NM	**NM**	NM	NM	**NM**
MW-10	NM	NM	**NM**	NM	NM	**NM**	NM	NM	**NM**
PSMW-1	13.02	16.91	**3.89**	NM	NM	**NM**	NM	NM	**NM**
VER-1	12.46	16.44	**3.98**	NM	NM	**NM**	NM	NM	**NM**
GAGW-07	NM	NM	**NM**	ND	19.58	**0.00**	NM	NM	**NM**
GAGW-08	NM	NM	**NM**	NM	NM	**NM**	NA	16.30	**0.00**

Notes:
NM = Not Monitored
ND = Not Detected
NA = Not Applicable

Golder Associates

TABLE 4C
LNAPL AND WATER LEVEL MEASUREMENTS
REVIEW AVENUE DEVELOPMENT-FORMER PHOENIX BEVERAGE PROPERTY
37-80 AND 37-30 REVIEW AVENUE
LONG ISLAND CITY, NEW YORK

Former Phoenix Beverage Property						
Date	**7/24/2004**	**7/24/2004**	**7/24/2004**	**8/31/2004**	**8/31/2004**	**8/31/2004**
Monitoring Point ID	**Depth to LNAPL (feet)**	**Depth to Groundwater (feet)**	**LNAPL Apparent Thickness (feet)**	**Depth to LNAPL (feet)**	**Depth to Groundwater (feet)**	**LNAPL Apparent Thickness (feet)**
GAL-14	12.02	20.05	**8.03**	NM	NM	**NM**
GAL-15	ND	14.43	**0.00**	NM	NM	**NM**
GAL-17	11.72	16.93	**5.21**	NM	NM	**NM**
MW-8	12.90	18.57	**5.67**	NM	NM	**NM**

Notes:
NM = Not Monitored
ND = Not Detected
NA = Not Applicable

Golder Associates

TABLE 4D
LNAPL AND WATER LEVEL MEASUREMENTS
REVIEW AVENUE DEVELOPMENT - REVIEW AVENUE
37-80 AND 37-30 REVIEW AVENUE
LONG ISLAND CITY, NEW YORK

Review Avenue									
Date	**7/24/2004**	**7/24/2004**	**7/24/2004**	**8/31/2004**	**8/31/2004**	**8/31/2004**	**6/20/2008**	**6/20/2008**	**6/20/2008**
Monitoring Point ID	**Depth to LNAPL (feet)**	**Depth to Groundwater (feet)**	**LNAPL Apparent Thickness (feet)**	**Depth to LNAPL (feet)**	**Depth to Groundwater (feet)**	**LNAPL Apparent Thickness (feet)**	**Depth to LNAPL (feet)**	**Depth to Groundwater (feet)**	**LNAPL Apparent Thickness (feet)**
MW-14S	ND	18.78	**0.00**	ND	18.77	**0.00**	ND	18.49	**0.00**
MW-14D	NM	NM	**NM**	NM	NM	**NM**	ND	18.45	**0.00**
MW-15	20.85	22.32	**1.47**	21.22	22.70	**1.48**	20.32	22.30	**1.98**
MW-16	ND	20.75	**0.00**	ND	20.15	**0.00**	ND	20.69	**0.00**
GAGW-04	21.48	23.22	**1.74**	21.80	23.53	**1.73**	21.18	22.74	**1.56**
GAGW-04D	NM	NM	**NM**	NM	NM	**NM**	ND	21.35	**0.00**

Notes:
NM = Not Monitored
ND = Not Detected
NA = Not Applicable

Golder Associates

TABLE 4D
LNAPL AND WATER LEVEL MEASUREMENTS
REVIEW AVENUE DEVELOPMENT - REVIEW AVENUE
37-80 AND 37-30 REVIEW AVENUE
LONG ISLAND CITY, NEW YORK

Review Avenue									
Date	**8/7/2008**	**8/7/2008**	**8/7/2008**	**4/14/2011**	**4/14/2011**	**4/14/2011**	**4/27/2011**	**4/27/2011**	**4/27/2011**
Monitoring Point ID	**Depth to LNAPL (feet)**	**Depth to Groundwater (feet)**	**LNAPL Apparent Thickness (feet)**	**Depth to LNAPL (feet)**	**Depth to Groundwater (feet)**	**LNAPL Apparent Thickness (feet)**	**Depth to LNAPL (feet)**	**Depth to Groundwater (feet)**	**LNAPL Apparent Thickness (feet)**
MW-14S	NM	NM	**NM**	NM	NM	**NA**	ND	19.75	**0.00**
MW-14D	NM	NM	**NM**	NM	NM	**NA**	ND	19.70	**0.00**
MW-15	20.78	22.05	**1.27**	NM	NM	**NA**	21.90	23.20	**1.30**
MW-16	NM	NM	**NM**	NM	NM	**NA**	ND	19.30	**0.00**
GAGW-04	NM	NM	**NM**	NM	NM	**NA**	22.45	23.80	**1.35**
GAGW-04D	NM	NM	**NM**	NM	NM	**NA**	ND	22.85	**0.00**

Notes:
NM = Not Monitored
ND = Not Detected
NA = Not Applicable

At Golder Associates we strive to be the most respected global group of companies specializing in ground engineering and environmental services. Employee owned since our formation in 1960, we have created a unique culture with pride in ownership, resulting in long-term organizational stability. Golder professionals take the time to build an understanding of client needs and of the specific environments in which they operate. We continue to expand our technical capabilities and have experienced steady growth with employees now operating from offices located throughout Africa, Asia, Australasia, Europe, North America and South America.

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South America	+ 55 21 3095 9500

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Golder Associates

File Location:
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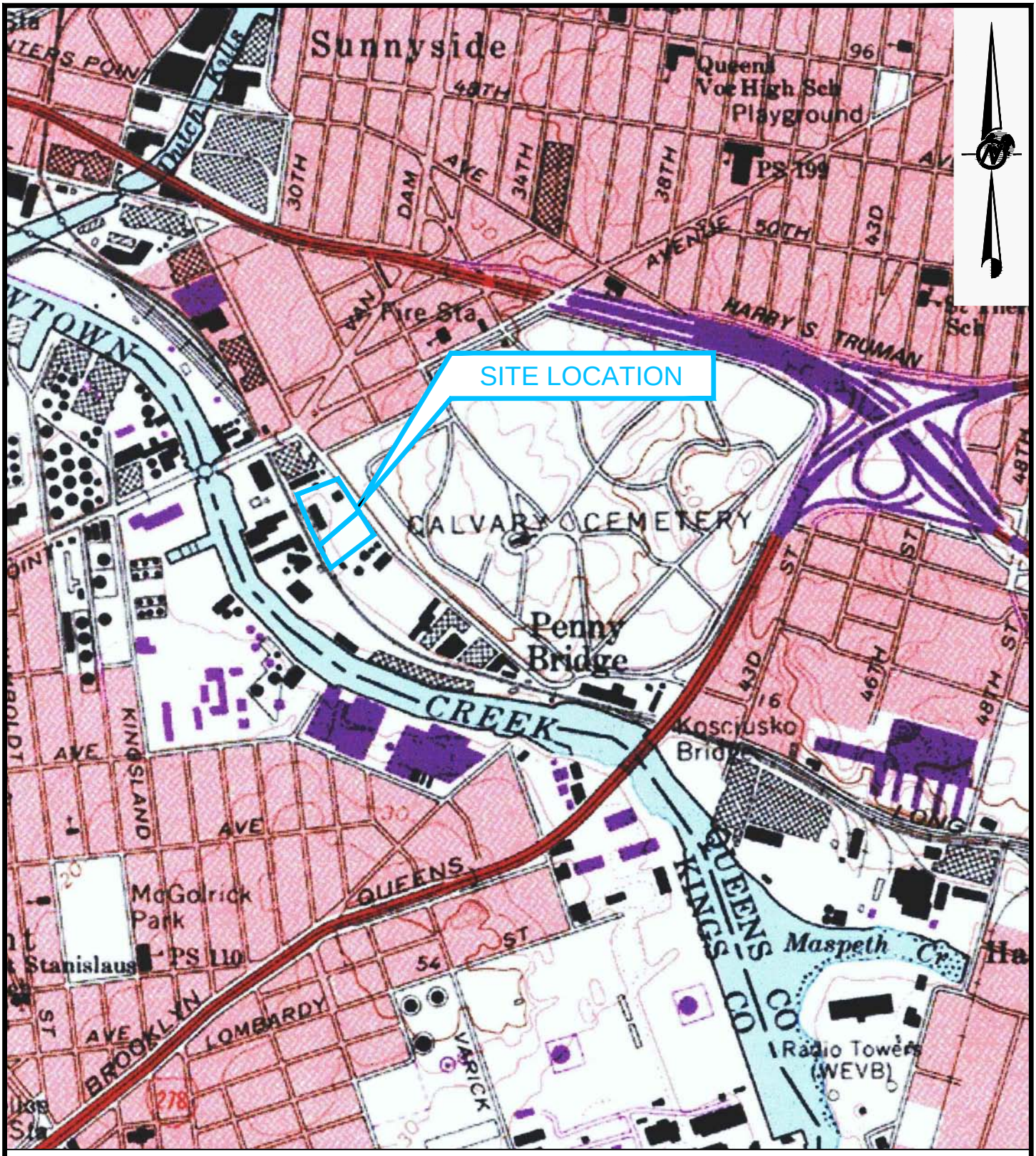
FIGURES



REFERENCES

1.) MAP TAKEN FROM U.S.G.S. 7.5 MINUTE QUADRANGLE OF BROOKLYN, NEW YORK, DATED 1979.

1000 0 1000
SCALE FEET

Golder Associates
Philadelphia USA

FILE No.	0236151002C001
PROJECT No.	023-6151002
REV.	0

SCALE	AS SHOWN
DATE	11/2011
DESIGN	AGE
CADD	YPW
CHECK	KGK
REVIEW	RES

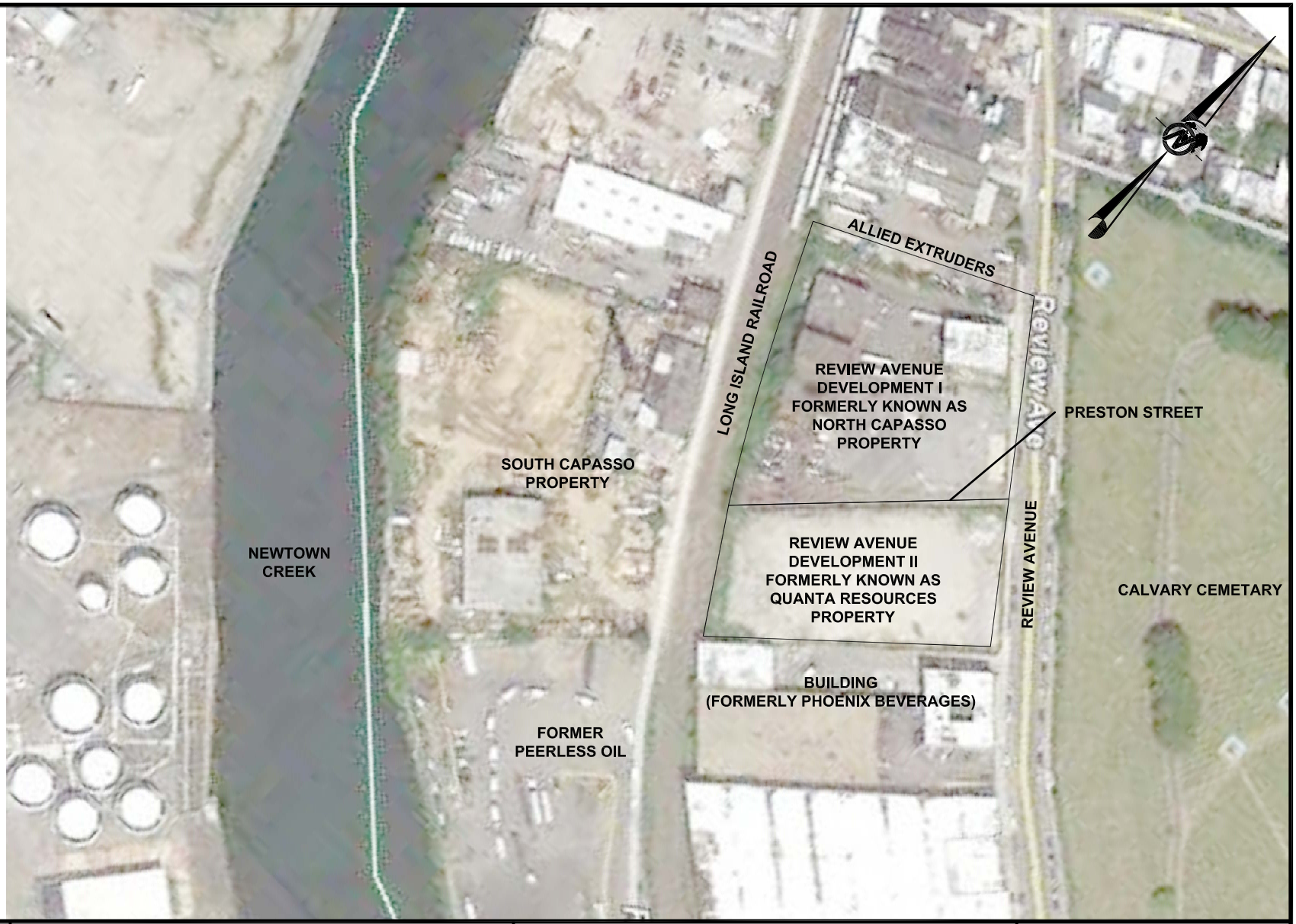
TITLE

SITE LOCATION MAP

REVIEW AVENUE DEVELOPMENT

FIGURE 1

Drawing file: 0236151002C001 Fig1.dwg Nov 23, 2011 - 11:52am



REFERENCE

1.) AERIAL PHOTOGRAPH TAKEN FROM DIGITAL IMAGE BY GOOGLE EARTH, IMAGE DATE JUNE 17, 2010.

SCALE 200 0 200 FEET

FIGURE 2

PROJECT No. 023-6151002

FILE No. 02361510002C002

REV. 0 SCALE AS SHOWN

DESIGN	AGE	07/2011
CADD	YPW	11/2011
CHECK	KGK	11/2011
REVIEW	RES	11/2011

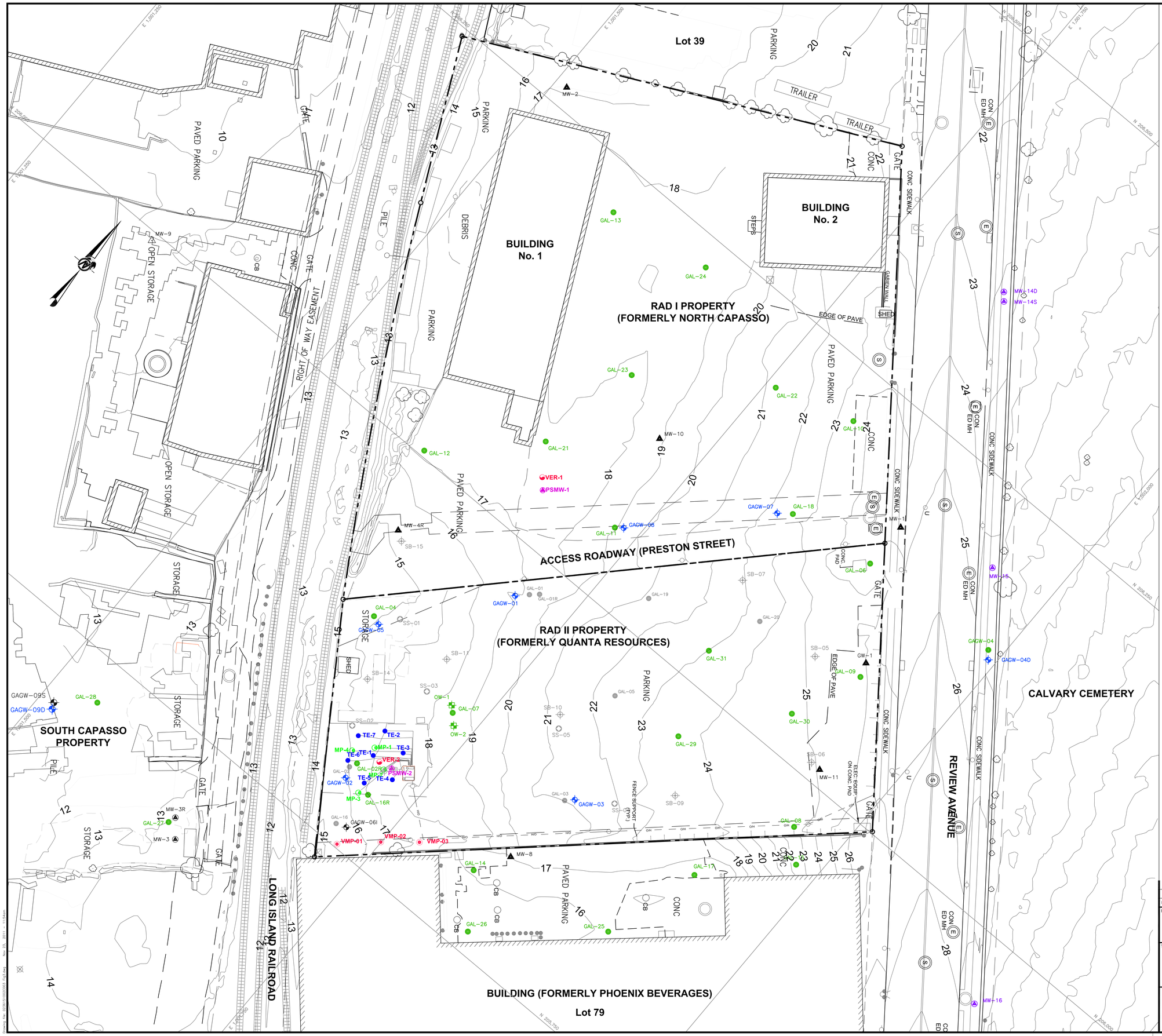
TITLE

REVIEW AVENUE DEVELOPMENT AERIAL MAP

PROJECT

REVIEW AVENUE DEVELOPMENT
BROWNFIELD CLEANUP PROGRAM
REMEDIAL ACTION WORK PLAN FOR
SITES C241005 & C241089
QUEENS COUNTY, NEW YORK

Golder Associates
Philadelphia USA



LEGEND

- THERMAL ENHANCED (TE) UNIT FOR LNAPL PILOT TEST (GOLDER 2008)
- VACUUM ENHANCED RECOVERY (VER) WELL FOR LNAPL PILOT TEST (GOLDER 2008)
- MONITORING WELL FOR LNAPL PILOT TEST (GOLDER 2008)
- TEMPERATURE AND VAPOR MONITORING POINT FOR LNAPL PILOT TEST (GOLDER 2008)
- VAPOR MONITORING POINT (GOLDER 2008)
- LNAPL MONITORING WELL (SEE NOTE 2)
- LNAPL MONITORING WELL (GOLDER ASSOCIATES 2003/2004/2005/2008) (SEE REFERENCE 2)
- SHALLOW GROUNDWATER MONITORING WELL (GOLDER ASSOCIATES 2004) (SEE REFERENCE 2)
- DEEP GROUNDWATER MONITORING WELL (GOLDER ASSOCIATES 2003/2004) (SEE REFERENCE 2)
- SOIL BORING (GOLDER ASSOCIATES 2003/2004) (SEE REFERENCE 2)
- ROEHR CHEMICAL INVESTIGATION WELL LOCATION (NOVEMBER 2000) (SEE REFERENCE 2)
- EXISTING ON-SITE AND OFF-SITE MONITORING WELL LOCATION (SEE REFERENCE 2)
- EXISTING OFF-SITE MONITORING WELL LOCATION (LOCATION APPROXIMATE)
- LNAPL PILOT TEST STUDY OBSERVATION WELL (SEE REFERENCE 2)
- EXISTING OFF-PROPERTY MONITORING WELL LOCATIONS (SEE REFERENCES 3 AND 4)
- CONCRETE SURVEY MONUMENT
- REVIEW AVENUE DEVELOPMENT PROPERTY BOUNDARY (SEE REFERENCE 1)
- RAILROAD
- FENCE LINE
- 5 FOOT CONTOUR LINE (FT.-MSL)
- 1 FOOT CONTOUR LINE (FT.-MSL)
- EASEMENT

NOTES

1.) FT-MSL - FEET MEAN SEA LEVEL

2.) LNAPL MONITORING WELLS GAL-01, GAL-01R, GAL-02, GAL-03, GAL-05, GAL-16, GAL-19, AND GAL-20 WERE NOT LOCATED DURING APRIL 2011 WELL SURVEYING ACTIVITIES.

REFERENCES

1.) BASE MAP TAKEN AND PROPERTY BOUNDARY FROM DIGITAL FILE 2148-DELIVERY-2.dwg, ENTITLED "BOUNDARY AND TOPOGRAPHIC PLAN, BLOCK 312 LOTS 41 & 69, 37-80 REVIEW AVENUE, PREPARED FOR: GOLDER ASSOCIATES, LOCATED IN: LONG ISLAND CITY, QUEENS, N.Y. PROVIDED BY GEOD CORPORATION, DATED JUNE 10, 2011.

2.) WELL COORDINATES TAKEN FROM A MICROSOFT EXCEL FILE Quanta Samples and Wells.xls, 2148A 8-23-04.xls, 2148A 4-11-05.xls, AND 2340 MONITORING WELLS.xls PROVIDED BY GEOD CORP.

3.) LOCATION OF MW-9 DIGITIZED FROM HARDCOPY FIGURE TITLED "GROUNDWATER CONTOURS", PROVIDED BY HALEY & ALDRICH, DATED FEBRUARY 2004.

4.) LOCATION OF MW-7 DIGITIZED FROM HARDCOPY FIGURE TITLED "SITE PLAN WITH SITE INVESTIGATION BORING LOCATIONS", PROVIDED BY ENVIRON, DATED SEPTEMBER 2000.

5.) RAD II PROPERTY - BLOCK 312, LOT 69; BCA# C241005.

6.) RAD I PROPERTY - BLOCK 312, LOT 41; BCA# C241089.

SCALE 25 0 25 50 FEET

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW

PROJECT

REVIEW AVENUE DEVELOPMENT
BROWNFIELD CLEANUP PROGRAM
REMEDIAL ACTION WORK PLAN FOR SITES C241005 & C241089
QUEENS COUNTY, NEW YORK

TITLE

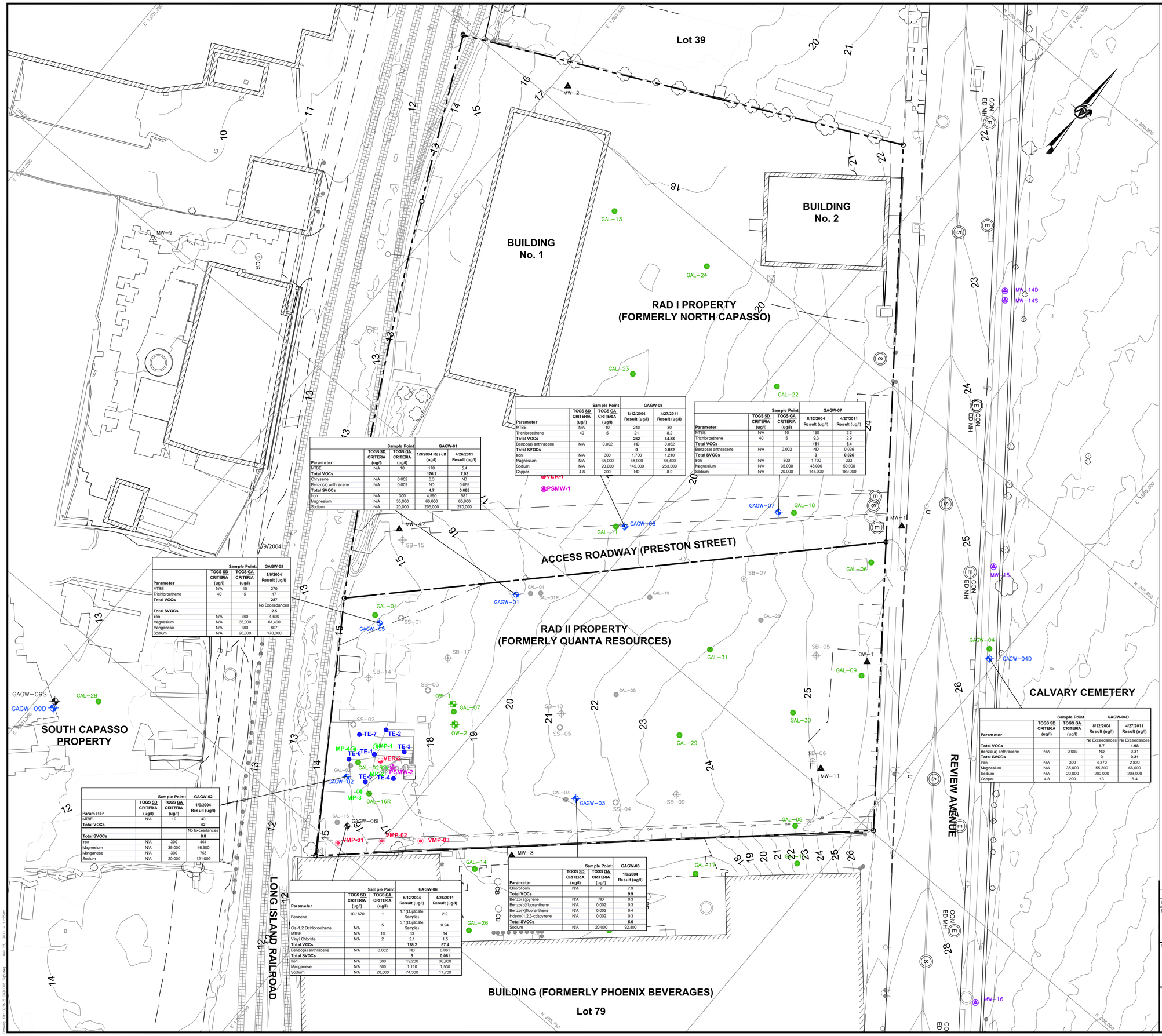
EXISTING SITE CONDITIONS

Golder Associates
Philadelphia USA

PROJECT No.	023-6151002		FILE No.	0236151002C003	
DESIGN	AGE	07/2011	SCALE	AS SHOWN	REV. 0
CADD	YPW	11/2011			
CHECK	KGK	11/2011			
REVIEW	RES	11/2011			

FIGURE 3

Drawing file: 0236151002C003.dgn Nov 23, 2011 - 11:54am



Parameter	Sample Point: TOGS SD CRITERIA (ug/l)	TOGS GA CRITERIA (ug/l)	GAGW-01 1/9/2004 Result (ug/l)	4/26/2011 Result (ug/l)
MTBE	N/A	10	170	5.4
Total VOCs			**176.2**	**7.03**
Chrysene	N/A	0.002	0.3	ND
Benzo(a) anthracene	N/A	0.002	ND	0.065
Total SVOCs			**4.7**	**0.065**
Iron	N/A	300	4,590	581
Magnesium	N/A	35,000	66,600	65,600
Sodium	N/A	20,000	205,000	270,000

Parameter	Sample Point: TOGS SD CRITERIA (ug/l)	TOGS GA CRITERIA (ug/l)	GAGW-05 1/9/2004 Result (ug/l)
MTBE	N/A	10	270
Trichloroethene	40	5	17
Total VOCs			**287**
Total SVOCs			No Exceedances **2.5**
Iron	N/A	300	4,600
Magnesium	N/A	35,000	61,400
Manganese	N/A	300	807
Sodium	N/A	20,000	170,000

Parameter	Sample Point: TOGS SD CRITERIA (ug/l)	TOGS GA CRITERIA (ug/l)	GAGW-02 1/9/2004 Result (ug/l)
MTBE	N/A	10	40
Total VOCs			**52**
Total SVOCs			No Exceedances **8.8**
Iron	N/A	300	464
Magnesium	N/A	35,000	46,300
Manganese	N/A	300	753
Sodium	N/A	20,000	121,000

Parameter	Sample Point: TOGS SD CRITERIA (ug/l)	TOGS GA CRITERIA (ug/l)	GAGW-03 1/9/2004 Result (ug/l)
Chloroform	N/A	7	7.9
Total VOCs			**9.9**
Benzo(a)pyrene	N/A	ND	0.3
Benzo(b)fluoranthene	N/A	0.002	0.3
Benzo(k)fluoranthene	N/A	0.002	0.4
Indeno(1,2,3-cd)pyrene	N/A	0.002	0.3
Total SVOCs			**5.6**
Sodium	N/A	20,000	92,300

Parameter	Sample Point: TOGS SD CRITERIA (ug/l)	TOGS GA CRITERIA (ug/l)	GAGW-04D 8/12/2004 Result (ug/l)	4/27/2011 Result (ug/l)
			No Exceedances	No Exceedances
Total VOCs			**8.7**	**1.98**
Benzo(a) anthracene	N/A	0.002	ND	0.31
Total SVOCs			**0**	**0.31**
Iron	N/A	300	4,370	2,820
Magnesium	N/A	35,000	55,300	66,000
Sodium	N/A	20,000	200,000	203,000
Copper	4.8	200	13	8.4

Parameter	Sample Point: TOGS SD CRITERIA (ug/l)	TOGS GA CRITERIA (ug/l)	GAGW-06I 8/12/2004 Result (ug/l)	4/26/2011 Result (ug/l)
Benzene	10 / 670	1	1.1(Duplicate Sample)	2.2
Cis-1,2 Dchloroethene	N/A	5	5.1(Duplicate Sample)	0.94
MTBE	N/A	10	33	14
Vinyl Chloride	N/A	2	2.1	1.5
Total VOCs			**128.2**	**57.4**
Benzo(a) anthracene	N/A	0.002	ND	0.061
Total SVOCs			**5**	**0.061**
Iron	N/A	300	19,200	30,900
Manganese	N/A	300	1,110	1,530
Sodium	N/A	20,000	74,300	17,700

Parameter	Sample Point: TOGS SD CRITERIA (ug/l)	TOGS GA CRITERIA (ug/l)	GAGW-07 8/12/2004 Result (ug/l)	4/27/2011 Result (ug/l)
MTBE	N/A	10	150	2.2
Trichloroethene	40	5	9.3	2.9
Total VOCs			**161**	**5.4**
Benzo(a) anthracene	N/A	0.002	ND	0.026
Total SVOCs			**0**	**0.026**
Iron	N/A	300	1,700	333
Magnesium	N/A	35,000	48,000	50,300
Sodium	N/A	20,000	145,000	189,000

Parameter	Sample Point: TOGS SD CRITERIA (ug/l)	TOGS GA CRITERIA (ug/l)	GAGW-08 8/12/2004 Result (ug/l)	4/27/2011 Result (ug/l)
MTBE	N/A	10	240	30
Trichloroethene	40	5	21	8.2
Total VOCs			**262**	**44.88**
Benzo(a) anthracene	N/A	0.002	ND	0.032
Total SVOCs			**0**	**0.032**
Iron	N/A	300	1,700	1,210
Magnesium	N/A	35,000	48,000	66,400
Sodium	N/A	20,000	145,000	263,000
Copper	4.8	200	ND	8.0

LEGEND

- THERMAL ENHANCED (TE) UNIT FOR LNAPL PILOT TEST (GOLDER 2008)
- VACUUM ENHANCED RECOVERY (VER) WELL FOR LNAPL PILOT TEST (GOLDER 2008)
- MONITORING WELL FOR LNAPL PILOT TEST (GOLDER 2008)
- TEMPERATURE AND VAPOR MONITORING POINT FOR LNAPL PILOT TEST (GOLDER 2008)
- VAPOR MONITORING POINT (GOLDER 2008)
- LNAPL MONITORING WELL (SEE NOTE 6)
- LNAPL MONITORING WELL (GOLDER ASSOCIATES 2003/2004/2005/2008) (SEE REFERENCE 2)
- SHALLOW GROUNDWATER MONITORING WELL (GOLDER ASSOCIATES 2004) (SEE REFERENCE 2)
- DEEP GROUNDWATER MONITORING WELL (GOLDER ASSOCIATES 2003/2004) (SEE REFERENCE 2)
- SOIL BORING (GOLDER ASSOCIATES 2003/2004) (SEE REFERENCE 2)
- ROEHR CHEMICAL INVESTIGATION WELL LOCATION (NOVEMBER 2000) (SEE REFERENCE 2)
- EXISTING ON-SITE AND OFF-SITE MONITORING WELL LOCATION (SEE REFERENCE 2)
- EXISTING OFF-SITE MONITORING WELL LOCATION (LOCATION APPROXIMATE)
- LNAPL PILOT TEST STUDY OBSERVATION WELL (SEE REFERENCE 2)
- EXISTING OFF-PROPERTY MONITORING WELL LOCATIONS (SEE REFERENCES 3 AND 4)
- CONCRETE SURVEY MONUMENT
- REVIEW AVENUE DEVELOPMENT PROPERTY BOUNDARY (SEE REFERENCE 1)
- RAILROAD
- FENCE LINE
- 20 5 FOOT CONTOUR LINE (FT.-MSL)
- 1 FOOT CONTOUR LINE (FT.-MSL)
- EASEMENT

NOTES

1.) FIGURE SHOWS GROUNDWATER QUALITY EXCEEDANCES BASED ON COMPARISON OF REPORTED ANALYTICAL RESULTS FROM SAMPLING EVENTS CONDUCTED IN JANUARY 2004 AND APRIL 2011 TO THE NEW YORK STATE TOGS 1.1.1 CLASS GA GROUNDWATER CRITERIA AND CLASS SD SURFACE WATER CRITERIA (WHERE APPLICABLE) (OCTOBER 1993, REVISED JUNE 1998 AND APRIL 2000 ADDENDUM).

2.) ALL RESULTS ARE SHOWN IN UG/L (PPB).

3.) THERE WERE NO DETECTIONS OF PCB'S.

4.) FT-MSL - FEET MEAN SEA LEVEL

5.) ND - NOT DETECTED

6.) LNAPL MONITORING WELLS GAL-01, GAL-01R, GAL-02, GAL-03, GAL-05, GAL-16, GAL-19, AND GAL-20 WERE NOT LOCATED DURING APRIL 2011 WELL SURVEYING ACTIVITIES.

7.) N/A INDICATES NO PUBLISHED CRITERIA.

REFERENCES

1.) BASE MAP TAKEN AND PROPERTY BOUNDARY FROM DIGITAL FILE 2148-DELIVERY-2.dwg, ENTITLED "BOUNDARY AND TOPOGRAPHIC PLAN, BLOCK 312 LOTS 41 & 69, 37-80 REVIEW AVENUE, PREPARED FOR: GOLDER ASSOCIATES, LOCATED IN: LONG ISLAND CITY, QUEENS, N.Y. PROVIDED BY GEOD CORPORATION, DATED JUNE 10, 2011.

2.) WELL COORDINATES TAKEN FROM A MICROSOFT EXCEL FILE Quanta Samples and Wells.xls, 2148A 8-23-04.xls, 2148A 4-11-05.xls, AND 2340 MONITORING WELLS.xls PROVIDED BY GEOD CORP.

3.) LOCATION OF MW-9 DIGITIZED FROM HARDCOPY FIGURE TITLED "GROUNDWATER CONTOURS", PROVIDED BY HALEY & ALDRICH, DATED FEBRUARY 2004.

4.) LOCATION OF MW-7 DIGITIZED FROM HARDCOPY FIGURE TITLED "SITE PLAN WITH SITE INVESTIGATION BORING LOCATIONS", PROVIDED BY ENVIRON, DATED SEPTEMBER 2000.

5.) RAD II PROPERTY - BLOCK 312, LOT 69; BCA# C241005.

6.) RAD I PROPERTY - BLOCK 312, LOT 41; BCA# C241089.

25 0 25 50
SCALE FEET

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW

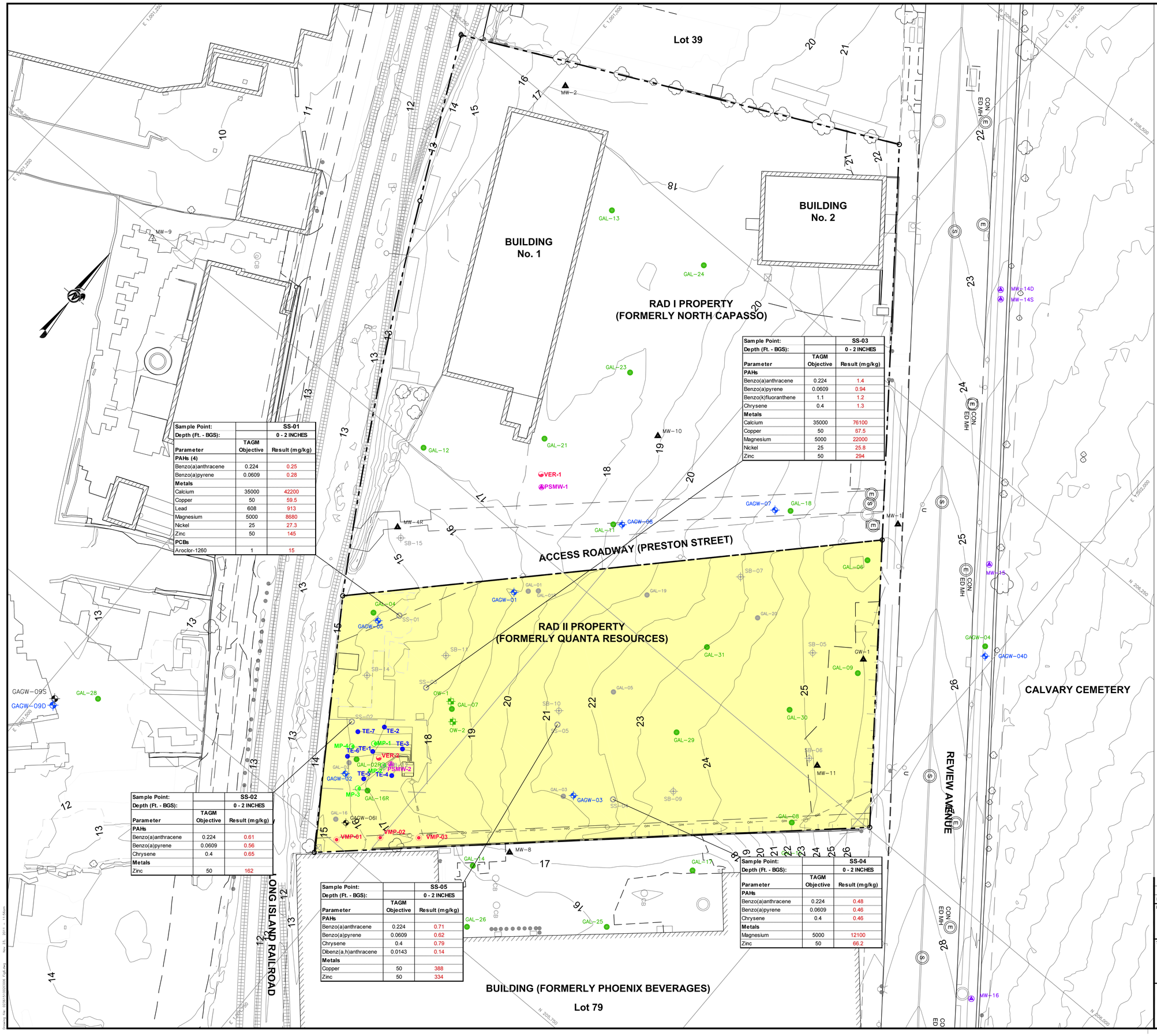
PROJECT
REVIEW AVENUE DEVELOPMENT
BROWNFIELD CLEANUP PROGRAM
REMEDIAL ACTION WORK PLAN FOR SITES C241005 & C241089
QUEENS COUNTY, NEW YORK

TITLE
COMPARISON OF GROUNDWATER SAMPLING RESULTS TO THE NEW YORK STATE TOGS 1.1.1 CLASS GA AND CLASS SD CRITERIA

Golder Associates
Philadelphia USA

PROJECT No.	023-6151002		FILE No.	0236151002C005	
DESIGN	AGE	07/2011	SCALE	AS SHOWN	REV. 0
CADD	YPW	11/2011			
CHECK	KGK	11/2011			
REVIEW	RES	11/2011			

FIGURE 5



Sample Point:		SS-01
Depth (Ft. - BGS):		0 - 2 INCHES
Parameter	TAGM Objective	Result (mg/kg)
PAHs (4)		
Benzo(a)anthracene	0.224	0.25
Benzo(a)pyrene	0.0609	0.28
Metals		
Calcium	35000	42200
Copper	50	59.5
Lead	608	913
Magnesium	5000	8680
Nickel	25	27.3
Zinc	50	145
PCBs		
Aroclor-1260	1	15

Sample Point:		SS-03
Depth (Ft. - BGS):		0 - 2 INCHES
Parameter	TAGM Objective	Result (mg/kg)
PAHs		
Benzo(a)anthracene	0.224	1.4
Benzo(a)pyrene	0.0609	0.94
Benzo(k)fluoranthene	1.1	1.2
Chrysene	0.4	1.3
Metals		
Calcium	35000	76100
Copper	50	67.5
Magnesium	5000	22000
Nickel	25	25.8
Zinc	50	294

Sample Point:		SS-02
Depth (Ft. - BGS):		0 - 2 INCHES
Parameter	TAGM Objective	Result (mg/kg)
PAHs		
Benzo(a)anthracene	0.224	0.61
Benzo(a)pyrene	0.0609	0.56
Chrysene	0.4	0.65
Metals		
Zinc	50	162

Sample Point:		SS-05
Depth (Ft. - BGS):		0 - 2 INCHES
Parameter	TAGM Objective	Result (mg/kg)
PAHs		
Benzo(a)anthracene	0.224	0.71
Benzo(a)pyrene	0.0609	0.62
Chrysene	0.4	0.79
Dibenz(a,h)anthracene	0.0143	0.14
Metals		
Copper	50	388
Zinc	50	334

Sample Point:		SS-04
Depth (Ft. - BGS):		0 - 2 INCHES
Parameter	TAGM Objective	Result (mg/kg)
PAHs		
Benzo(a)anthracene	0.224	0.48
Benzo(a)pyrene	0.0609	0.46
Chrysene	0.4	0.46
Metals		
Magnesium	5000	12100
Zinc	50	66.2

LEGEND

- THERMAL ENHANCED (TE) UNIT FOR LNAPL PILOT TEST (GOLDER 2008)
- VACUUM ENHANCED RECOVERY (VER) WELL FOR LNAPL PILOT TEST (GOLDER 2008)
- MONITORING WELL FOR LNAPL PILOT TEST (GOLDER 2008)
- TEMPERATURE AND VAPOR MONITORING POINT FOR LNAPL PILOT TEST (GOLDER 2008)
- VAPOR MONITORING POINT (GOLDER 2008)
- LNAPL MONITORING WELL (SEE NOTE 6)
- LNAPL MONITORING WELL (GOLDER ASSOCIATES 2003/2004/2005/2008) (SEE REFERENCE 2)
- SHALLOW GROUNDWATER MONITORING WELL (GOLDER ASSOCIATES 2004) (SEE REFERENCE 2)
- DEEP GROUNDWATER MONITORING WELL (GOLDER ASSOCIATES 2003/2004) (SEE REFERENCE 2)
- SOIL BORING (GOLDER ASSOCIATES 2003/2004) (SEE REFERENCE 2)
- ROEHR CHEMICAL INVESTIGATION WELL LOCATION (NOVEMBER 2000) (SEE REFERENCE 2)
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- EXISTING OFF-SITE MONITORING WELL LOCATION (LOCATION APPROXIMATE)
- LNAPL PILOT TEST STUDY OBSERVATION WELL (SEE REFERENCE 2)
- EXISTING OFF-PROPERTY MONITORING WELL LOCATIONS (SEE REFERENCES 3 AND 4)
- CONCRETE SURVEY MONUMENT
- REVIEW AVENUE DEVELOPMENT PROPERTY BOUNDARY (SEE REFERENCE 1)
- RAILROAD
- FENCE LINE
- 5 FOOT CONTOUR LINE (FT.-MSL)
- 1 FOOT CONTOUR LINE (FT.-MSL)
- EASEMENT
- INTERPRETED EXTENT OF SOIL EXCEEDING APPLICABLE STANDARD AND REQUIRING CAP

NOTES

1.) FT-MSL - FEET MEAN SEA LEVEL

2.) FIGURE SHOWS SURFICIAL URBAN FILL / SOIL EXCEEDANCES (RED) BASED ON COMPARISON OF REPORTED ANALYTICAL RESULTS TO NEW YORK STATE TECHNICAL AND ADMINISTRATIVE GUIDANCE MEMORANDUM #4046, RECOMMENDED SOIL CLEANUP OBJECTIVES (**TAGM**) AS DISCUSSED IN SECTION 5.2 OF THE REMEDIAL INVESTIGATION REPORT.

3.) **TAGM** VALUES ARE THE LOWER OF THE USEPA HEALTH BASED CRITERIA (RESIDENTIAL EXPOSURE SCENARIO) AND THE GROUNDWATER PROTECTION VALUE (DRINKING WATER SCENARIO). THUS, THE **TAGM** VALUES DO NOT DIRECTLY APPLY TO POTENTIAL EXPOSURE SCENARIOS ON THE REVIEW AVENUE DEVELOPMENT PROPERTY AND ARE USED FOR SCREENING PURPOSES ONLY.

4.) ALL RESULTS ARE SHOWN IN mg/kg (ppm).

5.) CHROMIUM WAS DETECTED IN THE DUPLICATE SAMPLE DSS-01 AT A CONCENTRATION AT 43.3 PPM WHICH EXCEEDS THE TAGM OBJECTIVE.

6.) LNAPL MONITORING WELLS GAL-01, GAL-01R, GAL-02, GAL-03, GAL-05, GAL-16, GAL-19, AND GAL-20 WERE NOT LOCATED DURING APRIL 2011 WELL SURVEYING ACTIVITIES.

REFERENCES

1.) BASE MAP TAKEN AND PROPERTY BOUNDARY FROM DIGITAL FILE 2148-DELIVERY-2.dwg, ENTITLED "BOUNDARY AND TOPOGRAPHIC PLAN, BLOCK 312 LOTS 41 & 69, 37-80 REVIEW AVENUE, PREPARED FOR: GOLDER ASSOCIATES, LOCATED IN: LONG ISLAND CITY, QUEENS, N.Y. PROVIDED BY GEOD CORPORATION, DATED JUNE 10, 2011.

2.) WELL COORDINATES TAKEN FROM A MICROSOFT EXCEL FILE Quanta Samples and Wells.xls, 2148A 8-23-04.xls, 2148A 4-11-05.xls, AND 2340 MONITORING WELLS.xls PROVIDED BY GEOD CORP.

3.) LOCATION OF MW-9 DIGITIZED FROM HARDCOPY FIGURE TITLED "GROUNDWATER CONTOURS", PROVIDED BY HALEY & ALDRICH, DATED FEBRUARY 2004.

4.) LOCATION OF MW-7 DIGITIZED FROM HARDCOPY FIGURE TITLED "SITE PLAN WITH SITE INVESTIGATION BORING LOCATIONS", PROVIDED BY ENVIRON, DATED SEPTEMBER 2000.

5.) RAD II PROPERTY - BLOCK 312, LOT 69; BCA# C241005.

6.) RAD I PROPERTY - BLOCK 312, LOT 41; BCA# C241089.

25 0 25 50
SCALE FEET

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW

PROJECT
REVIEW AVENUE DEVELOPMENT
BROWNFIELD CLEANUP PROGRAM
REMEDIAL ACTION WORK PLAN FOR SITES C241005 & C241089
QUEENS COUNTY, NEW YORK

TITLE
SURFICIAL URBAN FILL / SOIL EXCEEDANCES NEW YORK STATE TAGM 4046 RECOMMENDED SOIL CLEANUP OBJECTIVES FROM RI REPORT (JUNE 2005)

Golder Associates
Philadelphia USA

PROJECT No.	023-6151002		FILE No.	0236151002C006	
DESIGN	AGE	07/2011	SCALE	AS SHOWN	REV. 0
CADD	YPW	11/2011			
CHECK	KGK	11/2011			
REVIEW	RES	11/2011			

FIGURE 6

Drawing file: 0236151002C006.dgn Plotted: Nov 23, 2011 - 11:45am

Sample Point:	GAL-01	
Depth (Ft.- BGS):	5	11
Parameter	**TAGM**	**Result (mg/kg)**
Benzene	0.06	**0.41**	-
Xylene (Total)	1.2	1.2	**5.5**
Total VOCs	10	**10.2**	**18.5**

Sample Point:	SB-10			
Depth (Ft.- BGS):	5.5	10	15.5	19
Parameter	**TAGM**	**Result (mg/kg)**		
Benzene	0.06	**0.16**	**0.63**	-	-
1,2-Dichloroberzene	7.9	**11**	5.2	0.86	0.52
Ethylbenzene	5.5	**11**	**6.1**	0.49	0.25
Toluene	1.5	**3.3**	**5.1**	-	-
Trichloroethene	0.7	**1**	0.13	-	-
Vinyl Chloride	0.2	-	**1.7**	-	-
Xylene (Total)	1.2	**31**	**25**	**1.6**	0.71
Total VOCs	10	**63.8**	**48.4**	4.1	2.0

Sample Point:	SB-11			
Depth (Ft.- BGS):	5	10	16	20.5
Parameter	**TAGM**	**Result (mg/kg)**		
Acetone	0.2	**8.4**	-	-	-
Xylene (Total)	1.2	0.19	0.19	0.64	**1.9**
Total VOCs	10	**18.1**	0.9	2.1	6.6

Sample Point:	GAL-04	
Depth (Ft.- BGS):	6	9
Parameter	**TAGM**	**Result (mg/kg)**
Acetone	0.2	-	**3.3**
Xylene (Total)	1.2	0.35	**1.5**
Total VOCs	10	2.2	7.4

Sample Point:	SB-14				
Depth (Ft.- BGS):	5	11	16.5	21
Parameter	**TAGM**	**Result (mg/kg)**		
Benzene	0.06	-	**0.38**	**0.22**	-
1,1-Dichloroethane	0.2	-	**13**	-	-
Methylene Chloride	0.1	-	**1.1**	-	-
Tetrachloroethene	1.4	-	**5.5**	0.16	-
Toluene	1.5	-	**6.9**	**1.8**	0.094
Trichloroethene	0.7	-	**3.5**	-	-
Xylene (Total)	1.2	-	**14**	**7.8**	0.31
Total VOCs	10	0.0	**69.7**	**31.7**	4.3

Sample Point:	SB-12			
Depth (Ft.- BGS):	6.5	10	16.5	20.5
Parameter	**TAGM**	**Result (mg/kg)**		
Acetone	0.2	**1.9**	**0.73**	-	-
Benzene	0.06	**0.11**	-	-	-
1,1-Dichloroethane	0.2	**0.32**	-	-	-
Total VOCs	10	2.5	1.2	6.0	8.1

Sample Point:	GAL-02		
Depth (Ft.- BGS):	6.5	10	16.5
Parameter	**TAGM**	**Result (mg/kg)**	
Acetone	0.2	**2.4**	-	**2**
Benzene	0.06	**0.07**	-	-
1,1-Dichloroethane	0.2	**0.36**	-	-
Total VOCs	10	4.7	0.4	4.1

Sample Point:	SB-16 (GAL-19)
Depth (Ft. - BGS):	17
Parameter	**TAGM**	**Result (mg/kg)**
Methylene Chloride	0.1	**0.65**
Xylene (Total)	1.2	**3.4**
Total VOCs	10	8.8

Sample Point:	GAL-03				
Depth (Ft.- BGS):	6.5	11	14.5	19	23.5
Parameter	**TAGM**	**Result (mg/kg)**			
Acetone	0.2	**1.4**	**2.5**	-	-	-
Benzene	0.06	-	-	-	-	**0.086**
Xylene (Total)	1.2	-	0.11	0.15	0.29	**1.6**
Total VOCs	10	1.4	3.9	0.9	1.8	7.4

Sample Point:	SB-07			
Depth (Ft.- BGS):	6	11	16.5	22
Parameter	**TAGM**	**Result (mg/kg)**		
Acetone	0.2	**0.73**	-	-	-
Ethylbenzene	5.5	-	0.085	1.7	**6.7**
Xylene (Total)	1.2	-	0.29	**10**	**33**
Total VOCs	10	0.7	3.0	**15.4**	**53.7**

Sample Point:	SB-17 (GAL-20)
Depth (Ft. - BGS):	17
Parameter	**TAGM**	**Result (mg/kg)**
Xylene (Total)	1.2	**4.8**
Total VOCs	10	14.2

Sample Point:	SB-05				
Depth (Ft.- BGS):	6	10	15	21.5
Parameter	**TAGM**	**Result (mg/kg)**		
Acetone	0.2	-	-	**4.3**	-
Xylene (Total)	1.2	0.23	1	0.46	**1.8**
Total VOCs	10	1.1	3.1	5.4	2.9

Sample Point:	GAGW-04			
Depth (Ft.- BGS):	1	5	11	16
Parameter	**TAGM**	**Result (mg/kg)**			
		No Exceedances		
Total VOCs	10	0.0	0.0	0.0	0.0

Sample Point:	SB-06			
Depth (Ft.- BGS):	6.5	11	15	20
Parameter	**TAGM**	**Result (mg/kg)**		
Trichloroethene	0.7	**1.2**	-	-	-
Vinyl Chloride	0.2	**0.3**	-	-	-
Total VOCs	10	4.1	**15.5**	0.8	0.7

Sample Point:	SB-09			
Depth (Ft.- BGS):	5.5	9.5	16.5	20
Parameter	**TAGM**	**Result (mg/kg)**		
Acetone	0.2	-	**5.2**	**1.3**	-
Benzene	0.06	-	-	-	**0.093**
Xylene (Total)	1.2	0.12	0.52	**4.7**	**11**
Total VOCs	10	1.6	7.4	**10.9**	**29.9**

LEGEND

- THERMAL ENHANCED (TE) UNIT FOR LNAPL PILOT TEST (GOLDER 2008)
- VACUUM ENHANCED RECOVERY (VER) WELL FOR LNAPL PILOT TEST (GOLDER 2008)
- MONITORING WELL FOR LNAPL PILOT TEST (GOLDER 2008)
- TEMPERATURE AND VAPOR MONITORING POINT FOR LNAPL PILOT TEST (GOLDER 2008)
- VAPOR MONITORING POINT (GOLDER 2008)
- LNAPL MONITORING WELL (SEE NOTE 7)
- LNAPL MONITORING WELL (GOLDER ASSOCIATES 2003/2004/2005/2008) (SEE REFERENCE 2)
- SHALLOW GROUNDWATER MONITORING WELL (GOLDER ASSOCIATES 2004) (SEE REFERENCE 2)
- DEEP GROUNDWATER MONITORING WELL (GOLDER ASSOCIATES 2003/2004) (SEE REFERENCE 2)
- SOIL BORING (GOLDER ASSOCIATES 2003/2004) (SEE REFERENCE 2)
- ROEHR CHEMICAL INVESTIGATION WELL LOCATION (NOVEMBER 2000) (SEE REFERENCE 2)
- EXISTING ON-SITE AND OFF-SITE MONITORING WELL LOCATION (SEE REFERENCE 2)
- EXISTING OFF-SITE MONITORING WELL LOCATION (LOCATION APPROXIMATE)
- LNAPL PILOT TEST STUDY OBSERVATION WELL (SEE REFERENCE 2)
- EXISTING OFF-PROPERTY MONITORING WELL LOCATIONS (SEE REFERENCES 3 AND 4)
- CONCRETE SURVEY MONUMENT
- REVIEW AVENUE DEVELOPMENT PROPERTY BOUNDARY (SEE REFERENCE 1)
- RAILROAD
- FENCE LINE
- 20 — 5 FOOT CONTOUR LINE (FT.-MSL)
- 1 FOOT CONTOUR LINE (FT.-MSL)
- EASEMENT
- INTERPRETED EXTENT OF SOIL EXCEEDING APPLICABLE STANDARD AND REQUIRING CAP

NOTES

1.) FT-MSL – FEET MEAN SEA LEVEL

2.) FIGURE SHOWS SUBSURFACE SOIL EXCEEDANCES (RED) BASED ON COMPARISON OF REPORTED ANALYTICAL RESULTS TO NEW YORK STATE TECHNICAL AND ADMINISTRATIVE GUIDANCE MEMORANDUM #4046, RECOMMENDED SOIL CLEANUP OBJECTIVES (**TAGM**) AS DISCUSSED IN SECTION 4.2 OF THE DATA SUMMARY REPORT.

3.) **TAGM** VALUES ARE THE LOWER OF THE USEPA HEALTH BASED CRITERIA (RESIDENTIAL EXPOSURE SCENARIO) AND THE GROUNDWATER PROTECTION VALUE (DRINKING WATER SCENARIO). THUS, THE **TAGM** VALUES DO NOT DIRECTLY APPLY TO POTENTIAL EXPOSURE SCENARIOS ON THE REVIEW AVENUE DEVELOPMENT PROPERTY AND ARE USED FOR SCREENING PURPOSES ONLY.

4.) WHEN A SAMPLE WAS COLLECTED WITHIN URBAN FILL THE DEPTH IS SHADED ORANGE.

5.) (-) INDICATES NOT DETECTED RESULT

6.) ALL RESULTS ARE SHOWN IN mg/kg (ppm).

7.) LNAPL MONITORING WELLS GAL-01, GAL-01R, GAL-02, GAL-03, GAL-05, GAL-16, GAL-19, AND GAL-20 WERE NOT LOCATED DURING APRIL 2011 WELL SURVEYING ACTIVITIES.

REFERENCES

1.) BASE MAP TAKEN AND PROPERTY BOUNDARY FROM DIGITAL FILE 2148-DELIVERY-2.dwg, ENTITLED "BOUNDARY AND TOPOGRAPHIC PLAN, BLOCK 312 LOTS 41 & 69, 37-80 REVIEW AVENUE, PREPARED FOR: GOLDER ASSOCIATES, LOCATED IN: LONG ISLAND CITY, QUEENS, N.Y. PROVIDED BY GEOD CORPORATION, DATED JUNE 10, 2011.

2.) WELL COORDINATES TAKEN FROM A MICROSOFT EXCEL FILE Quanta Samples and Wells.xls, 2148A 8-23-04.xls, 2148A 4-11-05.xls, AND 2340 MONITORING WELLS.xls PROVIDED BY GEOD CORP.

3.) LOCATION OF MW-9 DIGITIZED FROM HARDCOPY FIGURE TITLED "GROUNDWATER CONTOURS", PROVIDED BY HALEY & ALDRICH, DATED FEBRUARY 2004.

4.) LOCATION OF MW-7 DIGITIZED FROM HARDCOPY FIGURE TITLED "SITE PLAN WITH SITE INVESTIGATION BORING LOCATIONS", PROVIDED BY ENVIRON, DATED SEPTEMBER 2000.

5.) RAD II PROPERTY – BLOCK 312, LOT 69; BCA# C241005.

6.) RAD I PROPERTY – BLOCK 312, LOT 41; BCA# C241089.

SCALE 25 0 25 50 FEET

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW

PROJECT
REVIEW AVENUE DEVELOPMENT
BROWNFIELD CLEANUP PROGRAM
REMEDIAL ACTION WORK PLAN FOR SITES C241005 & C241089
QUEENS COUNTY, NEW YORK

TITLE
SUBSURFACE SOIL VOC EXCEEDANCES NEW YORK STATE TAGM 4046 RECOMMENDED SOIL CLEANUP OBJECTIVES FROM RI REPORT (JUNE 2005)

Golder Associates
Philadelphia, USA

PROJECT No.	023-6151002	FILE No.	0236151002C007
DESIGN	AGE	07/2011	SCALE AS SHOWN	REV. 0
CADD	YPW	11/2011	
CHECK	KGK	11/2011	FIGURE 7
REVIEW	RES	11/2011	

Drawing File: 0236151002C007 Fig7.dwg Nov 23, 2011 - 11:58am

Sample Point:	GAL-01	
Depth (Ft.- BGS):	5	11
Parameter	TAGM	Result (mg/kg)
Benzo(a)anthracene	0.224	3	1.2
Benzo(a)pyrene	0.061	5	-
Benzo(b)fluoranthene	1.1	2.6	-
Chrysene	0.4	5.5	1.6
Dibenz(a,h)anthracene	0.014	1.4	-
Total SVOCs	500	37.4	36.2

Sample Point:	SB-10			
Depth (Ft.- BGS):	5.5	10	15.5	19
Parameter	TAGM	Result (mg/kg)		
2-Methylnaphthalene	36.4	47	56	21	7.2
4-Methylphenol	0.9	2.3	-	-	-
Benzo(a)anthracene	0.224	1.6	2.5	0.38	0.19
Benzo(a)pyrene	0.061	0.6	-	-	-
bis(2-Ethylhexyl)phthalate	50	120	7.5	1.5	0.6
Chrysene	0.4	1.8	3.7	0.55	0.44
Dibenz(a,h)anthracene	0.014	-	6.4	-	-
Indeno(1,2,3-cd)pyrene	3.2	-	5.9	-	0.11
Naphthalene	13	27	36	9.4	3.4
Phenol	0.03	3.7	1	-	-
Total SVOCs	500	238.9	161.1	39.5	14.4

Sample Point:	SB-11			
Depth (Ft.- BGS):	5	10	16	20.5
Parameter	TAGM	Result (mg/kg)		
Benzo(a)anthracene	0.224	-	0.17	1.2	2.1
Chrysene	0.4	0.81	0.4	1.7	3.3
Dibenz(a,h)anthracene	0.014	-	-	-	0.41
Total SVOCs	500	5.1	4.7	16.6	26.4

Sample Point:	GAL-04	
Depth (Ft.- BGS):	6	9
Parameter	TAGM	Result (mg/kg)
Benzo(a)anthracene	0.224	1.8	2.7
Benzo(a)pyrene	0.061	2.9	3.5
Benzo(b)fluoranthene	1.1	1.1	1.3
Chrysene	0.4	2	3.2
Dibenz(a,h)anthracene	0.014	1.1	1.2
Phenol	0.03	-	0.99
Total SVOCs	500	21.2	48.0

Sample Point:	SB-14			
Depth (Ft.- BGS):	5	11	16.5	21
Parameter	TAGM	Result (mg/kg)		
Benzo(a)anthracene	0.224	10	1	13	9.3
Benzo(a)pyrene	0.061	13	1.1	4	2.8
Benzo(b)fluoranthene	1.1	7.8	0.56	3.3	2.1
Chrysene	0.4	13	1.1	15	12
Dibenz(a,h)anthracene	0.014	9.4	0.37	1.9	1
Indeno(1,2,3-cd)pyrene	3.2	7	0.36	1.1	0.73
Total SVOCs	500	159.0	9.0	99.7	60.7

Sample Point:	SB-12			
Depth (Ft.- BGS):	6.5	10	16.5	20.5
Parameter	TAGM	Result (mg/kg)		
Benzo(a)anthracene	0.224	3.2	0.02	2.2	15
Benzo(a)pyrene	0.061	3.7	0.018	-	3.7
Benzo(b)fluoranthene	1.1	2.4	0.01	-	3.7
Chrysene	0.4	4.9	0.015	3.3	19
Dibenz(a,h)anthracene	0.014	3.4	-	-	1.8
Total SVOCs	500	38.5	0.1	15.6	99.2

Sample Point:	GAL-02		
Depth (Ft.- BGS):	6.5	10	16.5
Parameter	TAGM	Result (mg/kg)	
Benzo(a)anthracene	0.224	17	1.7	7.7
Benzo(a)pyrene	0.061	52	2.6	3
Benzo(b)fluoranthene	1.1	-	1.2	1.5
Chrysene	0.4	28	2.3	10
Dibenz(a,h)anthracene	0.014	14	1.1	0.98
Indeno(1,2,3-cd)pyrene	3.2	12	1.4	0.78
Total SVOCs	500	184.4	25.7	44.6

Sample Point:	GAL-03				
Depth (Ft.- BGS):	6.5	11	14.5	19	23.5
Parameter	TAGM	Result (mg/kg)			
Benzo(a)anthracene	0.224	-	-	0.14	0.84	12
Benzo(a)pyrene	0.061	0.68	-	-	0.17	1.9
Chrysene	0.4	-	-	0.55	1.5	21
Dibenz(a,h)anthracene	0.014	0.44	-	0.086	-	-
Dibenzofuran	6.2	3.3	6.4	0.075	0.1	1.2
Total SVOCs	500	23.1	38.3	2.8	7.8	95.8

Sample Point:	SB-16 (GAL-19)
Depth (Ft. - BGS):	17
Parameter	TAGM	Result (mg/kg)
Benzo(a)anthracene	0.224	0.48
Benzo(a)pyrene	0.0609	0.48
Chrysene	0.4	0.72
Dibenzo(a,h)anthracene	0.0143	0.21
Total SVOCs	500*	9.2

Sample Point:	SB-07			
Depth (Ft.- BGS):	8	11	16.5	22
Parameter	TAGM	Result (mg/kg)		
Benzo(a)anthracene	0.224	0.74	0.41	3.6	4.6
Benzo(a)pyrene	0.061	-	-	0.97	0.96
Chrysene	0.4	1.1	0.74	5	7.3
Dibenz(a,h)anthracene	0.014	-	0.14	0.28	-
Total SVOCs	500	10.9	7.1	23.4	44.5

Sample Point:	SB-17 (GAL-20)
Depth (Ft. - BGS):	17
Parameter	TAGM	Result (mg/kg)
Benzo(a)anthracene	0.224	8.3
Benzo(a)pyrene	0.0609	1.8
Benzo(b)fluoranthene	1.1	1.6
Chrysene	0.4	9.9
Dibenzo(a,h)anthracene	0.0143	0.29
Total SVOCs	500*	44.2

Sample Point:	SB-05			
Depth (Ft.- BGS):	6	10	15	21.5
Parameter	TAGM	Result (mg/kg)		
Benzo(a)anthracene	0.224	0.69	4.1	2	0.07
Chrysene	0.4	1.2	5.2	2.9	0.7
Dibenz(a,h)anthracene	0.014	-	-	-	0.036
Total SVOCs	500	8.8	13.1	7.0	7.1

Sample Point:	GAGW-04			
Depth (Ft.- BGS):	1	5	11	16
Parameter	TAGM	Result (mg/kg)		
Benzo(a)anthracene	0.224	1.9	-	-	0.034
Benzo(a)pyrene	0.061	1.7	-	-	-
Benzo(b)fluoranthene	1.1	1.4	-	-	-
Chrysene	0.4	3	-	-	0.052
Dibenz(a,h)anthracene	0.014	0.59	-	-	-
Total SVOCs	500	16.0	0.2	0.0	1.0

Sample Point:	SB-06			
Depth (Ft.- BGS):	6.5	11	15	20
Parameter	TAGM	Result (mg/kg)		
Benzo(a)anthracene	0.224	5.5	0.74	2.9	1.8
Benzo(a)pyrene	0.061	5.4	0.3	-	0.27
Benzo(b)fluoranthene	1.1	3	0.18	-	0.23
Chrysene	0.4	8.1	1	3.8	2.3
Dibenz(a,h)anthracene	0.014	2.7	0.13	-	0.19
Total SVOCs	500	45.0	8.5	12.2	12.1

Sample Point:	SB-09			
Depth (Ft.- BGS):	5.5	9.5	16.5	20
Parameter	TAGM	Result (mg/kg)		
Benzo(a)anthracene	0.224	7.3	13	16	21
Benzo(a)pyrene	0.061	1.3	1.2	1.8	3.5
Benzo(b)fluoranthene	1.1	-	-	2	-
Chrysene	0.4	12	18	20	29
Dibenz(a,h)anthracene	0.014	1.1	1.1	0.91	-
Total SVOCs	500	34.8	51.8	63.8	113.2

LEGEND

- THERMAL ENHANCED (TE) UNIT FOR LNAPL PILOT TEST (GOLDER 2008)
- VACUUM ENHANCED RECOVERY (VER) WELL FOR LNAPL PILOT TEST (GOLDER 2008)
- MONITORING WELL FOR LNAPL PILOT TEST (GOLDER 2008)
- TEMPERATURE AND VAPOR MONITORING POINT FOR LNAPL PILOT TEST (GOLDER 2008)
- VAPOR MONITORING POINT (GOLDER 2008)
- LNAPL MONITORING WELL (SEE NOTE 7)
- LNAPL MONITORING WELL (GOLDER ASSOCIATES 2003/2004/2005/2008) (SEE REFERENCE 2)
- SHALLOW GROUNDWATER MONITORING WELL (GOLDER ASSOCIATES 2004) (SEE REFERENCE 2)
- DEEP GROUNDWATER MONITORING WELL (GOLDER ASSOCIATES 2003/2004) (SEE REFERENCE 2)
- SOIL BORING (GOLDER ASSOCIATES 2003/2004) (SEE REFERENCE 2)
- ROEHR CHEMICAL INVESTIGATION WELL LOCATION (NOVEMBER 2000) (SEE REFERENCE 2)
- EXISTING ON-SITE AND OFF-SITE MONITORING WELL LOCATION (SEE REFERENCE 2)
- EXISTING OFF-SITE MONITORING WELL LOCATION (LOCATION APPROXIMATE)
- LNAPL PILOT TEST STUDY OBSERVATION WELL (SEE REFERENCE 2)
- EXISTING OFF-PROPERTY MONITORING WELL LOCATIONS (SEE REFERENCES 3 AND 4)
- CONCRETE SURVEY MONUMENT
- REVIEW AVENUE DEVELOPMENT PROPERTY BOUNDARY (SEE REFERENCE 1)
- RAILROAD
- FENCE LINE
- 5 FOOT CONTOUR LINE (FT.-MSL)
- 1 FOOT CONTOUR LINE (FT.-MSL)
- EASEMENT
- INTERPRETED EXTENT OF SOIL EXCEEDING APPLICABLE STANDARD

NOTES

1.) FT-MSL - FEET MEAN SEA LEVEL

2.) FIGURE SHOWS SUBSURFACE SOIL EXCEEDANCES (RED) BASED ON COMPARISON OF REPORTED ANALYTICAL RESULTS TO NEW YORK STATE TECHNICAL AND ADMINISTRATIVE GUIDANCE MEMORANDUM #4046, RECOMMENDED SOIL CLEANUP OBJECTIVES (**TAGM**) AS DISCUSSED IN SECTION 4.2 OF THE DATA SUMMARY REPORT.

3.) **TAGM** VALUES ARE THE LOWER OF THE USEPA HEALTH BASED CRITERIA (RESIDENTIAL EXPOSURE SCENARIO) AND THE GROUNDWATER PROTECTION VALUE (DRINKING WATER SCENARIO). THUS, THE **TAGM** VALUES DO NOT DIRECTLY APPLY TO POTENTIAL EXPOSURE SCENARIOS ON THE REVIEW AVENUE DEVELOPMENT PROPERTY AND ARE USED FOR SCREENING PURPOSES ONLY.

4.) WHEN A SAMPLE WAS COLLECTED WITHIN URBAN FILL THE DEPTH IS SHADED ORANGE.

5.) (-) INDICATES NOT DETECTED RESULT

6.) ALL RESULTS ARE SHOWN IN mg/kg (ppm).

7.) LNAPL MONITORING WELLS GAL-01, GAL-01R, GAL-02, GAL-03, GAL-05, GAL-16, GAL-19, AND GAL-20 WERE NOT LOCATED DURING APRIL 2011 WELL SURVEYING ACTIVITIES.

REFERENCES

1.) BASE MAP TAKEN AND PROPERTY BOUNDARY FROM DIGITAL FILE 2148-DELIVERY-2.dwg, ENTITLED "BOUNDARY AND TOPOGRAPHIC PLAN, BLOCK 312 LOTS 41 & 69, 37-80 REVIEW AVENUE, PREPARED FOR: GOLDER ASSOCIATES, LOCATED IN: LONG ISLAND CITY, QUEENS, N.Y. PROVIDED BY GEOD CORPORATION, DATED JUNE 10, 2011.

2.) WELL COORDINATES TAKEN FROM A MICROSOFT EXCEL FILE Quanta Samples and Wells.xls, 2148A 8-23-04.xls, 2148A 4-11-05.xls, AND 2340 MONITORING WELLS.xls PROVIDED BY GEOD CORP.

3.) LOCATION OF MW-9 DIGITIZED FROM HARDCOPY FIGURE TITLED "GROUNDWATER CONTOURS", PROVIDED BY HALEY & ALDRICH, DATED FEBRUARY 2004.

4.) LOCATION OF MW-7 DIGITIZED FROM HARDCOPY FIGURE TITLED "SITE PLAN WITH SITE INVESTIGATION BORING LOCATIONS", PROVIDED BY ENVIRON, DATED SEPTEMBER 2000.

5.) RAD II PROPERTY - BLOCK 312, LOT 69; BCA# C241005.

6.) RAD I PROPERTY - BLOCK 312, LOT 41; BCA# C241089.

SCALE 25 0 25 50 FEET

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW

PROJECT
REVIEW AVENUE DEVELOPMENT
BROWNFIELD CLEANUP PROGRAM
REMEDIAL ACTION WORK PLAN FOR SITES C241005 & C241089
QUEENS COUNTY, NEW YORK

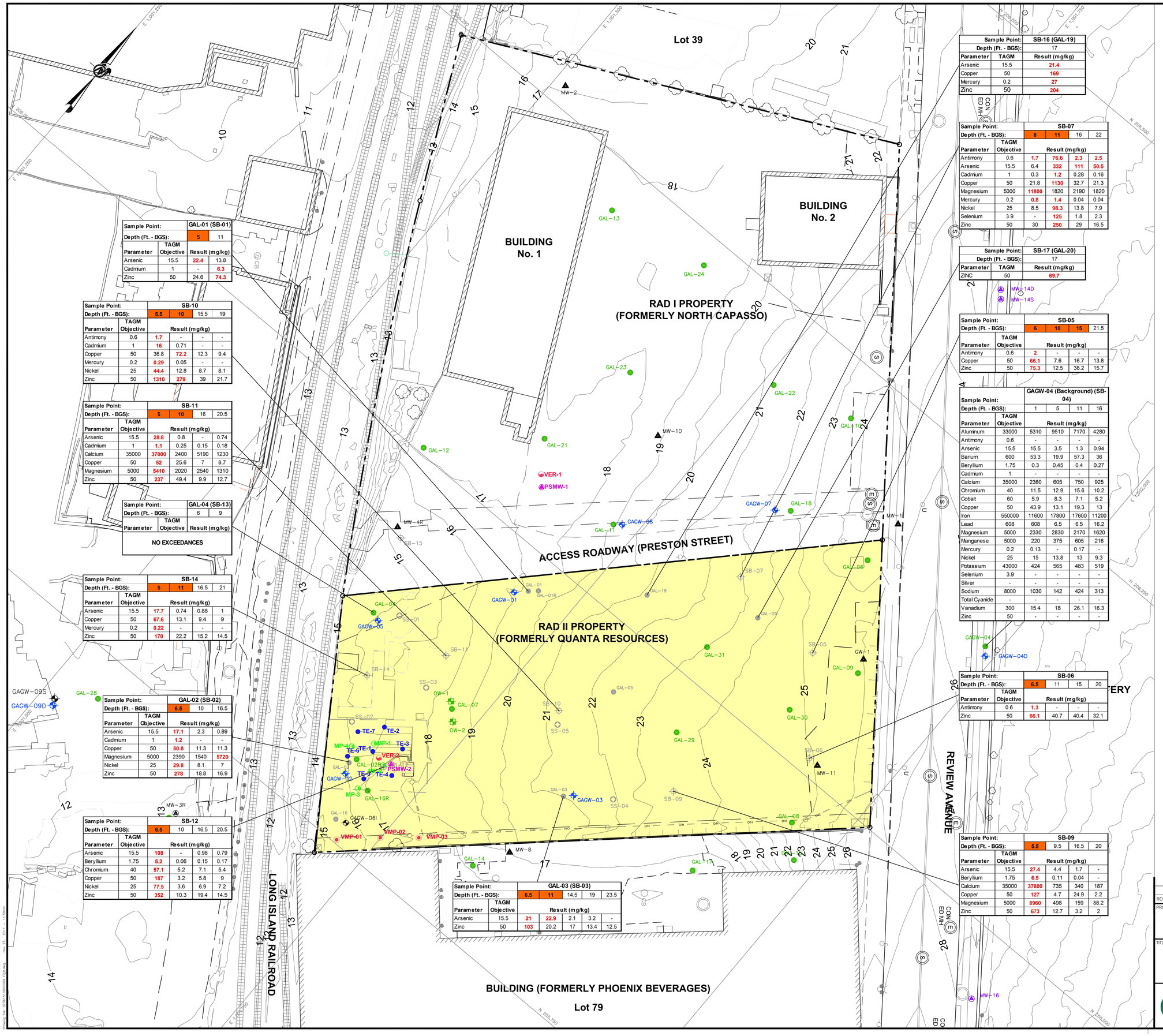
TITLE
SUBSURFACE SOIL SVOC EXCEEDANCES NEW YORK STATE TAGM 4046 RECOMMENDED SOIL CLEANUP OBJECTIVES FROM RI REPORT (JUNE 2005)

Golder Associates Philadelphia USA

PROJECT No.	023-6151002	FILE No.	02361510002C008
DESIGN	AGE	07/2011	SCALE AS SHOWN	REV. 0
CADD	YPW	11/2011	
CHECK	KGK	11/2011	
REVIEW	RES	11/2011	

FIGURE 8

Drawing file: 02361510002C008 (gif).dwg Nov 23, 2011 - 12:00pm



Sample Point:	GAL-01 (SB-01)	
Depth (Ft. - BGS):	5	11
Parameter / TAGM Objective	Result (mg/kg)	
Arsenic 15.5	22.4	13.8
Cadmium 1	-	6.3
Zinc 50	24.6	74.3

Sample Point:	SB-10			
Depth (Ft. - BGS):	5.5	10	15.5	19
Parameter / TAGM Objective	Result (mg/kg)			
Antimony 0.6	1.7	-	-	-
Cadmium 1	16	0.71	-	-
Copper 50	36.8	72.2	12.3	9.4
Mercury 0.2	0.29	0.05	-	-
Nickel 25	44.4	12.8	8.7	8.1
Zinc 50	1310	279	39	21.7

Sample Point:	SB-11			
Depth (Ft. - BGS):	5	10	16	20.5
Parameter / TAGM Objective	Result (mg/kg)			
Arsenic 15.5	28.8	0.8	-	0.74
Cadmium 1	1.1	0.25	0.15	0.18
Calcium 35000	37000	2400	5190	1230
Copper 50	52	25.6	7	8.7
Magnesium 5000	5410	2020	2540	1310
Zinc 50	237	49.4	9.9	12.7

Sample Point:	GAL-04 (SB-13)	
Depth (Ft. - BGS):	6	9
Parameter / TAGM Objective	Result (mg/kg)	

NO EXCEEDANCES

Sample Point:	SB-14			
Depth (Ft. - BGS):	5	11	16.5	21
Parameter / TAGM Objective	Result (mg/kg)			
Arsenic 15.5	17.7	0.74	0.88	1
Copper 50	67.6	13.1	9.4	9
Mercury 0.2	0.22	-	-	-
Zinc 50	170	22.2	15.2	14.5

Sample Point:	GAL-02 (SB-02)		
Depth (Ft. - BGS):	6.5	10	16.5
Parameter / TAGM Objective	Result (mg/kg)		
Arsenic 15.5	17.1	2.3	0.89
Cadmium 1	1.2	-	-
Copper 50	50.8	11.3	11.3
Magnesium 5000	2390	1540	5720
Nickel 25	29.8	8.1	7
Zinc 50	278	18.8	16.9

Sample Point:	SB-12			
Depth (Ft. - BGS):	6.5	10	16.5	20.5
Parameter / TAGM Objective	Result (mg/kg)			
Arsenic 15.5	108	-	0.98	0.79
Beryllium 1.75	5.2	0.06	0.15	0.17
Chromium 40	57.1	5.2	7.1	5.4
Copper 50	187	3.2	5.8	9
Nickel 25	77.5	3.6	6.9	7.2
Zinc 50	352	10.3	19.4	14.5

Sample Point:	GAL-03 (SB-03)				
Depth (Ft. - BGS):	6.5	11	14.5	19	23.5
Parameter / TAGM Objective	Result (mg/kg)				
Arsenic 15.5	21	22.9	2.1	3.2	-
Zinc 50	103	20.2	17	13.4	12.5

Sample Point:	SB-16 (GAL-19)	
Depth (Ft. - BGS):	17	
Parameter / TAGM	Result (mg/kg)	
Arsenic 15.5	21.4	
Copper 50	169	
Mercury 0.2	27	
Zinc 50	204	

Sample Point:	SB-07			
Depth (Ft. - BGS):	8	11	16	22
Parameter / TAGM Objective	Result (mg/kg)			
Antimony 0.6	1.7	76.6	2.3	2.5
Arsenic 15.5	6.4	332	111	50.5
Cadmium 1	0.3	1.2	0.28	0.16
Copper 50	21.8	1130	32.7	21.3
Magnesium 5000	11800	1820	2190	1820
Mercury 0.2	0.8	1.4	0.04	0.04
Nickel 25	8.5	98.3	13.8	7.9
Selenium 3.9	-	125	1.8	2.3
Zinc 50	30	250	29	16.5

Sample Point:	SB-17 (GAL-20)	
Depth (Ft. - BGS):	17	
Parameter / TAGM	Result (mg/kg)	
ZINC 50	69.7	

Sample Point:	SB-05			
Depth (Ft. - BGS):	6	10	15	21.5
Parameter / TAGM Objective	Result (mg/kg)			
Antimony 0.6	2	-	-	-
Copper 50	66.1	7.6	16.7	13.8
Zinc 50	75.3	12.5	38.2	15.7

Sample Point:	GAGW-04 (Background) (SB-04)			
Depth (Ft. - BGS):	1	5	11	16
Parameter / TAGM Objective	Result (mg/kg)			
Aluminum 33000	5310	9510	7170	4280
Antimony 0.6	-	-	-	-
Arsenic 15.5	15.5	3.5	1.3	0.94
Barium 600	53.3	19.9	57.3	36
Beryllium 1.75	0.3	0.45	0.4	0.27
Cadmium 1	-	-	-	-
Calcium 35000	2360	605	750	925
Chromium 40	11.5	12.9	15.6	10.2
Cobalt 60	5.9	8.3	7.1	5.2
Copper 50	43.9	13.1	19.3	13
Iron 550000	11600	17800	17600	11200
Lead 608	608	6.5	6.5	16.2
Magnesium 5000	2330	2830	2170	1620
Manganese 5000	220	375	605	216
Mercury 0.2	0.13	-	0.17	-
Nickel 25	15	13.8	13	9.3
Potassium 43000	424	565	483	519
Selenium 3.9	-	-	-	-
Silver -	-	-	-	-
Sodium 8000	1030	142	424	313
Total Cyanide -	-	-	-	-
Vanadium 300	15.4	18	26.1	16.3
Zinc 50	-	-	-	-

Sample Point:	SB-06			
Depth (Ft. - BGS):	6.5	11	15	20
Parameter / TAGM Objective	Result (mg/kg)			
Antimony 0.6	1.3	-	-	-
Zinc 50	66.1	40.7	40.4	32.1

Sample Point:	SB-09			
Depth (Ft. - BGS):	5.5	9.5	16.5	20
Parameter / TAGM Objective	Result (mg/kg)			
Arsenic 15.5	27.4	4.4	1.7	-
Beryllium 1.75	6.5	0.11	0.04	-
Calcium 35000	37800	735	340	187
Copper 50	127	4.7	24.9	2.2
Magnesium 5000	8960	498	159	88.2
Zinc 50	673	12.7	3.2	2

LEGEND

- THERMAL ENHANCED (TE) UNIT FOR LNAPL PILOT TEST (GOLDER 2008)
- VACUUM ENHANCED RECOVERY (VER) WELL FOR LNAPL PILOT TEST (GOLDER 2008)
- MONITORING WELL FOR LNAPL PILOT TEST (GOLDER 2008)
- TEMPERATURE AND VAPOR MONITORING POINT FOR LNAPL PILOT TEST (GOLDER 2008)
- VAPOR MONITORING POINT (GOLDER 2008)
- LNAPL MONITORING WELL (SEE NOTE 5)
- LNAPL MONITORING WELL (GOLDER ASSOCIATES 2003/2004/2005/2008) (SEE REFERENCE 2)
- SHALLOW GROUNDWATER MONITORING WELL (GOLDER ASSOCIATES 2004) (SEE REFERENCE 2)
- DEEP GROUNDWATER MONITORING WELL (GOLDER ASSOCIATES 2003/2004) (SEE REFERENCE 2)
- SOIL BORING (GOLDER ASSOCIATES 2003/2004) (SEE REFERENCE 2)
- ROEHR CHEMICAL INVESTIGATION WELL LOCATION (NOVEMBER 2000) (SEE REFERENCE 2)
- EXISTING ON-SITE AND OFF-SITE MONITORING WELL LOCATION (SEE REFERENCE 2)
- EXISTING OFF-SITE MONITORING WELL LOCATION (LOCATION APPROXIMATE)
- LNAPL PILOT TEST STUDY OBSERVATION WELL (SEE REFERENCE 2)
- EXISTING OFF-PROPERTY MONITORING WELL LOCATIONS (SEE REFERENCES 3 AND 4)
- CONCRETE SURVEY MONUMENT
- REVIEW AVENUE DEVELOPMENT PROPERTY BOUNDARY (SEE REFERENCE 1)
- RAILROAD
- FENCE LINE
- 5 FOOT CONTOUR LINE (FT.-MSL)
- 1 FOOT CONTOUR LINE (FT.-MSL)
- EASEMENT
- INTERPRETED EXTENT OF SOIL EXCEEDING APPLICABLE STANDARD

NOTES

1.) FT-MSL - FEET MEAN SEA LEVEL

2.) FIGURE SHOWS SUBSURFACE SOIL EXCEEDANCES (RED) BASED ON COMPARISON OF REPORTED ANALYTICAL RESULTS TO THE NEW YORK STATE TECHNICAL AND ADMINISTRATIVE GUIDANCE MEMORANDUM #4046, RECOMMENDED SOIL CLEANUP OBJECTIVES AS DISCUSSED IN SECTION 4.2 OF THE DATA SUMMARY REPORT.

3.) ALL RESULTS ARE SHOWN IN mg/kg (ppm).

4.) THE TAGM 4046 SOIL OBJECTIVE FOR METALS IS THE LARGER OF THE NUMERIC VALUE IN TAGM 4046 TABLE 4 OR BACKGROUND. BACKGROUND IS EASTERN UNITED STATES/NEW YORK STATE BACKGROUND AS REPORTED IN TAGM #4046 OR AS IDENTIFIED IN SOIL SAMPLE GAGW-04 (BACKGROUND), IN WHICH EVER IS HIGHER.

5.) LNAPL MONITORING WELLS GAL-01, GAL-01R, GAL-02, GAL-03, GAL-05, GAL-16, GAL-19, AND GAL-20 WERE NOT LOCATED DURING APRIL 2011 WELL SURVEYING ACTIVITIES.

REFERENCES

1.) BASE MAP TAKEN AND PROPERTY BOUNDARY FROM DIGITAL FILE 2148-DELIVERY-2.dwg, ENTITLED "BOUNDARY AND TOPOGRAPHIC PLAN, BLOCK 312 LOTS 41 & 69, 37-80 REVIEW AVENUE, PREPARED FOR: GOLDER ASSOCIATES, LOCATED IN: LONG ISLAND CITY, QUEENS, N.Y. PROVIDED BY GEOD CORPORATION, DATED JUNE 10, 2011.

2.) WELL COORDINATES TAKEN FROM A MICROSOFT EXCEL FILE Quanta Samples and Wells.xls, 2148A 8-23-04.xls, 2148A 4-11-05.xls, AND 2340 MONITORING WELLS.xls PROVIDED BY GEOD CORP.

3.) LOCATION OF MW-9 DIGITIZED FROM HARDCOPY FIGURE TITLED "GROUNDWATER CONTOURS", PROVIDED BY HALEY & ALDRICH, DATED FEBRUARY 2004.

4.) LOCATION OF MW-7 DIGITIZED FROM HARDCOPY FIGURE TITLED "SITE PLAN WITH SITE INVESTIGATION BORING LOCATIONS", PROVIDED BY ENVIRON, DATED SEPTEMBER 2000.

5.) RAD II PROPERTY - BLOCK 312, LOT 69; BCA# C241005.

6.) RAD I PROPERTY - BLOCK 312, LOT 41; BCA# C241089.

SCALE 25 0 25 50 FEET

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW

PROJECT
REVIEW AVENUE DEVELOPMENT
BROWNFIELD CLEANUP PROGRAM
REMEDIAL ACTION WORK PLAN FOR SITES C241005 & C241089
QUEENS COUNTY, NEW YORK

TITLE
SUBSURFACE SOIL METALS EXCEEDANCES NEW YORK STATE TAGM 4046 RECOMMENDED SOIL CLEANUP OBJECTIVES FROM RI REPORT (JUNE 2005)

Golder Associates Philadelphia USA

PROJECT No.	023-6151002	FILE No.	0236151002C009
DESIGN	AGE	07/2011	SCALE AS SHOWN REV. 0
CADD	YPW	11/2011	
CHECK	KGK	11/2011	FIGURE 9
REVIEW	RES	11/2011	

Lot 39

BUILDING No. 1

BUILDING No. 2

N: 206,252.494
E: 1,001,705.224
EL: 19.94

RAD I PROPERTY
(FORMERLY NORTH CAPASSO)

VISCOSITY: 20 TO 30 cSt
AVERAGE SPECIFIC FREE-PRODUCT
VOLUME: 0.09 FT

RAD II PROPERTY
(FORMERLY QUANTA RESOURCES)

VISCOSITY: 45 TO 120 cSt
AVERAGE SPECIFIC
FREE-PRODUCT VOLUME: 0.87 FT

VISCOSITY: 30 TO 50 cSt
AVERAGE SPECIFIC FREE-PRODUCT
VOLUME: 0.33 FT

ACCESS ROADWAY (PRESTON STREET)

PROPOSED
LNAPL RECOVERY AND
GROUNDWATER TREATMENT
BUILDING

NON-TSCA

TSCA

LNAPL STORAGE

PRE-TREATED
GROUNDWATER
TO SANITARY
SEWER SYSTEM

REVIEW AVENUE

CALVARY CEMETERY

LONG ISLAND RAILROAD

N: 205,739.434
E: 1,001,720.737
EL: 14.74

BUILDING (FORMERLY PHOENIX BEVERAGES)

Lot 79

MW-2 MW-9 MW-8 MW-1 MW-14D MW-14S MW-15 MW-16 GACW-04 GACW-04D

GAL-13 GAL-24 GAL-23 GAL-22 GAL-10 GAL-21 GAL-12 GAL-11 GAL-18 GAL-06 GAL-04 GAL-31 GAL-09 GAL-07 GAL-30 GAL-02R GAL-16R GAL-08

VER-1 PSMW-1 VER-2 PSMW-2

CB SMH

LEGEND

- VACUUM ENHANCED RECOVERY (VER) WELL FOR LNAPL PILOT TEST (GOLDER 2008)
- MONITORING WELL FOR LNAPL PILOT TEST (GOLDER 2008)
- LNAPL MONITORING WELL (GOLDER ASSOCIATES 2003/2004/2005/2008) (SEE REFERENCE 2)
- CONCRETE SURVEY MONUMENT
- PROPOSED LNAPL MONITORING WELL
- PROPOSED VACUUM ENHANCED RECOVERY (VER) WELLS
- PROPOSED SINGLE PHASE (SKIMMER) WELLS
- PRE-CAST CONCRETE VAULT (SIZE VARIES)
- EXISTING UTILITY MANHOLES
- PROPOSED VER RECOVERING UNDERGROUND CONVEYANCE INFRASTRUCTURE FOR PCB LIQUID LNAPL
- PROPOSED SKIMMER RECOVERING UNDERGROUND CONVEYANCE INFRASTRUCTURE
- REVIEW AVENUE DEVELOPMENT PROPERTY BOUNDARY (SEE REFERENCE 1)
- RAILROAD
- FENCE LINE
- EASEMENT
- LNAPL VISCOSITY ZONE 1 (AS REPRESENTED IN JUNE 2005 RI REPORT)
- LNAPL VISCOSITY ZONE 2 (AS REPRESENTED IN JUNE 2005 RI REPORT)
- LNAPL VISCOSITY ZONE 3 (AS REPRESENTED IN JUNE 2005 RI REPORT)

NOTES

1.) FT-MSL – FEET MEAN SEA LEVEL

2.) LNAPL WAS NOT OBSERVED IN WELL MW-2 DURING THE REMEDIAL INVESTIGATION (JUNE 2005) OR DURING A JUNE 20, 2008 WELL INSPECTION.

3.) RECOVERY WELL SPACING WILL BE AS GENERALLY DEPICTED IN FIGURE 10. THE VER WELL SPACING IN ZONE 2 AND SKIMMER WELL SPACING IN ZONE 3 MAY BE INCREASED LOCALLY BASED ON SITE CONSTRAINTS OR REDEVELOPMENT REQUIREMENTS. THE MAXIMUM VER WELL SPACING WILL NOT TO EXCEED 100 FEET.

4.) TO OPTIMIZE LNAPL RECOVERY AND TO LIMIT COLLECTING GROUNDWATER, THE VER WELLS WILL BE CYCLED ON AND OFF AT APPROXIMATELY 4 TO 8 HR INTERVALS.

5.) VER PILOT TEST INFRASTRUCTURE INSTALLED IN ZONE 1 IN 2008 TO BE REMOVED OR CLOSED, INCLUDING MONITORING PROBES (VMP-1, VMP-2, VMP-3, MP-1, MP-2, MP-3 AND MP-4) AND THERMAL ENHANCEMENT UNITS (TE-1, TE-2, TE-3, TE-4, TE-5, TE-6 AND TE-7). DEPENDING UPON DETAIL DESIGN, MONITORING WELL PSMW-1 AND PSMW-2 AND RECOVERY WELL VER-01 AND VER-02 MAY REMAIN.

6.) UNDERGROUND CONVEYANCE INFRASTRUCTURE AND VAULT LOCATIONS ARE SUBJECT TO CHANGE BASED ON SITE CONSTRAINTS OR REDEVELOPMENT REQUIREMENTS.

REFERENCES

1.) BASE MAP TAKEN AND PROPERTY BOUNDARY FROM DIGITAL FILE 2148-DELIVERY-2.dwg, ENTITLED "BOUNDARY AND TOPOGRAPHIC PLAN, BLOCK 312 LOTS 41 & 69, 37-80 REVIEW AVENUE, PREPARED FOR: GOLDER ASSOCIATES, LOCATED IN: LONG ISLAND CITY, QUEENS, N.Y. PROVIDED BY GEOD CORPORATION, DATED JUNE 10, 2011.

2.) EXISTING WELL COORDINATES TAKEN FROM A MICROSOFT EXCEL FILE Quanta Samples and Wells.xls, 2148A 8-23-04.xls, 2148A 4-11-05.xls, 2340 MONITORING WELLS.xls AND Monitoring Wells from 5-23-2011.xls PROVIDED BY GEOD CORP.

3.) RAD II PROPERTY – BLOCK 312, LOT 69; BCA# C241005.

4.) RAD I PROPERTY – BLOCK 312, LOT 41; BCA# C241089.

25 0 25 50
SCALE FEET

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW

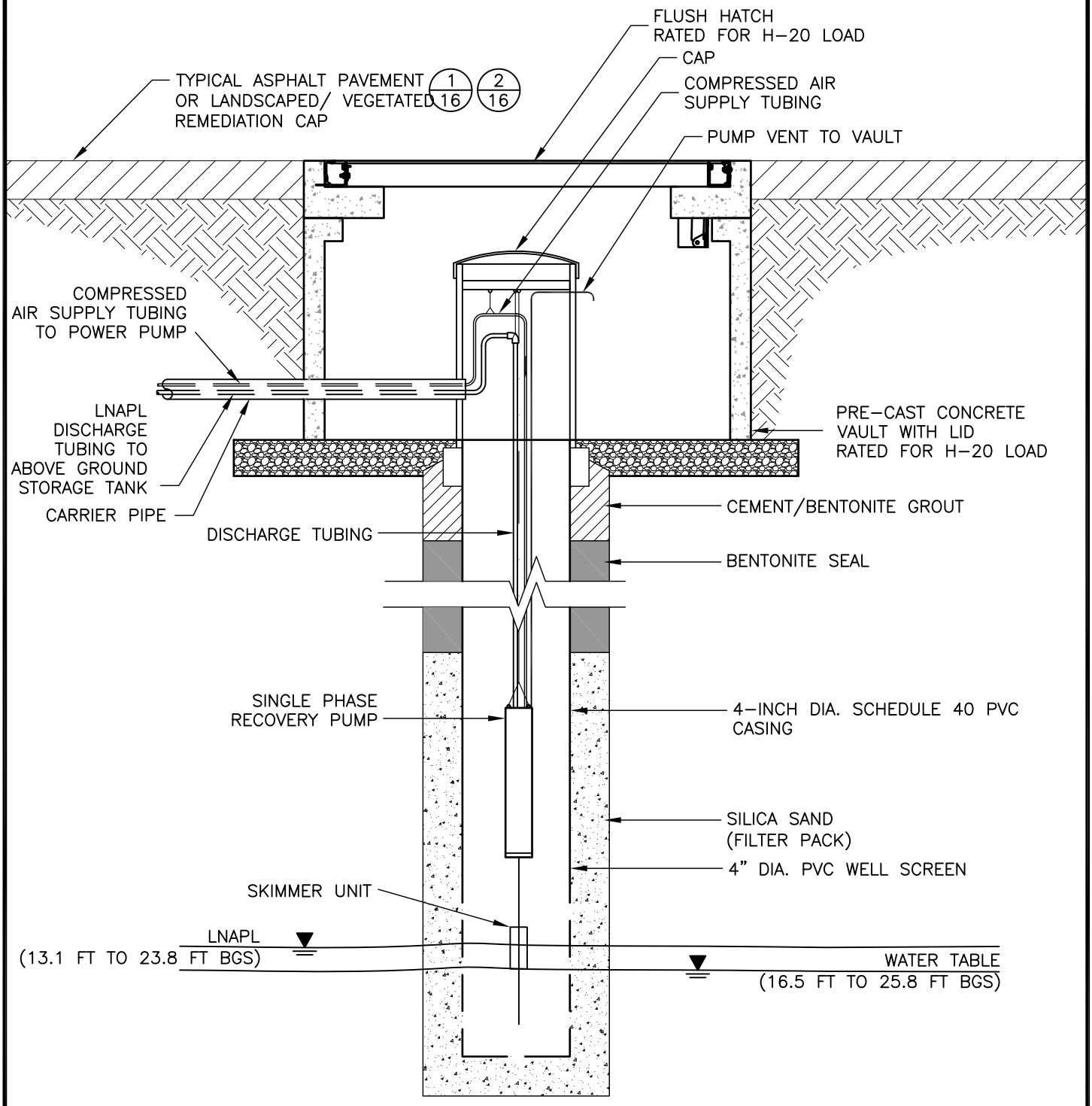
PROJECT
REVIEW AVENUE DEVELOPMENT
BROWNFIELD CLEANUP PROGRAM
REMEDIAL ACTION WORK PLAN FOR SITES C241005 & C241089
QUEENS COUNTY, NEW YORK

TITLE
**LNAPL RECOVERY WELL LAYOUT
SINGLE PHASE & VACUUM ENHANCED
AREA WIDE RECOVERY**

Golder Associates
Philadelphia USA

PROJECT No.	023-6151002	FILE No.	0236151002C012
DESIGN	AGE	07/2011	SCALE AS SHOWN REV. 0
CADD	YPW	11/2011	
CHECK	KGK	11/2011	**FIGURE 10**
REVIEW	RES	11/2011	

Drawing No. 0236151002012 Fig10.dwg Nov 23, 2011 - 12:26pm



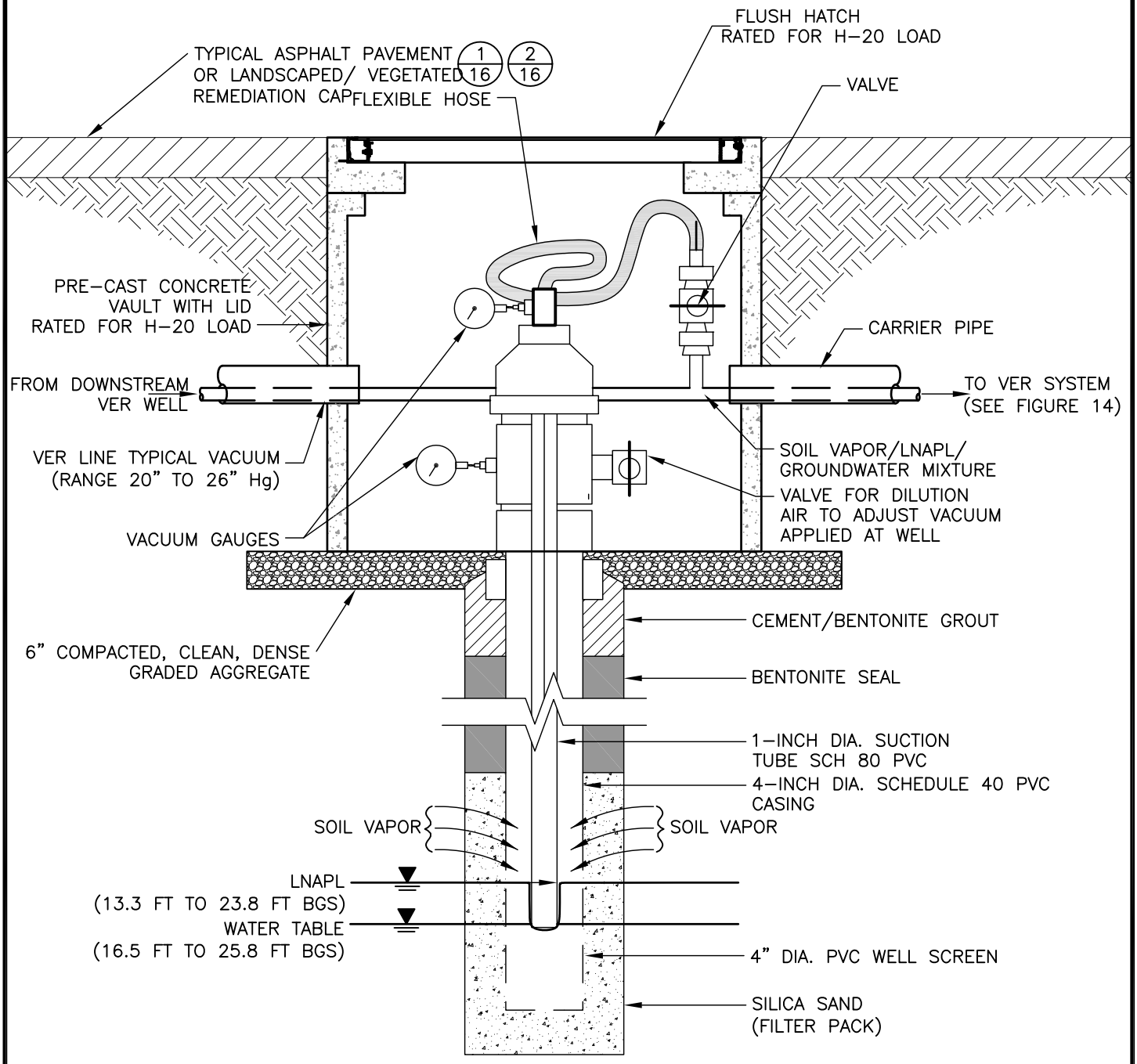
NOTES

1.) LNAPL/WATER LEVELS BASED ON APRIL 2011 MEASUREMENTS. BGS –BELOW GROUND SURFACE.

2.) GROUND SURFACE ON RAD I TO BE RESTORED TO AS–IS CONDITION AFTER INSTALLING RECOVERY WELLS AND PIPING.

Golder Associates Philadelphia USA	SCALE	N.T.S.	TITLE: TYPICAL SINGLE PHASE RECOVERY WELL
	DATE	11/2011	
	DESIGN	JAK	
	CADD	YPW	
FILE No. 0236151002C014	CHECK	KGK	
PROJECT No. 023–6151002 REV. 0	REVIEW	RES	REVIEW AVENUE DEVELOPMENT — FIGURE 12

Drawing file: 0236151002C014 Fig12.dwg Nov 23, 2011 – 12:02pm



NOTES

1.) VER WELL SPACING BASED ON PAVED CONDITIONS.

2.) LNAPL/WATER LEVELS BASED ON APRIL 2011 MEASUREMENTS. BGS –BELOW GROUND SURFACE.

3.) GROUND SURFACE ON RAD I TO BE RESTORED TO AS–IS CONDITION AFTER INSTALLING RECOVERY WELLS AND PIPING.

Golder Associates
Philadelphia USA

FILE No.	0236151002C015
PROJECT No.	023–6151002
REV.	0
SCALE	N.T.S.
DATE	11/2011
DESIGN	JAK
CADD	YPW
CHECK	KGK
REVIEW	RES

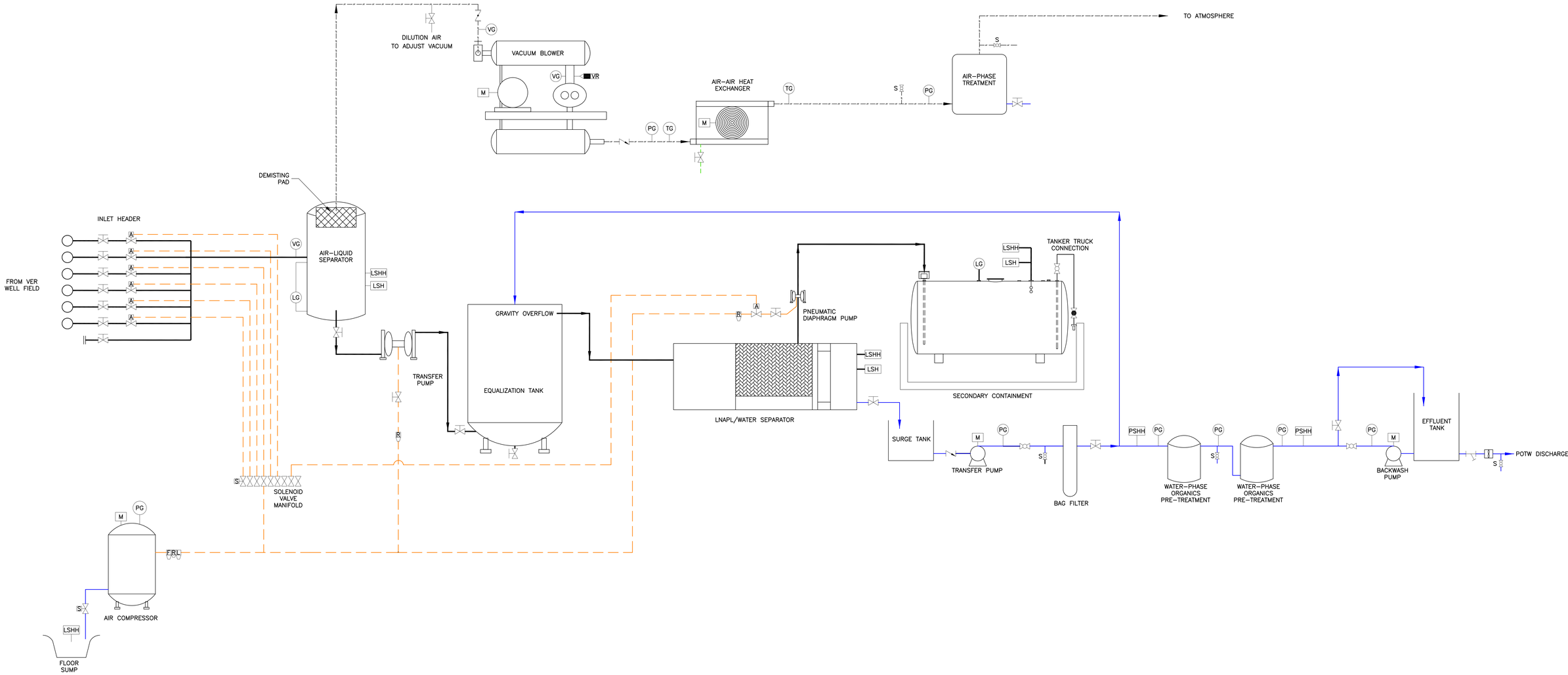
TITLE

TYPICAL VACUUM ENHANCED RECOVERY WELL

REVIEW AVENUE DEVELOPMENT

FIGURE 13

Drawing file: 0236151002C015 Fig13.dwg Nov 23, 2011 – 12:02pm



LEGEND

VG VACUUM GAUGE	VT VACUUM TRANSMITTER	M ELECTRICAL MOTOR	SOLENOID VALVE	PNEUMATIC LINE
PG PRESSURE GAUGE	LSHH LEVEL SWITCH – HIGH HIGH	MANUAL VALVE	AIR – ACTUATED VALVE	VER LINE
TG TEMPERATURE GAUGE	LSH LEVEL SWITCH – HIGH	BALL VALVE	SAMPLING PORT	AIR/VAPOR FLOW
LG LEVEL GAUGE	LSL LEVEL SWITCH – LOW	CHECK VALVE	REGULATOR	WATER FLOW
	TSHH TEMPERATURE SWITCH – HIGH HIGH	Y – STRAINER	FRL FILTER–REGULATOR–LUBRICANT	MIXED/PRODUCT FLOW
	PSHH PRESSURE SWITCH – HIGH HIGH	BUTTERFLY VALVE	FLOWMETER – TOTALIZER	
	PSL PRESSURE SWITCH – LOW		VR VACUUM – RELIEF VALVE	

NOTES

1.) ALL PROCESS EQUIPMENT TO BE INSTALLED IN HEATED / VENTILATED BUILDING. LNAPL STORAGE TANK TO BE INSTALLED OUTSIDE IN ROOFED SECONDARY CONTAINMENT AREA.

2.) PROCESS EQUIPMENT SUBJECT TO MODIFICATION PENDING FINAL DESIGN. SPECIFIC GROUNDWATER PRE–TREAMENT EQUIPMENT TO BE DETERMINED BASED ON FINAL DISCHARGE CRITERIA ISSUED BY THE NYCDEP (POTW). SPECIFIC TREATMENT EQUIPMENT FOR AIR EMISSIONS CONTROLS TO BE DETERMINED BASED ON FINAL PERMIT APPROVAL.

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW

PROJECT

REVIEW AVENUE DEVELOPMENT
BROWNFIELD CLEANUP PROGRAM
REMEDIAL ACTION WORK PLAN FOR SITES C241005 & C241089
QUEENS COUNTY, NEW YORK

TITLE

VACUUM ENHANCED RECOVERY MULTI-PHASE TREATMENT SYSTEM CONCEPTUAL PROCESS FLOW DIAGRAM

Golder Associates
Philadelphia USA

PROJECT No.	023–6151002		FILE No.	0236151002C017	
DESIGN	JAK	07/2011	SCALE	N.T.S.	REV. 0
CADD	YPW	11/2011			
CHECK	KGK	11/2011			
REVIEW	RES	11/2011			

FIGURE 14

Drawing No: 0236151002C017 Fig14.dwg Nov 23, 2011 - 12:24pm

LEGEND

- PROPERTY LINE
- EXISTING CONTOUR
- PROPOSED TOP OF REMEDIATION CAP CONTOUR
- PROPOSED 6" CURB (SEE DETAIL 3 OF FIGURE 16)
- PROPOSED STORMWATER FORCEMAIN
- PROPOSED STORMWATER GRAVITY MAIN
- PROPOSED NYDOT STANDARD INLET
- PROPOSED PRIMARY DETENTION TANK
- LIMITS OF PAVEMENT OR CLEAN SOIL CAP COVERING ON-SITE SOILS CONTAINING CONSTITUENTS ABOVE TAGM 4046 SOIL OBJECTIVES. SEE DETAILS 1 AND 2 ON FIGURE 17 FOR TYPICAL CAP SECTIONS.

REFERENCES

1.) BASE MAP TAKEN AND PROPERTY BOUNDARY FROM DIGITAL FILE 2148-DELIVERY-2.dwg, ENTITLED "BOUNDARY AND TOPOGRAPHIC PLAN, BLOCK 312 LOTS 41 & 69, 37-80 REVIEW AVENUE, PREPARED FOR: GOLDER ASSOCIATES, LOCATED IN: LONG ISLAND CITY, QUEENS, N.Y. PROVIDED BY GEOD CORPORATION, DATED JUNE 10, 2011.

2.) RAD II PROPERTY – BLOCK 312, LOT 69; BCA# C241005.

3.) RAD I PROPERTY – BLOCK 312, LOT 41; BCA# C241089.

NOTES

1.) CAPACITIES OF SUBSURFACE STORMWATER DETENTION STRUCTURES TO BE DETERMINED DURING DESIGN AND PERMIT TO BE ISSUED BY THE SEWER UTILITY AUTHORITY (NYCDEP).

2.) FUTURE DEVELOPMENT MAY INCLUDE IMPROVEMENTS TO THE EXISTING ACCESS ROADWAY AFFECTING THE WIDTH AND ELEVATION. FUTURE DEVELOPMENT MAY ALSO PROVIDE FOR GRAVITY CONNECTION OF STORMWATER FLOW FROM SITE TO COMBINED SEWER UTILITY TIE-IN SOUTHWEST OF THE RAILROAD ALONG THE UTILITY EASEMENT.

3.) PROPOSED GRADING PLAN MAY BE REVISED DURING FINAL DESIGN IN COORDINATION WITH FUTURE PARKING DEVELOPMENT PLANS.

4.) SEE DETAIL 3 ON FIGURE 16 FOR TYPICAL SECTION A-A'.

5 STORY BRICK BLDG.

PARKING

PAVED PARKING

Block 312 Lot 41
Area = 115,633 Sq. Feet 2.653 Acres
Easement Area 15,282 Sq. Feet

EXISTING RETAINING WALL

EXISTING ACCESS ROADWAY/ UTILITY EASEMENT (SEE NOTE 2)

PROPOSED 6" CURB

EXISTING RETAINING WALL

PROPOSED PRIMARY DETENTION TANK (SEE NOTE 1)

ELEC. EQUIPMENT ON CONC. PAD

TIE INTO EXISTING STORM SEWER SYSTEM

EXISTING RETAINING WALL

PROPOSED 6" CURB

Block 312 Lot 69
Area = 73,865 Sq. Ft. 1.695 Acres
Easement Area 1,635 Sq. Feet

PROPOSED STORMWATER DISCHARGE FORCEMAIN

NYDOT STANDARD INLET

PILE

LONG ISLAND RAILROAD

PROPOSED 6" CURB

PROPOSED SUBSURFACE STORMWATER DETENTION AND PUMP CHAMBER FOR CONNECTION TO PUBLIC UTILITY (SEE NOTE 1)

NYDOT STANDARD INLET

EXISTING RETAINING WALL

NYDOT STANDARD INLET

STORAGE

Block 312
Lot 79

CEMETERY

REVIEW AVENUE

RIM=25.25'

RIM=27.39'

RIM=28.62'

GRATE=25.37'

GRATE=25.61'

POB
N 206162.46'
E 1001886.22'

CONC SIDEWALK

EDGE OF PAVE

CONC

PAVED PARKING

-3.0%

-3.1%

1%

SCALE 20 0 20 40 FEET

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW

PROJECT

REVIEW AVENUE DEVELOPMENT
BROWNFIELD CLEANUP PROGRAM
REMEDIAL ACTION WORK PLAN FOR SITES C241005 & C241089
QUEENS COUNTY, NEW YORK

TITLE

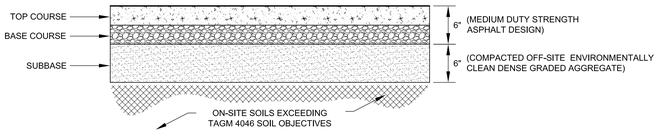
RAD II REMEDIATION CAP AND STORMWATER MANAGEMENT PLAN

Golder Associates
Philadelphia USA

PROJECT No.	023-6151002		FILE No.	0236151002C019	
DESIGN	JB	07/2011	SCALE	AS SHOWN	REV. 0
CADD	GLS	11/2011			
CHECK	KGK	11/2011			
REVIEW	RES	11/2011			

FIGURE 15

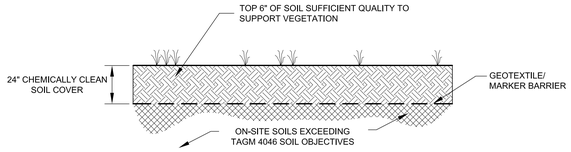
Drawing No: 0236151002C019 Fig15.dwg Nov 23, 2011 - 2:56pm



TYPICAL REMEDIATION CAP ASPHALT PAVEMENT SECTION ON RAD II

1/16

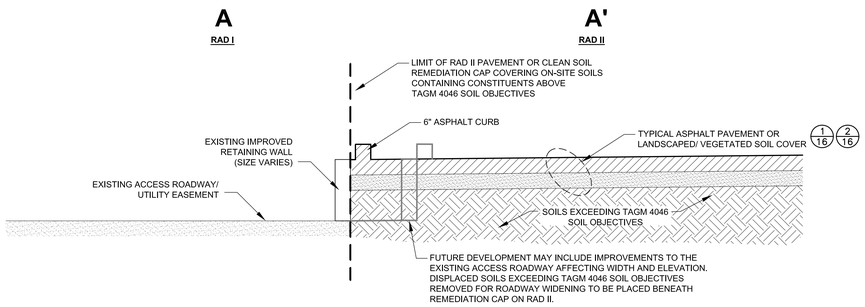
NOT TO SCALE



TYPICAL LANDSCAPED/ VEGETATED REMEDIATION SOIL COVER ON RAD II

2/16

NOT TO SCALE



TYPICAL SECTION A-A'

3/16

NOT TO SCALE

RAD II SUBSURFACE STORMWATER DETENTION AND PUMP CHAMBER

4/16

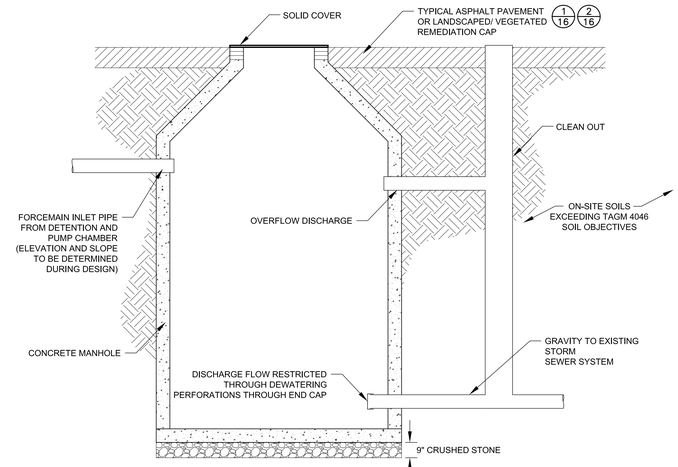
NOT TO SCALE

NOTES

1.) SOILS EXCEEDING TAGM 4046 SOIL OBJECTIVES EXCAVATED FOR INSTALLATION OF DETENTION VAULT TO BE REUSED ON RAD II BELOW REMEDIATION CAP.

2.) VOLUME AND DIMENSIONS OF PRECAST CONCRETE DETENTION VAULT TO BE DETERMINED DURING DESIGN.

3.) DISCHARGE PUMP TO START AND STOP BASED ON FLOAT. HIGH ALARM FLOAT TO NOTIFY OPERATOR WITH AUTO-DIALER.



PRIMARY DETENTION TANK

5/16

NOT TO SCALE

NOTES

1.) SOILS EXCEEDING TAGM 4046 SOIL OBJECTIVES EXCAVATED FOR INSTALLATION OF DETENTION TANK TO BE REUSED ON RAD II BELOW REMEDIATION CAP.

2.) MANHOLE DIMENSIONS, PIPE SIZES, ELEVATIONS AND SLOPES TO BE DETERMINED DURING DESIGN.

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW

PROJECT

REVIEW AVENUE DEVELOPMENT
BROWNFIELD CLEANUP PROGRAM
REMEDIAL ACTION WORK PLAN FOR SITES C241005 & C241089
QUEENS COUNTY, NEW YORK

TITLE

RAD II REMEDIATION CAP AND STORMWATER MANAGEMENT PLAN DETAILS

Golder Associates
Philadelphia USA

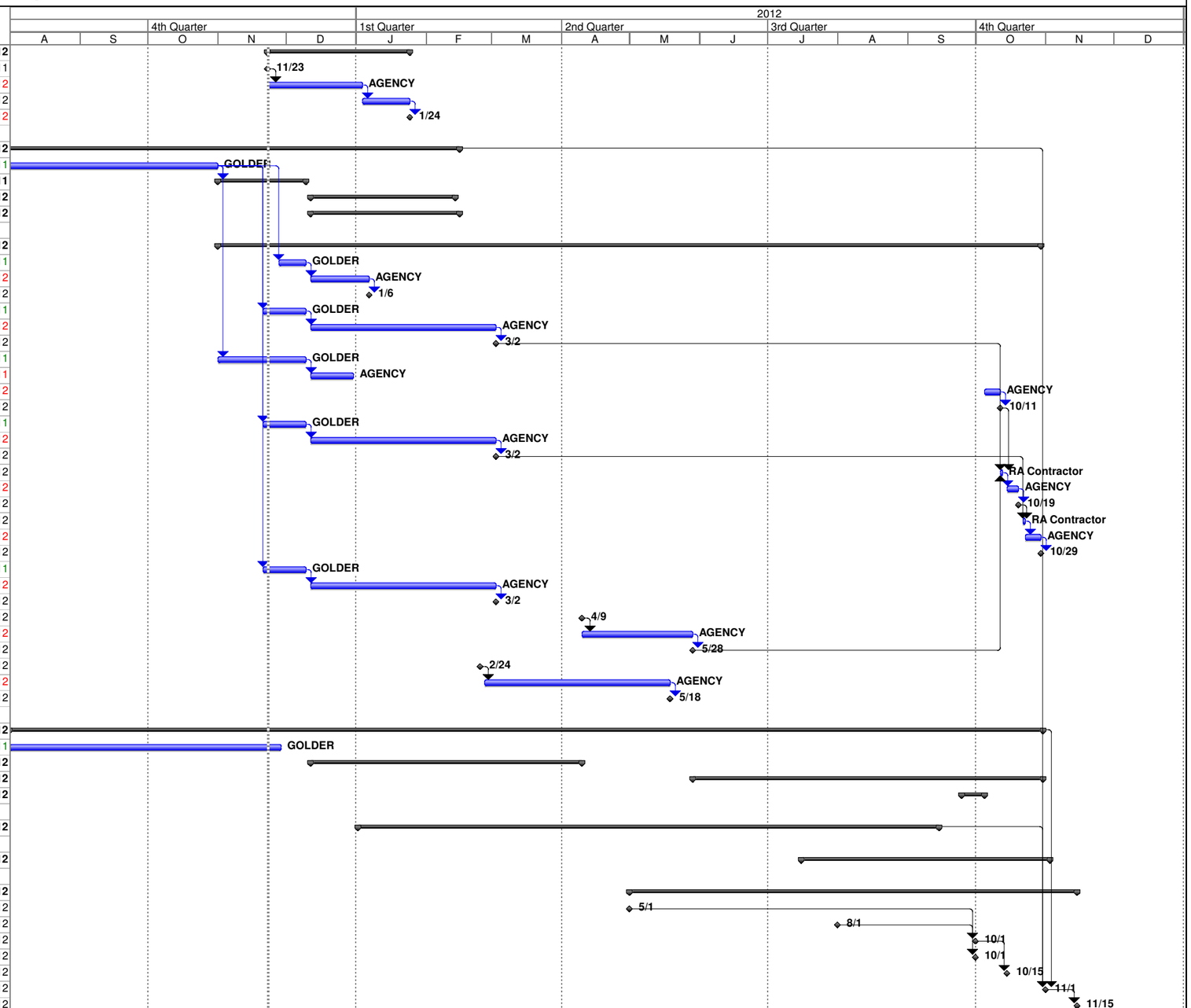
PROJECT No.	023-6151002		FILE No.	0236151002C020
DESIGN	JB	07/2011	SCALE AS SHOWN	REV. 0
CADD	JB	11/2011		
CHECK	KGK	11/2011		
REVIEW	RES	11/2011		

FIGURE 16

Drawing No: 0236151002C020_Fig16.dwg Nov 23, 2011 - 12:24pm

Figure 17: Remedial Action Work Plan Schedule

ID	Task Name	Duration	Start	Finish
1	**NYSDEC Approval of RAWP**	**45 days**	**Wed 11/23/11**	**Tue 1/24/12**
2	Submit RAWP to NYSDEC	0 days	Wed 11/23/11	Wed 11/23/11
3	NYSDEC review of RAWP	30 days	Wed 11/23/11	Tue 1/3/12
4	Resolution of NYSDEC Comments	15 days	Wed 1/4/12	Tue 1/24/12
5	NYSDEC approval of RAWP	0 days	Tue 1/24/12	Tue 1/24/12
6				
7	**LNAPL Extraction and Conveyance Design and Installation**	**147 days**	**Tue 7/26/11**	**Wed 2/15/12**
8	Permit Level Design	70 days	Tue 7/26/11	Mon 10/31/11
9	**Final Design**	**29 days**	**Tue 11/1/11**	**Fri 12/9/11**
12	**RAD II - Procument & Construction**	**46 days**	**Mon 12/12/11**	**Mon 2/13/12**
19	**RAD I - Procument & Construction**	**48 days**	**Mon 12/12/11**	**Wed 2/15/12**
26				
27	**Permit Applications & Approval**	**260 days**	**Tue 11/1/11**	**Mon 10/29/12**
28	Combustible (LNAPL) Storage Tank Application preparation and submittal	10 days	Mon 11/28/11	Fri 12/9/11
29	Combustible (LNAPL) Storage Tank Application Review (FDNY)	20 days	Mon 12/12/11	Fri 1/6/12
30	Combustible (LNAPL) Storage Tank Application - conditional approval (FDNY)	0 days	Fri 1/6/12	Fri 1/6/12
31	GW Pretreatment Application Preparation and submittal - Dewatering Scheme	15 days	Mon 11/21/11	Fri 12/9/11
32	GW Pretreatment Application Review (NYCDEP) - dewatering scheme	60 days	Mon 12/12/11	Fri 3/2/12
33	GW Pretreatment Application Approval (NYCDEP) - dewatering scheme	0 days	Fri 3/2/12	Fri 3/2/12
34	GW Pretreatment Application Preparation and submittal - Letter of Approval	29 days	Tue 11/1/11	Fri 12/9/11
35	GW Pretreatment Application Review & Comments (NYCDEP) - Letter of Approval	15 days	Mon 12/12/11	Fri 12/30/11
36	GW Pretreatment Application Review Effluent Data (NYCDEP) - Letter of Approval	5 days	Fri 10/5/12	Thu 10/11/12
37	GW Pretreatment Application Approval (NYCDEP) - Letter of Approval	0 days	Thu 10/11/12	Thu 10/11/12
38	GW Pretreatment Application Preparation and submittal - Site Connection	15 days	Mon 11/21/11	Fri 12/9/11
39	GW Pretreatment Application Review (NYCDEP) - Site Connection	60 days	Mon 12/12/11	Fri 3/2/12
40	GW Pretreatment Application Approval (NYCDEP) - Site Connection	0 days	Fri 3/2/12	Fri 3/2/12
41	GW Pretreatment Application Preparation and submittal - GW Discharge Permit	1 day	Fri 10/12/12	Fri 10/12/12
42	GW Pretreatment Application Review (NYCDEP) - GW Discharge Permit	5 days	Mon 10/15/12	Fri 10/19/12
43	GW Pretreatment Application Approval - GW Discharge Permit	0 days	Fri 10/19/12	Fri 10/19/12
44	GW Pretreatment Application Preparation and submittal - Sewer Connection	1 day	Mon 10/22/12	Mon 10/22/12
45	GW Pretreatment Application Review (NYCDEP) - Sewer Connection	5 days	Tue 10/23/12	Mon 10/29/12
46	GW Pretreatment Application Approval - Sewer Connection	0 days	Mon 10/29/12	Mon 10/29/12
47	Air Emissions Application Preparation and Submittal	15 days	Mon 11/21/11	Fri 12/9/11
48	Air Emission Application Review (NYCDEP)	60 days	Mon 12/12/11	Fri 3/2/12
49	Air Emission Application Approval (NYCDEP)	0 days	Fri 3/2/12	Fri 3/2/12
50	Submit Building Permit application to Buildings Department (NYCDOB) by D/B Contr	0 days	Mon 4/9/12	Mon 4/9/12
51	Building permit application review/comment period (NYCDOB)	35 days	Tue 4/10/12	Mon 5/28/12
52	Building permit application approval (NYCDOB)	0 days	Mon 5/28/12	Mon 5/28/12
53	Submit Stormwater Discharge to POTW (NYCDEP) application	0 days	Fri 2/24/12	Fri 2/24/12
54	Agency review of Stormwater Discharge application	60 days	Mon 2/27/12	Fri 5/18/12
55	Agency approval Stormwater Discharge to POTW application	0 days	Fri 5/18/12	Fri 5/18/12
56				
57	**VER & Treatment Bldg & Start-up**	**327 days**	**Mon 8/1/11**	**Tue 10/30/12**
58	Permit Level Design	86 days	Mon 8/1/11	Mon 11/28/11
59	**Final design**	**86 days**	**Mon 12/12/11**	**Mon 4/9/12**
67	**Construction**	**111 days**	**Tue 5/29/12**	**Tue 10/30/12**
79	**Start-up and commissioning**	**8 days**	**Tue 9/25/12**	**Thu 10/4/12**
86				
87	**RAD II Remediation Cap - design and installation**	**185 days**	**Mon 1/2/12**	**Fri 9/14/12**
98				
99	**Prepare RA Completion (Engineering) Report**	**80 days**	**Mon 7/16/12**	**Fri 11/2/12**
107				
108	**NYSDEC Brownfield Cleanup Program Milestone Dates**	**142 days**	**Tue 5/1/12**	**Thu 11/15/12**
109	Preliminary Environmental Easement Package (to NYSDEC)	0 days	Tue 5/1/12	Tue 5/1/12
110	Draft Site Management Plan (to NYSDEC)	0 days	Wed 8/1/12	Wed 8/1/12
111	Environmental Easement executed by Applicant (to NYSDEC)	0 days	Mon 10/1/12	Mon 10/1/12
112	Final Site Management Plan approved by DEC	0 days	Mon 10/1/12	Mon 10/1/12
113	Environmental Easement recorded and notices provided (to NYSDEC)	0 days	Mon 10/15/12	Mon 10/15/12
114	Construction Completed	0 days	Thu 11/1/12	Thu 11/1/12
115	Final Engineering Report submitted in final form (to NYSDEC)	0 days	Thu 11/15/12	Thu 11/15/12



Date: Wed 11/23/11
By: KGK
Review: RES

Task | Progress | Summary | External Tasks | Deadline
Split | Milestone | Project Summary | External Milestone

Review Avenue Development
Brownfield Cleanup Program

APPENDIX A

POST-RI WELL INSTALLATION LOGS

RECORD OF BOREHOLE GAL-02R

SHEET 1 of 1

PROJECT: Review Avenue Development
PROJECT NUMBER: 023-6151.001
DRILLED DEPTH: 26.0 ft
AZIMUTH: N/A
LOCATION: RAD II

DRILL METHOD: Hollow-Stem Auger
DRILL RIG: CME 85
DATE STARTED: 7/15/08
DATE COMPLETED: 7/15/08
WEATHER: Sunny

DATUM:
COORDS: not surveyed
GS ELEVATION:
TOC ELEVATION:
TEMPERATURE: 80 F

INCLINATION: -90
DEPTH W.L. FROM TOC:
ELEVATION W.L .:
DATE W.L.:
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES TYPE	BLOWS per 6 in	REC / ATT	PID per 6" (ppm)	Sample Interval	Laboratory Sample ID / Date/Time Collected	Analyses	Peak PID Reading per SS (ppm)	MONITORING WELL / PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS
0		0.0 - 8.0 Hollow-Stem Auger Drilled (FILL)													
5															
10		8.0 - 12.0 Wet, dark grey, medium to fine SAND, oil stained, strong HC odor			8.0	SS	3 3 4 5	1.5 2.0	118 101 90				118		
						SS	4 5 5 6	1.5 2.0	139 80 114				139		
15		12.0 - 16.0 Oil wet, dark grey, medium to fine SAND, trace coarse sand, subangular fine gravel, strong HC odor			12.0	SS	6 6 7 9	1.5 2.0	116 96 85				116		
						SS	4 4 7 8	1.5 2.0	86 80 92				92		
20		16.0 - 20.0 Oil wet, dark grey to tan, fine to coarse SAND, trace angular fine gravel, strong HC odor			16.0	SS	5 7 7 8	1.0 2.0	60 65				65		
						SS	5 8 10 9	1.0 2.0							
		20.0 - 22.0 Wet, dark grey to tan, medium SAND, trace subangular gravel, oil stained, slight HC odor			20.0	SS	4 4 9 9	1.0 2.0	51 46				51		
25		22.0 - 26.0 Wet, dark grey to tan, coarse to fine SAND, some subrounded coarse to fine gravel, slight HC odor			22.0	SS	5 7 8 10	1.2 2.0	48 33				48		
						SS	5 8 10 4	1.2 2.0	114 70 84				114		
		Boring completed at 26.0 ft													
30															
35															
40															

Peak PID Reading per SS (ppm): 250, >500

MONITORING WELL / PIEZOMETER DIAGRAM and NOTES:
Cement Grout
Bentonite Seal #00 Sand Choker
#1 Filter Sand Pack

WELL CONSTRUCTION DETAILS:

WELL CASING
Interval: 0-8 ft bgs
Material: Sch 40 PVC
Diameter: 2"
Joint Type: Threaded

WELL SCREEN
Interval: 8-23 ft bgs
Material: Sch 40 PVC
Diameter: 2"
Slot Size: 0.010
End Cap: Sch 40 PVC

FILTER PACK
Interval: 7-23 ft bgs
Type: #1 Sand
Quantity: 450 lbs

FILTER PACK SEAL
Interval: 6-7 ft bgs
Type: #00 Sand
Quantity: 25 lbs

ANNULUS SEAL
Interval: 0-6 ft bgs
Type: Bentonite/Cement Grout
Quantity: 50 lbs/10 Gallons

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: AmeriDrill, Inc
DRILLER: T. Brown

GA INSPECTOR: KMB/JLH
CHECKED BY: TGS
DATE: 8/26/11

Golder Associates

QUANTA SOIL BORING 023-6151.001 RAD II REVISED 08262011.GPJ GOLDER NJ-PA.GDT 8/26/11

RECORD OF BOREHOLE GAL-16R

SHEET 1 of 1

PROJECT: Review Avenue Development
PROJECT NUMBER: 023-6151.001
DRILLED DEPTH: 26.0 ft
AZIMUTH: N/A
LOCATION: RAD II

DRILL METHOD: Hollow-Stem Auger
DRILL RIG: CME 85
DATE STARTED: 7/18/08
DATE COMPLETED: 7/18/08
WEATHER: Sunny

DATUM:
COORDS: not surveyed
GS ELEVATION:
TOC ELEVATION:
TEMPERATURE: 80 F

INCLINATION: -90
DEPTH W.L. FROM TOC:
ELEVATION W.L .:
DATE W.L.:
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: TYPE	BLOWS per 6 in	REC / ATT	PID per 6" (ppm)	Sample Interval	Laboratory Sample ID / Date/Time Collected	Analyses	Peak PID Reading per SS (ppm)	MONITORING WELL / PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS
0		0.0 - 8.0 Hollow-Stem Auger Drilled (FILL)												Cement Grout	
5															
10		8.0 - 12.0 Moist, dark grey to tan, medium to fine SAND, trace concrete fragments, slight HC odor			8.0	SS	2 3 3 4	1.0 / 2.0	39 60				60	Bentonite Seal #00 Sand Choker	
						SS	5 5 6 8	0.9 / 2.0	61 41				61		
		12.0 - 15.5 Very Moist, dark grey to tan, medium to fine SAND, trace subrounded fine gravel, moderate HC odor			12.0	SS	6 8 9 8	1.3 / 2.0	37 22				37		
15						SS	5 5 8 10	1.5 / 2.0	28 29 32				32		
		15.5 - 20.0 Oil wet, dark grey to tan, medium to fine SAND, little to some subrounded coarse to fine gravel, strong HC odor			15.5	SS	10 11 10 9	1.0 / 2.0	37 33				37		
						SS	13 15 17 13	0.6 / 2.0	71				71	#1 Sand Filter Pack	
20		20.0 - 22.0 Wet, tan to brown, medium to coarse SAND, some subrounded coarse to fine gravel, oil stained, slight HC odor			20.0	SS	7 10 13 9	0.7 / 2.0	42				42		
		22.0 - 24.0 Wet, grey to tan, medium to coarse SAND and subrounded coarse to fine GRAVEL			22.0	SS	7 9 11 12	2.0 / 2.0	64 60 32				64		
25		24.0 - 26.0 Wet, grey to tan, coarse to fine SAND, slight HC odor			24.0	SS	10 13 12 15	1.1 / 2.0	48 62				62		
		Boring completed at 26.0 ft													
30															
35															
40															

Peak PID Reading per SS (ppm): 250, >500

WELL CASING
Interval: 0-11 ft bgs
Material: Sch 40 PVC
Diameter: 2"
Joint Type: Threaded

WELL SCREEN
Interval: 11-27 ft bgs
Material: Sch 40 PVC
Diameter: 2"
Slot Size: 0.010
End Cap: Sch 40 PVC

FILTER PACK
Interval: 10-27 ft bgs
Type: #1 Sand
Quantity: 400 lbs

FILTER PACK SEAL
Interval: 9-10 ft bgs
Type: #00 Sand
Quantity: 25 lbs

ANNULUS SEAL
Interval: 0-9 ft bgs
Type: Bentonite/Cement Grout
Quantity: 50 lbs/10 Gallons

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: AmeriDrill, Inc
DRILLER: T. Brown

GA INSPECTOR: KMB/JLH
CHECKED BY: TGS
DATE: 8/26/11

Golder Associates

QUANTA SOIL BORING 023-6151.001 RAD II REVISED 08262011.GPJ GOLDER NJ-PA.GDT 8/26/11

RECORD OF BOREHOLE GAL-29

SHEET 1 of 1

PROJECT: Review Avenue Development
PROJECT NUMBER: 023-6151.001
DRILLED DEPTH: 34.0 ft
AZIMUTH: N/A
LOCATION: RAD II

DRILL METHOD: Hollow-Stem Auger
DRILL RIG: CME 85
DATE STARTED: 7/17/08
DATE COMPLETED: 7/17/08
WEATHER: Sunny

DATUM:
COORDS: not surveyed
GS ELEVATION:
TOC ELEVATION:
TEMPERATURE: 80 F

INCLINATION: -90
DEPTH W.L. FROM TOC:
ELEVATION W.L .:
DATE W.L.:
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES TYPE	BLOWS per 6 in	REC / ATT	PID per 6" (ppm)	Sample Interval	Laboratory Sample ID / Date/Time Collected	Analyses	Peak PID Reading per SS (ppm)	MONITORING WELL / PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS
0		0.0 - 8.0 Hollow-Stem Auger Drilled (FILL)													
		8.0 - 10.0 Moist, black, fine SAND, HC odor			8.0	SS	3 2 3 4	1.0 2.0	88 111				111	Cement Grout	
10		10.0 - 13.5 Moist, mottled black to tan, silty fine SAND, fine sand Laminations, slight HC odor			10.0	SS	4 8 9 7	1.5 2.0	28 33 27		SB-29 (11-12) 7/17/2008 10:35:00 AM		33		
						SS	7 6 7 8	1.5 2.0	55 46 97				97		
		13.5 - 16.0 Moist, laminated, stiff, grey to tan, silty CLAY, slight HC odor			13.5	SS	3 5 6 9	1.0 2.0	91 30				91		
15		16.0 - 22.0 Moist, brown to tan, medium to fine SAND, trace angular to subrounded gravel, slight HC odor, black staining at 20 ft bgs			16.0	SS	12 19 16 18	1.0 2.0	114 112		SB-29 (17-18) 7/17/2008 10:55:00 AM		114	Bentonite Seal	
						SS	17 15 12 13	1.0 2.0	100 54				100	#00 Sand Choker	
20						SS	6 12 17 13	0.5 2.0	99				99		
		22.0 - 24.0 Oil wet, brown, medium to fine SAND and angular fine GRAVEL, strong HC odor			22.0	SS	14 12 11 10	0.5 2.0	100				100		
		24.0 - 34.0 Wet, black, medium SAND, trace angular to subangular fine gravel, slight HC odor			24.0	SS	4 3 9 10	1.5 2.0	55 43		SB-29 (25-26) 7/17/2008 11:25:00 AM		55	#00 Sand Filter Pack	
25						SS	9 12 17 19	1.5 2.0	53 48 52				53		
						SS	11 16 16 19	1.0 2.0	38 42				42		
30						SS	9 15 21 24	1.5 2.0	42 50 38		SB-29 (31-32) 7/17/2008 11:45:00 AM		50		
						SS	7 8 11 16	1.5 2.0	25 31 28		SB-29 (33-34) 7/17/2008 12:00:00 PM		31		
		Boring completed at 34.0 ft													
35															
40															

WELL CASING
Interval: 0-20 ft bgs
Material: Sch 40 PVC
Diameter: 2"
Joint Type: Threaded

WELL SCREEN
Interval: 20-30 ft bgs
Material: Sch 40 PVC
Diameter: 2"
Slot Size: 0.010
End Cap: Sch 40 PVC

FILTER PACK
Interval: 19-30 ft bgs
Type: #1 Sand
Quantity: 200 lbs

FILTER PACK SEAL
Interval: 18-19 ft bgs
Type: #00 Sand
Quantity: 25 lbs

ANNULUS SEAL
Interval: 0-18 ft bgs
Type: Bentonite/Cement Grout
Quantity: 50 lbs/50 Gallons

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: AmeriDrill, Inc
DRILLER: T. Brown

GA INSPECTOR: KMB
CHECKED BY: TGS
DATE: 8/26/11

Golder Associates

QUANTA SOIL BORING 023-6151.001 RAD II REVISED 08262011.GPJ GOLDER NJ-PA.GDT 8/26/11

RECORD OF BOREHOLE GAL-30

SHEET 1 of 1

PROJECT: Review Avenue Development
PROJECT NUMBER: 023-6151.001
DRILLED DEPTH: 28.0 ft
AZIMUTH: N/A
LOCATION: RAD II

DRILL METHOD: Hollow-Stem Auger
DRILL RIG: CME 85
DATE STARTED: 7/17/08
DATE COMPLETED: 7/17/08
WEATHER: Sunny

DATUM:
COORDS: not surveyed
GS ELEVATION:
TOC ELEVATION:
TEMPERATURE: 80 F

INCLINATION: -90
DEPTH W.L. FROM TOC:
ELEVATION W.L .:
DATE W.L.:
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES TYPE	BLOWS per 6 in	REC / ATT	PID per 6" (ppm)	Sample Interval	Laboratory Sample ID / Date/Time Collected	Analyses	Peak PID Reading per SS (ppm)	MONITORING WELL / PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS
0		0.0 - 8.0 Hollow-Stem Auger Drilled (FILL)													
		8.0 - 11.5 Moist, light grey to brown, silty fine SAND, trace concrete fragments, slight to strong HC odor			8.0	SS	4 4 5 6	0.5 2.0	180				180		
10						SS	4 4 5 4	1.5 2.0	185 1685 997		SB-30 (10.5-11.5) 7/17/2008 8:05:00 AM		1685		
		11.5 - 13.0 Moist, laminated, soft, light grey, silty CLAY			11.5	SS	4 4 5 7	1.5 2.0	942 500 731				942		
		13.0 - 15.0 Moist, laminated, grey, clayey SILT, trace fine sand, HC odor, oil staining			13.0										
15		15.0 - 20.0 Dry, light brown to tan, coarse to fine SAND, trace angular to subrounded fine gravel			15.0	SS	10 14 15 17	2.0 2.0	439 80 20		SB-30 (15-16) 7/17/2008 8:25:00 AM		439	Cement Grout	
						SS	17 11 15 17	1.0 2.0	4 0				4	Bentonite Seal #00 Sand Choker	
						SS	34 24 25 29	1.0 2.0	191				191		
20		20.0 - 22.0 Moist, tan, medium to coarse SAND and angular to subangular fine GRAVEL, HC odor			20.0	SS	15 24 26 28	1.0 2.0	210 139		SB-30 (21-22) 7/17/2008 9:00:00 AM		210		
		22.0 - 24.0 Wet, light grey to tan, medium to coarse SAND and subangular to rounded Gravel, strong HC odor, slight oil staining			22.0	SS	23 34 26 20	1.0 2.0	185 110				185	#1 Sand Filter Pack	
25		24.0 - 26.0 Wet, black, medium to coarse SAND, trace subrounded fine gravel, slight HC odor, oil staining			24.0	SS	4 7 11 14	1.0 2.0	29 53		SB-30 (25-26) 7/17/2008 9:30:00 AM		53		
		26.0 - 28.0 Wet, black to tan, coarse to fine SAND, trace rounded fine gravel			26.0	SS	15 19 16 17	1.5 2.0	22 25 27		SB-30 (27-28) 7/17/2008 9:40:00 AM		27		
30		Boring completed at 28.0 ft													
35															
40															

WELL CASING
Interval: 0-18 ft bgs
Material: Sch 40 PVC
Diameter: 2"
Joint Type: Threaded

WELL SCREEN
Interval: 18-28 ft bgs
Material: Sch 40 PVC
Diameter: 2"
Slot Size: 0.010
End Cap: Sch 40 PVC

FILTER PACK
Interval: 17-28 ft bgs
Type: #1 Sand
Quantity: 300 lbs

FILTER PACK SEAL
Interval: 16-17 ft bgs
Type: #00 Sand
Quantity: 25 lbs

ANNULUS SEAL
Interval: 0-16 ft bgs
Type: Bentonite/Cement Grout
Quantity: 50 lbs/25 Gallons

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: AmeriDrill, Inc
DRILLER: T. Brown

GA INSPECTOR: KMB
CHECKED BY: TGS
DATE: 8/26/11

Golder Associates

QUANTA SOIL BORING 023-6151.001 RAD II REVISED 08262011.GPJ GOLDER NJ-PA.GDT 8/26/11

RECORD OF BOREHOLE GAL-31

SHEET 1 of 1

PROJECT: Review Avenue Development
PROJECT NUMBER: 023-6151.001
DRILLED DEPTH: 28.0 ft
AZIMUTH: N/A
LOCATION: RAD II

DRILL METHOD: Hollow-Stem Auger
DRILL RIG: CME 85
DATE STARTED: 7/17/08
DATE COMPLETED: 7/17/08
WEATHER: Sunny

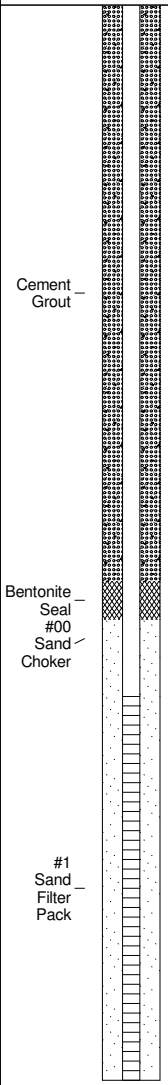
DATUM:
COORDS: not surveyed
GS ELEVATION:
TOC ELEVATION:
TEMPERATURE: 90 F

INCLINATION: -90
DEPTH W.L. FROM TOC:
ELEVATION W.L .:
DATE W.L.:
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	TYPE	BLOWS per 6 in	REC / ATT	PID per 6" (ppm)	Sample Interval	Laboratory Sample ID / Date/Time Collected	Analyses	Peak PID Reading per SS (ppm)
0		0.0 - 8.0 Hollow-Stem Auger Drilled (FILL)											
		8.0 - 10.0 Moist, brown, medium to fine SAND, trace angular rock fragments, shell, strong HC odor			8.0	SS	8 10 10 8	1.0 2.0	260				260
10		10.0 - 12.0 Moist, laminated, olive-green to brown, silty CLAY, trace fine sand, HC odor			10.0	SS	4 4 3 5	1.5 2.0	86 294 200		SB-31 (11-12) 7/17/2008 1:35:00 PM		294
		12.0 - 13.5 Moist, laminated, mottled gey to olive-green, SILT, slight HC odor			12.0	SS	4 4 5 8	1.0 2.0	30 11.5				30
		13.5 - 18.0 Dry, light tan, medium to fine SAND			13.5	SS	14 14 12 16	0.0 2.0					
15						SS	18 16 15 15	0.0 2.0					
		18.0 - 20.0 Moist, grey to tan, medium to fine SAND, some angular rock fragments, slight HC odor			18.0	SS	10 7 8 12	0.5 2.0	198				198
20		20.0 - 22.0 Wet, light grey, medium to coarse SAND and rounded to subangular fine GRAVEL, HC odor, product in spoon			20.0	SS	12 10 10 8	0.4 2.0	284				284
		22.0 - 28.0 Wet, light grey to tan, fine to medium SAND, some to trace angular to subrounded fine gravel, slight HC odor			22.0	SS	8 9 9 11	2.0 2.0	247 131 132		SB-31 (22-23) 7/17/2008 2:00:00 PM		247
25						SS	5 6 8 11	1.5 2.0	51 33		SB-31 (25-26) 7/17/2008 2:45:00 PM		51
						SS	5 10 12 15	1.5 2.0	48 50 49		SB-31 (27-28) 7/17/2008 2:50:00 PM		50
		Boring completed at 28.0 ft											
30													
35													
40													

Peak PID Reading per SS (ppm): 250, >500

MONITORING WELL / PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS

WELL CASING
Interval: 0-18 ft bgs
Material: Sch 40 PVC
Diameter: 2"
Joint Type: Threaded

WELL SCREEN
Interval: 18-28 ft bgs
Material: Sch 40 PVC
Diameter: 2"
Slot Size: 0.010
End Cap: Sch 40 PVC

FILTER PACK
Interval: 17-28 ft bgs
Type: #1 SAND
Quantity: 300 lbs

FILTER PACK SEAL
Interval: 16-17 ft bgs
Type: #00 Sand
Quantity: 25 lbs

ANNULUS SEAL
Interval: 0-16 ft bgs
Type: Bentonite/Cement Grout
Quantity: 50 lbs/30 Gallons

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: AmeriDrill, Inc
DRILLER: T. Brown

GA INSPECTOR: KMB
CHECKED BY: TGS
DATE: 8/26/11

Golder Associates

QUANTA SOIL BORING 023-6151.001 RAD II REVISED 08262011.GPJ GOLDER NJ-PA.GDT 8/26/11

RECORD OF BOREHOLE PSMW-1

SHEET 1 of 1

PROJECT: Review Avenue Development
PROJECT NUMBER: 023-6151.001
DRILLED DEPTH: 26.0 ft
AZIMUTH: N/A
LOCATION: RAD I

DRILL METHOD: Hollow-Stem Auger
DRILL RIG: CME 85
DATE STARTED: 7/16/08
DATE COMPLETED: 7/16/08
WEATHER: Sunny

DATUM:
COORDS: not surveyed
GS ELEVATION:
TOC ELEVATION:
TEMPERATURE: 80 F

INCLINATION: -90
DEPTH W.L. FROM TOC:
ELEVATION W.L .:
DATE W.L.:
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES TYPE	BLOWS per 6 in	REC / ATT	PID per 6" (ppm)	Sample Interval	Laboratory Sample ID / Date/Time Collected	Analyses	Peak PID Reading per SS (ppm)	MONITORING WELL / PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS
0		0.0 - 5.0 Vacuum Soft Dig Cleared, (ASPHALT and FILL)													
5		5.0 - 13.5 Dry, light tan, fine to coarse SAND, some angular to sub angular fine gravel, slight HC odor			5.0	SS	7 6 5 4	0.5 / 2.0	13				13		
						SS	5 5 5 6	1.0 / 2.0	8 14				14		
10						SS	4 9 7 8	2.0 / 2.0	12 20 22				22		
						SS	7 8 9 9	1.0 / 2.0	195 160				195		
		13.5 - 14.0 Oil wet, light tan, fine to coarse SAND, some angular to sub angular fine gravel, strong HC odor			13.5 14.0	SS	4 6 6 7	1.0 / 2.0							
15		14.0 - 21.5 Oil wet, black, fine to coarse SAND, strong HC odor				SS	3 3 4 3	1.5 / 2.0	189 245				245		
						SS	5 6 8 7	2.0 / 2.0							
20						SS	3 5 4 6	1.0 / 2.0	174 187				187		
		21.5 - 22.0 Wet, grey to tan, medium to coarse SAND, some angular fine gravel, trace silt nodules, oil staining			21.5 22.0	SS	4 5 7 8	1.0 / 2.0	178 187				187		
		22.0 - 24.0 Wet, light grey to tan, fine to coarse SAND, some rounded fine gravel, moderate HC odor			24.0	SS	4 6 7 9	1.0 / 2.0	142 197				197		
25		24.0 - 26.0 Wet, black, medium to fine SAND, some rounded fine gravel, trace silt nodules Boring completed at 26.0 ft													
30															
35															
40															

Peak PID Reading per SS (ppm): 250, >500

MONITORING WELL / PIEZOMETER DIAGRAM and NOTES:
- Cement Grout
- Bentonite Seal
- #00 Sand Choker
- #1 Sand Filter Pack

WELL CONSTRUCTION DETAILS

WELL CASING
Interval: 0-10 ft bgs
Material: Sch 40 PVC
Diameter: 2"
Joint Type: Threaded

WELL SCREEN
Interval: 10-25 ft bgs
Material: Sch 40 PVC
Diameter: 2"
Slot Size: 0.010
End Cap: Sch 40 PVC

FILTER PACK
Interval: 9-25 ft bgs
Type: #1 Sand
Quantity: 400 lbs

FILTER PACK SEAL
Interval: 8-9 ft bgs
Type: #00 Sand
Quantity: 25 lbs

ANNULUS SEAL
Interval: 0-8 ft bgs
Type: Bentonite/Cement Grout
Quantity: 50 lbs/10 Gallons

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: AmeriDrill, Inc
DRILLER: T. Brown

GA INSPECTOR: KMB
CHECKED BY: TGS
DATE: 8/26/11

Golder Associates

QUANTA SOIL BORING 023-6151.001 RAD II REVISED 08262011.GPJ GOLDER NJ-PA.GDT 8/26/11

RECORD OF BOREHOLE PSMW-2

SHEET 1 of 1

PROJECT: Review Avenue Development
PROJECT NUMBER: 023-6151.001
DRILLED DEPTH: 26.0 ft
AZIMUTH: N/A
LOCATION: RAD II

DRILL METHOD: Hollow-Stem Auger
DRILL RIG: CME 85
DATE STARTED: 7/14/08
DATE COMPLETED: 7/14/08
WEATHER: Sunny

DATUM:
COORDS: not surveyed
GS ELEVATION:
TOC ELEVATION:
TEMPERATURE: 80 F

INCLINATION: -90
DEPTH W.L. FROM TOC:
ELEVATION W.L .:
DATE W.L.:
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES TYPE	BLOWS per 6 in	REC / ATT	PID per 6" (ppm)	Sample Interval	Laboratory Sample ID / Date/Time Collected	Analyses	Peak PID Reading per SS (ppm)	MONITORING WELL / PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS
0		0.0 - 8.0 Hollow-Stem Auger Drilled (FILL)													
10		8.0 - 14.0 Dry to moist, dark grey to dark tan, medium SAND, trace subrounded fine gravel, wood fragments and concrete, slight to moderate HC odor			8.0	SS	3 3 5 4	1.0 / 2.0							
						SS	2 2 2 2	1.5 / 2.0	4 8				8 10		
						SS	2 2 3 3	1.0 / 2.0	8 10						
15		14.0 - 20.0 Oil wet, dark grey to black, medium to fine SAND, trace subrounded fine gravel, strong HC odor			14.0	SS	1 1 0 0	1.0 / 2.0	50 82				82		
						SS	3 2 2 2	1.2 / 2.0	50 86 100				100		
						SS	2 2 1 1	1.0 / 2.0	90 85				90		
20		20.0 - 24.0 Wet, light grey, medium to coarse SAND, trace to some subrounded to rounded coarse to fine gravel			20.0	SS	1 1 1 3	1.0 / 2.0	86 67				86		
						SS	4 4 7 9	1.0 / 2.0	87 100				100		
25		24.0 - 26.0 No Recovery			24.0	SS	3 4 7 8	0.0 / 2.0							
		Boring completed at 26.0 ft													

Peak PID Reading per SS (ppm): 250, 500

MONITORING WELL / PIEZOMETER DIAGRAM and NOTES:
- Cement Grout
- Bentonite Seal #00 Sand Choker
- #1 Sand Filter Pack

WELL CONSTRUCTION DETAILS

WELL CASING
Interval: 0-9 ft bgs
Material: Sch 40 PVC
Diameter: 2"
Joint Type: Threaded

WELL SCREEN
Interval: 9-24 ft bgs
Material: Sch 40 PVC
Diameter: 2"
Slot Size: 0.010
End Cap: Sch 40 PVC

FILTER PACK
Interval: 8-24 ft bgs
Type: #1 Sand
Quantity: 400

FILTER PACK SEAL
Interval: 7-8 ft bgs
Type: #00 Sand
Quantity: 25 lbs

ANNULUS SEAL
Interval: 0-7 ft bgs
Type: Bentonite/Cement Grout
Quantity: 25 lbs/10 Gallons

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: AmeriDrill, Inc
DRILLER: T. Brown

GA INSPECTOR: KMB/JLH
CHECKED BY: TGS
DATE: 8/26/11

Golder Associates

QUANTA SOIL BORING 023-6151.001 RAD II REVISED 08262011.GPJ GOLDER NJ-PA.GDT 8/26/11

RECORD OF BOREHOLE VER-1

SHEET 1 of 1

PROJECT: Review Avenue Development
PROJECT NUMBER: 023-6151.001
DRILLED DEPTH: 20.0 ft
AZIMUTH: N/A
LOCATION: RAD I

DRILL METHOD: Hollow-Stem Auger
DRILL RIG: CME 85
DATE STARTED: 7/16/08
DATE COMPLETED: 7/16/08
WEATHER: Sunny

DATUM:
COORDS: not surveyed
GS ELEVATION:
TOC ELEVATION:
TEMPERATURE: 90 F

INCLINATION: -90
DEPTH W.L. FROM TOC:
ELEVATION W.L .:
DATE W.L.:
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV / DEPTH (ft) REC / ATT	SAMPLES TYPE	MONITORING WELL / PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS
0		0.0 - 5.0 Vacuum soft dig cleared (ASPHALT and FILL) Lithilogy taken from PSMW-1					Cement Grout Bentonite Seal #00 Sand Choker	**WELL CASING** Interval: 0-5 ft bgs Material: Sch 5 Stainless Steel Diameter: 2" Joint Type: Threaded
5		5.0 - 13.5 Dry, light tan, fine to coarse SAND, some angular to sub angular fine gravel, slight HC odor			5.0			**WELL SCREEN** Interval: 5-20 ft bgs Material: Sch 5 Stainless Steel Diameter: 2" Slot Size: 0.010 End Cap: Sch 5 Stainless Steel
10								**FILTER PACK** Interval: 4-20 ft bgs Type: #1 Sand Quantity: 450 lbs
								FILTER PACK SEAL Interval: 3-4 ft bgs Type: #00 Sand Quantity: 50 lbs
								ANNULUS SEAL Interval: 0-3 ft bgs Type: Bentonite/Cement Grout Quantity: 25 lbs/5 Gallons
		13.5 - 14.0 Oil wet, light tan, fine to coarse SAND, some angular to sub angular fine gravel, strong HC odor			13.5 14.0		#1 Sand Filter Pack	
15		14.0 - 21.5 Oil wet, black, fine to coarse SAND, strong HC odor						
20								
		21.5 - 22.0 Wet, grey to tan, medium to coarse SAND, some angular fine gravel, trace silt nodules, oil staining			21.5 22.0			
		22.0 - 24.0 Wet, light grey to tan, fine to coarse SAND, some rounded fine gravel, moderate HC odor			24.0			
25		24.0 - 26.0 Wet, black, medium to fine SAND, some rounded fine gravel, trace silt nodules						
		Boring completed at 20.0 ft			26.0			
30								
35								
40								

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: AmeriDrill, Inc
DRILLER: T. Brown

GA INSPECTOR: KMB
CHECKED BY: TGS
DATE: 8/26/11

Golder Associates

QUANTA SOIL BORING 023-6151.001 RAD II REVISED 08262011.GPJ GOLDER NJ-PA.GDT 8/26/11

RECORD OF BOREHOLE VER-2

SHEET 1 of 1

PROJECT: Review Avenue Development
PROJECT NUMBER: 023-6151.001
DRILLED DEPTH: 26.0 ft
AZIMUTH: N/A
LOCATION: RAD II

DRILL METHOD: Hollow-Stem Auger
DRILL RIG: CME 85
DATE STARTED: 7/16/08
DATE COMPLETED: 7/16/08
WEATHER: Sunny

DATUM:
COORDS: not surveyed
GS ELEVATION:
TOC ELEVATION:
TEMPERATURE: 80 F

INCLINATION: -90
DEPTH W.L. FROM TOC:
ELEVATION W.L .:
DATE W.L.:
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES TYPE	BLOWS per 6 in	REC / ATT	PID per 6" (ppm)	Sample Interval	Laboratory Sample ID / Date/Time Collected	Analyses	Peak PID Reading per SS (ppm)	MONITORING WELL / PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS
0		0.0 - 8.0 Hollow-Stem Auger Drilled (FILL)												Cement Grout	
5														Bentonite Seal #00 Sand Choker	
10		8.0 - 13.5 Moist, grey to tan, medium to fine SAND, slight HC odor (Oil Staining at 8-10 ft bgs)			8.0	SS	2 2 3 5	1.5 / 2.0	4.7 10 11				11		
						SS	4 5 7 8	1.5 / 2.0	29 21 17				29		
						SS	8 9 9 11	1.0 / 2.0	28 32				32		
		13.5 - 22.0 Oil wet, dark grey to black, fine to coarse SAND, trace rounded fine gravel, HC odor			13.5	SS	7 7 8 6	1.0 / 2.0	18 28				28		
15						SS	6 7 8 10	1.0 / 2.0	12 14				14	#1 Sand Filter Pack	
						SS	7 9 10 10	1.2 / 2.0	91 63				91		
20						SS	6 8 8 10	1.5 / 2.0							
		22.0 - 26.0 Wet, dark grey, medium to coarse SAND, trace to some subangular fine gravel, slight HC odor, slight oil staining			22.0	SS	9 9 10 10	1.5 / 2.0	49 68 85				85		
25						SS	7 7 8 9	1.5 / 2.0	68 174 98				174		
		Boring completed at 26.0 ft													
30															
35															
40															

Peak PID Reading per SS (ppm) scale: 250, >500

WELL CASING
Interval: 0-9 ft bgs
Material: Sch 5 Stainless Steel
Diameter: 2'
Joint Type: Threaded

WELL SCREEN
Interval: 9-24 ft bgs
Material: Sch 5 Stainless Steel
Diameter: 2"
Slot Size: 0.010
End Cap: Sch 5 Stainless Steel

FILTER PACK
Interval: 8-24 ft bgs
Type: #1 Sand
Quantity: 350 lbs

FILTER PACK SEAL
Interval: 7-8 ft bgs
Type: #00 Sand
Quantity: 25 lbs

ANNULUS SEAL
Interval: 0-7 ft bgs
Type: Bentonite/Cement Grout
Quantity: 50 lbs/15 Gallons

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: AmeriDrill, Inc
DRILLER: T. Brown

GA INSPECTOR: KMB
CHECKED BY: TGS
DATE: 8/26/11

Golder Associates

QUANTA SOIL BORING 023-6151.001 RAD II REVISED 08262011.GPJ GOLDER NJ-PA.GDT 8/26/11

APPENDIX B

VER LNAPL RECOVERY PILOT STUDY DATA

Figure 1A
Test A - LNAPL Recoverability Pilot Study
Total Liquids Recovery vs Time

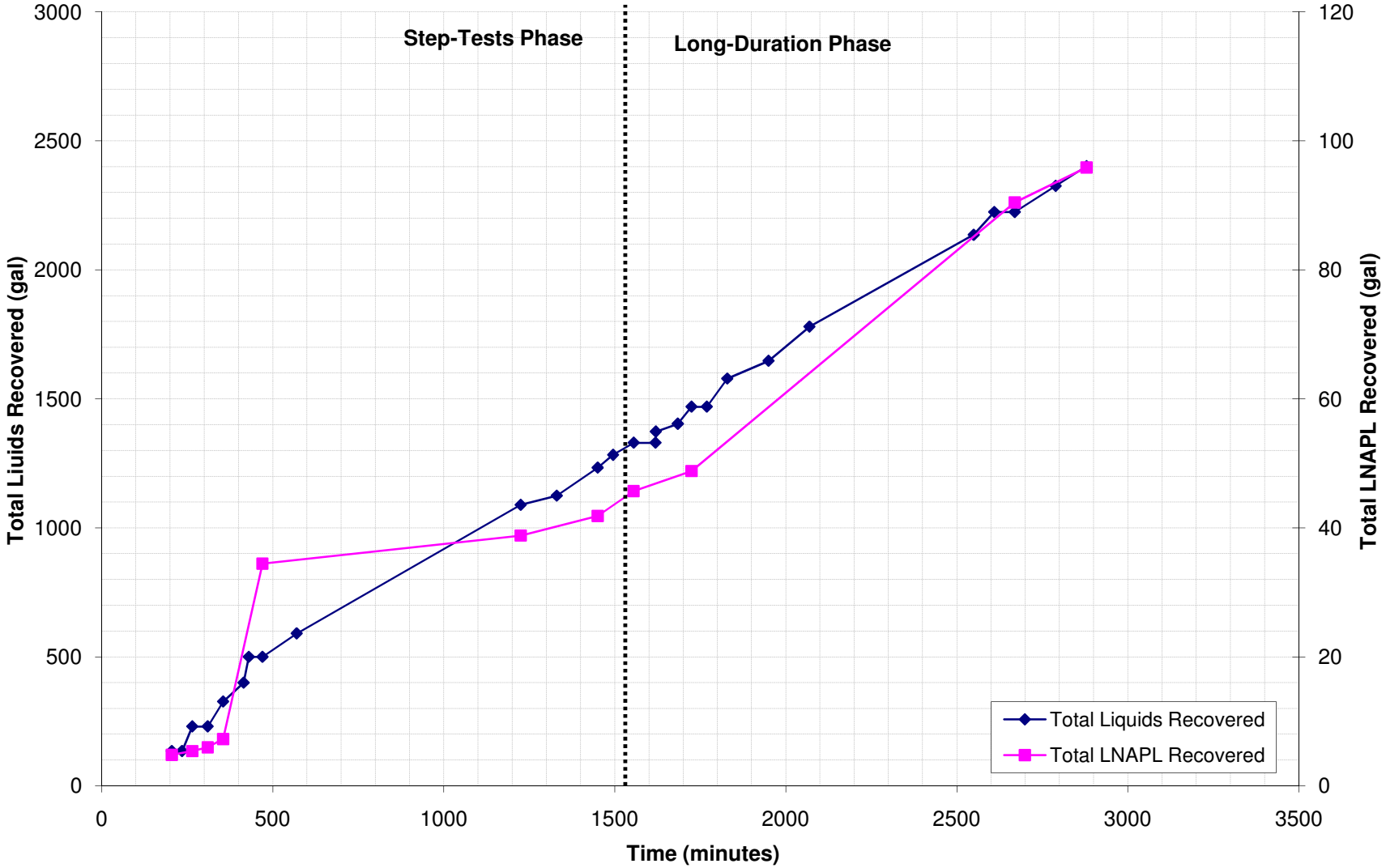


Figure 2A
Test A - LNAPL Recoverability Pilot Study
Vacuum Pressures at Monitoring Wells vs Time

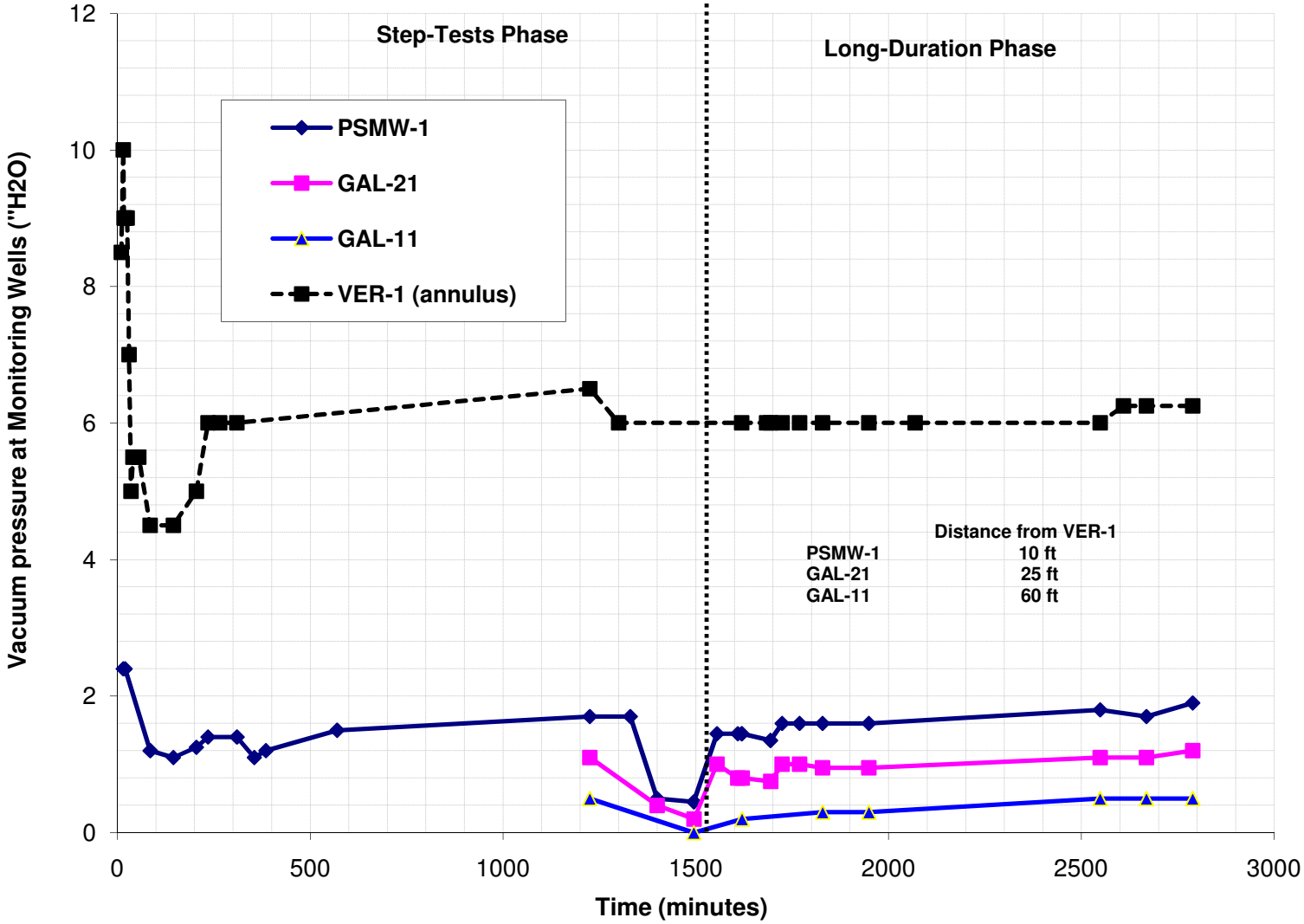


Figure 3A
Test A - LNAPL Recoverability Pilot Study
Water Table and LNAPL Depths vs Time

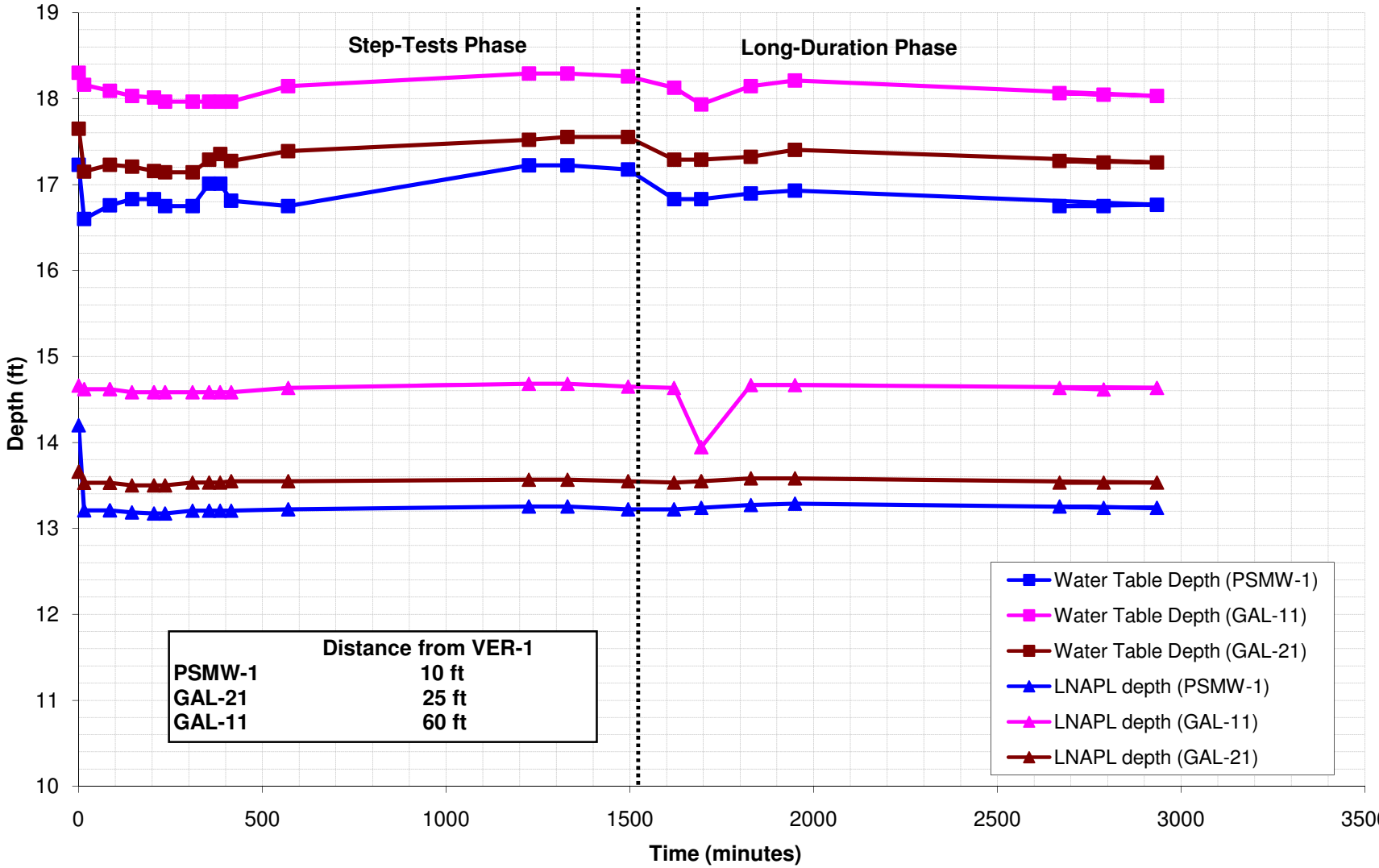


Figure 4A
Test A - LNAPL Recoverability Pilot Study
Vacuum Pressure vs Distance from VER-1

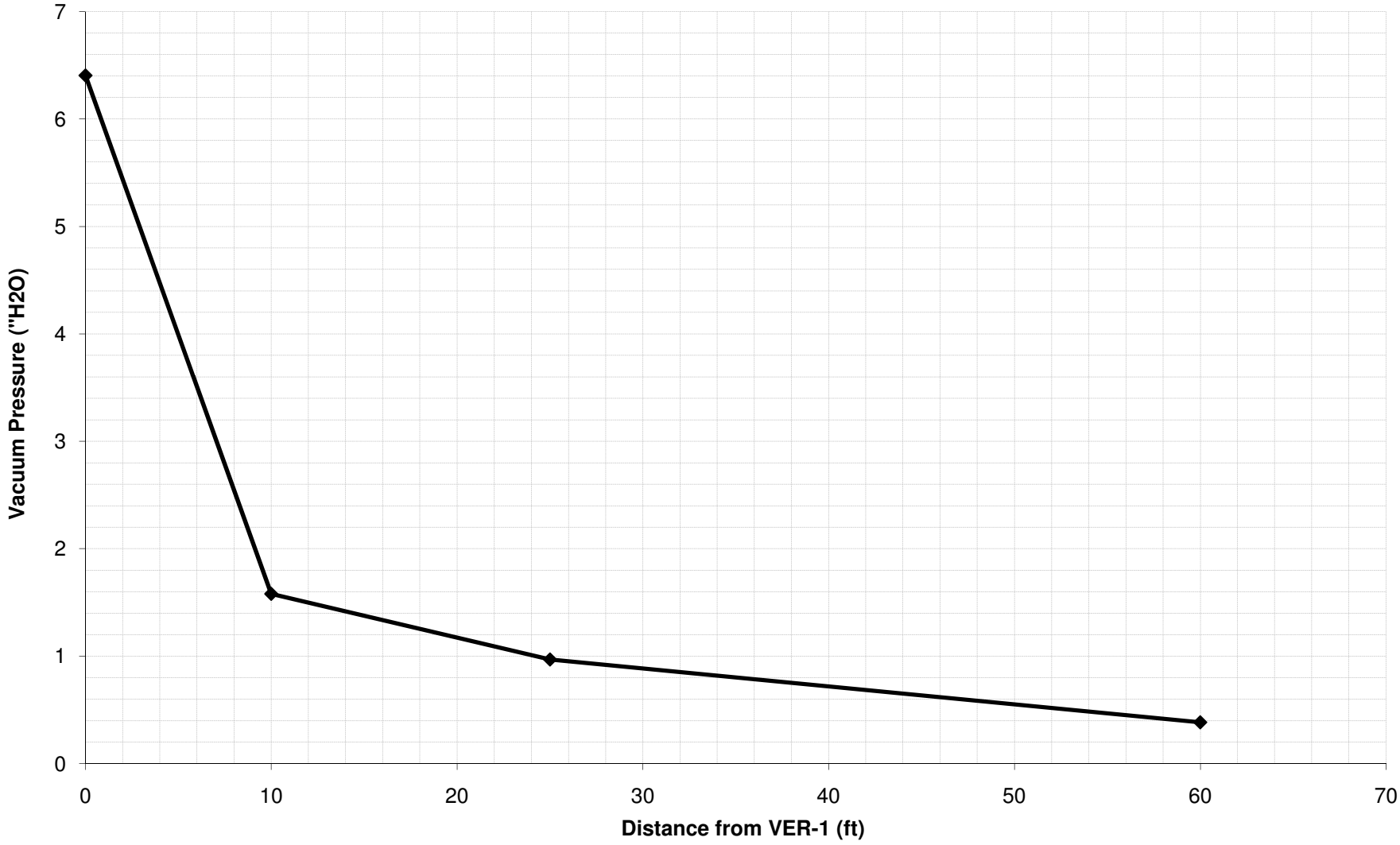


TABLE 1A
PILOT TEST A
FIELD DATA

	TIME	Cumulative time	Drop tube depth	Flowmeter readings	Cumulative groundwater pumped	Average groundwater flow (based on GWmetre)	Groundwater flow (based on measurment at well head)	Volumetric ratio oil/water	Vacuum at pump inlet	Vacuum at HVLS	Fresh Air at pump speed	Fresh air inlet at pump	Fresh air inlet at pump	Air at pump speed
		(min)	(ft)	(gallons)	(gallons)	(gpm)	(gpm)	(%)	("Hg)	("Hg)	(m/s)	m3/s	(SCFM)	(m/s)
DAY 1 (Sept 3rd)	7:30	-	-	593134.2	-	-	-	-	-	-	-	-	-	-
	11:35	0	12'	no flow	-	-	-	-	12.25	11	-	-	-	-
	11:45	10	12'	no flow	-	-	-	-	12.25	11	-	-	-	-
	11:50	15	12'	no flow	-	-	-	-	18	15.5	-	-	-	-
	11:52	17	System off	-	-	-	-	-	10	9	-	-	-	-
	11:55	20	12'8"	-	-	-	-	-	21	19	-	-	-	-
	12:00	25	12'8"	-	-	-	-	-	15	14	-	-	-	-
	12:05	30	13'	-	-	-	-	-	15	15	-	-	-	-
	12:10	35	12'10"	-	-	-	-	-	15	15.5	-	-	-	-
	12:15	40	13'	-	-	-	~0,5	-	15	15.75	5.1	0.04	87.61	-
	12:30	55	13'2"	-	-	-	~1	-	15	17	5.5	0.04	94.48	6.95
	13:00	85	13'2"	-	-	-	0.9	3	15	17.75	5.4	0.04	92.76	6.9
	14:00	145	13'4"	-	-	-	1.1	2.3	15	17.75	5.4	0.04	92.76	6.8
	15:00	205	13'4"	593268.6	134.4	0.81	1.05	2.5	15	17.75	0	0.00	0.00	6.8
	15:30	235	13'4"	593268.6	134.4	0.69	-	-	24	26.5	0	0.00	0.00	-
	16:00	265	13'4"	593364.4	230.2	1.02	1.1	1.9	24.5	26.5	0	0.00	0.00	2.8
	16:45	310	13'4"	593364.4	230.2	0.85	1.2	1.5	24	26	0	0.00	0.00	2.8
	17:30	355	14'	593460.5	326.30	1.04	2.2	1.1	25.5	27	0	0.00	0.00	2.1
	18:00	385	14'	-	-	-	1.9	1.6	21	22	-	-	-	-
	18:30	415	14'	593533.5	399.30	1.06	-	-	21	22	2.9	0.02	49.82	4.4
	18:45	430	13'2"	593633.8	499.60	1.28	-	-	19	21	3	0.02	51.54	4.97
	19:25	470	13'2"	593633.8	499.60	1.16	0.85	3.1	19.5	20.75	-	-	-	-
	21:05	570	13'2"	593724.8	590.60	1.11	-	-	19	20.5	2.7	0.02	46.38	4.95
DAY 2 (Sept 4th)	8:00	1225	13'2"	594223	1088.80	0.92	0.74	1,4/1,5	19	20.5	2.5	0.02	42.95	5.1
	9:15	1300	Pump off for 15 min (Holding tank clean up)				-	-			-	-	-	-
	9:45	1330	13'2"	594258.5	1124.30	0.87	-	-	19	19.5	2.5	0.02	42.95	Air sampling
10:45 Start of test without vacuum	10:55	1400	13'2"	-	-	-	-	-	-	-	-	-	-	-
	11:45	1450	13'9"	594367	1232.80	0.87	0.3	1,1/4,3	20	23.5	well open to atm	-	-	4.5
	12:30	1495	13'9"	594416.9	1282.70	0.88	-	-	20	23.5	well open to atm	-	-	4.5
13:05 Vacuum back on	13:30	1555	13'5"	594463.5	1329.30	0.88	1.1	2/1,2	20	22	0	0.00	0.00	-
	14:30	1609	13'5"	-	-	-	-	-	-	-	-	-	-	-
13:30 to 13:36 Low vac alarm	15:00	1619	13'5"	594463.5	1329.30	0.84	-	-	20	22	2.4	0.02	41.23	-
14:30 to 14:50 low vac alarm	15:30	1620	13'5"	594507	1372.80	0.87	-	-	20	23	2.5	0.02	42.95	-
	15:45	1684	13'5"	594537.1	1402.90	0.85	-	-	24	26	0	0.00	0.00	-
15:45 to 23:50 low vac alarm	System off													
DAY 3 (Sept 5th)	13:00	-	-	-	-	-	-	-	-	-	-	-	-	-
	17:05	0	-	594704.5	1402.90	-	-	-	-	-	-	-	-	-
	17:15	10	13'3"	-	-	-	-	-	19	18	-	-	-	5.4
Unit down until 17:15	17:45	40	13'3"	594770.5	1468.90	1.65	0.85	1,2/1,2	19.5	20	3	0.02	51.54	5.2
	18:30	85	13'3"	594770.5	1468.90	0.78	-	-	19	21	2.9	0.02	49.82	5.3
	19:30	145	13'3"	594879.8	1578.20	1.21	0.85	3,1/2	19	20.5	3.2	0.03	54.97	5.4
	21:30	265	13'3"	594948.5	1646.90	0.92	-	-	19	21	3.1	0.03	53.25	5.1
No access to RAD I (entry locked)	23:30	385	13'3"	595081	1779.40	0.98	-	-	19	20.5	3.1	0.03	53.25	5.2
DAY 4 (Sept 6th)	7:30	865	13'3"	595437.1	2135.50	0.85	-	-	19	21	3	0.02	51.54	5.1
	8:30	925	13'3"	595525.5	2223.90	0.89	-	-	23.5	24	0	0.00	0.00	Air sampling
	9:30	985	13'3"	595525.5	2223.90	0.83	0.85	2,3/1,5	24	24.5	0	0.00	0.00	Air sampling
	11:30	1105	13'3"	595626.5	2324.90	0.83	-	-	24	26	0	0.00	0.00	Air sampling
End of test	13:00	1195	-	595703.0	2401.40	0.84	-	-	-	-	-	-	-	-

TABLE 1A
PILOT TEST A
FIELD DATA

	TIME	Cumulative time	Air outlet at pump	Air outlet at pump	Temperature at pump speed	VOC - Inlet	VOC - outlet	Qualitative observations of effluent
		(min)	m3/s	(SCFM)	(^{o}F)	(ppm)	(ppm)	
DAY 1 (Sept 3rd)	7:30	-	-	-	-	-	-	-
	11:35	0	-	-	-	-	-	-
	11:45	10	-	-	-	-	-	-
	11:50	15	-	-	-	-	-	-
	11:52	17	-	-	-	-	-	-
	11:55	20	-	-	-	-	-	-
	12:00	25	-	-	-	-	-	Free product only: extraction well is being emptied
	12:05	30	-	-	-	-	-	Mix of oil and water
	12:10	35	-	-	-	-	-	-
	12:15	40	-	-	-	29	0	-
	12:30	55	0.06	119.39	-	34.5	0	-
	13:00	85	0.06	118.53	-	49.9	0	-
	14:00	145	0.06	116.81	-	47.5	0	Emulsion (oil fraction seems greater than RAD II)
	15:00	205	0.06	116.81	-	48.1	0	Separation in tube slower: 3 differents layers (free
	15:30	235	-	-	155	-	-	product, highly concentrated emulsion and less
	16:00	265	0.02	48.10	145	34.5	0	concentrated emulsion)
	16:45	310	0.02	48.10	145	44.5	0	-
	17:30	355	0.02	36.07	140	45.5	0	-
	18:00	385	-	-	-	-	-	-
	18:30	415	0.04	75.59	150	62.9	0	-
	18:45	430	0.04	85.38	150	43	0	-
	19:25	470	-	-	150	-	-	Emulsion (oil fraction seems greater than RAD II)
	21:05	570	0.04	85.03	150	33.6	0	-
DAY 2 (Sept 4th)	8:00	1225	0.04	87.61	-	31	-	Emulsion (oil fraction seems greater than RAD II)
	9:15	1300	-	-	-	-	-	-
	9:45	1330	-	-	-	Air sampling	Air sampling	-
10:45 Start of test without vacuum	10:55	1400	-	-	-	-	-	-
	11:45	1450	0.04	77.30	-	Air sampling	Air sampling	No free product observed in pumped fluid
	12:30	1495	0.04	77.30	-	Air sampling	Air sampling	-
13:05 Vacuum back on	13:30	1555	-	-	-	Air sampling	Air sampling	Emulsion (oil fraction seems greater than RAD II)
	14:30	1609	-	-	-	-	-	-
13:30 to 13:36 Low vac alarm	15:00	1619	-	-	-	Air sampling	Air sampling	-
14:30 to 14:50 low vac alarm	15:30	1620	-	-	-	Air sampling	Air sampling	-
	15:45	1684	-	-	-	Air sampling	Air sampling	-
15:45 to 23:50 low vac alarm								-
DAY 3 (Sept 5th)	13:00	-	-	-	-	-	-	-
	17:05	0	-	-	-	-	-	Emulsion (oil fraction seems greater than RAD II)
	17:15	10	0.04	92.76	176	89.7	0	Separation in tube slower: 3 differents layers (free
Unit down until 17:15	17:45	40	0.04	89.33	176	76.8	0	product, highly concentrated emulsion and less
	18:30	85	0.04	91.05	176	69.6	1.3	concentrated emulsion)
	19:30	145	0.04	92.76	176	61.1	0	-
	21:30	265	0.04	87.61	176	63.2	0	-
No access to RAD I (entry locked)	23:30	385	0.04	89.33	176	58.3	1.3	-
DAY 4 (Sept 6th)	7:30	865	0.04	87.61	176	30.1	0	-
	8:30	925	-	-	176	Air sampling	Air sampling	Emulsion (oil fraction seems greater than RAD II)
	9:30	985	-	-	176	Air sampling	Air sampling	-
	11:30	1105	-	-	176	Air sampling	Air sampling	-
End of test	13:00	1195	-	-	-	-	-	-

TABLE 1A
PILOT TEST A
FIELD DATA

	TIME	Cumulative time	Extraction well (VER-2)		PSMW-1				GAL-11				GAL-21		
		(min)	Pressure at annulus ("H2O)	Pressure at drop tube ("Hg)	Vacuum ("H2O)	Product depth (ft)	Water depth (ft)	Thickness of free product (ft)	Vacuum ("H2O)	Product depth (ft)	Water depth (ft)	Thickness of free product (ft)	Vacuum ("H2O)	Product depth (ft)	Water depth (ft)
DAY 1 (Sept 3rd)	7:30	-	-	-	-	14.2	17.23	3.03	-	14.66	18.3	3.64	-	13.66	17.65
	11:35	0	9	4	-	-	-	-	-	-	-	-	-	-	-
	11:45	10	8.5	4	-	-	-	-	-	-	-	-	-	-	-
	11:50	15	10	5	2.4	13.21	16.6	3.39	-	14.62	18.16	3.54	-	13.53	17.15
	11:52	17	9	3	-	-	-	-	-	-	-	-	-	-	-
	11:55	20	9	8	2.4	-	-	-	-	-	-	-	-	-	-
	12:00	25	9	5.5	-	-	-	-	-	-	-	-	-	-	-
	12:05	30	7	5	-	-	-	-	-	-	-	-	-	-	-
	12:10	35	5	7.5	-	-	-	-	-	-	-	-	-	-	-
	12:15	40	5.5	7	-	-	-	-	-	-	-	-	-	-	-
	12:30	55	5.5	5	-	-	-	-	-	-	-	-	-	-	-
	13:00	85	4.5	5	1.2	13.21	16.76	3.55	-	14.62	18.09	3.47	-	13.53	17.23
	14:00	145	4.5	5	1.1	13.19	16.83	3.65	-	14.58	18.03	3.44	-	13.50	17.21
	15:00	205	5	4.5	1.25	13.17	16.83	3.66	-	14.58	18.01	3.43	-	13.50	17.16
	15:30	235	6	6	1.4	13.17	16.75	3.58	-	14.58	17.96	3.38	-	13.50	17.14
	16:00	265	6	6	-	-	-	-	-	-	-	-	-	-	-
	16:45	310	6	6	1.4	13.21	16.75	3.54	-	14.58	17.96	3.38	-	13.53	17.14
	17:30	355	-	6	1.1	13.21	17.01	3.81	-	14.58	17.96	3.38	-	13.53	17.29
	18:00	385	-	6.5	1.2	13.21	17.01	3.81	-	14.58	17.96	3.38	-	13.53	17.36
	18:30	415	-	6.5	-	13.21	16.81	3.61	-	14.58	17.96	3.38	-	13.55	17.27
	18:45	430	-	5.5	-	-	-	-	-	-	-	-	-	-	-
	19:25	470	-	5.5	-	-	-	-	-	-	-	-	-	-	-
	21:05	570	-	-	1.5	13.22	16.75	3.53	-	14.63	18.14	3.51	-	13.55	17.39
DAY 2 (Sept 4th)	8:00	1225	6.5	5	1.7	13.25	17.22	3.97	0.5	14.68	18.29	3.61	1.1	13.57	17.52
	9:15	1300	6	5	-	-	-	-	-	-	-	-	-	-	-
	9:45	1330	-	-	1.7	13.25	17.22	3.97	-	14.68	18.29	3.61	-	13.57	17.55
10:45 Start of test without vacuum	10:55	1400	-	-	0.5	13.22	17.22	4.00	-	-	-	-	0.4	13.55	17.55
	11:45	1450	0	5	-	13.22	17.22	4.00	-	-	-	-	-	13.55	17.55
	12:30	1495	0	5	0.45	13.22	17.18	3.95	0	14.65	18.26	3.61	0.2	13.55	17.55
13:05 Vacuum back on	13:30	1555	-	-	1.45	13.22	17.01	3.79	-	-	-	-	1	13.55	17.55
	14:30	1609	-	-	1.45	13.22	16.85	3.63	-	-	-	-	0.8	13.53	17.29
13:30 to 13:36 Low vac alarm	15:00	1619	6	5.5	1.45	-	-	-	-	-	-	-	-	-	-
14:30 to 14:50 low vac alarm	15:30	1620	-	-	1.45	13.22	16.83	3.61	0.2	14.63	18.13	3.49	0.8	13.53	17.29
	15:45	1684	6	6	-	-	-	-	-	-	-	-	-	-	-
15:45 to 23:50 low vac alarm	System off														
DAY 3 (Sept 5th)	13:00	-	-	-	-	13.25	17.26	4.00	-	14.70	18.37	3.67	-	13.60	17.70
	17:05	0	-	-	-	-	-	-	-	-	-	-	-	-	-
	17:15	10	6	6	1.35	13.24	16.83	3.59	-	13.94	17.93	3.99	0.75	13.55	17.29
Unit down until 17:15	17:45	40	6	5	1.6	13.25	16.90	3.64	-	-	-	-	1	13.55	17.36
	18:30	85	6	5.5	1.6	13.27	16.91	3.64	-	-	-	-	1	13.57	17.32
	19:30	145	6	5.5	1.6	13.27	16.90	3.63	0.3	14.67	18.14	3.48	0.95	13.58	17.32
	21:30	265	6	5.25	1.6	13.29	16.93	3.64	0.3	14.67	18.21	3.54	0.95	13.58	17.40
No access to RAD I (entry locked)	23:30	385	6	5	-	-	-	-	-	-	-	-	-	-	-
DAY 4 (Sept 6th)	7:30	865	6	5.25	1.8	13.24	16.77	3.53	0.5	14.63	18.03	3.40	1.1	13.53	17.26
	8:30	925	6.25	5.5	-	-	-	-	-	-	-	-	-	-	-
	9:30	985	6.25	5.25	1.7	13.25	16.75	3.49	0.5	14.63	18.06	3.43	1.1	13.53	17.27
	11:30	1105	6.25	5.5	1.9	13.24	16.75	3.51	0.5	14.62	18.04	3.43	1.2	13.53	17.26
End of test	13:00	1195	-	-	-	-	-	-	-	-	-	-	-	-	-

TABLE 1A
PILOT TEST A
FIELD DATA

	TIME	Cumulative time		MW-10			
		(min)	Thickness of free product (ft)	Vacuum ("H2O)	Product depth (ft)	Water depth (ft)	Thickness of free product (ft)
DAY 1 (Sept 3rd)	7:30	-	3.99	-	14.61	17.45	2.84
	11:35	0	-	-	-	-	-
	11:45	10	-	-	-	-	-
	11:50	15	3.62	-	14.61	17.18	2.57
	11:52	17	-	-	-	-	-
	11:55	20	-	-	-	-	-
	12:00	25	-	-	-	-	-
	12:05	30	-	-	-	-	-
	12:10	35	-	-	-	-	-
	12:15	40	-	-	-	-	-
	12:30	55	-	-	-	-	-
	13:00	85	3.70	-	14.60	17.15	2.55
	14:00	145	3.71	-	14.57	17.27	2.71
	15:00	205	3.66	-	-	-	-
	15:30	235	3.64	-	14.55	17.27	2.72
	16:00	265	-	-	-	-	-
	16:45	310	3.61	-	14.55	17.27	2.72
	17:30	355	3.76	-	14.55	17.27	2.72
	18:00	385	3.82	-	14.55	17.27	2.72
	18:30	415	3.72	-	14.55	17.27	2.72
	18:45	430	-	-	14.55	17.27	2.72
	19:25	470	-	-	14.55	17.27	2.72
	21:05	570	3.84	-	-	-	-
DAY 2 (Sept 4th)	8:00	1225	3.95	0.0	14.60	17.55	2.95
	9:15	1300	-	-	-	-	-
	9:45	1330	3.99	-	-	-	-
10:45 Start of test without vacuum	10:55	1400	4.00	-	-	-	-
	11:45	1450	4.00	-	-	-	-
	12:30	1495	4.00	0.0	14.60	17.55	2.95
13:05 Vacuum back on	13:30	1555	4.00	-	-	-	-
	14:30	1609	3.76	-	-	-	-
13:30 to 13:36 Low vac alarm	15:00	1619	-	-	-	-	-
14:30 to 14:50 low vac alarm	15:30	1620	3.76	0.0	14.60	17.55	2.95
	15:45	1684	-	-	-	-	-
15:45 to 23:50 low vac alarm							
DAY 3 (Sept 5th)	13:00	-	4.10	-	14.65	17.70	3.05
	17:05	0	-	-	-	-	-
	17:15	10	3.74	0.0	14.62	17.37	2.76
Unit down until 17:15	17:45	40	3.81	0.0	-	-	-
	18:30	85	3.76	-	-	-	-
	19:30	145	3.74	-	14.63	17.44	2.81
	21:30	265	3.82	0.0	-	-	-
No access to RAD I (entry locked)	23:30	385	-	-	-	-	-
DAY 4 (Sept 6th)	7:30	865	3.72	-	14.60	17.27	2.67
	8:30	925	-	-	-	-	-
	9:30	985	3.74	0.0	14.58	17.29	2.71
	11:30	1105	3.72	0.0	14.58	17.32	2.74
End of test	13:00	1195	-	-	-	-	-

Figure 1B
Test B - LNAPL Recoverability Pilot Study
Total Liquids Recovery vs Time

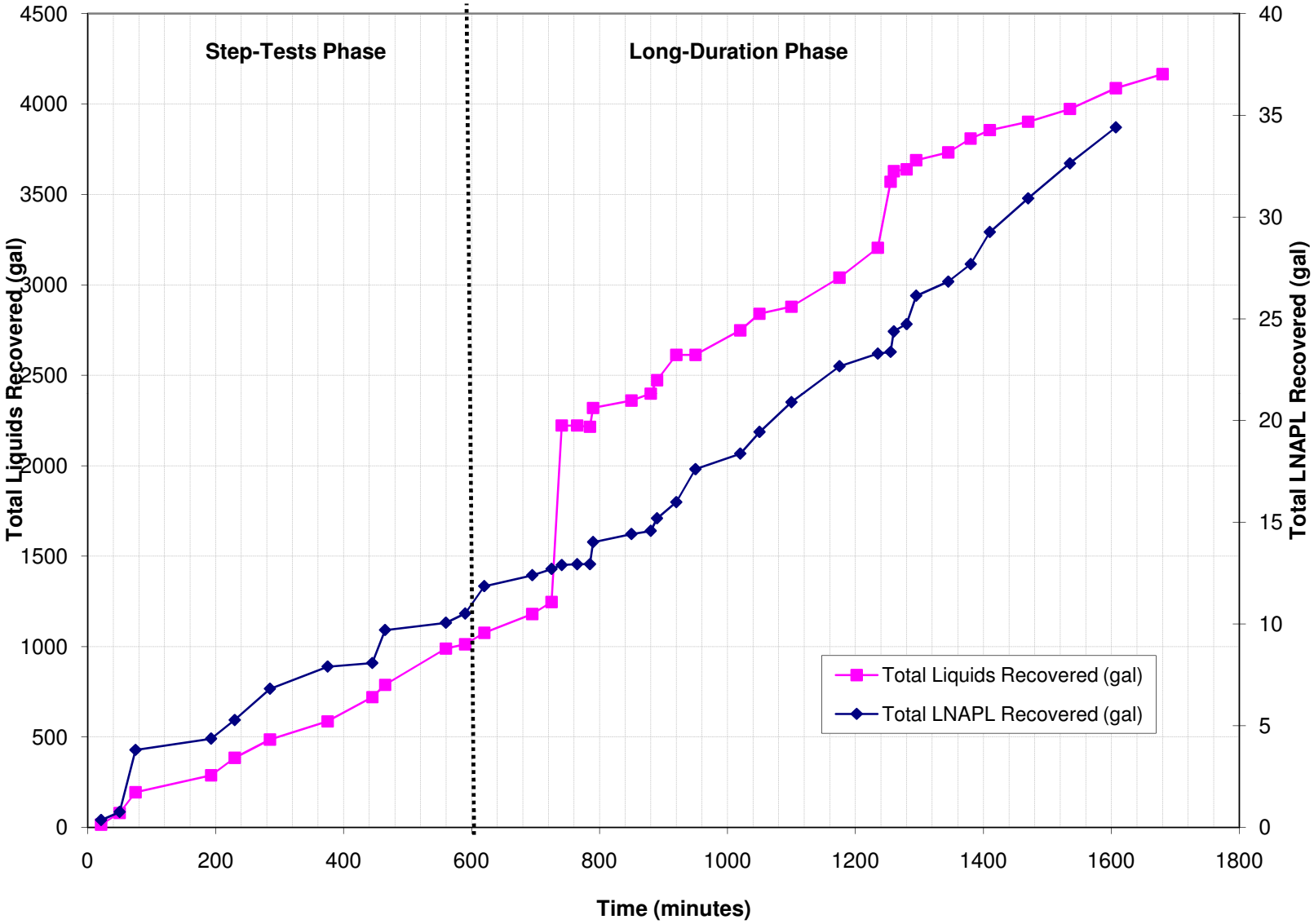


Figure 2B
Test B - LNAPL Recoverability Pilot Study
Vacuum Pressure at Monitoring Wells vs Time

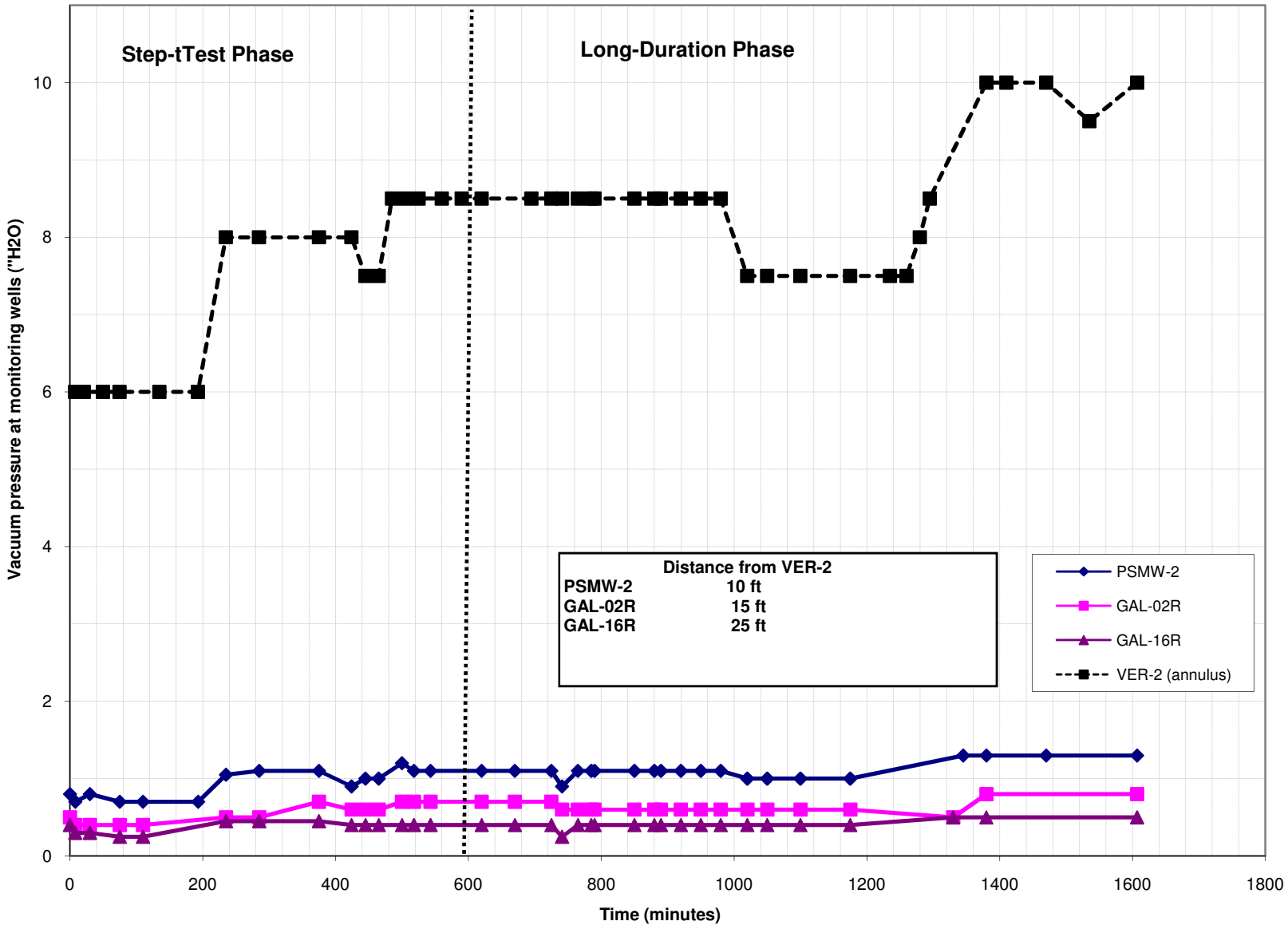


Figure 3B
Test B - LNAPL Recoverabillity Pilot Study
Water Table and LNAPL depths vs Time

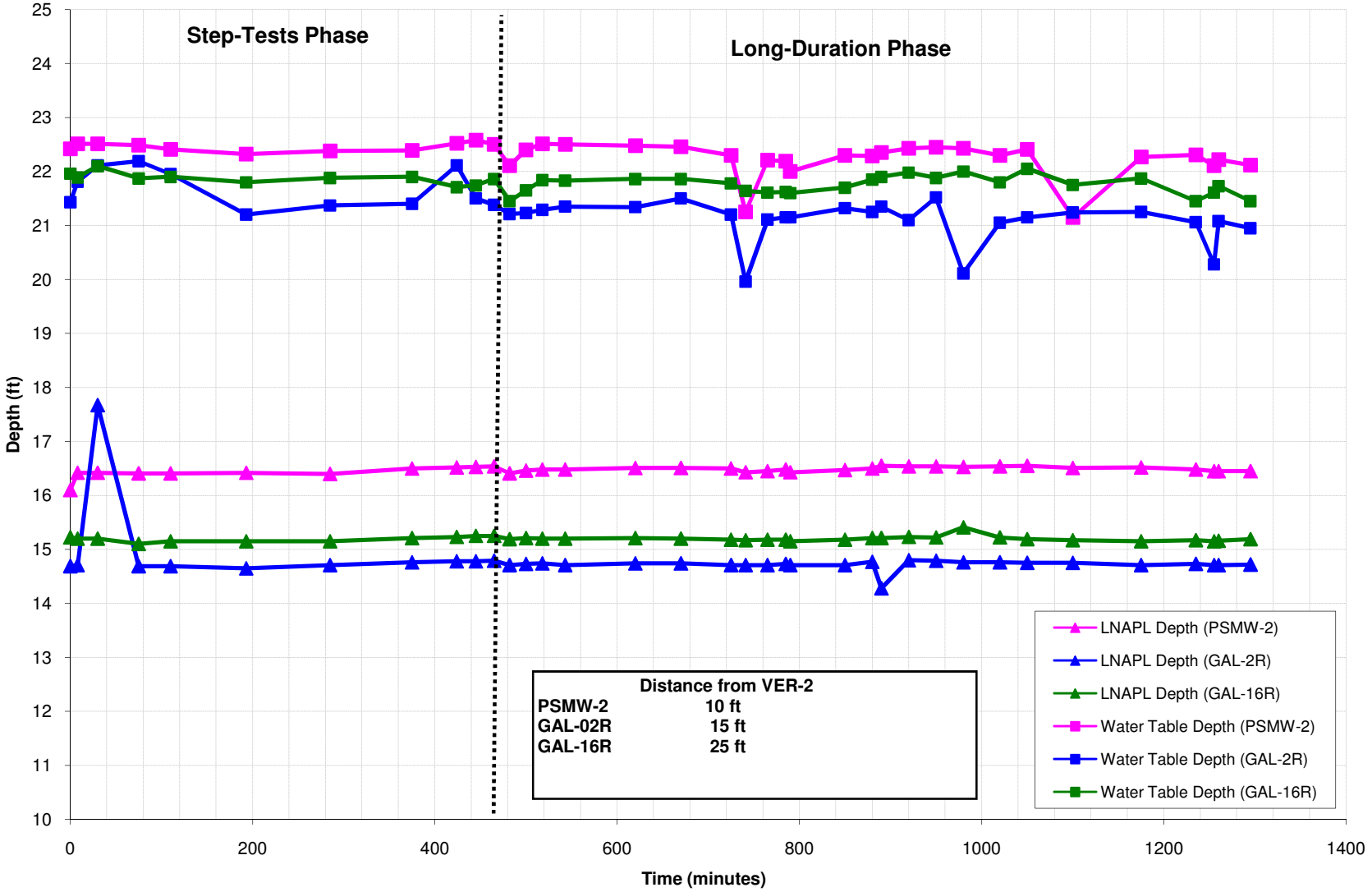


Figure 4B
Test B - LNAPL Recoverability Pilot Study
Vacuum Pressure vs Distance from VER-2

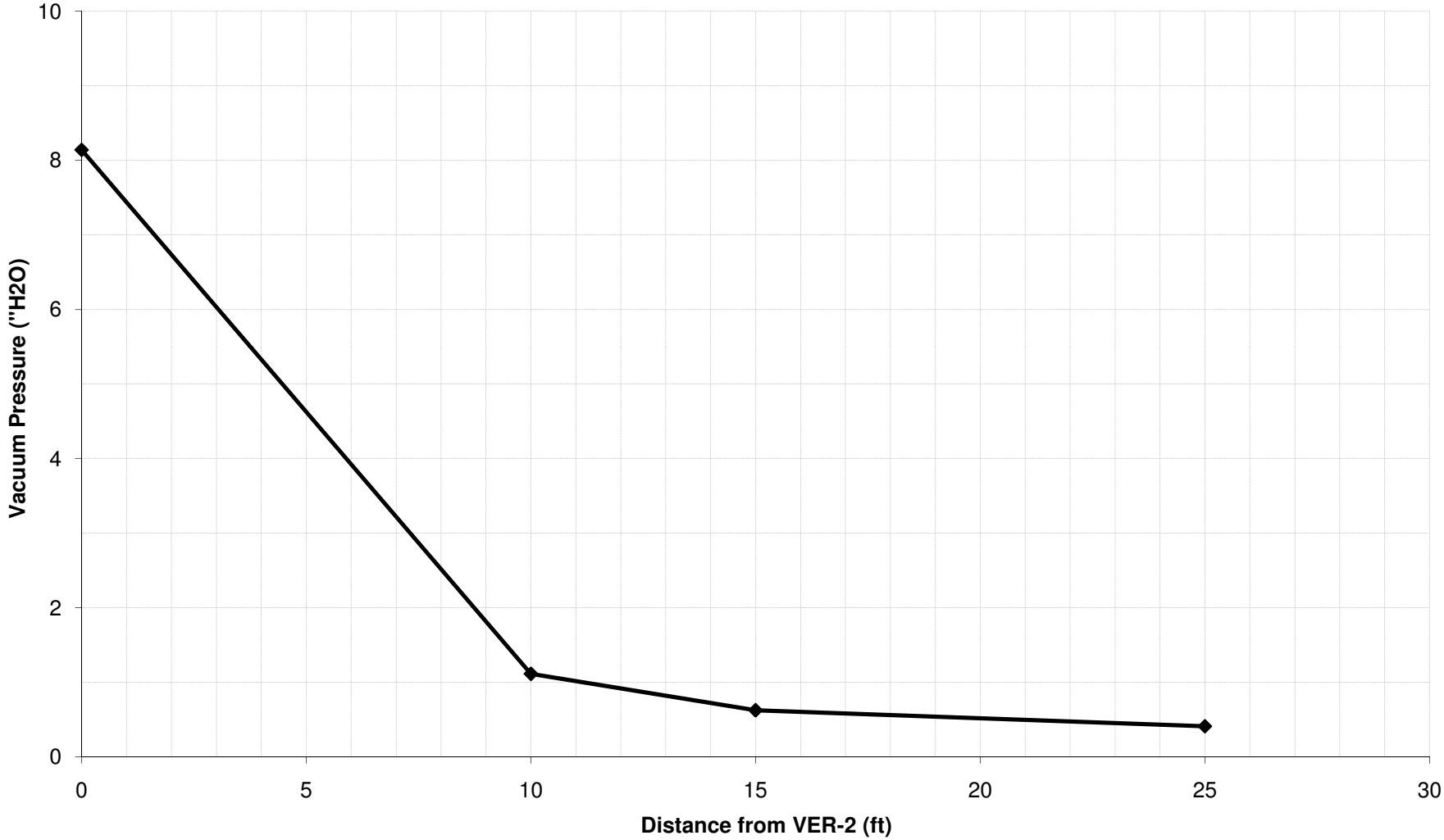


TABLE 1B
PILOT TEST B
FIELD DATA

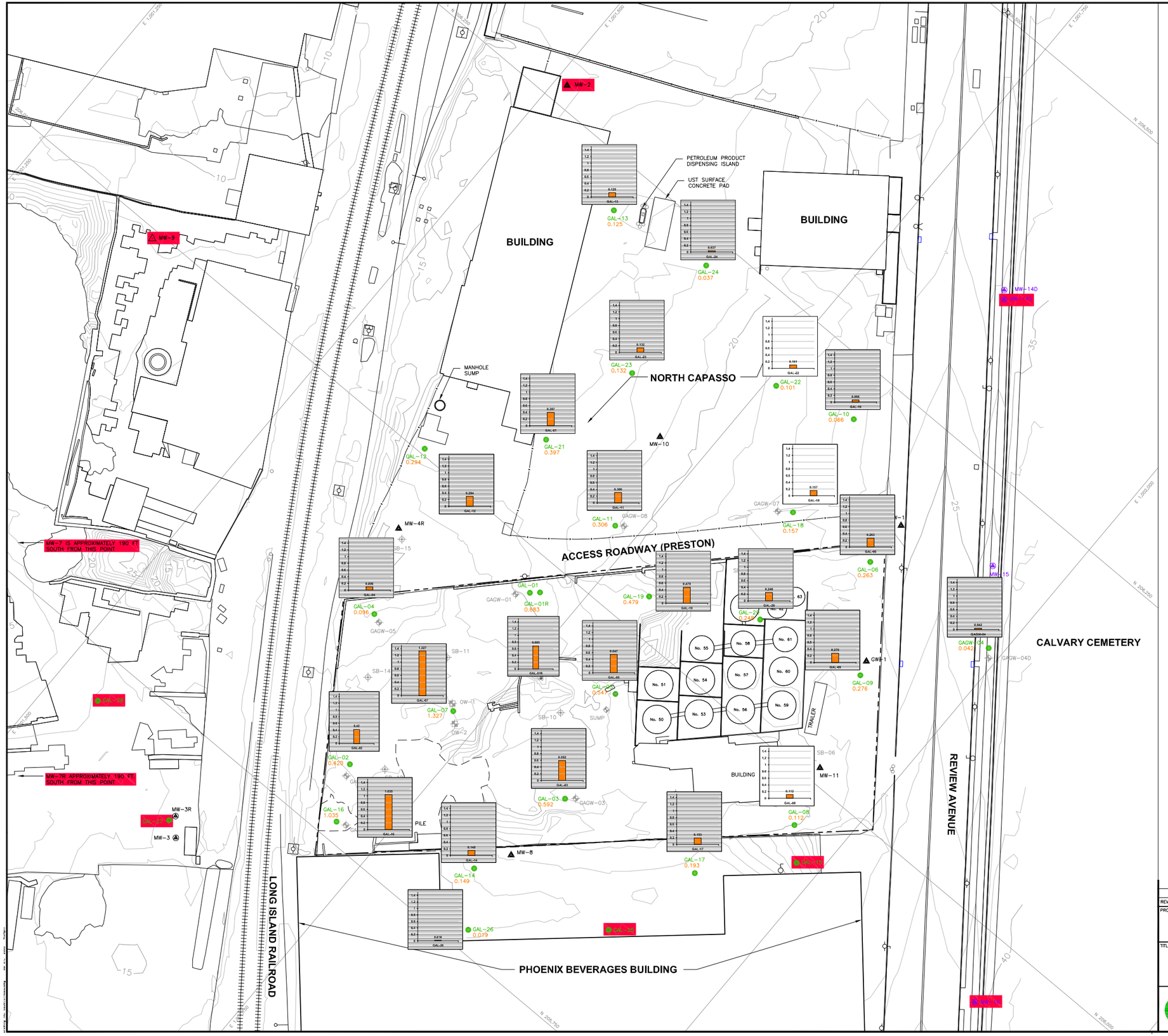
	Time	Cumulative time	Drop tube depth	Flowmeter reading	Cumulative groundwater pumped	Average groundwater flow (based on flowmetre readings)	Groundwater flow (based on measurment at well head)	Volumetric ratio oil/water	Vacuum at pump inlet	Vacuum at HVLS	Fresh Air at pump speed	Fresh air inlet at pump	Fresh air inlet at pump	Air at pump speed	Air outlet at pump	Air outlet at pump
		(min)	(ft)	(gallons)	(gallons)	(gpm)	(gpm)	(%)	("Hg)	("Hg)	(m/s)	m3/s	(SCFM)	(m/s)	m3/s	(SCFM)
Day 1 (Aug 26th)	14:10	-	17'	588906.1	-	-	-	-	17	17	-	-	-	-	-	-
	14:30	0	17'	588906.1	-	-	-	-	18.5	20	-	-	-	-	-	-
	14:38	8	17'4"	-	-	-	-	-	-	-	-	-	-	-	-	-
	14:44	14	17'4"	-	-	-	-	-	-	-	-	-	-	-	-	-
	14:51	21	17'4"	588921.1	15	0.71	-	-	18.5	20.5	-	-	-	-	-	-
	15:00	30	17'4"	-	-	-	-	-	19	21	-	-	-	-	-	-
	15:20	50	17'4"	588985.7	79.6	1.59	-	-	19	21	-	-	-	-	-	-
	15:45	75	17'4"	589099.9	193.8	2.58	-	-	19	21	3.74	0.03	64.25	5.27	0.04	90.53
	16:20	110	17'4"	-	-	-	-	-	-	-	-	-	-	-	-	-
	16:45	135	17'4"	-	-	-	-	-	19	21.5	3.82	0.03	65.62	5.2	0.04	89.33
	17:43	193	17'4"	589194.1	288	1.49	-	-	19	22	3.8	0.03	65.28	5.3	0.04	91.05
	18:20	230	17'4"	589290.9	384.8	1.67	-	-	-	-	-	-	-	-	-	-
	18:25	235	17'4"	-	-	-	-	-	-	27.5	0	0.00	0.00	1.9	0.02	32.64
	19:15	285	17'4"	589391.6	485.5	1.70	-	-	27	24.5	0	0.00	0.00	1.85	0.01	31.78
	20:45	375	17'4"	589492.1	586	1.56	-	-	27	24.5	0	0.00	0.00	1.8	0.01	30.92
	21:15	405	Test stopped	-	-	-	-	-	-	-	-	-	-	-	-	-
Day 2 (Aug 27th)	-	-	-	-	-	-	-	-	-	-	-			-		
	9:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	9:19	19	17'10"	589591.6	685.5	-	-	-	26.5	23.5	0	0.00	0.00	1.35	0.01	23.19
	9:40	40	17'10"	589626	719.9	0.86	-	-	26.5	24	-	-	-	1.4	0.01	24.05
	10:00	60	17'10"	589694	787.9	1.71	-	-	26.5	24	-	-	-	1.47	0.01	25.25
Test stopped	10:15	75	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Long term test started @	15:42	2	17'4"	-	-	-	-	-	-	-	-	-	-	-	-	-
15:40	15:45	5	17'4"	589789.1	883	-	-	-	26	23.5	0	0.00	0.00	1.59	0.01	27.31
	16:00	20	-	-	-	-	1.72	0.9	-	-	-	-	-	-	-	-
	16:05	25	17'4"	589789.1	883	0.00	-	-	25.5	24.5	0	0.00	0.00	2.03	0.02	34.87
	16:18	38	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	16:25	45	17'4"	589789.1	883	0.00	-	-	26	26.5	0	0.00	0.00	1.76	0.01	30.23
	16:43	63	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	17:00	80	17'4"	589894.5	988.4	1.32	-	-	26	27	0	0.00	0.00	1.77	0.01	30.41
	17:30	110	17'4"	589918	1011.9	1.17	-	-	26	26	0	0.00	0.00	2.04	0.02	35.04
	18:00	140	17'4"	589982	1075.9	1.38	1.58	1.3	26	26	0	0.00	0.00	2.06	0.02	35.39
	18:50	190	17'4"	-	-	-	-	-	-	-	-	-	-	-	-	-
	19:15	215	17'4"	590085.8	1179.7	1.38	1.51	-	25.5	24.5	-	-	-	2.14	0.02	36.76
	19:45	245	17'4"	590151.9	1245.8	1.48	-	-	25.5	24.5	-	-	-	1.99	0.02	34.19
Day 3 (Aug 28th)	-	-	-	-	-	-	-	-	-	-	-			-		
Unit was done on arrival	7:30	-	-	591118.2	2212.1	-	-	-	-	-	-	-	-	-	-	-
Unit back running'@	8:00	-	-	591118.2	2212.1	-	-	-	-	-	-	-	-	-	-	-
8:40	8:56	16	17'4"	591128.2	2222.1	0.62	-	-	25.5	23.5	0	0.00	0.00	1.85	0.01	31.78
Unit stop @	9:20	40	17'4"	591128.2	2222.1	0.25	-	-	26	24.5	0	0.00	0.00	1.6	0.01	27.49
10:25	9:40	60	17'4"	591121	2214.9	0.05	1.69	0.8	26	24.5	0	0.00	0.00	1.85	0.01	31.78
Unit back running'@	11:50	65	17'4"	591225.1	2319	1.64	1.75	1.1	26	24.5	0	0.00	0.00	1.84	0.01	31.61
11:45	12:50	125	17'4"	591266.5	2360.4	1.19	-	-	26	24.5	0	0.00	0.00	1.66	0.01	28.52
Unit stopped for 30min.	13:20	155	17'4"	591304.5	2398.4	1.20	-	-	26	27	0	0.00	0.00	1.76	0.01	30.23
DT lowered	14:00	165	17'7"	591378.3	2472.2	1.58	1.96	1.3	26	27.5	0	0.00	0.00	1.74	0.01	29.89
@13:55	14:30	195	17'7"	591518.8	2612.7	2.05	-	-	26	27.5	0	0.00	0.00	1.81	0.01	31.09
	15:00	225	17'7"	591518.8	2612.7	1.78	1.72	1.3	26	28	0	0.00	0.00	1.69	0.01	29.03
	15:30	255	17'7"	-	-	-	1.83	0.5	26	28	0	0.00	0.00	1.88	0.02	32.30
DT lowered	16:10	295	17'10"	591654	2747.9	1.82	1.90	1.4	26	28	0	0.00	0.00	2	0.02	34.36
@16:04	16:40	325	17'10"	591746	2839.9	1.93	-	-	26	28	0	0.00	0.00	1.69	0.01	29.03
	17:30	375	17'10"	591785	2878.9	1.78	1.88	1.1	26.5	28	0	0.00	0.00	1.45	0.01	24.91
DT lift 3"	18:45	450	17'10"	591945.5	3039.4	1.84	1.98	1.1	26.5	28	-	-	-	1.51	0.01	25.94
@19:20	19:45	510	17'7"	592111	3204.9	1.95	1.80	1.6	-	-	-	-	-	-	-	-
Day 4 (Aug 29th)	-	-	-	-	-	-	-	-	-	-	-			-		
Unit is down on arrival	7:50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GWTT work on unit:	8:06	0	17'7"	592455.6	3549.5	-	-	-	28	24.5	0	0.00	0.00	1.49	0.01	25.60
08:10 to 8:20 and	8:36	20	17'7"	592476	3569.9	1.02	-	-	25.5	23.5	0	0.00	0.00	1.68	0.01	28.86
8:40 to 10:09	9:55	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Clay filters changed to fiber glass	10:10	25	17'7"	592534.5	3628.4	3.16	-	-	26	23.5	0	0.00	0.00	1.72	0.01	29.55
DT lift 4"@	10:30	45	17'7"	592545	3638.9	1.99	-	-	26	24	0	0.00	0.00	1.75	0.01	30.06
10h39	10:45	60	17'3"	592595	3688.9	2.32	1.45	1.2	25	24	0	0.00	0.00	2.5	0.02	42.95
	11:20	95	17'0"	-	-	-	1.05	1.4	-	-	-	-	-	-	-	-
DT lift 3"@	11:35	110	17'0"	592638	3731.9	1.66	1.26	1.2	25	24	0	0.00	0.00	-	-	-
11h02	12:10	145	16'10"	592715	3808.9	1.79	-	-	25	24	0	0.00	0.00	2.23	0.02	38.31
DT lift 2"@	12:40	175	16'10"	592761.6	3855.5	1.75	0.93	1.6	25	24	0	0.00	0.00	2.3	0.02	39.51
12h02	13:40	235	16'10"	592808	3901.90	1.50	0.84	1.5	25	24	0	0.00	0.00	2.2	0.02	37.79
	14:45	300	16'11"	592878.5	3972.4	1.41	0.84	1.7	25	27	0	0.00	0.00	2.18	0.02	37.45
	15:57	372	16'11"	592993	4086.90	1.44	-	-	25	26.5	0	0.00	0.00	sampling	-	-
	16:50	425	16'11"	-	-	-	1.14	1.5	-	-	-	-	-	-	-	-
Test stopped	17:10	445	-	593071.5	4165.40	1.38	-	-	-	-	-	-	-	-	-	-

TABLE 1B
PILOT TEST B
FIELD DATA

	Time	Cumulative time	Temperature at pump speed	VOC - Inlet	VOC - outlet	Qualitative observations of effluent	Extraction well (VER-2)		PSMW-2				GAL-02R		
		(min)	(°F)	(ppm)	(ppm)		Pressure at annulus ("H2O)	Pressure at drop tube ("Hg)	Vacuum ("H2O)	Product depth (ft)	Water depth (ft)	Thickness of free product (ft)	Vacuum ("H2O)	Product depth (ft)	Water depth (ft)
Day 1 (Aug 26th)	14:10	-	170	-	-	Product only (Well is being emptied)	9	5	1.1	16.1	22.42	6.32	0.6	14.69	*21.43*
	14:30	0	176	19.6	-	Mix of oil and water	6.5	5	0.8	-	-	-	0.5	-	-
	14:38	8	-	-	-	Mix of oil and water	6	5	0.7	16.42	22.51	6.09	0.4	14.71	21.81
	14:44	14	-	-	-	Emulsion (small oil fraction)	-	-	-	-	-	-	-	-	-
	14:51	21	176	-	-	No significant free product in affluent (Grab sample)	6	5	-	-	-	-	-	-	-
	15:00	30	-	-	-	Emulsion (small oil fraction)	-	-	0.8	16.42	22.51	6.09	0.4	17.67	22.11
	15:20	50	178	21.8	-	Emulsion (small oil fraction)	6	5	-	-	-	-	-	-	-
	15:45	75	178	21.4	-	Emulsion (small oil fraction)	6	5	0.7	16.41	22.49	6.08	0.4	14.69	22.19
	16:20	110	-	4.2	-	Emulsion (small oil fraction)	-	-	0.7	16.41	22.41	6	0.4	14.69	21.95
	16:45	135	-	-	-	Emulsion (small oil fraction)	6	5	-	-	-	-	-	-	-
	17:43	193	176	22.1	10.4	Emulsion (small oil fraction)	6	5	0.7	16.42	22.32	5.9	-	14.65	21.2
	18:20	230	-	-	-	-	-	-	-	-	-	-	-	-	-
	18:25	235	170	24.8	3.2	Emulsion (small oil fraction)	8	8.5	1.05	-	-	-	0.5	14.68	21.3
	19:15	285	170	27.4	0.9	Emulsion + free product	8	8.5	1.1	16.4	22.38	5.98	0.5	14.71	21.37
	20:45	375	170	30.8	0.6	Emulsion + free product	8	8.5	1.1	16.5	22.39	5.89	0.7	14.76	21.4
	21:15	405	-	-	-	-	-	-	-	-	-	-	-	-	-
Day 2 (Aug 27th)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	9:00	-	-	-	-	-	-	-	-	16.4	22.17	5.77	-	14.71	21.13
	9:19	19	143	28.5	0.1	Emulsion + free product	8	9.5	0.9	16.52	22.52	6	0.6	14.78	22.11
	9:40	40	170	35.2	0.7	Emulsion + free product	7.5	9.5	1	16.53	22.58	6.05	0.6	14.78	21.5
	10:00	60	170	34.5	1.4	Emulsion + free product	7.5	9.5	1	16.54	22.5	5.96	0.6	14.79	21.38
Test stopped	10:15	75	-	-	-	-	-	-	-	-	-	-	-	-	-
Long term test started @	15:42	2	-	-	-	-	-	-	-	16.41	22.11	5.7	-	14.71	21.21
15:40	15:45	5	148	30.8	14.6	Emulsion + free product	8.5	8	-	-	-	-	-	-	-
	16:00	20	-	-	-	Emulsion + free product	-	-	1.2	16.46	22.4	5.94	0.7	14.73	21.23
	16:05	25	170	36.1	2	Emulsion + free product	8.5	8	-	-	-	-	-	-	-
	16:18	38	-	-	-	-	-	-	1.1	16.48	22.51	6.03	0.7	14.74	21.29
	16:25	45	170	30.8	0	Emulsion + free product	8.5	8	-	-	-	-	-	-	-
	16:43	63	-	-	-	-	-	-	1.1	16.48	22.5	6.02	0.7	14.71	21.35
	17:00	80	170	-	0	Emulsion + free product	8.5	8	-	-	-	-	-	-	-
	17:30	110	170	31.2	0	Emulsion + free product	8.5	8	-	-	-	-	-	-	-
	18:00	140	170	32.4	0.3	Emulsion + free product	8.5	8	1.1	16.51	22.48	5.97	0.7	14.74	21.34
	18:50	190	-	-	-	-	-	-	1.1	16.51	22.46	5.95	0.7	14.74	21.5
	19:15	215	170	35.3	0.9	-	8.5	8	-	-	-	-	-	-	-
	19:45	245	170	34.1	0.8	Emulsion + free product	8.5	8	1.1	16.5	22.3	5.8	0.7	14.71	21.2
Day 3 (Aug 28th)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unit was done on arrival	7:30	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unit back running'@	8:00	-	-	-	-	-	-	-	-	16.47	21.95	5.48	-	14.7	21
8:40	8:56	16	164	46.5	0.8	Emulsion + free product	8.5	8	0.9	16.43	21.25	4.82	0.6	14.71	19.96
Unit stop @	9:20	40	170	47.4	1.8	Emulsion + free product	8.5	8	1.1	16.45	22.21	5.76	0.6	14.71	21.11
10:25	9:40	60	170	43.6	1.8	Emulsion + free product	8.5	8	1.1	16.48	22.19	5.71	0.6	14.73	21.15
Unit back running'@	11:50	65	170	44.9	1.5	Emulsion + free product	8.5	8	1.1	16.43	22	5.57	0.6	14.71	21.15
11:45	12:50	125	170	42	1.7	Emulsion + free product	8.5	8	1.1	16.47	22.3	5.83	0.6	14.71	21.32
Unit stopped for 30min.	13:20	155	170	41.6	2.1	Emulsion + free product	8.5	8	1.1	16.5	22.29	5.79	0.6	14.77	21.25
DT lowered	14:00	165	170	42.4	2.1	Emulsion + free product	8.5	8	1.1	16.55	22.35	5.8	0.6	14.28	21.35
@13:55	14:30	195	170	43.2	1.6	Emulsion + free product	8.5	8	1.1	16.54	22.43	5.89	0.6	14.8	21.1
	15:00	225	170	42.9	1.3	Emulsion + free product	8.5	8	1.1	16.54	22.45	5.91	0.6	14.79	21.52
	15:30	255	170	-	-	-	8.5	8	1.1	16.53	22.43	5.9	0.6	14.76	20.11
DT lowered	16:10	295	170	-	-	Emulsion + free product	7.5	9	1	16.54	22.3	5.76	0.6	14.76	21.05
@16:04	16:40	325	170	-	-	Emulsion + free product	7.5	8.5	1	16.55	22.41	5.86	0.6	14.75	21.15
	17:30	375	170	47.5	1.4	Emulsion + free product	7.5	8.5	1	16.51	21.15	4.64	0.6	14.75	21.24
DT lift 3"	18:45	450	170	48.6	1.7	Emulsion + free product	7.5	8.5	1	16.52	22.27	5.75	0.6	14.71	21.25
@19:20	19:45	510	-	-	-	-	-	-	-	-	-	-	-	-	-
Day 4 (Aug 29th)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unit is down on arrival	7:50	-	-	-	-	-	-	-	0.9	16.36	22	5.64	-	14.68	21.23
GWTT work on unit:	8:06	0	130	43.8	0.8	Emulsion + free product	7.5	8.5	-	-	-	-	-	-	-
08:10 to 8:20 and	8:36	20	170	64.2	2.1	Emulsion + free product	-	-	-	16.48	22.31	5.83	-	14.73	21.06
8:40 to 10:09	9:55	-	-	-	-	Emulsion + free product	-	-	0.8	16.33	22	5.67	0.5	14.67	20.97
Clay filters changed to fiber glass	10:10	25	170	51.3	2.4	Emulsion + free product	7.5	8.5	-	16.45	22.11	5.66	-	14.71	20.28
DT lift 4"@	10:30	45	170	59.6	2	Emulsion + free product	8	8.5	-	-	-	-	-	-	-
10h39	10:45	60	170	116	10.6	Emulsion + free product	8.5	8.5	-	16.45	22.22	5.77	-	14.71	21.08
	11:20	95	-	-	-	-	-	-	-	16.45	22.12	5.67	0.5	14.72	20.95
DT lift 3"@	11:35	110	170	-	-	Emulsion + free product	-	-	1.3	16.42	22.11	5.69	-	14.71	20.85
11h02	12:10	145	172	-	-	Emulsion + free product	10	8	1.3	16.45	22.05	5.6	0.8	14.71	20.45
DT lift 2"@	12:40	175	172	31.1	1.1	Emulsion + free product	10	7.5	-	16.44	22.1	5.66	-	14.71	21
12h02	13:40	235	172	27.1	6.4	Emulsion + free product	10	7	1.3	16.44	22.15	5.71	0.8	14.71	21.15
	14:45	300	172	33.4	2	Emulsion + free product	9.5	8	-	16.44	22.15	5.71	-	14.71	21.15
	15:57	372	72	sampling	sampling	Emulsion + free product	10	7.5	1.3	16.48	22.1	5.62	0.8	14.75	21.15
	16:50	425	-	-	-	Emulsion + free product	-	-	-	-	-	-	-	-	-
Test stopped	17:10	445	-	-	-	Emulsion + free product	-	-	-	-	-	-	-	-	-

TABLE 1B
PILOT TEST B
FIELD DATA

	Time	Cumulative time		GAL-16R				GAL-07				GACW-02	
		(min)	Thickness of free product (ft)	Vacuum ("H2O)	Product depth (ft)	Water depth (ft)	Thickness of free product (ft)	Vacuum ("H2O)	Product depth (ft)	Water depth (ft)	Thickness of free product (ft)	Vacuum ("H2O)	Water depth (ft)
Day 1 (Aug 26th)	14:10	-	6.74	0.4	15.22	21.96	6.74	-	-	-	-	-	-
	14:30	0	-	0.4	-	-	-	-	-	-	-	-	-
	14:38	8	7.1	0.3	15.2	21.89	6.69	-	-	-	-	-	-
	14:44	14	-	-	-	-	-	-	-	-	-	-	-
	14:51	21	-	-	-	-	-	-	-	-	-	-	-
	15:00	30	4.44	0.3	15.2	22.1	6.9	-	-	-	-	-	-
	15:20	50	-	-	-	-	-	-	-	-	-	-	-
	15:45	75	7.5	0.25	15.1	21.87	6.77	-	-	-	-	-	-
	16:20	110	7.26	0.25	15.15	21.9	6.75	-	-	-	-	-	-
	16:45	135	-	-	-	-	-	-	-	-	-	-	-
	17:43	193	6.55	-	15.15	21.8	6.65	-	-	-	-	-	-
	18:20	230	-	-	-	-	-	-	-	-	-	-	-
	18:25	235	6.62	0.45	15.15	21.77	6.62	-	-	-	-	0	-
	19:15	285	6.66	0.45	15.15	21.88	6.73	-	-	-	-	-	-
	20:45	375	6.64	0.45	15.21	21.9	6.69	-	-	-	-	1.05	-
	21:15	405	-	-	-	-	-	-	-	-	-	-	-
Day 2 (Aug 27th)	-	-	-	-	-	-	-	-	-	-	-	-	-
	9:00	-	6.42	-	15.22	21.73	6.51	-	18.04	24.12	6.08	-	-
	9:19	19	7.33	0.4	15.23	21.71	6.48	-	18.06	24.18	6.12	-	-
	9:40	40	6.72	0.4	15.25	21.74	6.49	-	-	-	-	0	17.12
	10:00	60	6.59	0.4	15.25	21.86	6.61	-	18.06	24.24	6.18	0.2	-
Test stopped	10:15	75	-	-	-	-	-	-	-	-	-	-	-
Long term test started @	15:42	2	6.5	-	15.19	21.45	6.26	-	-	-	-	-	-
15:40	15:45	5	-	-	-	-	-	-	-	-	-	-	-
	16:00	20	6.5	0.4	15.21	21.65	6.44	-	-	-	-	-	-
	16:05	25	-	-	-	-	-	-	-	-	-	-	-
	16:18	38	6.55	0.4	15.2	21.84	6.64	-	-	-	-	-	-
	16:25	45	-	-	-	-	-	-	-	-	-	-	-
	16:43	63	6.64	0.4	15.2	21.83	6.63	-	-	-	-	-	-
	17:00	80	-	-	-	-	-	-	-	-	-	-	-
	17:30	110	-	-	-	-	-	-	-	-	-	-	-
	18:00	140	6.6	0.4	15.21	21.86	6.65	-	-	-	-	-	-
	18:50	190	6.76	0.4	15.2	21.86	6.66	-	18.02	24.09	6.07	-	-
	19:15	215	-	-	-	-	-	-	-	-	-	-	-
	19:45	245	6.49	0.4	15.18	21.78	6.6	-	-	-	-	-	-
Day 3 (Aug 28th)	-	-	-	-	-	-	-	-	-	-	-	-	-
Unit was done on arrival	7:30	-	-	-	-	-	-	-	-	-	-	-	-
Unit back running'@	8:00	-	6.3	-	15.19	21.64	6.45	-	18	24.09	6.09	-	17.12
8:40	8:56	16	5.25	0.25	15.17	21.64	6.47	-	-	-	-	-	-
Unit stop @	9:20	40	6.4	0.4	15.18	21.61	6.43	-	-	-	-	-	-
10:25	9:40	60	6.42	0.4	15.18	21.62	6.44	-	-	-	-	-	-
Unit back running'@	11:50	65	6.44	0.4	15.15	21.6	6.45	-	-	-	-	-	-
11:45	12:50	125	6.61	0.4	15.18	21.7	6.52	-	-	-	-	-	-
Unit stopped for 30min.	13:20	155	6.48	0.4	15.21	21.85	6.64	-	-	-	-	-	-
DT lowered	14:00	165	7.07	0.4	15.21	21.9	6.69	-	-	-	-	-	-
@13:55	14:30	195	6.3	0.4	15.23	21.98	6.75	-	-	-	-	-	-
	15:00	225	6.73	0.4	15.22	21.88	6.66	-	-	-	-	-	-
	15:30	255	5.35	0.4	15.41	22	6.59	-	-	-	-	-	-
DT lowered	16:10	295	6.29	0.4	15.22	21.8	6.58	-	-	-	-	-	-
@16:04	16:40	325	6.4	0.4	15.19	22.05	6.86	-	-	-	-	-	-
	17:30	375	6.49	0.4	15.17	21.75	6.58	-	17.99	24.14	6.15	-	-
DT lift 3"	18:45	450	6.54	0.4	15.15	21.87	6.72	-	-	-	-	-	-
@19:20	19:45	510	-	-	-	-	-	-	-	-	-	-	-
Day 4 (Aug 29th)	-	-	-	-	-	-	-	-	-	-	-	-	-
Unit is down on arrival	7:50	-	6.55	-	15.18	21.8	6.62	-	18.02	24.19	6.17	-	17.4
GWTT work on unit:	8:06	0	-	-	-	-	-	-	-	-	-	-	-
08:10 to 8:20 and	8:36	20	6.33	-	15.17	21.45	6.28	-	-	-	-	-	-
8:40 to 10:09	9:55	-	6.3	0.4	15.14	21.8	6.66	-	-	-	-	-	-
Clay filters changed to fiber glass	10:10	25	5.57	-	15.15	21.61	6.46	-	-	-	-	-	-
DT lift 4"@	10:30	45	-	-	-	-	-	-	-	-	-	-	-
10h39	10:45	60	6.37	-	15.16	21.73	6.57	-	-	-	-	-	-
	11:20	95	6.23	0.5	15.19	21.45	6.26	-	-	-	-	-	-
DT lift 3"@	11:35	110	6.14	-	15.15	21.65	6.5	-	-	-	-	-	-
11h02	12:10	145	5.74	0.5	15.15	21	5.85	-	-	-	-	-	-
DT lift 2"@	12:40	175	6.29	-	15.15	21.75	6.6	-	-	-	-	-	-
12h02	13:40	235	6.44	0.5	15.15	21.79	6.64	-	-	-	-	-	-
	14:45	300	6.44	-	15.15	21.55	6.4	-	-	-	-	-	-
	15:57	372	6.4	-	15.2	21.9	6.7	-	-	-	-	-	-
	16:50	425	-	-	-	-	-	-	-	-	-	-	-
Test stopped	17:10	445	-	-	-	-	-	-	-	-	-	-	-



LEGEND

- LNAPL MONITORING WELL (GOLDER ASSOCIATES 2003/2004/2005) (SEE REFERENCE 2)
- SHALLOW GROUNDWATER MONITORING WELL (GOLDER ASSOCIATES 2004) (SEE REFERENCE 2)
- DEEP GROUNDWATER MONITORING WELL (GOLDER ASSOCIATES 2003/2004) (SEE REFERENCE 2)
- SOIL BORING (GOLDER ASSOCIATES 2003/2004) (SEE REFERENCE 2)
- ROEHR CHEMICAL INVESTIGATION WELL LOCATION (NOVEMBER 2000) (SEE REFERENCE 2)
- EXISTING ON-SITE AND OFF-SITE MONITORING WELL LOCATION (SEE REFERENCE 2)
- EXISTING OFF-SITE MONITORING WELL LOCATION (LOCATION APPROXIMATE)
- SUMP (SEE REFERENCE 2)
- LNAPL PILOT TEST STUDY OBSERVATION WELL (SEE REFERENCE 2)
- EXISTING OFF-PROPERTY MONITORING WELL LOCATIONS (SEE REFERENCE 5)
- EXISTING ABOVE GROUND TANK (REPORTED TO BE EMPTY)
- QUANTA PROPERTY BOUNDARY (SEE REFERENCE 3)
- RAILROAD
- FENCE LINE
- 20 — 5 FOOT CONTOUR LINE (FT.-MSL)
- 1 FOOT CONTOUR LINE (FT.-MSL)
- SPECIFIC FREE-PRODUCT VOLUME OF LNAPL IN SOIL (SEE NOTES 1 AND 2)
- 0.652 — SPECIFIC FREE-PRODUCT VOLUME OF LNAPL IN SOIL (FT.) (SEE NOTES 1 AND 2)
- GAL-25 — LNAPL NOT PRESENT (SEE NOTE 3)

NOTES

1.) REFER TO APPENDIX L OF THE RI FOR DISCUSSION OF THE ESTIMATION OF SPECIFIC FREE-PRODUCT VOLUME. THE MODEL PREDICTION VALUES ADJUSTED FOR TPH CONCENTRATIONS WERE USED.

2.) THE SPECIFIC FREE-PRODUCT VOLUME IS BY DEFINITION PER UNIT AREA AND THEREFORE HAS A UNIT LENGTH OF FEET.

3.) DURING THE RI, LNAPL WAS NOT OBSERVED IN WELLS MW-2, MW-7R, MW-14S, MW-16S, GAL-15, GAL-27 AND GAL-28. PRIOR TO THE RI, LNAPL HAD NOT BEEN OBSERVED IN WELLS MW-7 AND MW-9. THE LAST MEASUREMENT COLLECTED AT MW-7 WAS ON OCTOBER 3, 2000 AND FEBRUARY 11, 2003 AT MW-9. GOLDER WAS NOT ABLE TO LOCATE MW-7 AND WAS NOT PROVIDED ACCESS TO THE PROPERTY WHERE MW-9 IS LOCATED.

REFERENCES

1.) BASE MAP TAKEN FROM DIGITAL FILE 2148.dwg, ENTITLED TOPOGRAPHIC SURVEY OF QUANTA RESOURCES SUPERFUND SITE, LONG ISLAND CITY, NY, PROVIDED BY GEOD CORPORATION, DATED JANUARY 11, 2004.

2.) WELL COORDINATES TAKEN FROM A MICROSOFT EXCEL FILE Quanta Samples and Wells.xls, 2148A 8-23-04.xls AND 2148A 4-11-05.xls, PROVIDED BY GEOD CORP.

3.) PROPERTY BOUNDARY TAKEN FROM DIGITAL FILE 2148 Boundary.dwg, TITLED "MAP SHOWING BOUNDARY OF BLOCK 312 LOT 69", DATED APRIL 29, 2004, PROVIDED BY GEOD CORP.

4.) DEBRIS PILE BOUNDARY REVISED PER FIELD OBSERVATIONS MADE BY GOLDER ASSOCIATES PERSONNEL DURING SITE VISITS.

5.) LOCATION OF MW-9 DIGITIZED FROM HARDCOPY FIGURE TITLED "GROUNDWATER CONTOURS", PROVIDED BY HALEY & ALDRICH, DATED FEBRUARY 2004.

6.) LOCATION OF MW-7 DIGITIZED FROM HARDCOPY FIGURE TITLED "SITE PLAN WITH SITE INVESTIGATION BORING LOCATIONS", PROVIDED BY ENVIRON, DATED SEPTEMBER 2000.

SCALE 25 0 25 50 FEET

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RW

PROJECT

QUANTA RESOURCES SITE
FEASIBILITY STUDY REPORT
QUEENS COUNTY, NEW YORK

TITLE

TOTAL SPECIFIC LNAPL VOLUME AT LNAPL MONITORING WELLS

Golder Associates Philadelphia USA

PROJECT No.	023-6151		FILE No.	0236151N022	
DESIGN	SDM	06/01/05	SCALE	AS SHOWN	REV. 0
CADD	RG	07/01/05			
CHECK	SDM	07/01/05			
REVIEW	RSW	07/01/05			

FIGURE 16

APPENDIX C

HEALTH AND SAFETY PLAN

HEALTH AND SAFETY PLAN

HEALTH AND SAFETY PLAN (HASP)

Review Avenue Development Properties

Long Island City, Queens, New York

Review Avenue Development I
37-30 Review Avenue
(BCA # 241089)

Review Avenue Development II
37-80 Review Avenue
(BCA # 241005)

Submitted To: Cresswood Environmental Consultants, LLC
Site Address:
37-80 Review Avenue
Long Island City, Queens, New York

Submitted By: Golder Associates Inc.
Spring Mill Corporate Center
555 North Lane, Suite 6057
Conshohocken, PA 19428 US

November 2011 **023-6151.002**

A world of capabilities delivered locally

Golder Associates

1. Project Title and Safety Representative's Signatures:

Project Name: Review Avenue Development (RAD), includes RAD I and RAD II

Task: Light Non-Aqueous Phase Liquid (LNAPL) Recovery Well Installation

Requested by: Kevin Killoran

Proposed Start-Up Date:_____ Project No.: 023-6151.002

Reviewed by the Office Health and Safety Coordinator (HSC)

Printed Name: James Valenti

Signature: _____ Date:_____

Prepared by and Approved by Project Manager

Printed Name: Kevin Killoran

Signature: _____ Date:_____

Revised and Approved by Project Director

Printed Name: Robert Stetkar

Signature: _____ Date:_____

2. Project Description:

Review Avenue Development (RAD I & II) activities will include the following activities:

- Activity 1 – Removal/deconstruction of area and equipment formerly installed for VER pilot tests including decommissioning of wells/monitoring points installed for VER pilot tests.
- Activity 2 – Install LNAPL recovery wells using Hollow Stem Auger drilling methodology.
- Activity 3 – Trench between wells to install piping that leads to the main system enclosure.
- Activity 4 – Collect samples to properly characterize the investigative derived waste (IDW), transportation, and disposal of the IDW 55-gallon waste drums.

Job safety analyses (JSA) for tasks associated with the above work will be prepared as needed.

Each subcontractor will be required to provide a task specific Health and Safety Plan (HASP).

3. Site Locations:

Review Avenue Development I (RAD I)

37-80 Review Avenue

Long Island City, Queens, New York

Brownfield Cleanup Agreement (BCA) #C241005

Review Avenue Development II (RAD II)

37-30 Review Avenue

Long Island City, Queens, New York

BCA #C241089

4. Facility/Work Site Description:

Previous site activities on RAD I include the recycling of gear oil and other petroleum products. Site investigations have identified impact to groundwater and soil 8 ft below ground surface. RAD II is currently used as a parking lot and has recently been regraded. It is fenced on all sides. RAD I is located adjacent to RAD II and has two buildings on the property. One five story brick building is used for storage and automotive repairs. One two story brick building is used for storage and office space. Other portions of RAD I are paved and used as a parking lot. Impacts to soil and groundwater on RAD I result from historic activities that took place on the RAD II property. Site-specific Constituents of Concern (COCs) are VOCs, SVOCs, PCBs, and

metals in LNAPL, groundwater and soil. Potential COCs in soil are below pavement on RAD I and below the crushed concrete/gravel surface material on RAD II. The potential for LNAPL impacted soil should be monitored carefully for any work more than 8 ft below ground surface (bgs). Possible pathways for exposure are inhalation and dermal absorption during intrusive activities (drilling, excavation) and during IDW sampling and disposal. There is potential for explosive vapors to be present from soil vapor (gases) historically detected at the site.

5. Proposed Personnel and Tasks:

Project Manager: Kevin Killoran

Field Operations Leader & Personnel: Varies for each planned activity (see below)

Newark Health and Safety Coordinator: Frank Malinky

Operations Health and Safety Coordinator: James Valenti

Proposed Field Team	Activity	Job Function
Kevin Killoran	All	Project Management
To Be Determined	1,2,3	Field Operation Leader & Site Safety Officer, general oversight of subcontractors. Collect field data and samples.
To Be Determined	4	Review IDW paperwork (manifest, DOT labels, etc) and sign shipping manifest

6. Other Potential Hazards:

- ☒ Chemical
- ☐ Radiological
- ☒ Fire/Explosion
- ☐ Heat Stress
- ☒ Electrical Utilities
- ☒ Machinery/Mechanical Equipment
- ☒ Trips, Slips, Falls
- ☒ Trenching/Shoring
- ☒ Heavy Equipment/Vehicular Traffic
- ☒ Overhead Hazards (Utilities)
- ☒ Unstable/Uneven Terrain
- ☒ **Other** - see specific JSA

7. Chemical/Radiological Hazard Evaluation:

Waste Media

- ☒ Airborne Contamination
- ☐ Surface Contamination
- ☒ Contaminated Soil
- ☒ Contaminated Groundwater
- ☐ Contaminated Surface Water
- ☒ Solid Waste
- ☒ Liquid Waste

Hazardous Characteristics

- ☒ Ignitable
- ☐ Corrosive
- ☐ Reactive
- ☒ Explosive
- ☒ Toxic (non-radiological)
- ☐ Radioactive
- ☐ Sludge

Substances:

The tasks will involve the reasonable possibility of exposure to the substances listed below at concentrations or in quantities which may be hazardous to the health of the site personnel.

Airborne Exposure Limits

	OSHA PEL		ACGIH TLV	IDLH	Ionization Potential
Chemical	**TWA**	**STEL**			**(eVolts)**
VOCs (vapors)					
Benzene	1 ppm	5ppm	0.5 ppm (TWA)	500 ppm*	9.24
Ethylbenzene	100 ppm	NE	100 ppm (TWA)/125 ppm (STEL)	800 ppm	8.76
Toluene	200 ppm	NE	50 ppm (TWA)	500 ppm	8.82
Trichloroethylene	100 ppm	NE	50 ppm (TWA)	1000 ppm	9.45
Vinyl Chloride	1 ppm		1 ppm	Ca	9.99
MTBE	NE	NE	50 ppm (TWA)	Ca	-
1,1 Dichloroethane	100 ppm		100 ppm	3000 ppm	11.06
Acetone	1000 ppm		500 ppm	2500 ppm	9.69
Xylenes	100 ppm	NE	100 ppm (TWA)/150 ppm (STEL)	900 ppm	8.56
Metals (in particulates)					
Antimony	0.5 mg/m3	NE	0.5 mg/m3	5 mg/m3	NA
Arsenic	0.01 mg/m3	NE	0.01 mg/m3	5 mg/m3	NA
Beryllium	0.002 mg/m3	NE	0.002 mg/m3	4 mg/m3	NA
Cadmium	0.005 mg/m3	NE	0.01 mg/m3	9 mg/m3	NA
Chromium	1 mg/m3	NE	0.5 mg/m3	250 mg/m3	NA
Copper	1 mg/m3	NE	1 mg/m3	250 mg/m3	NA
Lead	0.05 mg/m3	NE	0.05 mg/m3 (TWA)	100 mg/m3	NA
Other					
PCBs (particulates)	1 mg/m3	NE	1 mg/m3	5 mg/m3	NA
H2S (vapor)	NE	50 ppm	1 ppm	100 ppm	
Explosive Vapors (total)	NA	NA	NA	25% LEL**	NA

Notes:
Listed chemicals are those detected on site used to establish protection levels. All concentrations are expressed in ppm with the exception of IP, which is presented in eV.

OSHA PEL - Occupational Safety and Health Administration Permissible Exposure Limit
OSHA TWA - refers to concentrations that must not be exceeded during any 8-hour work shift of a 40-hour workweek.

STEL - for both NIOSH and OSHA refers to the short-term exposure limit 15-minute TWA exposure that should not be exceeded at any time during a workday
ACGIH TLV - American Conference of Governmental Industrial Hygienists Threshold Limit Value

IDLH - Immediately Dangerous to Life or Health concentrations

Minimize - minimize exposure to the lowest achievable concentration.
*** or Ca** - indicates that NIOSH considers the chemical to be a potential occupational carcinogen and the exposure limit is considered the lowest achievable exposure.
**** Project-specific IDLH-equivalent action level for flammable atmospheres** **NE** - none established

8. Ambient Air/Site Monitoring Procedures:

The following instruments shall be used to monitor the work environment and workers' breathing zones prior to site entry and at the specified intervals.

Subcontractors are responsible for conducting their own monitoring and determining the appropriate action level and response for their activities.

Instrument	Monitoring Frequency
__X__ PID (HNU, OVM) w/ 10.6 eV lamp	Cont. 15min 30min. hourly other
__X__ FID	Cont. 15min. 30min. hourly other
__X__ Combustible Gas Indicator	Cont. 15min. 30min. hourly other
_____ H2S Detector	Cont. 15min. 30min. hourly other
__X__ Colorimetric Detector Tubes	Cont. 15min. 30min. hourly other
_____ Other (describe below)	

- A VRae LEL, or equivalent, which measures LEL, will be utilized to monitor for the presence of potentially explosive vapors. If LEL readings are less than or equal to 10%, then proceed with planned work activities. If explosive vapor levels exceed 10% LEL for longer than one minute, work should be halted pending discussion with the HSC and PM. Continuous LEL monitoring will be performed for all intrusive activities. Periodic LEL monitoring will be performed during non-intrusive activities that may introduce an ignition source such as electrical equipment starting or stopping, welding, cutting with torches, or energizing electrical cabinets and enclosures, during vapor monitoring and sampling events, etc.

- Continuous VOC monitoring will be performed within the exclusion area during all intrusive activities. This monitoring includes the use of a PID (with 10.6 eV lamp) for VOCs that will be calibrated prior to use each day. When chronic visible airborne dust is present, an MIE PDM-3 Miniram or equivalent will be used to measure particulate concentrations. The particulate monitor will also be calibrated according to the manufacturer's instructions prior to field use. Action levels for establishing worker protection are summarized in Section 12.

- Where worker health and safety monitoring detects sustained (15 minute) VOC readings greater than 5 ppm above background and/or chronic visible airborne dust, then additional VOC readings and/or dust

observations will be taken at the downwind perimeter of the Exclusion Zone (an approximate 25-foot radius around the work area) or at the property boundary, whichever is closer to the intrusive activity. If VOC readings persist at greater than 5 ppm above background (or spike above 25 ppm) or visible airborne dust persists, then corrective actions will be taken (such as containerizing or covering drill cuttings and/or wetting the ground surface).

- Monitoring will then be repeated to assess the effectiveness of the corrective measures taken. Should VOC levels persist at concentrations greater than 5 ppm above background (or spikes above 25 ppm) or visible dust persists, then the monitoring point will be moved further down gradient to the property boundary.

- Should monitoring at the property boundary detect VOCs greater than 5 ppm above background (or spikes greater than 25 ppm) or visible airborne dust, then the work will cease and alternate investigation and/or corrective action procedures implemented in consultation with the HSC and PM.

- Monitoring results will be recorded in field notebooks or Air Monitoring Field Record (Attachment A).

An air monitoring decision tree is attached (Attachment B) to illustrate the air monitoring approach used during the system installation and operation. The decision also can be referred to during other site activities that may have intrusive activities for additional guidance.

9. Action Levels/Criteria:

Subcontractors are responsible for conducting their own monitoring and determining the appropriate action level and response for their activities. Task personnel shall observe the following Action Levels in the Exclusion Zone:

Instrument	Action Level/Criteria	Specific Action
PID	PID reading is >1.0 ppm above background level for 30 min OR ≥ 5.0 ppm for 15 min (in breathing zone)	Cease work and evacuate area. Evaluate if mechanical ventilation is feasible.
FID	>1.0 ppm Any point where a source of ignition exists	Cease work and evacuate area. Evaluate if mechanical ventilation is feasible.
Combustible Gas	10 % LEL for 1 minute or longer Any point where a source of ignition exists	Cease work and evacuate area. Evaluate if mechanical ventilation is feasible.
Dust Monitoring Device	>5mg/m3 sustained for 10 minutes above background >25 mg/m3 peak above background	Use wet methods (potable water spray) or other controls to reduce levels Level C PPE if water spray fails to reduce dust concentrations. Cease work and contact Project Manager.

Task personnel shall observe the following Action Levels during downwind perimeter monitoring:

Instrument	Action Level/Criteria	Specific Action
PID	PID reading ≥ 1.0 ppm above background for 15 min OR Peak ≥5 ppm above background	Stop work and institute controls.
Dust Monitoring Device	>150 µg/m3 average sustained for more than 15 minutes at downwind perimeter >100 µg/m3 above upwind background, or visible dust migrating from disturbance area beyond perimeter Dust suppression cannot control downwind levels to <100 µg/L compared with upwind	Collect upwind perimeter reading for comparison with downwind reading. Use wet methods (potable water spray) or other controls to reduce levels Level C PPE if water spray fails to reduce dust concentrations. Cease work and contact Project Manager.

See Site's Community Action Monitoring Plan (CAMP) for additional details on downwind monitoring.

10. Personal Monitoring:

☐ Passive Dosimeter ☐ Personal Air Sampling ☒ Other

Description/Other:

During Drilling and IDW sample/disposal, personnel will monitor their air space with a PID for VOCs and Multi Gas meter for LEL.

Additional LEL monitoring will be done prior to energizing, de-energizing, or opening any electrical power panel or instrument/control panel, including the ConEd meter and associated electrical equipment located at the entrance to the site.

11. Onsite Control:

Kevin Killoran and the designated field staff have been designated as persons responsible to coordinate access control on the work site.

Control boundaries have been established, and the Exclusion Zone (the contaminated area) and Decontamination Zone have been designated and are identified as follows:

Site:

Exclusion Zone:

- Activity 1: An area approximately 25ft in diameter around any pilot study well that is decommissioned.
- Activities 2: Working area behind the drilling rig, which is an area approximately 25 ft in diameter around bore-hole.
- Activity 3: Working area behind the excavator, which is an area approximately 25 ft from the trench.
- Activity 4: Areas where containerized/stockpiled IDW is staged.

Decontamination Zone:

- To be determined in the field based upon exclusion zones identified above.

12. Personal Protective Equipment:

Table A-5

Initial PPE, Air Monitoring and Associated Upgrade Requirements

Task	Initial Level of Protection for Task	Air Monitor Equip. for Each Task Group	Upgrade Criteria for Each Task Group	Upgraded Level of Protection
General Site Visit	D-1	NA	Condition Dependent	Condition Dependent
Groundwater Sampling **LNAPL Sampling**	D-2	PID/Draeger Tube	VOCs continuously > than 5 ppm for more than 5 minutes, > 1 ppm for more than 30 minutes or any peak > than 25 ppm above background	Level C and take Draeger Tube sample
		Multirae Plus LEL/H2S meter	10% LEL within top of casing	Ventilation/use of non-spark tools and intrinsically safe electrical equipment until level reduces to 5% LEL
		PID/Draeger Tubes - Benzene and Vinyl Chloride	Vinyl Chloride or Benzene > 1ppm	Temporarily cease work until concentration subsides and evacuate immediate area or Level B if concentration does not subside
Drilling/Well Installation	D-2	PID/Draeger Tube	VOCs continuously > than 5 ppm for more than 5 minutes, > 1ppm for more than 30 minutes or any peak > than 25 ppm above background	Level C and take Draeger Tube sample
		PID/Draeger Tubes - Benzene and Vinyl Chloride	Vinyl Chloride or Benzene > 1ppm	Temporarily cease work until concentration subsides and evacuate immediate area or Level B if concentration does not subside
		MIE PDM-3 miniram (or equivalent)	>2mg/m^3 to 5 mg/m^3 sustained for 10 minutes above background	Use wet methods (potable water spray) or other controls to reduce levels Level C PPE if water spray fails to reduce dust concentrations
	modified D-1		> 25 mg/m^3 peak or 5 mg/m3 sustained above background	Cease work and contact Project Director
Liquids Management **Equip Decon/Liquids Waste Management**	D-2	Multirae Plus LEL/H2S meter	10% LEL within top of casing, in enclosed operation area or at liquids storage area	Ventilation/use of non-spark tools and intrinsically safe electrical equipment until level reduces to 5% LEL
		PID/Draeger Tube	VOCs continuously > than 5 ppm for more than 5 minutes, > 1ppm for more than 30 minutes or any peak > than 25 ppm above background	Level C and take Draeger Tube sample
Site Work/Ground Disturbance	modified D-1	MIE PDM-3 miniram (or equivalent)	>2mg/m^3 to 5 mg/m^3 sustained for 10 minutes above background	Use wet methods (potable water spray) or other controls to reduce levels Level C PPE if water spray fails to reduce dust concentrations
			>25 mg/m3 peak or 5 mg/m3 sustained above background	Cease work and contact Project Director

Notes:

(1) **The HSO must be advised of conditions that warrant a change in PPE and approve the revised procedure.**

Condition Dependent: Personnel are to use prudent judgement and select additional PPE based on current Site conditions (e.g., wet or muddy) to prevent unnecessary contamination.

(2) Site personnel are permitted, with HSC approval , to downgrade from Level D-2 when exposure to water/sediment samples is not expected. This substitution is permitted to reduce the possibility of heat stress caused by working in full coverall protection.

The following scheme will be used to designate the required level(s) of personal protective equipment and respiratory protection: the alphabetical designations "B", "C", and "D" shall refer specifically to levels of respiratory protection, namely pressure-demand air-supplying respirators with escape provisions ("B"), air purifying respirators ("C"), and no respiratory protection ("D"). Since potential dermal exposure hazards may require a wide variety of personal protective clothing without regard to the required level of respiratory protection, the numerical designations "D-1," modified "D-1," and "D-2" will be used to specify the level of protective clothing that is to be employed in addition to the designated level of respiratory protection as described below (i.e., the level of protective equipment can be completely defined by a designation of "D-1," "D-2," etc.). The required levels of protective equipment and upgrade criteria for each work task are specified in the above table. All equipment and clothing shall be inspected by the wearer prior to use. All suspect protective equipment will be rejected and disposed of as non-contaminated waste.

The initial level of personal protective clothing required during Site activities will be D-1, which consists of the following:

LEVEL D-1, PROTECTIVE CLOTHING

1. Standard work clothes (long pants and sleeved shirt);
2. Steel-toed boots;
3. Safety glasses;
4. Fluorescent Orange or yellow safety vests;
5. Hard hats; and
6. Hearing protection (during drilling and other noise-producing activities).

Protective clothing will be upgraded during sampling activities and will consist of the following:

MODIFIED LEVEL D-1, PROTECTIVE CLOTHING

1. Level D-1 protective clothing;
2. Inner latex gloves;
3. Outer NBR gloves; and
4. Chemical-resistant boot covers, or overboots that can be decontaminated.

LEVEL D-2, PROTECTIVE CLOTHING

1. Level D-1 protective clothing;
2. Inner latex gloves;
3. Outer NBR gloves;
4. Chemical resistant boot covers, or overboots that can be decontaminated; and
5. Polycoated Tyvek with taped openings.

LEVEL C PROTECTION

1. Level D-2 protective clothing
2. Full face air-purifying respirator[1]

LEVEL B PROTECTION

1. Level D-2 protective clothing; and
2. Supplied air pressure demand respirator (open or closed circuit, Grade D air).

Where air purifying respirators are authorized (Level C - emergency stabilization/demobilization), organic vapor cartridges in combination with dust and mist filters are the appropriate respiratory protection equipment for use with the specific substances and concentrations anticipated. Level C will only be implemented to stabilize the site for demobilization in the event conditions exist which prevents working in Level D. If Level C is required, cartridges will be replaced after 4 hours of continuous use. More frequent change out may be necessary if break-through is detected.

Additionally, soil sampling may be required. During sampling NBR gloves may be required for enhanced protection. If grossly contaminated soil is encountered, anyone in direct contact with soil must used NBR outer gloves or equivalent. Attachment E contains Golder's Standard Work Procedure Sampling Contaminated Soil/Waste Piles.

No changes to the specified levels of protection shall be made without the knowledge and approval of the Health and Safety Coordinator/Field Operations Leader and the Project Manager.

13. Decontamination:

Personnel and equipment leaving the Exclusion Zone (except for as indicated for vapor intrusion sampling) shall proceed through the following decontamination procedures when departing work zones:

LEVEL D PERSONNEL DECONTAMINATION	
Station	**Procedure**
Decontamination	Decontaminate boots, remove latex gloves, hard-hat, safety glasses and hearing protection, wash face and hands prior to leaving Decontamination area.

EMERGENCY LEVEL D PERSONNEL DECONTAMINATION	
Station	**Procedure**
Decontamination	Wash/rinse and/or remove all clothing that has contacted excessively contaminated soil/groundwater if possible. If not possible, wrap person in blanket or plastic to minimize contamination to other personnel. Alert emergency medical personnel regarding potential contamination, instruct as necessary. A person familiar with the site and the incident should accompany the contaminated employee to the hospital.

EQUIPMENT DECONTAMINATION	
Station	**Equipment & Procedure**
Decontamination	Steam power wash down-hole equipment and sample equipment between each boring. Additionally, decontaminate all down-hole equipment and drill rig prior to demobilization.
Decontamination	All bowls and spoons used for soil sampling will be decontaminated with Alconox, Isopropyl, and Nitric Acid before and after each sample.

Containerization, Transportation, and Disposal of IDW:

Containerization

IDW, including personnel and equipment decontamination fluids and contaminated or disposable PPE, will be containerized in 55-gallon, DOT-approved steel drums. These containers will be clearly labeled and stored onsite in a designated area to be determined in the field. Containerized IDW will be characterized for subsequent disposal.

Decontamination of heavy equipment items such as drilling rig equipment and VER system components will entail protection of the equipment with plastic sheeting to the greatest extent feasible. Drilling/heavy equipment will be cleaned with a pressure steam washer. This practice will take place in a designated area of the site and in a manner which precludes further contamination of the site or adjacent areas.

Transportation and Disposal

The drums will be sampled, in order to characterize the waste within the drums. Then, the 55-gallon drums staged on site will be loaded onto a properly placard tractor trailer, utilizing a drum cart. Finally, the drums will be taken to a licensed disposal facility under chain-of-custody, and disposed of in accordance with state and federal laws.

14. Confined Entry Procedures: ☐ Not Applicable

A confined space is defined as any space not currently used or intended for human occupancy, having a limited means of egress, which is subject to the accumulation of toxic contaminants, a flammable or oxygen deficient atmosphere, or other hazards, such as engulfment, or electrical or mechanical hazards should equipment be inadvertently activated while an employee is in the space. Confined spaces include but are not limited to storage tanks, process vessels, bins, boilers, ventilation or exhaust ducts, air pollution control devices, smoke stacks, underground utility vaults, sewers, septic tanks, and open top spaces more than four feet in depth, such as test pits, waste disposal trenches, sumps, and vats.

Yes	N/A		Yes	N/A	
☐	☐	Provide Forced Ventilation	☒	☐	Refer to Personal Protective Equip. (#14)
☒	☐	Test Atmosphere For	☒	☐	Refer to Emergency Procedures (#22)
☒	☐	(a) $\%O_2$	☒	☐	Other Special Procedures –
			☒		Lockout/Tagout & Confined Space Entry
☒	☐	(b) %LEL			
☐	☐	(c) Other			

Descriptions/Other:

Confined Space Entry may be required to clean water storage tank. Work, if required, will be performed by subcontractor experienced with this type of work. Subcontractors will follow their own HASP and established procedures for this work and provide confined space training records for field team.

15. Cutting/Welding Procedures: ☐ Not Applicable

Yes	N/A	
☐	☐	Relocate or Protect Combustibles
☐	☐	Wet Down or Cover Combustible Floor
☒	☐	Check Flammable Gas Concentrations (%LEL) in air
☐	☐	Cover Wall, Floor, Duct and Tank Openings
☒	☐	Provide Fire Extinguisher

Other Special Instructions:

If the need arises to perform Hot Work (cutting, welding, etc.), due to the high Lower Explosive Limits (LEL) observed in previous investigations, NO hot work of any kind will be performed within 50 feet of drilling operations or open bore/well location.

Smoking will not be allowed in the exclusion zones. A smoking area will be designated by the Site Safety Officer in the field.

16. Onsite Organization and Coordination:

Project Manager: Kevin Killoran
Field Operations Leader: Varies for each planned activity (reference activity list)
Site Safety Officer: Varies for each planned activity (reference activity list)

17. Special Instructions:

In addition to the potential volatile, semi-volatile, and/or inorganic contaminants listed in the tables in Section 9, workers should also be cognizant of hazards such as heat stress and working around heavy equipment. To ensure compliance and understanding of safety issues, a daily safety meeting will be conducted at the job site each morning prior to commencement of work activities. Attendance by all workers is mandatory, and a Daily Safety Briefing form will be signed by everyone in attendance of the daily safety meeting.

JSAs will be included in Attachment D as needed.

Refer to Attachment E for Standard Work Procedure for additional information or special instruction for this project.

Activities: 1 & 2: PROCEDURES FOR DRILLING AND WELL INSTALLATION

Required Monitoring Equipment: MultiRAE PLUS Gas Monitor, or equivalent, which measures LEL, oxygen (O_2), hydrogen sulfide (H_2S) and volatile organic compounds (VOCs) and a flame ionization detector (FID). The "LEL and FID meter" should be in good working condition, and should be calibrated according to the manufacturer's instructions, or as otherwise required by the HASP. Please remember that the LEL meter requires oxygen to work properly (see specific requirements of the manufacturer) and oxygen should be assessed during each reading. Both meters must be intrinsically safe.

During drilling operations, LEL readings must be continuously monitored at the top of the borehole and around the borehole. In addition, at least every five feet of drilling, the LEL probe must be lowered in the borehole or casing. Do not lower probe into water. Use the in-line water trap when working around liquids.

No open flames, matches, cigarette lighters, or fires of any kind shall be allowed in the vicinity of the drilling operations. If the elevated levels are due to localized pocket of gas, levels may drop and drilling can proceed, with caution and vigilant monitoring. If levels increase, the hole may be purged with nitrogen. If subsequent combustible gas levels at the surface and combustible gas/oxygen level at depth no longer indicate the presence of an explosion hazard, work may continue with frequent monitoring and extreme caution. **If explosive gas**

levels exceed 10% LEL beyond the mouth of the hole, work should be halted pending discussion with the Health and Safety Coordinator.

Combustible gas levels **must** always be determined prior to any welding on casing or in the vicinity of the borehole. Readings must be taken at depth, at the mouth of the casing, and around the outside of the casing at ground level. Readings in excess of 10% LEL indicate the need purge the borehole/casing with nitrogen or use an inflatable bladder to isolate the borehole atmosphere from any potential ignition sources. Should explosive gas in excess of 10% LEL be detected in the casing annulus, work will temporarily cease, ignition sources will be secured and the Site Safety Officer and Golder Project Manager will be immediately contacted. If the condition does not subside, engineering controls will be established. These controls will be situation dependent and will be tested for effectiveness before any welding occurs.

During drilling operations, continuous VOC air monitoring must be performed in the breathing zone with a PID (as discussed in the Site HASP) and FID as discussed above under Procedures for Monitoring LNAPL Wells.

Various Activities: PROCEDURES FOR MONITORING LNAPL WELLS

Required Monitoring Equipment: MultiRAE PLUS Gas Monitor, or equivalent, which measures LEL, oxygen (O_2), hydrogen sulfide (H_2S) and volatile organic compounds (VOCs) and a flame ionization detector (FID). The "LEL and FID meter" should be in good working condition, and should be calibrated according to the manufacturer's instructions, or as otherwise required by the HASP. Please remember that the LEL meter requires oxygen to work properly (see specific requirements of the manufacturer) and oxygen should be assessed during each reading. Both meters must be intrinsically safe.

Monitoring Procedures:

1. Approach closed well from upwind side.
2. Use LEL and FID meter to monitor air in the breathing zone and near surface of closed well.

- If LEL readings are less than or equal to 10% and FID readings are less than 1 ppm above background, then loosen well lid bolts with standard wrench and use spark proof pry bar to remove well lid for access to flush mount housing.
- If LEL readings exceed 10% or the FID exceed 1 ppm above the background, then go to Step 5.

3. Use LEL meter to monitor air inside of flush mount housing (above well cap).

   - If LEL readings are less than or equal to 10%, then loosen expandable well cap wing nut by hand and remove cap for access to well casing.
   - If LEL readings exceed 10%, then go to Step 5.
   - Breathing zone must be continuously monitored with the FID. If any FID readings exceed 1 ppm above background, then go to Step 5.

4. Use LEL meter to monitor air inside of well casing.

   - If LEL readings are less than or equal to 10%, then proceed with normal monitoring procedures (see HASP) in addition to continuously monitoring the breathing zone with an FID meter.
   - If LEL readings inside well casing exceed 10%, then go to Step 5.

5. If at any time LEL levels are not acceptable (i.e., greater than or equal to 10%) or FID levels are not acceptable (i.e., greater than 1 ppm than background in the breathing zone), then do not attempt to monitor well. Allow area being monitored to vent for five (5) minutes, or if monitoring flush mount housing or well casing, alternatively purge with nitrogen. The well should be flushed with nitrogen until the LEL level is below 10%. Repeat LEL readings and venting/purging as necessary to see if LEL readings drop to, and maintain, an acceptable level. If LEL levels do not drop and stay at an acceptable level, close well (if opened and closing it is deemed safe), and leave area immediately. Contact the Site Safety Officer and/or the Project Manager for further instructions and/or alternate plans.

18. Sanitation Requirements:

Potable water supply available on work site?	☐ Yes ☒ No
Portable toilets located on work site?	☒ Yes ☐ No
Temporary washing/shower facilities required at work site?	☐ Yes, describe below. ☒ No

Nearest water and wash facilities need to be identified. If nothing available then at least a portable eyewash and/or emergency shower need to be available.

19. Field Safety Procedures Change Authorization:

This Safety Procedures Change Authorization Form will be completed and signed before any safety procedures identified in this Site Safety Plan can be modified by the Field Team. All revisions to safety procedures must be approved by the Project Manager.

Instruction Number _____ Duration of Authorization Requested _____ Date:

to be changed ☐ Today only

☐ Duration of Task

Description of Procedures Modification:

Justification:

Person Requesting Change:	**Verbal Authorization Received From:**
Name	Name Time
Title	Title
Signature	Approved By (Signature of person named above to be obtained within 48 hours of verbal authorization)

20. Emergency Procedures:

(This Section of the Health & Safety Plan, and the Hospital Route Figure, are to be posted at a prominent location on site. The Hospital Route Figure, which has written directions, is located in Attachment C.)

Yes No

☐ ☒ On-site Communications Required? Emergency Channel:

Nearest Telephone: Golder field personnel will be equipped with cellular telephones. No landlines are

available.

Fire and Explosion:

In the event of a fire or explosion, if the situation can be readily controlled with available resources without jeopardizing the health and safety of you, the public, or other site personnel, take immediate action to do so, otherwise:

1. Notify emergency personnel by calling 911.
2. If possible, isolate the fire to prevent spreading.
3. Evacuate the area.

Attachment E contains Golder's Safe Work Procedure for Fire Protection.

Chemical Exposure:

Site workers must notify the Site Safety Officer immediately in the event of any injury or any of the signs or symptoms of overexposure to hazardous substances identified in the following table.

EXPOSURE/FIRST AID INFORMATION		
Substances Present	**Symptoms of Acute Exposure**	**First Aid**
Acetone (Dimethyl ketone) CAS No. 67-64-1	Irritation of eyes, nose, throat, headache, dizziness, central nervous system depressant/depression, dermatitis	Eye: Irrigate immediately Skin: Soap/water wash immediately Inhalation: Respiratory support Swallow: Immediately medical attention
Antimony CAS # 7440-36-0	Irritation of eyes, skin, nose, throat, mouth, coughing, dizziness, headache, nausea, vomiting, diarrhea, stomach cramps, insomnia, loss of smell senses	Eye: Irrigate immediately Skin: Soap wash immediately Inhalation: Respiratory support Swallow: Immediate medical attention
Arsenic CAS No. 7440-38-2	Ulceration of septum, dermatitis, gastrointestinal distress, peripheral neuropathy, Respiratory irritation, hyperpigmentation of skin	Eye: Irrigate immediately Skin: Soap/water wash immediately Inhalation: Fresh air Swallow: Immediately medical attention
Benzene CAS No. 71-43-2	Irritation of eyes, skin, nose, resp. system, giddiness, headache, nausea, staggered gait, fatigue, anorexia, lassitude, dermatitis, bone marrow depression	Eye: Irrigate immediately Skin: Soap/water wash immediately Inhalation: Respiratory support Swallow: Immediately medical attention
Beryllium CAS No. 7440-41-7	Chronic: Anorexia, weight loss, weakness, chest pain, cough, pulmonary insufficiency, eye irritation, dermatitis	Eye: Irrigate immediately Inhalation: Fresh air
Cadmium CAS No. 7440-43-9	Pulmonary edema, Inhalation difficulty, cough, chest tightness, substernal, pain, headache, chills, muscle aches, nausea, vomiting, diarrhea, loss of smell	Eye: Irrigate immediately Skin: Soap wash immediately Inhalation: Respiratory support Swallow: Immediately medical attention
Chromium CAS No. 7440-47-3	Eye irritation, sensitization dermatitis	Eye: Irrigate immediately Skin: Water flush promptly Inhalation: Respiratory support Swallow: Immediately medical attention
Copper CAS No. 7440-50-8	Irritation of eyes, nose, pharynx, nasal septum perforation, metallic taste, dermatitis	Eye: Irrigate immediately Skin: Soap wash promptly Inhalation: Respiratory support Swallow: Immediately medical attention
1,1-Dichloroethane (1,1 DCA) CAS No. 75-34-3	Irritation of skin, central nervous system depressant	Eye: Irrigate immediately Skin: Soap/water flush promptly Inhalation: Respiratory support Swallow: Immediately medical attention
Ethylbenzene CAS No. 100-41-4	Irritation, headache, dermatitis, narcosis, coma	Eyes: Water irrigation immediately Skin: Water flush promptly Inhalation: Respiratory support Swallow: Immediately medical attention
Lead CAS No. 7439-92-1	Weakness, lassitude, insomnia, facial pallor, tremor, constipation, abdominal pain	Eyes: Water irrigation immediately Skin: Soap/water flush promptly Inhalation: Respiratory support Swallow: Immediately medical attention
Toluene CAS No. 108-88-3	Irritation, fatigue, weakness, confusion, euphoria, dizziness, headache, dilated pupils	Eyes: Water irrigation immediately Skin: Soap/water wash promptly Inhalation: Respiratory support

EXPOSURE/FIRST AID INFORMATION		
Substances Present	**Symptoms of Acute Exposure**	**First Aid**
		Swallow: Immediately medical attention
Trichloroethene (TCE) CAS No. 79-01-6	Irritation of eyes, skin, headache, vertigo, visual disturbance., fatigue, giddiness, tremor, nausea, vomiting, dermatitis, cardiac arrhythmias	Eyes: Water irrigation immediately Skin: Soap/water wash promptly Inhalation: Respiratory support Swallow: Immediately medical attention
Vinyl chloride CAS No. 75-01-4	Weakness, abdominal pain, gastrointestinal bleeding, pallor or cyanosis of extremities	Eyes: Water irrigation immediately Skin: Soap/water wash promptly Inhalation: Respiratory support Swallow: Immediate med. attention
o, m, p, Xylenes	Irritation, dizziness, excitement, drowsiness, incoherence, staggering gait, nausea, vomiting	Eyes: Water irrigation immediately Skin: Soap/water wash promptly Inhalation: Respiratory support Swallow: Immediately med. attention

Biological Exposure Risks:

The scope of services for this project may create opportunities for site personnel to come in contact with potentially dangerous plants and animals. Precautionary measures should be taken to reduce possible contact with hazardous flora and fauna which may include, but not be limited to: application of bug spray, caution and care in handling collected organisms including wearing gloves, avoiding or leaving an area identified as containing a suspected hazardous plant or animal (e.g. poisonous snake) until the hazardous organism has been properly identified and/or removed.

In general, almost any terrestrial animal can be hazardous at times. Larger mammals and some birds may attack if you are in their territory, too close to their nest, between them and their offspring, etc. Also, if you are handling/attempting to handle wildlife, there may be a risk of bites or scratches leading to infection, excessive bleeding, or worse. Please always use caution when working with/around wildlife. Although they are often wary and will stay away from you, there are specific situations/times where this is not the case. Attachment E contains Golder's Standard Work Procedure Biological Exposure Risks Hazardous Flora and Fauna.

Heat Illness/Stress:

Heat stress awareness will be elevated while wearing Tyveks. Frequent breaks may be required to rehydrate and cool down during drilling activities. Site workers must notify the Site Safety Officer immediately in the event of any personnel exhibiting heat illness/stress symptoms. Attachment E contains Golder's Standard Work Procedure for Heat Stress, which identifies symptoms and prevention methodologies.

Cold Illness/Stress:

In a cold environment, body heat must be conserved to maintain the core temperature at normal levels and to ensure an adequate blood flow to the brain and extremities. Feelings of cold and discomfort should not be ignored, since these may be early warning signals. The effects of cold are such that problems can occur before the worker is aware of them, and furthermore, over-exposure to cold may affect judgment. Attachment E contains Golder's Standard Work Procedure for Cold Environment - Cold Stress, which identifies symptoms and prevention methodologies.

Inclement Weather:

Severe weather can occur at any hour of the day and any day of the year. Hurricanes, hailstorms, tornadoes, snowstorms, ice storms, wind storms, floods, severe cold, heat waves and drought occur daily. Attachment E contains Golder's Standard Work Procedure for Inclement Weather.

Slips, Trips, and Falls:

The majority of falls occur on slippery, uneven, defective, cluttered or obstructed walking surfaces. Falls from elevations while reaching for an overhead object are common, and frequently cause severe injuries. Attachment E contains Golder's Standard Work Procedure for Slips, Trips, and Falls.

Hand and Portable Tools:

Hand and power tools are a common part of our everyday lives and are present in nearly every industry. These tools help us to easily perform tasks that otherwise would be difficult or impossible. However, these simple tools can be hazardous and have the potential for causing severe injuries when used or maintained improperly.

Special attention toward hand and power tool safety is necessary in order to reduce or eliminate these hazards. In the process of removing or avoiding the hazards, workers must learn to recognize the hazards associated with the different types of tools and the safety precautions necessary to prevent those hazards. The following risk control measures are suggested to reduce hazards associated hand and portable power tools. Attachment E contains Golder's Standard Work Procedure for Hand and Portable Power Tool Safety.

Electrical Hazards:

The potential does exist for electrical hazards which demands care and common sense be exercised. Under normal conditions, the potential for electrical hazards is minimized since the electrical components and wires are housed in enclosures, conduits or control panels. If abnormal conditions exist, the potential for electrical hazards will increase. An abnormal condition could include a damaged conduits or enclosures, or troubleshooting of the equipment. In the event an abnormal condition exists, a qualified person (i.e., electrician, electrical technician or engineer) will be dispatched to the site to inspect the situation and make necessary repairs, modifications or adjustments.

Connection and disconnection of any electrical systems on the trailers should be handled by qualified electrician. Any time any type of work needs to be performed on a piece of equipment which is powered electrically, the employee(s) must lock out and tag out the main breaker panel.

Refer to Attachment E for Lock-out/Tag-out Procedure for working on the electrical equipment.

Motor Vehicles & Driving On Company Business:

Unlike other workplaces, the roadway is not a closed environment. Preventing work-related roadway crashes requires strategies that combine traffic safety principles and sound safety management practices. Although employers cannot control roadway conditions, they can promote safe driving behavior by providing safety information to workers and by setting and enforcing driver safety policies. Vehicle crashes are not an unavoidable part of doing business. Attachment E contains Golder's Standard Work Procedure for Motor Vehicles & Driving on Company Business.

Onsite Injury or Illness:

In the event of an injury requiring more than minor first aid, or any employee reporting any sign or symptom of exposure to hazardous substances, immediately take the individual to Woodall Medical Center located at 760 Broadway, Emergency Center phone (718) 963-8000

In the event of life-threatening or traumatic injury, implement appropriate first-aid and immediately call for emergency medical assistance at 911. The nearest designated trauma center is Woodall Medical Center located at 760 Broadway, Emergency Center phone (718) 963-8000.

See attached map for directions.

Personnel With First Aid/CPR Training (Names):

All Field Operation Leaders. Refer to Section 5 for proposed field team.

Designated Back-Up Personnel (Names):

Project Manager: Kevin Killoran

Required Emergency Back-Up Equipment:

Fully charged ABC Class fire extinguisher.

First Aid Kit.

Emergency Response Authority:

The designated Site Safety Officer has final authority for first response to on-site emergency situations for Golder personnel. For on-site emergency that occur with a sub-contractor's personnel, the subcontractor lead person shall be responsible for final authority on the required first response.

Upon arrival of the appropriate emergency response personnel, the Site Safety Officer shall defer all authority but shall remain on the scene if necessary to provide any and all possible assistance. At the earliest opportunity, the Site Safety Officer or designee shall contact the Project Manager or Health and Safety Coordinator.

Project Manager: Kevin Killoran Phone: (w) 610/941-8173 (m) 610/316-5139

Project Field Operations Leader Varies, see section 5 Phone (w) _____ (m)_____

Newark Health and Safety Coordinator Frank Malinky Phone (w) 973/645-1922 (m) 908/601-3268

Project Health and Safety Coordinator James Valenti Phone (w) 856/793-2005

Golder National H&S Leader Jane Mills Phone (m)206/295-7002

Injury Intervention Support WorkCare Phone 888-449-7787

21. Safety Briefing:

The following personnel were present at pre-job/daily safety briefing conducted at _____ (time) on _____ (date) at _____ (location), and have read the above plan and are familiar with its provisions:

Name	Signature

Fully charged ABC Class fire extinguisher available on site? ☒ YES

Fully stocked First Aid Kit available on site? ☒ YES

All project personnel advised of location of nearest phone? ☐ YES

All project personnel advised of location of designated medical facility or facilities? ☐ YES

Printed Name of Field Operations Leader or Site Safety Officer

_____ _____

Signature Date

ATTACHMENT A

AIR MONITORING FIELD RECORD

AIR MONITORING FIELD RECORD

JOB NAME: _____ JOB NO. _____ SHEET _____ of _____

LOCATION: _____

DATE: _____

TIME START: _____ TEMP: _____ WIND: _____ PRECIPITATION: _____

TIME STOP: _____

INSTRUMENT USED: _____ SERIAL NUMBER: _____

STAFF ONSITE: _____

SPAN Gas:

SPAN Concentration:

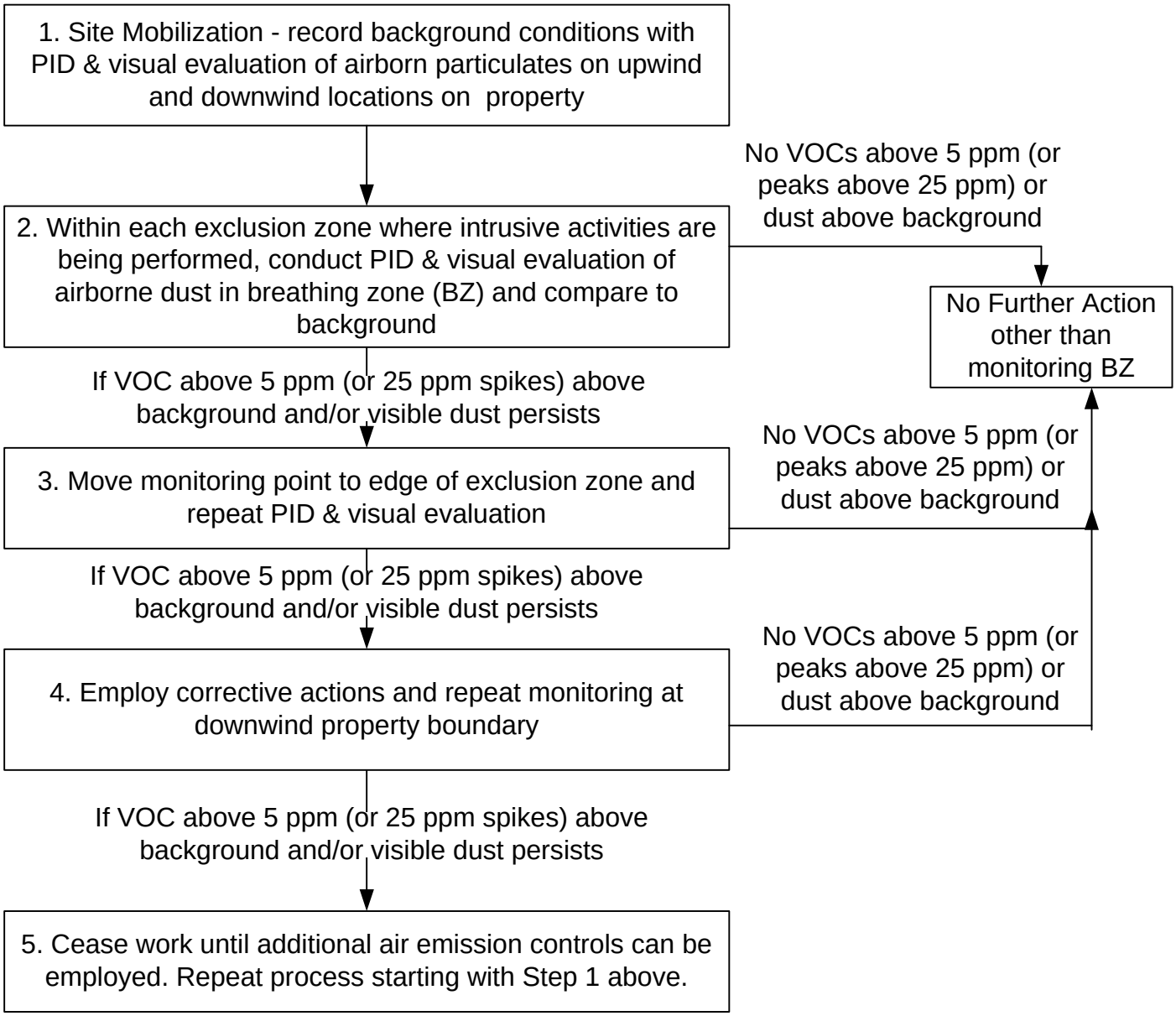
DATE	TIME	READING (Units)	LOCATION
			CALIBRATION
			AMBIENT

Printed Name: _____ Signature: _____

ATTACHMENT B

AIR MONITORING DECISION TREE

Air Monitoring Plan Decision Tree *
LNAPL Recoverability Pilot Study
Review Avenue Development Site



*Assumes engineering controls and standard management practices for worker health and safety will control potential sources of off-property releases of particulates and VOCs given the limited nature of the LNAPL pilot study field activities.

ATTACHMENT C

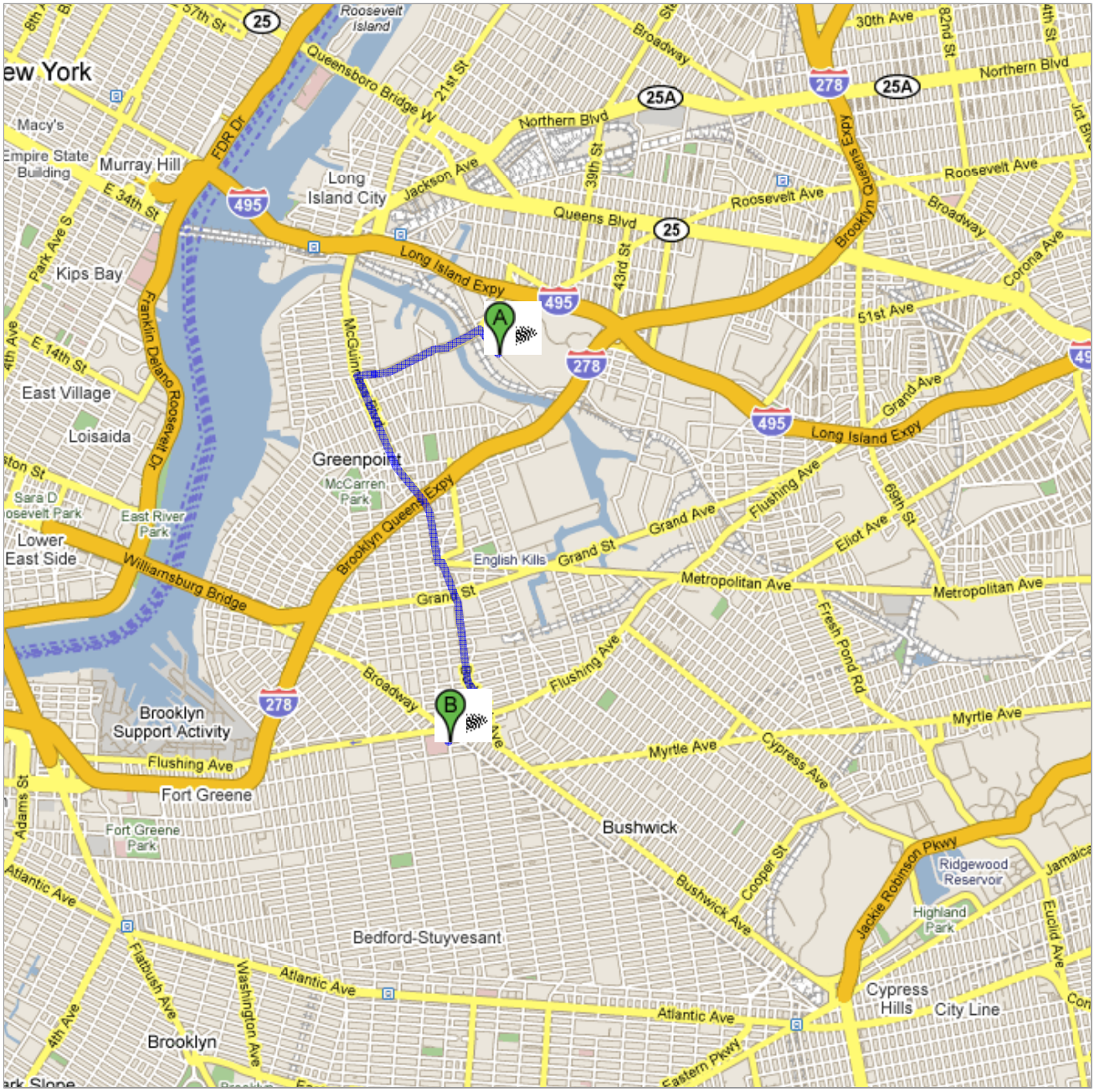
HOSPITAL ROUTE FIGURE AND DIRECTIONS

Google Maps

Directions to New York, New York

3.4 mi – about **12 mins**

Woodhull Medical-Mental Health Center
Emergency: 911
General Information: (718) 963-8000



3780 Review Ave
Queens, NY 11101

1.	Head **northwest** on **Review Ave** toward **37th St**	go 0.2 mi total 0.2 mi
2.	Turn **left** at **Greenpoint Ave/JJ Bryne Memorial Bridge** Continue to follow Greenpoint Ave About 2 mins	go 0.8 mi total 0.9 mi
3.	Turn **left** at **McGuinness Blvd** About 2 mins	go 0.8 mi total 1.7 mi
4.	Slight **left** at **Humboldt St** About 3 mins	go 0.4 mi total 2.1 mi
5.	Turn **left** at **Metropolitan Ave**	go 177 ft total 2.2 mi
6.	Turn **right** at **Bushwick Ave** About 3 mins	go 0.9 mi total 3.1 mi
7.	Turn **right** at **Flushing Ave** About 1 min	go 0.2 mi total 3.3 mi
8.	Slight **left** at **Sumner Pl** About 1 min	go 0.1 mi total 3.4 mi

Woodhull Medical-Mental Health Center
New York, New York

These directions are for planning purposes only. You may find that construction projects, traffic, weather, or other events may cause conditions to differ from the map results, and you should plan your route accordingly. You must obey all signs or notices regarding your route.

ATTACHMENT D

JOB SAFETY ANALYSIS (JSA) FORM

(TO BE PREPARED AS NEEDED)

ATTACHMENT E

STANDARD WORK PROCEDURES

1.0 SCOPE

This SWP applies to all Golder Associates Inc. and Golder Construction Services (Golder) staff that work on a project site with potential for chemical exposure

2.0 CHEMICAL SUBSTANCE

The following safety protocol is intended for personnel who, during the course of their work, may be exposed to or encounter chemical or biological substances not usually encountered under normal working conditions.

Anyone who continually encounters chemical or biological substances will have the appropriate OSHA training. Any individual who does not usually deal with but comes across chemical or biological substances should locate someone with the appropriate OSHA training immediately and inform them of the hazard.

These chemical or biological substances may include the residues from industrial processes or commercial activities, compounds used in manufacturing, and/or materials present in specialized work environments. These substances, if present in sufficient concentrations, could potentially affect worker health and safety. Therefore, it is important to be aware that such hazards could exist and take appropriate measures to reduce and/or eliminate potential exposure.

Note

This protocol does not include exposure to ionizing radiation. Specialized safety measures, monitoring and testing is required for such environments, and is beyond the scope of this protocol.

As a matter of company policy, Golder personnel will not work in chemical and/or biological environments considered immediately dangerous to life or health (IDLH), or requiring personal protective measures to US Environmental Protection Agency (USEPA) Level A (i.e., self-contained breathing apparatus (SCBA) and fully-encapsulating, chemically resistant clothing), unless specific and specialized training for working in such environments is provided to personnel, all required equipment is provided, and all required monitoring (air, exposure, medical, etc.) is undertaken.

Chemicals have the potential to cause irritating localized effects, acute toxic effects or longer term carcinogenic effects. The hazards posed by each chemical will depend on the type of chemical, the form in which it is available for exposure, the frequency of exposure and the duration of each exposure.

Chemicals that employees can come into contact with could be in a solid, liquid or gas form. Each form of each chemical will pose its own hazards.

Pathways leading to possible health effects relate to the inhalation, ingestion or dermal contact with the chemical.

Using lead as an example it can be ingested as solid, cause burns to the skin as a liquid and inhaled as a gas following heating, or when sprayed as a component of a product such as paint. Each of these three forms will cause differing potential acute or toxic health effects either immediately or over time.

For each exposure scenario, the specific physical and chemical properties of chemicals will strongly influence the hazard posed by the chemical. Factors such as boiling point, vapor pressure, flammable limits, melting point, freezing point, corrosiveness, auto ignition temperatures, and vapor density will all affect the risk of injury/illness to an exposed worker.

- Inhalation of chemical and/or biological substances;
- Ingestion of chemical and/or biological substances; and

- Contact with or absorption of chemical and/or biological substances.

3.0 POSSIBLE CONSEQUENCES

- Short term health effects such as eye irritations, breathing difficulties, burns and poisoning
- Long term health effects such as organ damage, possible carcinogenic related disease

4.0 PRECAUTIONS

Prior to undertaking site work:

- Review the historical activities at and/or previous use of the site or environment in question to identify potential chemicals and/or biological substances that may be present. If possible, ask the Client and/or former site workers for information.
- If chemicals are known to be in use at a site, obtain and review Material Safety Data Sheet (MSDS) documentation.
- Once potential chemical and/or biological hazards have been identified, consult reference materials concerning health effects, allowable exposure limits and appropriate personal protective equipment to be used when encountering such substances. Standard references, available at Golder, include:
  - OSHA Permissible Exposure Limit (PEL) for General Industry: 29 CFR 1910.1000 Z-1 Table.
  - OSHA Permissible Exposure Limit (PEL) for Construction Industry: 29 CFR 1926.55 Appendix A.
  - OSHA Permissible Exposure Limit (PEL) for Maritime: 29 CFR 1915.1000 Table Z-Shipyards.
  - National Institute for Occupational Safety and Health (NIOSH) "Pocket Guide to Chemical Hazards" (latest edition).
  - American Conference of Governmental Industrial Hygienists (ACGIH) "Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices" (latest edition).
- Air monitoring requirements (i.e., the selection of specific, air monitoring devices such as photo and flame ionization detectors, combustible gas meters, chemical specific meters, etc.), the calibration and maintenance requirements of such equipment, the selection and use of appropriate respiratory protection equipment, project-specific medical monitoring requirements, and other procedures deemed appropriate for the protection of human health will be detailed in the HASP or a separate SWP.
- It is important to note that the actual conditions encountered at a site may be different from those anticipated. Therefore, should levels of contamination (i.e., concentrations of chemical and/or biological substances) or physical working conditions (i.e., unstable ground, etc.) be encountered at a site that are substantially different from those originally anticipated, or should any situation arise which is obviously beyond the scope of the monitoring, respiratory protection and/or decontamination procedures specified in the plan, work activities will be halted, pending review by the Project Manager and/or Project Health and Safety Officer.

Revised procedures and protective measures, compatible with the site conditions encountered, will then be identified and implemented.

5.0 MINIMUM PERSONAL PROTECTION EQUIPMENT REQUIRED

- Steel-toed safety boots
- Coveralls
- Hard hat
- Respirator (if required)
- High visibility reflective vest (around moving equipment)
- Hearing Protection (as conditions dictate)
- Eye Protection (as conditions dictate)

5.1 Additional Equipment (Chemical and/or Biological Substances)

- Chemically-resistant safety boots
- Chemically-resistant gloves (latex, nitrile, butyl rubber, etc.)
- Chemically-resistant clothing (Tyvek, Samex suits, etc.)
- Air purifying respirators or supplied air equipment
- Air monitoring equipment

6.0 TRAINING

- OSHA 10 hour Construction Safety course
- First Aid and CPR courses
- 40 Hour HAZWOPER Class or specific Hazard Communication Training

7.0 APPLICABLE OSHA REGULATION PARTS

Further information can be found on chemical and/or biological exposure measures in 29 CFR Sections 1910, 1915, & 1926 as noted on page 2 and:

29 CFR 1910.1200 Hazard Communication
29 CFR 1910.120 HAZWOPER

1.0 SCOPE

This SWP applies to all Golder Associates Inc. and Golder Construction Services (Golder) staff that work in the field in locations where there may be biological exposure risks to hazardous flora and fauna.

2.0 BIOLOGICAL EXPOSURE RISKS – HAZARDOUS FLORA AND FAUNA INFORMATION

The scope of services for this project may create opportunities for site personnel to come in contact with potentially dangerous plants and animals. Precautionary measures should be taken to reduce possible contact with hazardous flora and fauna which may include, but not be limited to: application of bug spray, caution and care in handling collected organisms including wearing gloves, avoiding or leaving an area identified as containing a suspected hazardous plant or animal (e.g. poisonous snake) until the hazardous organism has been properly identified and/or removed.

If a field team member comes in contact with or is bitten or stung by any hazardous plant or animal, always follow the proper first aid procedures and contact the Site Safety Officer immediately.

In general, almost any terrestrial animal can be hazardous at times. Larger mammals and some birds may attack if you are in their territory, too close to their nest, between them and their offspring, etc. Also, if you are handling/attempting to handle wildlife, there may be a risk of bites or scratches leading to infection, excessive bleeding, or worse. Please always use caution when working with/around wildlife. Although they are often wary and will stay away from you, there are specific situations/times where this is not the case.

3.0 HAZARDOUS INSECTS

Poisonous Spiders

- **Widow Spiders** (genus *Latrodectus*) Southern Black Widow, Northern Black Widow, Brown Widow, and Red Widow
- **Recluse Spiders** (genus *Loxosceles*) - Brown Recluse, Mediterranean Recluse, Chilean Recluse

While the poisonous spiders listed above are not known to be aggressive, spider bites can occur when the spiders are disturbed or feel threatened. Be careful of reaching under objects where the spider is hiding or when putting on clothing, gloves or shoes that have been sitting or stored for a long time into which the spider has crawled. The most common symptoms are intense pain, rigid abdominal muscles, muscle cramping, malaise, local sweating, nausea, vomiting, and hypertension. Blisters frequently appear at the bite site, which can become necrotic. If bitten, remain calm, and seek medical attention (contact your physician, hospital and/or poison control center). Apply an ice pack directly to the bite area to relieve swelling and pain. If possible to do so without further endangerment, collect the spider (even a mangled specimen has diagnostic value) for positive identification by a spider expert.

Bees, Wasps, Yellow jackets, Mosquitoes and Fire Ants

The hazards associated with insect bites and stings are based on allergic reactions to the venom produced by the insect. Anyone who has a history of severe allergic reactions to bee stings should carry an anaphylactic kit with an Epinephrine syringe (epi-pen), with them at all times when working in the field. If an epi-pen is unavailable, remove the victim from the area (to avoid further stinging), monitor for signs of anaphylactic shock, and seek medical attention.

Tick Identification

- Ticks are divided into two families, "soft" ticks and "hard" ticks. Their only source of nutrition is blood sucked from their hosts.
- Hard ticks live on the ground in vegetation, such as grassy meadows, woods, brush, weeds, and leaf litter.
- Ticks produce a cement-like substance that helps anchor them to the host.
- Ticks inject saliva (the saliva may also contain disease organisms, such as *Borrelia burgdorferi* which cause Lyme disease) containing a kind of anticoagulant into the blood pool to keep the blood from clotting.
- The Brown Dog Tick (*Rhipicephalus sanguineus*) has evolved to live indoors and can be found living inside your home. Brown Dog Ticks do not feed on humans.
- **Treatment for Ticks**
- Use a small pair of curved forceps or tweezers, wear some gloves so you don't spread bacteria from the tick to your hands.
- Using tweezers, flip the tick over onto its back. Grasp tick firmly with the tweezers as close to the skin as possible. Gently pulling until the tick comes free. Do Not Twist or turn.
- Once removed, rinse it down a sink or flush it down a toilet. Consider keeping it in a tightly closed jar or taped to a piece of paper. You may need to show the tick to the doctor if you become ill from the tick bite.
- The area of the bite should leave a small crater or indentation where the head and mouthparts were embedded. If significant portions of the head or mouthparts remain, they may need to be removed by a doctor.
- Cleanse the bite area with soap and water or a mild disinfectant. Observe the area for several days for any reaction to the bite, such as a rash or signs of infection. Apply antibiotic cream to the area.
- Remember to wash your hands thoroughly after handling any tick or instruments that touched a tick. Clean and disinfect any instruments that were used.
- Most tick bites are probably harmless and may cause no problems. Ticks that have never fed, if handled properly, will not cause any harm. The earlier a tick is removed, the less the likelihood that the tick transmitted any disease.

Poison Ivy (*Rhus radicans*) Identification

- Three forms of poison ivy, 1) Erect woody shrub, 2) Running Shrub 3) Woody Vine.
- Three leaflets, two to four inches long, dull or glossy green with pointed tips.
- The middle leaflet is generally larger than the two laterals.
- The margins of the leaflets are variable, appearing irregularly toothed, lobed, or smooth.
- The leaves are positioned *alternately* on the stems.
- Woody vines grow on trees or objects for support and have aerial roots along the stem.

- **Treatment for Poison Ivy**
- Have a 'poison ivy action kit' ready, with rubbing alcohol,
- a large bottle of water, some soap and gloves,
- Cleanse exposed areas with rubbing alcohol.
- Next, wash the exposed areas with water only (no soap yet, since soap can move the urushiol, which is the oil from the poison ivy that triggers the rash, around your body and actually make the reaction worse).
- Now, take a shower with soap and warm water.
- Lastly, put gloves on and wipe everything you had with you, including shoes, tools, and your clothes, with rubbing alcohol and water.
- Apply Ivy-Block to exposed areas to prevent Poison Ivy.

Do NOT burn these poisonous plants! The smoke will irritate your skin badly, and if it enters your nasal passages, throat and lungs it will likely cause serious problems and could result in death.

Poison Oak Identification

- Grows in the Eastern United States (from New Jersey to Texas) as a low shrub.
- Grows in the Western United States (along the Pacific coast) as 6-foot-tall clumps or vines up to 30 feet long.
- Oak-like leaves, usually in clusters of three.
- Can have clusters of yellow berries.
- **Treatment for Poison Oak**
- Initial treatment consists of washing the area with water immediately after contact with the plants. To relieve symptoms, use wet compresses and take cool baths.
- Nonprescription antihistamines and calamine lotion also may help relieve symptoms.
- Moderate or severe cases of the rash may require treatment by a health professional, who may prescribe corticosteroid pills, creams, or ointments.

Do NOT burn these poisonous plants! The smoke will irritate your skin badly, and if it enters your nasal passages, throat and lungs it will likely cause serious problems and could result in death.

Poison Sumac Identification

- Grows exclusively in very wet or flooded soils.
- Ranges in eastern United States and Canada.
- Pinnate leaves, 25-50 cm long.
- 7 - 13 leaflets to each leaf, leaflets are 4-10 cm long.
- Red Leaf veins.
- Small white or grey berry, produced in panicles 10-20 cm long.
- Panicles distinguish it from other sumacs which have red berries.

Treatment for Poison Sumac

- Immediately wash everything that might have touched the plant.
- Soothe itching with cool, wet compresses.
- Add ground oatmeal (approximately 5 cups) or baking soda to a cool bath and soak for 15 to 30 minutes you can even add baking soda or epsom salts to your bath, or make a paste of either of these and apply it to the rash.
- Opt for lotions containing calamine, alcohol and zinc acetate; these will dry the blisters and help speed healing and leave rash open to air. That will help it heal.

- Take an oral antihistamine if you are extremely uncomfortable or if the rash is covering a large area of your body.

Do NOT burn these poisonous plants! The smoke will irritate your skin badly, and if it enters your nasal passages, throat and lungs it will likely cause serious problems and could result in death.

Wild Parsnip Identification

- Pinnately compound leaves, with a main stem and 5 to 15 leaflets.
- Yellow flowers, in flat-topped umbrella-like clusters at the top of the plant.
- Wild parsnip rosettes are among the first plants to become green in spring, and its flowers turn a prominent yellow in midsummer. After flowering and going to seed, plants die and turn brown in fall, but first year rosettes remain green until frost.
- Grows throughout the United States along: Roadsides, abandoned fields, unmowed pastures, edges of woods, prairie restorations.

Treatment for Wild Parsnip

- Take Ibuprophen for help with swelling and pain. The burned area can be covered with a cool, wet cloth. If blisters are present, do not pop them and if the blisters rupture, leave the skin "bandage" in place. To avoid infection, keep the area clean and apply an antibiotic cream.
- Adding Domeboro powder to cool cloth compresses can help dry any of the seeping blisters.
- Doctors will recommend a topical or systemic cortisone-steroid for extreme discomfort. See a doctor for serious cases.
- Washing with Fels-Naptha soap will not help.

Snakes

- leave snakes alone;
- wear rubber boots, long trousers and long sleeved shirts; the fangs of a snake will not normally penetrate such clothing;
- be noisy when walking in the bush; stamp your feet;
- look carefully when walking through grass; and
- do not place bare hands in hollow logs, under piles of wood or rubbish. **WEAR GLOVES.**

Snake Bite Victims

Most snake bites occur on the limbs, with 75% of reported cases being on the lower limbs. If anyone is bitten be more concerned about the casualty than about identifying the snake. Unconsciousness and breathing failure may occur. The only widely acceptable treatment for venomous snakebites involves the use of antivenin. If someone is bitten by a venomous snake, seek immediate medical attention at the nearest hospital or medical facility. Stay calm, remove any rings that could restrict circulation if tissues swell, keep the bitten limb below the level of the heart, and immediately seek medical attention.

Symptoms of Snake Bite

- headache
- double-vision
- drowsiness
- nausea
- pain or tightness in the chest or abdomen
- giddiness or faintness
- diarrhea

These symptoms do not appear immediately, but from about 15 minutes to 2 hours after being bitten. If a snake bite is suspected, act promptly and obtain medical assistance without delay - **HOWEVER, STAY CALM.**

Signs of Snake Bite

Look for:

- 2 puncture marks about 1 cm apart at the site of the bite, although sometimes they may only be a fang scratch on the skin (although this depends on the size of the snake)
- swelling of the area around the bite
- bruising
- sweating
- vomiting
- breathing difficulties

Management of Snake Bite Victims

- keep the victim at rest
- reassure the victim
- immediately apply a pressure immobilization bandage over the bitten area and around the limb
- apply the bandage firmly enough to compress tissues, but not so firmly as to restrict the flow of blood to the limb below the bandage
- bandage from the bite to the fingers or toes, then up to the armpit or groin

- bandage as much of the limb as possible
- if assistance is available, get them to seek medical aid urgently. It is better to wait for the arrival of an ambulance or ambulance officer rather then to move the victim, but isolation and other circumstances should determine what is to be done
- periodically observe and record the pulse and breathing
- carry out EAR/CPR if breathing or circulation fails

As a precaution: **Do not catch a snake and do not handle one unless you are sure it is not venomous.** In addition, for a short time after a snake is killed, its reflexes may continue to work. Those reflexes typically cause the body to writhe slowly for awhile, but they can cause a convulsive contraction and a bite, so you should not handle a freshly killed venomous snake. Though US medical professionals may not agree on every aspect of what to do for snakebite first aid, they are nearly unanimous in their views of what not to do. Among their recommendations:

WARNING - WHAT NOT TO DO

- **NEVER** wash the venom off the skin; the venom will help identify what type of snake is involved - EMERGENCY DECONTAMINATION PROCEDURES DO NOT APPLY;
- **NEVER** cut or excise the bitten area. Such measures have not been proven useful and may cause further injury.
- **NEVER** try to suck the venom out of the wound; and
- **NEVER** use a constrictive bandage or tourniquet. This cuts blood flow completely and may result in loss of the affected limb.
- **NEVER** ice or any other type of cooling on the bite. Research has shown this to be potentially harmful.

Timber Rattlers Identification

- The Timber Rattler is an endangered species.
- Adult timber rattlers average 35 to 50 inches in total length.
- The tail is short and thick, all black, and tipped with a tan rattle.
- Timber rattlers are diurnal (active during the day) and nocturnal (active after dark) in the summer, but only diurnal in the spring and fall.
- This venomous species can inflict a serious bite, and people are urged to walk away from them when encountered. Records show that there is a greater risk of being bitten if an attempt is made to kill them
- During the summer, they inhabit deciduous forests and open valleys. Rock fissures and crevices provide communal dens for over wintering.
- Timber rattlers begin emerging from hibernation in April to early May.

Treatment for Timber Rattlers

- Moderate symptoms will include mild swelling, discoloration, and pain at the wound site, and may also include general tingling, weakness, rapid pulse, and dimness of vision, nausea, vomiting, and shortness of breath.
- For moderate symptoms, apply a band 3/4 inch to 11/2 inches wide to the limb, 2 to 4 inches above the wound (but not around a joint, or on the head, neck, or trunk). Make it snug, but loose enough so you can slip a finger under it. Check the victim's pulse beyond the band periodically; to be sure blood is flowing past the band. Loosen the band if it becomes too tight.
- Severe symptoms include rapid swelling and numbness, followed by severe pain at the wound site; there may also be pinpoint-size pupils, facial twitching, slurred speech, convulsions, paralysis, and loss of consciousness. For severe symptoms, apply the band, and then make a shallow cut-just through the skin-through each fang puncture, 1/2 inch long and parallel with the long axis of the limb. (Make no cuts on the head, neck, or trunk). Apply a suction cup for 30 minutes, or use your mouth to such out the venom. Don't apply ice packs or any other kind of cold therapy. Continue treatment until you can get medical help. Most people who die of snakebite today die because they didn't seek medical help or delayed too long in going to the hospital. Preventive medicine is the best method for dealing with snakebites.
- Begin first aid treatment by keeping the victim calm and immobile, preferably lying down. Immobilize the bitten limb, at or below heart level. If the victim will be able to get to a hospital within 4 or 5 hours-and no symptoms develop-no more first aid is necessary.

4.0 HAZARDOUS FRESHWATER AND SALTWATER LIFE

Fin spines

Many fish have sharp spines in their fins that can cause puncture wounds if not handled properly. Although most do not have toxins/venom in their spines, the wound may still get infected if not properly cleansed and bandaged. Sharp teeth that may cause moderate to severe lacerations if not handled properly. The following sections provide examples of fishes and/or organisms that may require special handling or avoidance.

Stingrays

Stingray skin can be slippery, and need to be handled with gloves. If a stingray stings you, seek immediate medical attention. Infection can develop from bacteria entering the wound via seawater or from the stinger (spine) itself. A stingray spine can also break off in the wound and cause infection if it is not removed; however, **the spine is serrated, so if the spine breaks off in the wound, do not remove it yourself**. Instead, apply first aid for a puncture wound, including flushing/rinsing the wound with fresh water or hydrogen peroxide if available, and seek immediate medical attention. Sometimes the spine will stick into the person without breaking off of the animal. In this case, cut the spine from the animal close to the base of the tail, leaving as much of it sticking out of the wound as possible. The pain of the stingray toxin can be alleviated before reaching a medical facility by applying a heat compress to the wound or soaking it in clean, hot water which breaks down the protein-based toxin.

Catfishes

Catfishes have spines very similar to stingrays. Treat as you would for a stingray wound.

Scorpionfishes, Leatherjackets, Toadfishes

Some, if not all species of fish in these groups have poisonous spines in their dorsal, pectoral, and/or anal fins. The spines are very sharp and the toxin in them can cause varying degrees of reaction. By far, the scorpionfishes have the most potent toxin in their spines and some species can be much larger than others. In the case of being stung by any of these fish, apply first aid for a puncture wound, and watch for signs of reaction to the toxins. Seek medical attention if necessary. The pain of the toxin can be alleviated before reaching medical facilities by applying a heat compress to the wound or soaking it in clean, hot water.

Sea Urchins

Sea urchins have sharp spines that project out and protect their main body, or test, from all angles. While some species have poisonous or toxic spines, the primary hazard is from puncture wounds where the spine breaks off in the wound and the resulting infection. The spines, like the rest of the urchin's body, are primarily made of calcium that can be brittle and hard to remove. If someone gets stuck with urchin spines, flush the area well with water and hydrogen peroxide (if available). If the wound is large or there are large pieces of spine embedded in the wound, apply first aid as you would for a normal puncture wound and monitor for signs of allergic reaction to possible toxins. Applying a heat pack in the immediate area of the wound may relieve some of the pain associated with the toxin if it is present. It may be necessary to go to the hospital to get the pieces of spine removed.

Jellyfish

Most species of Jellyfish have stinging cells, called nematocysts, which trigger or "fire" upon touch. If jellyfish are encountered in the net, the use of gloves in handling them can prevent the person from being stung, as the nematocysts are usually very small and will not penetrate the glove. However, be cautious after handling jellyfish even with a glove, as some of the nematocysts can rub off and remain on the glove and still fire long after the jellyfish has been removed. If someone gets stung by a jellyfish, it is best to rinse the area with vinegar (do not use fresh water, as that can cause more nematocysts to fire). Different species of jellies have various levels of toxin in their sting. There is a potential for allergic reaction, so monitor the victim and seek medical attention if necessary.

Corals and Sponges

Corals and Sponges have stinging cells similar to Jellyfish. If someone is stung by a species of coral or sponge, treat the same as above for jellyfish.

Crabs/Crayfish/Lobsters

All of the above can have very strong and very sharp claws. Use caution when handling them.

Oysters/Mussels/Clams

Oysters and Mussels have extremely sharp edges that can cut easily. Care should be taken when handling and always wear gloves.

American Alligator (may encounter on land or in the water).

The best treatment for alligator wounds is avoidance or prevention of encounters. When left alone, alligators will stay away from humans and pose little threat. The springtime is when alligator breeding season begins in Florida. During breeding season, male alligators become very territorial and will defend their area against intruders. Following the breeding, in June-July, females will lay their eggs in nests created in the preceding months. These nests are mounds of mud, leaves and other vegetation and can be ~1 meter tall and ~2 meters wide. Look out for these nests near the shoreline of swamps, rivers, and estuaries, as female alligators remain near the nest, in nearby water or other shelter, throughout the incubation period, which averages 65 days, and will defend her nest if danger threatens. If someone is attacked by an alligator, apply first aid, including pressure to any open wounds, and seek immediate medical attention.

1.0 SCOPE

This SWP applies to all Golder Associates Inc. and Golder Construction Services (Golder) staff that work in the field in locations where there is potential for heat stress conditions to develop.

2.0 HEAT STRESS

Employees may experience heat stress due to a combination of elevated ambient temperatures and the concurrent use of personal protection equipment; this depends in part on the location of the site, the type of work, and the time of year. The project manager (PM) should consider the need to monitor heat stress during the project planning stage. The Site Safety Officer (SSO) and/or field staff will evaluate heat stress using the techniques specified below whenever the ambient temperature exceeds 21^{o}C or 70^{o}F.

3.0 HEAT STRESS RELATED PROBLEMS

- **Heat Rash** - caused by continuous exposure to heat and humid air and aggravated by chafing clothes. Decreases ability to tolerate heat, as well as being a nuisance;
- **Heat Cramps** - caused by profuse perspiration with inadequate fluid intake and chemical replacement. Signs: muscle spasms and pain in the extremities and abdomen;
- **Heat Exhaustion** - caused by increased stress on various organs to meet increased demands to cool the body. Signs: shallow breathing; pale, cool, moist skin; profuse sweating; dizziness, and lassitude. If symptoms occur, the employee should leave the work area and proceed to the nearest air-conditioned location, drinks liquids such as water or Gatorade, and rest until the symptoms pass. Contact the Golder PM immediately; and
- **Heat Stroke** - the most severe form of heat stress. Body must be cooled immediately to prevent severe injury and/or death. Signs: red, hot, dry skin; no perspiration; nausea; dizziness and confusion; strong, rapid pulse; coma. Medical help must be obtained immediately. If heat stroke is suspected, implement emergency response plan. Remove excess clothing and cool the person by sponging with cool or luke warm water. Never place ice on the person or throw water on the individual. Contact the Golder Project Manager as soon as time permits.

4.0 HEAT STRESS MANAGEMENT

4.1 Heat Stress Monitoring

The American Conference of Governmental Industrial Hygienists (1992) states that workers should not be permitted to work when their deep body temperature exceeds 38°C (100.4°F).

For strenuous field activities that are part of ongoing site work activities in hot weather, the following procedures shall be used to monitor the body's physiological response to heat, and to monitor the work cycle of each site worker. There are two phases to this monitoring: initial work/rest cycle determination and physiological monitoring. The initial work/rest cycle is used to estimate how long the first work shifts

of the day should be. Heart rate monitoring of each worker will establish the length of the successive work periods.

4.2 Determination of Initial work/Rest Cycles

Measure the air temperature with a standard thermometer. Estimate the fraction of sunshine by judging what percent the sun is out: 100% sunshine - no cloud cover = 1.0; 50 % sunshine and 50% cloud cover = 0.5; 0% sunshine = full cloud cover = 0.0.

Plug these variable into the following equation to determine the adjusted temperature:
T (^{o}C, adjusted) = T (^{o}C, actual) + (7.2 x fraction sunshine)

Use the chart below to determine the length of the first work shift. At the first break, initiate the heart rate monitoring as described in the next section.

ADJUSTED TEMPERATURE	NORMAL WORK CLOTHING	IMPERMEABLE CLOTHING
21^{o} - 25^{o}C (70-77^{o}F)	150 Minutes	120 Minutes
25^{o} - 28^{o}C (77-82^{o}F)	120 Minutes	90 Minutes
28^{o} - 31^{o}C (82-88^{o}F)	90 Minutes	60 Minutes
31^{o} - 32^{o}C (88-90^{o}F)	60 Minutes	30 Minutes
>32^{o}C (>90^{o}F)	45 Minutes	15 Minutes

4.3 Heart Rate Monitoring

Heart rate (HR) should be measured by radial pulse for 30 seconds as early as possible in the resting period. The HR at the beginning of the rest period should not exceed 110 beats/minute. If the HR is higher, the next work period should be shortened by 33 percent while the length of the rest period stays the same. If the pulse rate still exceeds 110 beats/minute at the beginning of the next rest period, the following work period should be further shortened by 33 percent while the length of the rest period stays the same.

4.4 Heat Stress Prevention

The best approach is preventive heat stress management. In general:

- have workers drink additional water before beginning work;

- provide disposable cups of water that is maintained at 10 to 16^{o}C (50 to 60 ^{o}F);
- urge workers to drink one to two cups of water every 20 minutes or at each rest break for a total of four to eight litres per day;
- provide a cool, preferably air-conditioned area for rest breaks;
- discourage the drinking of alcohol at night and discourage the intake of coffee during working hours;
- monitor for signs of heat stress;
- acclimatize workers to site work conditions by slowly increasing workloads, i.e., do not begin site work activities with extremely demanding activities; and
- Reschedule your work hours so that you are not working in the heat of the day between 10 am and 2 pm.

4.5 Sun Protection

- Employees are encouraged to maximize use of the shade provided by trees, buildings and other structures. Where there is limited access to natural shade, fixed or portable shade structures may be used and will be provided where practical.
- Rotate your work with others between indoor/shaded areas and outdoor/exposed locations to minimize time spent in the sun.
- The selection of appropriate protective clothing will take into account both the need to block out UV and the need to reduce the effects of heat.
- It is recommended that Golder employees tight woven clothing which has a minimum UPF of at least 30. Clothing should be lightweight, loose fitting and have a collar to assist with keeping cool.
- Hats provide shade and the bigger the brim the greater the amount of shade that is provided. Hats should be made of close-weave material and have a wide brim or be legionnaire-style. In circumstances where the wearing of a broad-brimmed hat causes difficulties due to their size sunscreen and other protective measures should be used instead.
- Safety glasses will be supplied to protect the eyes from effects of UV radiation and potential eye injuries from flying objects, dust or chemical splashes. Safety glasses complying with **ANSI Z87.1-2003** are recommended.
- Sunscreen does not offer complete protection and should always be used in conjunction with other protection such as protective clothing. Broad spectrum and water-resistant sunscreen with a sun protection factor (SPF) of 30+ should be used.
- Staff using sunscreen are encouraged to regularly check use by dates to ensure sunscreen is not out of date.
- Sunscreen will be placed in an easily accessible location and employees instructed in correct application and use. Sunscreen should be generously applied to all areas of exposed skin at least twenty minutes before going outside and should be reapplied at least every two hours.

1.0 SCOPE

This SWP applies to all Golder Associates Inc. and Golder Construction Services (Golder) staff that work in the field in locations where there is potential for cold stress conditions to develop.

2.0 COLD ENVIRONMENT – COLD STRESS

In a cold environment, body heat must be conserved to maintain the core temperature at normal levels and to ensure an adequate blood flow to the brain and extremities. Feelings of cold and discomfort should not be ignored, since these may be early warning signals. The effects of cold are such that problems can occur before the worker is aware of them, and furthermore, over-exposure to cold may affect judgment.

3.0 MAIN FACTORS INVOLVED IN CAUSING COLD STRESS

- Temperature
- Humidity
- Movement of air
- Radiant temperature of the surroundings
- Clothing/physical activity

4.0 COLD STRESS RELATED PROBLEMS

- Frostbite is a condition in which the skin and underlying tissues freeze. Usually affects fingers, hands, toes, feet, ears and nose.
- Hypothermia is a condition in which a person's body temperature falls below 95^0 F or 35 degrees Centigrade. Hypothermia occurs when more heat is lost from the body than the body can produce. It usually happens when a person is exposed to extremely cold temperatures but it can occur even at moderate temperatures. It does not have to be freezing outside for a person to become hypothermic. For example, falling into cold water or wearing wet clothing in cold weather can bring on hypothermia. Failing to wear a hat in cold weather can also lead to hypothermia, since a large amount of body heat escapes from the head. Extreme fatigue, hunger or lack of fluids can also lead to hypothermia. As well, excessive wind can increase the amount of heat lost and cause hypothermia.

5.0 FROSTBITE MANAGEMENT

- Move person to a warm dry area. Don't leave the person alone.
- Minimize walking on frozen feet.
- Do not apply any lotions or ointments to frozen skin.
- Remove any wet or tight clothing that may cut off blood flow to the affected area.
- DO NOT rub the affected area, because rubbing causes damage to the skin and tissue.

- Gently place the affected are in a warm (105ºF) water bath and monitor the water temperature to slowly warm the tissue. Don't pour warm water directly on the affected area because it will warm the tissue too fast causing tissue damage. Warming takes about 25-40 minutes.
- After the affected area has been warmed, it may become puffy and blister. The affected area may have a burning feeling or numbness. When normal feeling, movement, and skin color have returned, the affected area should be dried and wrapped to keep it warm. NOTE: If there is a chance the affected are may get cold again, do not warm the skin. If the skin is warmed and then becomes cold again, it will cause severe tissue damage.
- Seek medical attention as soon as possible and contact the Site Safety Officer.

6.0 HYPOTHERMIA MANAGEMENT

The most obvious sign of hypothermia is a low core body temperature. The person with hypothermia may not realize that his or her prolonged exposure to cold requires emergency medical care. Other signs and symptoms include:

- apathy or loss of interest in surroundings
- lethargy or difficulty moving
- confusion
- drowsiness
- loss of coordination
- cold skin
- shock caused by decreased blood flow
- slurred speech
- uncontrollable shivering
- weakness

If a person is suspected of suffering from hypothermia, contact the Site Safety Officer, and apply first aid.

6.1 What should be done (land):

- Move the person to a warm, dry area. Don't leave the person alone. Remove any wet clothing and replace with warm, drying clothing or wrap the person in blankets.
- Have the person drink warm, sweet drinks (sugar water or sports-type drinks) if they are alert. Avoid drinks with caffeine (coffee, tea or hot chocolate) or alcohol.
- Have the person move their arms and legs to create muscle heat. If they are unable to do this, place warm bottles or hot packs in the arm pits, groin, neck and head areas. DO NOT rub the person's body or place them in a warm bath. This may stop their heart.

6.2 What should be done (water):

- DO NOT remove any clothing. Button, buckle, zip and tighten any collars, cuffs, shoes, and hoods because the layer of trapped water closest to the body provides a layer of

insulation that slows the loss of heat. Keep the head out of the water and put on a hat or hood.

- Get out of the water as quickly as possible or climb on anything floating. DO NOT attempt to swim unless a floating object technical water rescue can be reached because swimming or other physical activity uses the body's heat and reduces survival time by about 50 percent.
- If getting out of the water is not possible, wait quietly and conserve body heat by folding arms across the chest, keeping thighs together, bending knees, and crossing ankles. If another person is in the water, huddle together with chests held closely.

7.0 PRECAUTIONS

- Use the buddy system.
- Recognize the environment and workplace conditions that lead to potential cold-induced illnesses and injuries.
- Learn the sign and symptoms of cold induced illnesses/injuries and what to do to help the worker.
- Dress appropriately for expected weather conditions. Dress in a minimum of three layers (a skin layer to absorb moisture and keep the skin dry, an insulating layer, and an outer protective layer), wear a hat and gloves, in addition to underwear that will keep water away from the skin.
- Take frequent short breaks in warm dry shelters to allow the body to warm up.
- Perform work during the warmest part of the day.
- Eat warm, high calorie foods like hot pasta dishes.
- Avoid vasodilators, which allow the body to lose heat faster - which can accelerate hypothermia. These include alcohol and drugs;
- Avoid vasoconstrictors, including tobacco products, which constrict blood vessels and can accelerate the onset of frostbite;
- Avoid touching cold metal with bare skin; and
- Keep active.

1.0 SCOPE

This SWP applies to all Golder Associates Inc. and Golder Construction Services (Golder) staff that work in the field in locations where there is potential inclement weather conditions to develop.

2.0 INTRODUCTION

Severe weather can occur at any hour of the day and any day of the year. Hurricanes, hailstorms, tornadoes, snowstorms, ice storms, wind storms, floods, severe cold, heat waves and drought occur daily.

2.1 TORNADOES/SEVERE WEATHER

Tornadoes are nature's most violent storms. They are most frequently reported east of the Rocky Mountains during spring and summer months. Peak tornado season in the southern states is March through May; in the northern states, it is late spring through early summer. Tornadoes are most likely to occur between 3 p.m. and 9 p.m., but can occur at any time.

Tornadoes generally occur near the trailing edge of a thunderstorm; however, it is not uncommon to see clear, sunlit skies behind a tornado. Some tornadoes are clearly visible, while rain or nearby low-hanging clouds obscure others. Occasionally, tornadoes develop so rapidly that little, if any, advance warning is possible. Before a tornado hits, the wind may die down and the air may become very still. A cloud of debris can mark the location of a tornado even if a funnel is not visible. Winds are generally in excess of 100 miles per hour but can be as high as 300 mph.

Whenever weather conditions develop that indicate tornadoes are expected, the National Weather Service issues a tornado watch to alert people in a designated area for a specific time period. The tornado watch is upgraded to a tornado warning when a funnel cloud is actually sighted. Tornadoes are often preceded by large hail, which follows shortly after the heavy rains and gusts from a thunderstorm have already passed.

What to do before a Tornado:

Be alert to changing weather conditions. If you see approaching storms or any of the danger signs, be prepared to take shelter immediately.

Look for the following danger signs:

- Dark, often greenish sky
- Large hail
- A large, dark, low-lying cloud (particularly if rotating)
- Loud roar, similar to a freight train.

Hazards and Possible Consequences:

Some of the hazards associated with tornadoes include:

- Lightning;
- High winds;
- Heavy rain; and
- Hail.

The most serious hazard caused by severe weather is lightning and heavy winds. The most serious hazard caused by tornadoes is from the force of violent wind strength and the fact that these same winds project dangerous debris through the air.

Secondary hazards include the following:

- Flash flooding;
- Electric power outages;
- Transportation-system and communication-system disruption; and
- Fires.

Control Measures:

Actions to be taken during severe weather include:

- If severe weather strikes without warning, take cover immediately.
- Seek shelter in designated shelters, basement, storm cellar, hallways or under furniture or other solid structure; or the lowest building level. If there is no basement, go to the center of an interior room on the lowest level away from corners, windows, doors, and outside walls. Put as many walls as possible between you and the outside.
- Remain calm. Do not run, push, or panic;
- Do not open windows;
- Do not use telephones except to report a site emergency;
- Use a battery operated radio in case of a power failure;
- Do not leave the shelter unless directed to do so by your Supervisor (if applicable); and
- Wait for the “All Clear” announcement, (30 minutes after last thunder/lightning event), if applicable.

2.2 HURRICANES

A hurricane is a type of tropical cyclone, the generic term for a low pressure system that generally forms in the tropics. The Atlantic hurricane season lasts from June to November, with the peak season from mid-August to late October. Hurricanes and tropical storms can also spawn tornadoes and microbursts, create storm surges along the coast, and cause extensive damage from heavy rainfall. Winds can exceed 155 miles per hour. Hurricanes are classified into five categories based on their wind speed,

central pressure, and damage potential. Category Three and higher hurricanes are considered major hurricanes, though Categories One and Two are still extremely dangerous and warrant your full attention.

Hazards and Possible Consequences:

- Hurricane Winds
- Rainfall and Flooding
- Storm Surge
- Tornadoes

3.0 COMMUNICATIONS

The Site Safety Officer will act as the Golder Incident Coordinator during all hurricane events. He/she will monitor the National Oceanic and Atmospheric Administration (NOAA) broadcasts and the instructions of local authorities. He/she will notify all facility site staff of the Hurricane status, Shutdown Orders, and Evacuation Orders.

If a hurricane is likely in your area, you should:

- Listen to the radio or TV for information.
- Secure the building, close storm shutters, and secure outdoor objects or bring them indoors.
- Turn off utilities if instructed to do so. Otherwise, turn the refrigerator thermostat to its coldest setting and keep its doors closed.
- Turn off propane tanks. Avoid using the phone, except for serious emergencies.
- Ensure a supply of water for sanitary purposes such as cleaning and flushing toilets. Fill large containers with water.

If you're at the site 36 hours before the predicted arrival of a hurricane:

- Survey site grounds and pick up all loose items and debris.
- Move all barricading materials, such as sandbags and plywood to areas where they will be installed.
- Notify contractors to secure their areas.
- Remove all trailers and scaffolding from site.
- Review hurricane preparedness plan with all personnel.
- Dismiss all site personnel.
- Secure vehicles as needed.
- Bring in outdoor equipment and anchor items that cannot be brought in.
- Close and board up windows.

4.0 WINTER STORMS

Heavy snowfall and extreme cold can immobilize an entire region. Even areas that normally experience mild winters can be hit with a major snowstorm or extreme cold. Winter storms can result in flooding, storm surge, closed highways, blocked roads, downed power lines and hypothermia. Some indicators of a winter storm are freezing rain, sleet, frost/freeze and blizzards.

Freezing Rain: Rain that freezes when it hits the ground, creating a coating of ice on roads, walkways, trees, and power lines.

Sleet: Rain that turns to ice pellets before reaching the ground. Sleet also causes moisture on roads to freeze and become slippery.

Blizzard: Sustained winds or frequent gusts to 35 miles per hour or greater and considerable amounts of falling or blowing snow (reducing visibility to less than a quarter mile) are expected to prevail for a period of three hours or longer.

Add the following supplies to your disaster supplies kit:

- Rock salt to melt ice on walkways
- Sand to improve traction
- Snow shovels and other snow removal equipment

Guidelines:

- Listen to your radio, television, or NOAA Weather Radio for weather reports and emergency information.
- Eat regularly and drink ample fluids, but avoid caffeine and alcohol.
- Conserve fuel.
- Maintain ventilation when using kerosene heaters to avoid build-up of toxic fumes. Refuel kerosene heaters outside and keep them at least three feet from flammable objects.

If you are outdoors:

- Avoid overexertion when shoveling snow. Overexertion can bring on a heart attack-a major cause of death in the winter. If you must shovel snow, stretch before going outside.
- Cover your mouth. Protect your lungs from extremely cold air by covering your mouth when outdoors. Try not to speak unless absolutely necessary.
- Keep dry. Change wet clothing frequently to prevent a loss of body heat. Wet clothing loses all of its insulating value and transmits heat rapidly.
- Watch for signs of frostbite. These include loss of feeling and white or pale appearance in extremities such as fingers, toes, ear lobes, and the tip of the nose. If symptoms are detected, get medical help immediately.

- Watch for signs of hypothermia. These include uncontrollable shivering, memory loss, disorientation, incoherence, slurred speech, drowsiness, and apparent exhaustion.

If you are driving:

Drive only if it is absolutely necessary. If you must drive, consider the following:

- Travel in the day, don't travel alone, and keep others informed of your schedule. Stay on main roads; avoid back road shortcuts.

If a blizzard traps you in the car:

- Pull off the highway. Turn on hazard lights and hang a distress flag from the radio antenna or window.
- Remain in your vehicle where rescuers are most likely to find you. Do not set out on foot unless you can see a building close by where you know you can take shelter. Be careful; distances are distorted by blowing snow. A building may seem close, but be too far to walk to in deep snow.
- Run the engine and heater about 10 minutes each hour to keep warm. When the engine is running, open a downwind window slightly for ventilation and periodically clear snow from the exhaust pipe. This will protect you from possible carbon monoxide poisoning.
- Exercise to maintain body heat, but avoid overexertion. In extreme cold, use road maps, seat covers, and floor mats for insulation. Huddle with passengers and use your coat for a blanket.
- Take turns sleeping. One person should be awake at all times to look for rescue crews.
- Drink fluids to avoid dehydration.
- Be careful not to waste battery power. Balance electrical energy needs - the use of lights, heat, and radio - with supply.
- Turn on the inside light at night so work crews or rescuers can see you.
- Leave the car and proceed on foot - if necessary - once the blizzard passes.

1.0 SCOPE

This SWP applies to Golder Associates Inc. and Golder Construction Services (Golder) staff working on a project where soil sampling is conducted.

2.0 DEFINITIONS

Photo ionizing air monitoring instrument (PID): A direct reading air monitoring instrument equipped with an ultraviolet light source that ionizes organic vapors with ionization potentials less than that of the lamp.

Flame ionizing air monitoring instrument (FID): A direct reading air monitoring instrument equipped with a hydrogen flame that ionizes (through combustion) all combustible organic vapors.

3.0 KEY POTENTIAL HAZARDS

- Chemical exposure via inhalation, skin contact or ingestion (See Chemical Exposure Risks SWP).
- Heat or cold stress (See Inclement Weather, Heat Stress and Cold Stress SWPs).
- Lightning and high winds.
- Drilling (See Drilling SWP).
- Motor vehicles (See Motor Vehicles and Driving on Company Business SWPs)
- Slip, Trip and Fall (See Slips, Trips and Falls SWP)
- Electrical device hazards
- Excavations (See Trenching and Shoring SWP).
- Working near or over water (See Working Over Water SWP).
- Heavy lifting.
- Insect bites and stings (See Biological Exposure Risks SWP).

If any of these hazards are anticipated on the project site, the corresponding SWP must be included in the Health and Safety Plan (HASP).

4.0 CHEMICAL HAZARDS

Sampling soils involves obtaining representative samples from waste piles, beneath bodies of water, on level or sloped grounds, and in excavations. Avoid direct contact between contaminated soil and any skin surface or eyes.

Air monitoring should be performed utilizing an intrinsically safe photo ionizing (PID) or flame ionizing (FID) instrument. Action levels for exposure measurements should be made based on the anticipated contaminants present, exposure controls in place, and personal protective equipment (PPE).

Maintain material safety data sheets (MSDS) or equivalent for all chemicals of concern at the site. Detailed chemical safety information can be found at www.osha.gov and www.cdc.gov/NIOSH.

5.0 PRECAUTIONS

Sampling for contaminated soils or sludges often occurs at sites that are known hazardous waste sites or adjacent to such sites. Follow all local regulations in regards to working at such properties.

This project presents construction related hazards such as trips, falls, and slips, and resulting injuries which are typical of undeveloped or industrial sites

- Wear proper footwear, including steel toes for earthwork;
- Clean boots and testing equipment, since slips may result from mud on a hard surface;
- Never jump across obstacles (ie: anchor trenches) and
- Do not walk on improvised plank bridges across ditches or anchor trenches unless they have been inspected by a competent person.
- Observe site traffic rules and right-of-way practices at all times. Heavy equipment and trucks should be assumed to have the right-of-way. Generally, the following rules apply to determining the right-of-way:
- Heavier equipment has the right-of-way.
- Loaded trucks and equipment have precedence over unloaded ones.
- Equipment moving down slope has precedence over one going upslope.
- Other general site vehicle operation rules are as follows:
- Observe speed limits within the site which usually do not exceed 15 miles per hour;
- Do not follow another vehicle too closely as material may fall off the vehicle or be thrown by the tires when in motion;
- Large equipment may have a significant “blind spot” on the right side of the vehicle. Avoid passing heavy equipment unless specifically instructed to do so by the operator of that equipment. Assume the equipment operator does not know you are present in an area and maneuver accordingly;
- Listen for and heed back-up alarms from heavy equipment and
- When possible, make eye contact with equipment operators.
- Park the company vehicle near the work location to mark your presence in the area. Wear high visibility clothing (reflective vests) to aid the operator in noticing your presence. Use extreme caution when operating in dusty conditions. Drive with your headlights on to increase your visibility. If conditions become dusty and significantly reduce visibility across the site, leave the area and wait for conditions to improve and contact the Golder Project Manager.
- Do not ride on the contractor’s equipment, and do not attempt to operate any such equipment.
- Do not ride on anything that does not have a seat designed for human occupancy.
- Wear your seatbelt at all times when operating a motor vehicle.
- Wear proper footwear including steel toes for earthwork.

- Wear long pants and long sleeved shirts.
- Clean boots and testing equipment as needed, since slips may result from mud on a hard surface.
- Never jump across obstacles (i.e.: anchor trenches).
- Do not walk on improvised plank bridges across ditches or anchor trenches unless they have been inspected and approved by a competent person.
- Wear high visibility clothing (reflective vests) to help motor vehicle operators notice your presence.

When traversing a site on foot, or when operating a motor vehicle, observe site traffic rules and right-of-way practices at all times. Heavy equipment and trucks should be assumed to have the right-of-way.

6.0 MINIMUM PERSONAL PROTECTIVE EQUIPMENT REQUIRED

- Hard hat, as required
- Safety glasses (splash goggles should be made available depending on the known hazards that may be present in the groundwater)
- Respirator with appropriate cartridges, as required
- High visibility clothing (reflective vest)
- Steel-toed and shank safety boots
- Nitrile gloves (or appropriate gloves depending on the known hazards that may be present in the groundwater)

7.0 TRAINING

- OSHA 10-hour Construction Safety
- Emergency First Aid/CPR Course
- Golder and/or site-specific training (including HASP review)
- Emergency and First Aid Course.

1.0 SLIPS, TRIPS AND FALLS

Over half of all office injuries are the result of falls. The majority of falls occur on slippery, uneven, defective, cluttered or obstructed walking surfaces. A significant number of debilitating falls are the result of a person falling out of his or her own chair, typically while in the process of sitting down, or leaning back. Falls from elevations while reaching for an overhead object are also common, and frequently cause severe injuries.

2.0 PRECAUTIONS WHEN IN THE OFFICE - HOUSEKEEPING

- Watch your step! Wipe up spilled liquids immediately. Tripping hazards such as defective floors, missing floor tiles, loose or matted carpeting, bunched-up floor mats, extension cords, phone cords, etc., should be corrected or reported and repaired immediately. Don't carry loads that are so large or bulky that the line of vision is impaired.
- Be careful when sitting down. Sitting on the edge of a seat, sitting too far back, or kicking the chair out from under one's self can result in a fall and fractured vertebrae. Occasionally check the mechanical condition of chairs commonly used.
- Be especially careful going up and down stairs. Avoid using stairs if both arms are loaded. Watch your step and if possible always have one hand free to use a railing. Maintain 3 points of contact when ascending/descending.

3.0 PRECAUTIONS WHEN OUT IN THE FIELD

In the field, falls are the second leading cause of work-related deaths.

4.0 TYPES OF FALLS

Falls are of two basic types: elevated falls and same-level falls. Same-level falls are most frequent, but elevated falls are more severe.

- Same-Level Falls: high frequency--low severity
- Elevated Falls: lower frequency--high severity

Same-level falls are generally slips or trips. Injury results when the individual hits a walking or working surface or strikes some other object during the fall. Over 60 percent of elevated falls are from less than 10 feet.

5.0 SAME-LEVEL FALLS

Examples of same-level falls are described below.

6.0 SLIP AND FALL

Slips are primarily caused by a slippery surface and compounded by wearing the wrong footwear. In normal walking, two types of slips occur. The first of these occurs as the heel of the forward foot contacts the walking surface. Then, the front foot slips forward, and the person falls backward.

The second type of fall occurs when the rear foot slips backward. The force to move forward is on the sole of the rear foot. As the rear heal is lifted and the force moves forward to the front of the sole, the foot slips back and the person falls.

The force that allows you to walk without slipping is commonly referred to as "traction." Common experience shows that dry concrete sidewalks have good traction, while icy surfaces or freshly waxed floors can have low traction. Technically, traction is measured as the "coefficient of friction." A higher coefficient of friction means more friction, and therefore more traction. The coefficient of friction depends on two things: the quality of both the walking surface and the soles of your shoes.

To prevent slips and falls, a high coefficient of friction (COF) between the shoe and walking surface is needed. On icy, wet, and oily surfaces, the COF can be as low as 0.10 with shoes that are not slip resistant. A COF of 0.40 to 0.50 or more is needed for excellent traction. To put these figures in perspective, a brushed concrete surface and a rubber heel will often show a COF greater than 1.0. Leather soles on a wet smooth surface, such as ceramic tile or ice, may have a COF as low as 0.10.

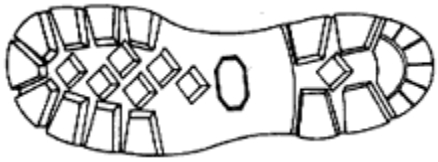


Figure 1. Shoes with soft rubber soles and heels with rubber cleats provide a high coefficient of friction (COF).

Providing dry walking and working surfaces and slip-resistant footwear are the answer to slips and their resultant falls and injuries. Obviously, high heels, with minimal heel-to-surface contact, taps on heels, and shoes with leather or other hard, smooth-surfaced soles lead to slips, falls, and injuries. Shoes with rubber-cleated, soft soles and heels provide a high COF and are recommended for most agricultural work.

In work areas where the walking and working surface is likely to be slippery, non-skid strips or floor coatings should be used. Since a COF of 0.40 to 0.50 is preferred for walking and working surfaces, we should strive for a surface which provides a minimum of 50 percent of this friction. If the working surface is very slippery, no footwear will provide a safe COF.

Trip and Fall Trips occur when the front foot strikes an object and is suddenly stopped. The upper body is then thrown forward, and a fall occurs.

As little as a 3/8" rise in a walkway can cause a person to "stub" his toe resulting in a trip and fall. The same thing can happen going up a flight of stairs: Only a slight difference in the height of subsequent steps and a person can trip and fall.

7.0 CONTRIBUTING FACTORS

Proper housekeeping in work and walking areas can contribute to safety and the prevention of falls. Not only is it important to maintain a safe working environment and walking surface, these areas must also be kept free of obstacles which can cause slips and trips. One method which promotes good housekeeping in work environments is the painting of yellow lines to identify working and walking areas. These areas should never be obstructed by objects of any kind.

Adequate lighting to ensure proper vision is also important in the prevention of slips and falls. Moving from light to dark areas, or vice versa, can cause temporary vision problems that might be just enough to cause a person to slip on an oil spill or trip over a misplaced object.

Carrying an oversized object can also obstruct one's vision and result in a slip or a trip. This is a particularly serious problem on stairs.

8.0 BEHAVIORS THAT LEAD TO FALLS

In addition to wearing the wrong footwear, there are specific behaviors which can lead to slips, trips, and falls. Walking too fast or running can cause major problems. In normal walking, the most force is exerted when the heel strikes the ground, but in fast walking or running, one lands harder on the heel of the front foot and pushes harder off the sole of the rear foot; thus, a greater COF is required to prevent slips and falls. Rapid changes in direction create a similar problem.

Other problems that can lead to slips, trips and falls are: distractions; not watching where one is going; carrying materials which obstruct view; wearing sunglasses in low-light areas; and failure to use handrails. These and other behaviors, caused by lack of knowledge, impatience, or bad habits developed from past experiences, can lead to falls, injuries, or even death.

1.0 SCOPE

This SWP applies to Golder Associates Inc. and Golder Construction Services (Golder) staff working on a project where groundwater sampling is conducted.

2.0 DEFINITIONS

Photo ionizing air monitoring instrument – A direct reading air monitoring instrument equipped with an ultraviolet light source that ionizes organic vapors with ionization potentials less than that of the lamp.

Flame ionizing air monitoring instrument – A direct reading air monitoring instrument equipped with a hydrogen flame that ionizes (through combustion) all combustible organic vapors.

3.0 KEY HAZARDS

- Chemical exposure via inhalation, skin contact or ingestion (See Chemical Exposure Risks SWP);
- Compressed gases for calibration (See Compressed Gases SWP);
- Heat or cold stress (See Inclement Weather, Heat Stress and Cold Stress SWPs);
- Lightning and high winds (See Inclement Weather SWP);
- Drilling (See Drilling SWP);
- Motor vehicles (See Motor Vehicles and Driving on Company Business SWPs);
- Slips, Trips and Falls (See Slips, Trips and Falls SWP);
- Electrical device hazards;
- Excavations (See Trenching and Shoring SWP);
- Working near or over water (See Working Over Water SWP);
- Heavy lifting and
- Insect Bites and Stings (See Biological Exposure Risks SWP).

If any of these hazards are anticipated on the project site, the corresponding SWP must be included in the Health and Safety Plan (HASP).

4.0 CHEMICAL HAZARDS

Groundwater sampling often involves using line-operated pumps to extract water from the subsurface. Ensure that the generator utilized is equipped with ground fault interrupter (GFI) circuitry to prevent possible shock hazards. Collect development or purge water in containers as required for proper disposal. Use secure areas for waste storage to protect the public and client staff from investigation derived waste (IDW). If internal combustion engines (generators) are used, they must be in an area with adequate ventilation, and free of combustible materials (i.e. dry grass, gasoline, etc.).

Keep your face as far from the opening of the well as possible to avoid inhaling volatile contaminants. Avoid any direct contact with a skin surface or eyes with groundwater. Continuous air monitoring should be performed utilizing a photo ionizing or flame ionizing instrument that can measure a minimum of 0.5 PPM organic vapor. Calibrate the air monitoring instrument daily as described in the literature provided. In general, total organic vapor readings of less than 1 PPM are safe. Steady breathing zone measurements at 1 PPM or above warrant engineering controls (ventilation) or personal protective equipment (respiratory protection) to reduce exposure. Concentrations in the well opening that exceed 500 PPM could indicate a large quantity of organic vapor, which poses not only a toxicity risk, but also a flammability risk. Wells with high organic vapor concentrations should be sampled carefully with a minimum of ferrous tools or other sources of ignition.

The site-specific Health and Safety Plan (HASP) addressing both known and reasonably anticipated hazards should be prepared prior to the commencement of work. Chemical hazards and their means of detection and control should be reviewed prior to field mobilization.

Maintain material safety data sheets (MSDS) or equivalent for all chemicals of concern at the site including any chemicals required as part of the sampling program (i.e. calibration gas, sample preservatives, etc.). Detailed chemical safety information can be found at www.osha.gov and www.cdc.gov/NIOSH.

5.0 PRECAUTIONS

Sampling groundwater often occurs at sites that contain known hazardous wastes are adjacent to similar sites. Follow all local regulations in regards to working at such properties.

This project presents construction related hazards such as trips, falls, and slips, and resulting injuries which are typical of undeveloped or industrial sites

- Wear proper footwear, including steel toes for earthwork;
- Clean boots and testing equipment, since slips may result from mud on a hard surface;
- Never jump across obstacles (i.e.: anchor trenches) and
- Do not walk on improvised plank bridges across ditches or anchor trenches unless they have been inspected by a competent person.
- Observe site traffic rules and right-of-way practices at all times. Heavy equipment and trucks should be assumed to have the right-of-way. Generally, the following rules apply to determining the right-of-way:
- Heavier equipment has the right-of-way.
- Loaded trucks and equipment have precedence over unloaded ones.
- Equipment moving down slope has precedence over one going upslope.
- Other general site vehicle operation rules are as follows:
- Observe speed limits within the site which usually do not exceed 15 miles per hour;

- Do not follow another vehicle too closely as material may fall off the vehicle or be thrown by the tires when in motion;
- Large equipment may have a significant "blind spot" on the right side of the vehicle. Avoid passing heavy equipment unless specifically instructed to do so by the operator of that equipment. Assume the equipment operator does not know you are present in an area and maneuver accordingly;
- Listen for and heed back-up alarms from heavy equipment and
- When possible, make eye contact with equipment operators.
- Park the company vehicle near the work location to mark your presence in the area. Wear high visibility clothing (reflective vests) to aid the operator in noticing your presence. Use extreme caution when operating in dusty conditions. Drive with your headlights on to increase your visibility. If conditions become dusty and significantly reduce visibility across the site, leave the area and wait for conditions to improve and contact the Golder Project Manager.
- Do not ride on the contractor's equipment, and do not attempt to operate any such equipment.
- Do not ride on anything that does not have a seat designed for human occupancy.
- Wear your seatbelt at all times when operating a motor vehicle.

Because monitoring wells may provide habitat for insects such as bees, spiders, and wasps, use caution when initially opening the well. When opening the well protective cover, open the cover and stand back for a few minutes to allow any flying insects an opportunity to leave. Prior to removing the well cap, inspect the inside of the protective casing to make sure no inhabitants are present.

6.0 MINIMUM PERSONAL PROTECTIVE EQUIPMENT REQUIRED

- Hard hat, as required
- Safety glasses (splash goggles should be made available depending on the known hazards that may be present in the groundwater)
- Respirator with appropriate cartridges, as required
- High visibility clothing (reflective vest)
- Steel-toed and shank safety boots
- Nitrile gloves (or appropriate gloves depending on the known hazards that may be present in the groundwater)

7.0 TRAINING

- 40-hour HAZWOPER or equivalent local requirement (8-hour annual refresher required).
- OSHA 10-hour Construction Safety
- Emergency First Aid/CPR Course
- Golder and/or site-specific training (including HASP review)

8.0 REFERENCES

- 29 CFR 1910.1000: Air Contaminants

- 29 CFR 1926.59: Hazard Communication
- 29 CFR 1926 Subpart E: Personal Protective and Life Saving Equipment

1.0 SCOPE

This Standard Work Practice (SWP) applies to all Golder Associates Inc. and Golder Construction Services (Golder) staff that may experience a fire related hazard.

2.0 FIRE PROTECTION

All Golder offices will have an office specific Emergency Action Plan (EAP) and within that plan will contain a Fire Prevention and Response Plan (FPRP). Every employee must review the EAP and FPRP to familiarize with emergency response and fire safety within that office. The plans contain the requirements for providing safety procedures, emergency contact information, evacuation routes, muster points, etc.

Golder employees traveling outside of the office environment, performing work activities, and/or working on a job site who will be handling or near flammable materials, fueling/re-fueling, and/or transporting flammable materials shall review this SWP for fire protection.

3.0 DEFINITIONS

- Flammable materials are defined as any material which is easily ignited and capable of burning rapidly
- Fueling is defined as to supplying with any substance that is burned for heat or power, such as gasoline or diesel fuel

4.0 KEY HAZARDS

- Mild to severe burns
- Smoke inhalation (toxic fumes)
- Flammable gas, vapor or mist
- Chemicals with the potential to cause acute or chronic health effects
- Materials can become reactive or unstable over time

5.0 PRECAUTIONS

To protect against fire, the following risk control measures must be adopted:

- Smoking is prohibited indoors and in all areas where flammable, combustible or similar hazardous materials are stored or used, except in any locations specifically provided for such purposes
- Always be aware of the material you are working with, read the labels and Material Safety Data Sheets (MSDS). If there are still questions and/or concerns then contact trained health and safety personnel
- Ensure that the flammable substance is not of a sufficient quantity to create an explosive atmosphere if it is accidentally released

- Always store flammable substances in accordance to Occupational Safety and Health Administration (OSHA) regulations. The storage containers must be the proper container for the appropriate substance and must be properly labeled
- Mechanized equipment must be shut down prior to and during re-fuelling operations
- Do not use cell phones or other electronic devices during re-fuelling operations or when working near flammable substances that cause vapors, gasses, and/or mist
- Closed systems with an automatic shut-off that will prevent spillage if connections are broken may be used to fuel diesel powered equipment that is left running
- No re-fuelling activities will be conducted over water. When filling tanks for motor boats, the boat should be secured to the boat dock/jetty
- All re-fuelling operations shall be performed in the appropriate manner, avoiding fire hazards from cigarettes, electrical equipment, hot metal surfaces, and other relevant hazards. All sources of ignition are prohibited in areas where flammable liquids are stored, handled or processed. Suitable NO SMOKING signs shall be posted in all such areas
- Dispensing systems must be electrically bonded and grounded
- Observe precautions during re-fuelling operations in hot weather because tanks and containers may become pressurized at elevated temperatures
- Flashlights and electric lanterns used during handling of flammable liquids shall be of the types listed by the Underwriters Laboratories (UL), or other nationally recognized testing laboratory for use in hazardous areas
- Should the worker's clothing or skin become contaminated with the flammable material, it is imperative that the worker change their clothing immediately, avoiding any sparks or open flames that exist or may be created. Once they have removed the contaminated clothing, they must ensure that it is decontaminated prior to using it again. If the skin in contaminated, it should be washed as soon as possible
- Internal combustion engines other than vehicles should be located outside of hazardous locations whenever possible when flammable materials are present. This is because the vapors can cause flashback, and other serious concerns. If internal combustion engines are required to be in the hazardous location, they must be equipped with combustion air intake and a flame arresting device at the exhaust to diminish the fire hazard
- Catalytic converters on the underside of vehicles can become sufficiently hot to ignite dry grass. Employees should avoid driving over dry grass that is higher than the ground clearance of the vehicle, and be aware of the potential fire hazard posed by the catalytic converter at all times. Never allow a running vehicle to remain in a stationary position over dry grass or other combustible materials
- Fire extinguishers and first aid kits are required for all field projects and vehicles. Contact your office Health and Safety Coordinator (HSC) before the onset of travelling or the start of a project for the appropriate fire extinguisher for the task
- Before any flame/spark producing activities, request a hot work permit from a controlling entity and follow all requirements as required

6.0 EXTINGUISHER TYPES

When choosing the appropriate fire extinguisher, two things should be considered:

- The material you wish to protect

- The type of extinguishing agent that will be most effective at suppressing the possible type of fire caused by these materials

Fuel Source	Class of Fire	Type of Extinguisher (Extinguishing Agent)
Ordinary combustibles (e.g. trash, wood, paper, cloth)	A	Water; chemical foam; dry chemical
Flammable liquids (e.g. oils, grease, tar, gasoline, paints, thinners)	B	Carbon dioxide (CO_2); halon; dry chemical; Aqueous Film Forming Foam (AFFF)
Electricity (e.g. live electrical equipment)	C	CO_2; halon; dry chemical
Combustible metals (e.g. magnesium, titanium)	D	Dry powder (suitable for the specific combustible metal involved)

7.0 FIRE SUPPRESSION

For fire located in structures, portable fire extinguishers should only be used when:

- The fire is confined to a small area and is not growing
- Everyone has exited the building
- The fire department has been called or is being called
- The room is not filled with smoke

Vehicle fires also pose hidden dangers dependent upon what portion of the vehicle is involved. Typical hazards around burning vehicles include:

- Most vehicles contain a wide range of synthetic materials that when burned, release toxic gases and substances that can easily be inhaled or absorbed through the skin by direct contact
- Compressed gas cylinders/struts associated with hinge mechanisms under hoods, around hatch windows, bumpers, etc. present dangers
- Airbags, electrical hazards, and cooling systems all present dangers
- Magnesium components in the vehicles can react violently with the water
- Beware the contents of vehicles (propane cylinders, calibration gas, gas cans, etc.)
- **Never** approach a burning vehicle directly from the front or rear

8.0 EXTINGUISHER OPERATIONS

Only use a fire extinguisher compatible with the type of fire. When in doubt use an ABC fire extinguisher. To operate a fire extinguisher, remember the word PASS:

- **P**ull the pin. Hold the extinguisher with the nozzle pointing away from you, and release the locking mechanism
- **A**im low. Point the extinguisher at the base of the fire
- **S**queeze the lever slowly and evenly
- **S**weep the nozzle from side-to-side

Allow the fire department to make the determination that a fire has been extinguished.

9.0 PERSONAL PROTECTIVE EQUIPMENT

Personal Protective Equipment (PPE) will vary based on the activity and job requirements. However, when handling flammable material this additional PPE will be required:

- Gloves as specified in a chemical MSDS
- Safety glasses, goggles, and/or face shield as specified in a MSDS
- Approved container for storing flammable materials
- Flammable retardant clothing, as required

10.0 TRAINING

Every employee, as required, shall be trained in general principles of fire extinguisher use and the hazards involved in fire fighting before the job starts or any work activity begins. A refresher on fire protection shall be conducted at a minimum of once a year along with the EAP and FRPR. Additional training in handling, transporting, and/or identify flammable substances can include but not be limited to the following:

- OSHA 10 hour construction as required, as required
- HAZWOPER training, as required
- First-aid, Cardiopulmonary Resuscitation (CPR) and Automated External Defibrillator (AED) training, as required
- Site and chemical specific PPE training, as required

11.0 EXTINGUISHER INSPECTIONS

An inspection is a “quick check” to give reasonable assurance that a fire extinguisher is available, fully charged and operable. Inspections should always be conducted when extinguishers are initially placed in service and thereafter at approximately 30-day intervals. Remember to sign and date the inspection on the extinguisher tag.

12.0 EXTINGUISHER MAINTENANCE

Fire extinguishers should be maintained at regular intervals (at least once a year), or when specifically indicated by an inspection. Maintenance is a "thorough check" of the extinguisher by a trained professional and is intended to give maximum assurance that an extinguisher will operate effectively and safely. It includes a thorough examination and any necessary repair, recharging or replacement. Maintenance may reveal the need for hydrostatic testing of an extinguisher. A tag wired to the extinguisher should indicate the date of the extinguisher maintenance and who conducted the maintenance.

13.0 APPLICABLE OSHA REGULATION PARTS

- 29 Code of Federal Regulations (CFR) 1910 Subpart E and Subpart L
- 29 CFR 1910.157 (Fire Protection)

1.0 SCOPE

This Standard Work Procedure (SWP) applies to all Golder Associates Inc. and Golder Construction Services (Golder) staff working on projects where hand or portable power tools may be utilized by Golder staff.

2.0 HAND AND PORTABLE POWER TOOL SAFETY

Hand and power tools are a common part of our everyday lives and are present in nearly every industry. These tools help us to easily perform tasks that otherwise would be difficult or impossible. However, these simple tools can be hazardous and have the potential for causing severe injuries when used or maintained improperly. Special attention toward hand and power tool safety is necessary in order to reduce or eliminate these hazards. In the process of removing or avoiding the hazards, workers must learn to recognize the hazards associated with the different types of tools and the safety precautions necessary to prevent those hazards. The following risk control measures are suggested to reduce hazards associated hand and portable power tools:

2.1 General Safety Precautions

Employees who use hand and power tools and who are exposed to the hazards of falling, flying, abrasive and splashing objects, or exposed to harmful dusts, fumes, mists, vapors, or gases must be provided with the particular personal equipment necessary to protect them from the hazard. All hazards involved in the use of power tools can be prevented by following five basic safety rules:

- Keep all tools in good condition with regular maintenance.
- Use the right tool for the job.
- Examine each tool for damage before use.
- Operate according to the manufacturer's instructions.
- Provide and use the proper protective equipment.

Employees and employers have a responsibility to work together to establish safe working procedures. If a hazardous situation is encountered, it should be brought to the attention of the proper individual immediately

2.2 Hand Tools

By definition, hand tools are non-powered. They include anything from axes to wrenches. The greatest hazards posed by hand tools result from misuse and improper maintenance.

Some examples:

- Using a screwdriver as a chisel may cause the tip of the screwdriver to break and fly, hitting the user or other employees.

- If a wooden handle on a tool such as a hammer or an axe is loose, splintered, or cracked, the head of the tool may fly off and strike the user or another worker.
- A wrench must not be used if its jaws are sprung, because it might slip.
- Impact tools such as chisels, wedges, or drift pins are unsafe if they have mushroomed heads.
- The heads might shatter on impact, sending sharp fragments flying.

The employer is responsible for the safe condition of tools and equipment used by employees but the employees have the responsibility for properly using and maintaining tools. Employers should caution employees that saw blades, knives, or other tools be directed away from aisle areas and other employees working in close proximity. Knives and scissors must be sharp. Dull tools can be more hazardous than sharp ones.

Appropriate personal protective equipment, e.g., safety goggles, gloves, etc., should be worn due to hazards that may be encountered while using portable power tools and hand tools. Safety requires that floors be kept as clean and dry as possible to prevent accidental slips with or around dangerous hand tools.

Around flammable substances, sparks produced by iron and steel hand tools can be a dangerous ignition source. Where this hazard exists, spark-resistant tools made from brass, plastic, aluminum, or wood will provide for safety.

3.0 POWER TOOL PRECAUTIONS

Power tools can be hazardous when improperly used. There are several types of power tools, based on the power source they use: electric, pneumatic, liquid fuel, hydraulic, and powder-actuated.

Employees should be trained in the use of all tools - not just power tools. They should understand the potential hazards as well as the safety precautions to prevent those hazards from occurring.

The following general precautions should be observed by power tool users:

- Never carry a tool by the cord or hose.
- Never yank the cord or the hose to disconnect it from the receptacle.
- Keep cords and hoses away from heat, oil, and sharp edges.
- Disconnect tools when not in use, before servicing, and when changing accessories such as blades, bits and cutters.
- All observers should be kept at a safe distance away from the work area.
- Secure work with clamps or a vise, freeing both hands to operate the tool.
- Avoid accidental starting. The worker should not hold a finger on the switch button while carrying a plugged-in tool.

- Tools should be maintained with care. They should be kept sharp and clean for the best performance. Follow instructions in the user's manual for lubricating and changing accessories.
- Be sure to keep good footing and maintain good balance.
- The proper apparel should be worn. Loose clothing, ties, or jewelry can become caught in moving parts.
- All portable electric tools that are damaged shall be removed from use and tagged "Do Not Use."

4.0 ELECTRIC TOOLS

Employees using electric tools must be aware of several dangers; the most serious is the possibility of electrocution.

Among the chief hazards of electric-powered tools are burns and slight shocks which can lead to injuries or even heart failure. Under certain conditions, even a small amount of current can result in fibrillation of the heart and eventual death. A shock also can cause the user to fall off a ladder or other elevated work surface.

To protect the user from shock, tools must either have a three-wire cord with ground and be grounded, be double insulated, or be powered by a low-voltage isolation transformer. Three-wire cords contain two current-carrying conductors and a grounding conductor. One end of the grounding conductor connects to the tool's metal housing. The other end is grounded through a prong on the plug. Anytime an adapter is used to accommodate a two-hole receptacle, the adapter wire must be attached to a known ground. The third prong should never be removed from the plug.

Double insulation is more convenient. The user and the tools are protected in two ways: by normal insulation on the wires inside, and by a housing that cannot conduct electricity to the operator in the event of a malfunction.

These general practices should be followed when using electric tools:

- Electric tools should be operated within their design limitations.
- Gloves and safety footwear are recommended during use of electric tools.
- When not in use, tools should be stored in a dry place.
- Electric tools should not be used in damp or wet locations.
- Work areas should be well lighted.

5.0 REGULATORY CITATION

OSHA 29 CFR 1910 Subpart P - Hand and Portable Powered Tools and Other Hand-Held Equipment. General requirements: Each employer shall be responsible for the safe condition of tools and equipment used by employees, including tools and equipment which may be furnished by employees.

1.0 SCOPE

This Standard Work Procedures (SWP) applies to all Golder Associates Inc. and Golder Construction Services (Golder) staff working in high noise environments.

2.0 DEFINITION

Noise induced hearing loss is an insidious, debilitating disease. Employees are advised of the potentially harmful effects of excessive noise and should make every effort to limit their exposure both at work and at home. Although noise-induced hearing loss is one of the most common occupational illnesses, it is often ignored because there are no visible effects, it usually develops over a long period of time, and, except in very rare cases, there is no pain. What does occur is a progressive loss of communication, socialization, and responsiveness to the environment.

Work-related hearing loss continues to be a critical workplace safety and health issue. Noise-induced hearing loss is preventable, but once acquired, hearing loss is permanent and irreversible. Prevention measures must be taken by employers and workers to ensure the protection of workers' hearing. The following table below is the Occupational Safety and Health Administrations (OSHA) permissible sound exposure limits found in 29 Code of Federal Regulations (CFR) 1910.95 Table G-16.

Duration per day (hours of exposure)	Sound level (dBA, slow response)
8	90
6	92
4	95
3	97
2	100
1-1/2	102
1	105
1/2	110
1/4 or less	115

3.0 HAZARDS

Golder shall administer a hearing conservation program when employees are exposed to sounds equal or greater than 85 dB(A) on an 8 hour Time-Weighted Average (TWA) bases. Golder will provide earplugs and/or earmuffs to all employees who work where peak noise levels may equal or exceed 85 dB(A) at no cost to the employee. Unless specific noise readings are available to demonstrate otherwise, noise levels near heavy equipment, drill rigs, pile drivers, concrete coring devices, etc. should be assumed to equal or

exceed 85 dB(A). Employees shall use the issued hearing protection devices when in any of the following situations:

- When work area safety requirements include hearing protection
- When working in an area of steady state (continuous) noise that interferes with normal speech between individuals who are standing at a distance of three feet apart
- When working in an area of any impact noise (such as driving casing or piles) where the noise is loud enough to cause discomfort
- When in areas where signs are posted requiring hearing protection
- When noise levels measured with a properly calibrated sound level meter equal or exceed 85 dB(A)
- At sound levels at or above 105dB dual hearing protection must be implemented
- At no time shall employees be exposed to sounds either protected or unprotected above 115dB continuously or 140dB with impact/impulsive pressure.

4.0 POSSIBLE CONSEQUENCES

Permanent hearing loss or impairment can result from prolonged exposure to noise at levels above 85 dB(A) on an 8 hour TWA basis. Hearing loss or impairment can also result from shorter exposures at higher sound levels.

5.0 TRAINING

Employees required to work in areas where peak noise levels may equal or exceed 85 dB(A) will be provided with appropriate training regarding hearing conservation before commencing work in these areas. Training will include addressing ambient conditions, as well as changed conditions. Refresher training will be provided as conditions change, or, at a minimum, on an annual basis. Records of training will be maintained in the employee's personnel file, as required in 29 CFR 1910.95 and 1910.120.

6.0 MEDICAL MONITORING

All Golder technical employees participate in the company's medical monitoring program which includes annual or biennial physicals. The medical monitoring program consists of regular, annual, biennial, or periodic physical examinations including audiometric testing in accordance with 29 CFR 1910.95 and 29 CFR 1910.120(f). Prior to beginning employment with Golder, all new employees complete a pre-employment physical examination at no cost to the prospective employee that, among other items, includes a baseline audiogram for the employee. Prior to the baseline audiogram the employee must not be exposed to workplace noise by at least 14 hours. In the event that a standard threshold shift is determined during a regular, periodic audiogram, the employee will be notified within 21 days of the determination. In addition, employee work habits, Personal Protective Equipment (PPE) and site situations will be evaluated

to determine what alternative hearing conservation methods would be appropriate. This evaluation will be conducted in consultation with a qualified medical professional.

Medical monitoring results (including audiograms) are provided to the employee after completion of the physical examination and evaluation of the data by Golder's occupational medical physician or other licensed physician. Audiogram results are retained by Golder with the employee's medical monitoring records for a period of time in accordance with the provisions of 29 CFR 1910.95(m) and 1910.1020(d).

7.0 CONTROL MEASURES

- Where reasonable and practicable, Golder will reduce the worker's exposure to high noise situations through the use of engineering, and administrative controls. Should these controls not be sufficient or effective, PPE will be used to protect the worker
- Employees shall complete a hazard assessment prior to starting work in an area of high noise, to ensure that all hazards are accounted for, and the appropriate PPE is utilized. Employees shall comply with all ear plugs/muffs manufacturer's guidelines, and government standards regarding ear protection
- Noise levels will be monitored at regular intervals throughout the work period to ensure worker safety. If the noise monitoring confirms excessive noise at a worksite, sound level measurements will be used to evaluate the efficacy of the planned PPE. In the event that planned PPE will not provide sufficient hearing protection, the site safety contact will consult with the office or regional Health and Safety Coordinator to develop an alternative approach to protect worker hearing
- Hearing protection PPE will be inspected prior to the start of work each day to ensure that the PPE is functioning as designed, and if the PPE is in anyway compromised, it is replaced. Hearing PPE will be provided by Golder at no cost to the employee

8.0 PERSONAL PROTECTIVE EQUIPMENT

- Ear plugs (Compliant with American National Standards Institute (ANSI) S3.19-1974.)
- Ear muffs (Compliant with ANSI S3.19-1974.)

9.0 JOB STEPS & PRECAUTIONS

- Workers shall read and understand the SWPs regarding Hearing Protection and PPE
- A site specific Health and Safety Plan (HASP) will contain a hazard assessment that will be completed prior to work commencing to determine the hazards as well as the required PPE
- PPE will be inspected daily to ensure it is in good working order

10.0 APPLICABLE OSHA REGULATION PARTS

- 29 CFR 1910.95 (Occupational Health and Environment Control)
- ANSI S3.19-1974 (Test method)

1.0 SCOPE

This Standard Work Procedure (SWP) applies to all Golder Associates Inc. and Golder Construction Services (Golder) Company Drivers who operate Company Vehicles or who operate their personal vehicles on Company-Related Business.

2.0 MOTOR VEHICLES AND DRIVING ON COMPANY-RELATED BUSINESS

Unlike other workplaces, the roadway is not a closed environment. Preventing work-related roadway crashes requires strategies that combine traffic safety principles and sound safety management practices. Although employers cannot control roadway conditions, they can provide safety information to workers and set and enforce driver safety policies to promote safe driving behavior. Vehicle crashes are not an unavoidable part of doing business.

All employees must comply with the Golder Motor Vehicle Policy effective October 16, 2009. The terms in this SWP are defined in that Policy.

3.0 GENERAL GUIDELINES

- Only employees who are authorized to drive a company owned motor vehicle or while on company business (company owned, private, or hired) may operate the vehicle.
- Enforce mandatory seat belt use. Seat belts shall be worn by all drivers and passengers in vehicles on company business while the vehicle is in motion.
  - No persons should ride in or on a vehicle unless it is designed to seat a passenger.
- Must carry appropriate insurance if using private vehicles for work purposes.
- Consider the risks driving while fatigued presents on all projects. Do not require workers to drive irregular hours or far beyond their normal working hours.
- Develop work schedules that allow employees to obey speed limits and to follow applicable hours-of-service regulations.
- Do not tailgate or drive in an aggressive manner. Maintain a minimum of 2 seconds behind other vehicles and in the event of inclement weather increase the distance between vehicles to a minimum of 4 seconds or as road and weather conditions warrant.
- Observe all the rules and regulations pertaining to the use of public land. Always ask permission before crossing pastoral land. Leave gates as you find them. Keep to constructed vehicle tracks. Avoid areas that are easily damaged, such as swamps, alpine snow plains and vegetated sand dunes.
- Do not operate any vehicle while under the influence of alcohol, illegal drugs, or certain medications (prescription or over the counter) that might impair your ability to safely operate the vehicle.

- Observe all fire restrictions.
- For portable electronic devices see the Motor Vehicle Policy (dated October 16, 2009) and the SWP 23 “Cellular Telephone Use” for additional information.
  - The employee operating a vehicle while conducting company related business shall not talk (including hand free units), text, email, surf the internet, etc. If the employee needs to perform any of these tasks then they shall park the vehicle in a designated parking spot. Do not park off the side of a road.
  - Employees are strongly discouraged from performing other activities that result in taking away meaningful attention to operating a vehicle safely (e.g. playing with the radio, eating, reading, applying makeup, shaving, etc.)
- Employees are to report any traffic violations and/or vehicle accidents or damage that occurred on company related business to the Project Manager or the Human Resource Representative.

4.0 VEHICLE MAINTENANCE AND FLEET MANAGEMENT

- Adopt and enforce a structured vehicle maintenance program for Golder-owned vehicles.
- Maintain Vehicle Condition Check-out/Check-in list for Golder-owned vehicles.
- Test the brakes, wipers, tires, lights, and turn signals, fluids (oil, break, and washer) and verify that the vehicle has an inflated spare tire and jack prior to use (in company, private, or rented vehicles). Address any notes or oral warnings concerning vehicle deficiencies, which must be remedied at the earliest possible opportunity. If any safety concerns are identified, the vehicle must not be used.
- Report vehicle deficiencies to the Office Manager as soon as they are noticed. The Office Manager, or their delegate, will arrange for maintenance of the vehicle.
- Equip Golder-owned, rented, or private vehicles used for on-site work with fire extinguishers and first aid kits, if required.
- Ensure rented or client-provided vehicles are in a roadworthy condition.

5.0 SAFETY PROGRAMS

- Teach workers strategies for recognizing and managing driver fatigue and in-vehicle distractions.
- Provide appropriate training to workers operating specialized motor vehicles or equipment.
- Emphasize the need to follow safe driving practices on and off the job.
- Consider fire safety when parking vehicles in areas with dried grasses, leaves, or other plant material. Hot engine fluids, catalytic converters or other vehicle equipment could ignite dry plant material, and cause a fire.

6.0 DRIVER PERFORMANCE

- Make sure each driver of a vehicle being used on company business (company owned, private, or hired) possesses a valid driver's license that is appropriate for the type of vehicle to be driven.
- Check driving records of prospective employees, and perform periodic rechecks after hiring.
- Maintain complete and accurate records of workers' driving performance.

7.0 SECURING LOADS

Unsecured and poorly secured items inside or outside of a vehicle can be extremely dangerous if they are loose or become airborne. They can harm the vehicle driver and passenger, and/or occupants in vehicles behind you. The following recommendations should be followed:

- Use tie-down straps that are in good condition and rated for the load you will carry. Ratcheting tie downs are better than bungee cords or tie downs that just pull tight.
- Loads shall not exceed the manufactures specifications and legal limits for the vehicle.
- Install mounts to secure loads that you haul frequently in the same vehicle or trailer.
- Secure tarps covering loads so they are snug and do not flap.
- Check your load after you have driven a short distance to make sure it has not shifted.
- Do not pile items higher than the side walls of the truck bed or trailer.

8.0 VEHICLE SAFETY EQUIPMENT

You may not know when a highway emergency will happen, but you can be prepared by ensuring that your vehicle is equipped to deal with roadside emergencies. Consider carrying items such as the following, and know how to use them properly:

- Flashlight
- Reflective safety vest
- Light sticks
- Fire extinguisher
- Tire inflator or sealant
- Reflective triangles or flares
- Blanket
- Tow rope or cable with a hook (in case the vehicle is disabled)

9.0 DRIVING TECHNIQUES FOR 4-WHEEL DRIVING

9.1 Driving In Heavy Vegetation

- Get out and check road conditions before proceeding if you are unsure of the ground ahead, especially if there is mud or water.
- Position your hands on the steering wheel so that your thumbs are on the outside the steering wheel.
- Do not change transmission gears in the middle of a hazardous area, if in doubt always choose the lower gear.
- Tire pressures play an important part in off-road driving. Lowering tire pressures helps in getting through. 140-180 kPa (20-26 psi) is a good tire pressure for soft tracks. If you choose to use a lower tire pressure, the vehicle must be operated at a lower speed. Remember to re-inflate your tires as soon as you're back on hard ground.
- Cross small ridges 'square on' and cross ditches at a slight angle.
- Turn the steering wheel from side to side to maintain traction and move forward if you begin to lose traction going uphill, along a rutted track, or in mud.

9.2 Driving On Steep Hills

- Use low second or third gear for going uphill and low first gear for going downhill.
- Use the footbrake sparingly and with caution.
- Avoid turning the vehicle sideways on a hill. If the vehicle begins to slide sideways, very slightly accelerating and steering into the slide will normally straighten your descent.
- Allow any vehicle in front of your vehicle plenty of room.
- Do not touch the clutch or accelerator if you stall going uphill.

9.3 Sand Driving

- Speed and flotation are the keys to success. High transmission gear ratio is best, if possible.
- Lower the tire pressure to 20 psi. If you choose to use a lower tire pressure, the vehicle must be operated at a lower speed. Remember to re-inflate your tires as soon as you are back on hard ground.
- Drive in existing wheel tracks if they are present.
- Avoid sudden changes in direction or acceleration. Coast to a stop if possible.
- Approach dunes head on.

- Avoid braking when descending a dune. Point the front of the vehicle downhill. Do not go fast, but also do not go so slow that the wheels stop rolling, or the vehicle begins to slide sideways. A touch on the throttle will keep the wheels moving and the vehicle pointing in the right direction.
- Try to rock the vehicle backwards or forwards, building up a small stretch of hardpack sand that you can accelerate from if the vehicle gets stuck. Do not spin the wheels!
- Be sure that recovery gear is always in the vehicle in these driving conditions.
- Wash the vehicle after use.

9.4 Snow, Rain, and Ice Driving

- Carry chains and install them on the tires when required.
- Prepare your vehicle and carry safety gear.
- Travel only on roads and tracks that are open to traffic.
- Drive with low beam lights on. Do not travel when visibility is poor.
- Vehicles travelling uphill in snow and ice conditions have right of way.
- Park only where directed and as close to the bank as possible. When parking, leave the vehicle in gear. Do not use the handbrake - it could freeze in the “on” position.
- Lift the wiper blades off the wind shield when leaving the vehicle parked.
- Watch for other travelers and animals and drive slowly in areas where they may be present. In the event that an animal is encountered on a road where driving conditions are poor due to the presence of snow, ice, or rain, do not over steer to avoid hitting the animal. The act of over steering may cause the vehicle to slide or roll. Most of the time the animal will move out of the road before the vehicle reaches it.
- Consider increasing the load or weight on the rear axle of front-wheel drive vehicles to improve traction when driving in snow, ice, or rain.

9.5 Driving in Mud

- Good tires with deep tread are helpful when driving in muddy conditions.
- Low second or third are probably the best gears for vehicle operation.
- Move the steering wheel rapidly from side to side to improve traction.
- Keep a steady pace.
- Stay out of ruts if possible.
- Rock the vehicle backwards or forwards by alternating between first and reverse if you do become stuck.

9.6 Driving in Fog/Limited Visibility

- Drive with low beam lights on. Do not travel when visibility is poor.
- Drive slowly and carefully.
- Pull over to a safe location if you cannot see vehicles in front or behind you until weather improves.

10.0 REGULATORY CITATION

There are no Federal OSHA regulations relating to driving safety. The Department of Transportation (DOT) Title 49 (Transportation) Subtitle VI (Motor Vehicle and Driver Programs) provides information about commercial motor vehicle operations.

1.0 SCOPE

This SWP applies to all Golder Associates Inc. and Golder Construction Services (Golder) staff working on projects where the control of energy sources through lockout/tagout will be required.

2.0 PURPOSE

Golder Associates Inc. (Golder) has developed this written Control of Hazardous Energy Lockout/Tagout Program in compliance with the Occupational Safety and Health Administration (OSHA) Standard, 29 CFR 1910.147 and 1926.417. A copy of 29 CFR 1910.147, the Lockout/Tagout standard, is included in **Appendix A**. This program is to be used in conjunction with Golder's overall Health and Safety Program to achieve the following objectives:

- Provide written standard operating procedures for applying lockout/tagout devices to equipment;
- Protect all employees who could be exposed, during the servicing and maintenance of equipment, to unexpected energization, start up, or release of stored energy that could result in injury or death. Specifically, this program is designed to protect employees from the following types of hazards:
  - Electrical hazards resulting from direct contact with energized circuits, such as those found in fans, motors, or control panels.
  - Mechanical hazards caused by movement of blades, presses, pump shafts, gears, etc.
  - Chemical hazards resulting from the sudden release of materials from valves, pipes, tanks, etc.
  - Thermal hazards associated with hot steam in pipes, heat from a furnace, etc.
  - Pneumatic hazards associated with pneumatic pumps, pneumatic lines and tubing, pressurized fittings, etc.
  - Hydraulic hazards associated with hydraulic equipment, such as loading and unloading platforms, forklifts, etc.
  - Stored Energy hazards from stored energy in batteries, capacitors, springs, gravity, etc.
- Provide a basis for training employees in the proper use of lockout/tagout devices.
- Evaluate Energy Lockout/Tagout Program Compliance.

In order to accomplish these objectives, Golder will:

- Evaluate energy/stored energy sources on Golder work sites;
- Select and distribute appropriate lockout/tagout devices to authorized employees;
- Provide education and training on the proper use of lockout/tagout devices;
- Provide initial and annual refresher training of both affected and authorized employees.
  - Training frequency may be modified based on changes in: job duties, equipment, lockout/tagout device changes, procedures for equipment, or any other issues that would warrant additional training

- Conduct a periodic inspection of the energy control procedure at least annually to ensure that the procedure and the requirements of both Golder's policy and all OSHA standards are being followed.
- Conduct periodic inspection by an authorized employee other than the ones(s) utilizing the energy control procedure being inspected and correct any problems or deviations of the program.
- Where lockout and/or tagout is used for energy control, the periodic inspection shall include a review between the inspector and each authorized employee of that employee's responsibilities under the energy control procedure being inspected.
- Certify that the periodic inspections have been performed. The certification shall identify the machine or equipment on which the energy control procedure was being utilized, the date of the inspection, the employees included in the inspection, and the person performing the inspection.
- Ensure that no employee, either affected or authorized shall remove, defeat, or otherwise render another person(s) locks and/or tags useless thereby reenergizing any system. If this does occur, severe repercussions up to and including termination of those responsible will occur.

3.0 ASSIGNMENT OF RESPONSIBILITIES AND AUTHORITY FOR IMPLEMENTATION

3.1 Corporate Health and Safety Officer

The specific responsibilities of the National Health and Safety Leader (NHSL) include:

1. Oversee development and implementation of the written program;
2. Review and evaluate energy hazard information as requested by the regional offices;
3. Audit all elements of the program to evaluate the effectiveness and extent of compliance with Energy Lockout/Tagout Program requirements;
4. Provide assistance to the regions on lockout/tagout equipment selection, training, and record keeping for regional employees; and
5. Assign appropriate responsibility at the regional level for implementing, administering, and enforcing the program.

3.2 Office Health and Safety Coordinators

The individual with overall responsibility and authority for implementing Golder's Energy Lockout/Tagout Program is the Office Health and Safety Coordinator (HSC). The HSC's responsibilities include:

- Maintain an inventory of equipment lockout/tagout devices; and
- Provide Energy Lockout/Tagout training to current employees, all new field employees at the time of hire, and to all field employees annually thereafter.

3.3 Employees

No Energy Lockout/Tagout Program can be successful without support and implementation by all individuals within the company. Employees' responsibilities include:

- Follow company guidelines for use of equipment lockout/tagout devices when servicing or maintaining equipment on Golder work sites.

3.4 Subcontractors

Subcontractors are responsible for providing their employees with proper training and equipment lockout/tagout devices. Golder may order work stopped if contractors do not have required training or equipment warranted by conditions at the site.

4.0 DEFINITIONS

Affected employee An employee whose job requires him/her to operate or use equipment on which servicing or maintenance is being performed under lockout or tagout or whose job requires him/her to work in an area where such servicing or maintenance is being performed.

Authorized employee - A person who locks out or tags out equipment in order to perform servicing or maintenance on that equipment. An authorized employee and an affected employee may be the same person when the affected employee's duties also include performing maintenance or servicing on equipment which must be locked out and/or tagged out.

Capable of being locked out - An energy isolating device is capable of being locked out if it has a clasp or other means of attachment to which, or through which, a lock can be affixed, or it has a locking mechanism built into it. Other energy isolating devices are capable of being locked out, if lockout can be achieved without the need to dismantle, rebuild, or replace the energy isolating device or permanently alter its energy control capability.

Energized - Connected to an energy source or containing residual or stored energy.

Energy sources - Energy sources include electrical, mechanical, chemical, thermal, pneumatic, hydraulic and others.

Energy isolating device - A mechanical device that physically prevents the transmission or release of energy, including but not limited to the following: A manually operated electrical circuit breaker; a disconnect switch; a manually operated switch by which the conductors of a circuit can be disconnected from all ungrounded supply conductors, and, in addition, no pole can be operated independently; a line valve; a block; and any similar device used to block or isolate energy. Push buttons, selector switches and other control circuit type devices are not energy isolating devices.

Hot tap - A procedure used in the repair, maintenance and services activities which involves welding on a piece of equipment (pipelines, vessels or tanks) under pressure, in order to install connections or appurtenances. It is commonly used to replace or add sections of pipeline without the interruption of service for air, gas, water, steam, and petrochemical distribution systems.

Lockout - The placement of a lockout device on an energy isolating device, in accordance with an established procedure ensuring that the energy isolating device and the equipment being controlled cannot be operated until the lockout device is removed.

Lockout device - A device that utilizes a positive means such as a lock, either key or combination type, to hold an energy isolating device in the safe position and prevent the energizing of a machine or equipment. Included are blank flanges and bolted slip blinds.

Maintenance/service work - Work place activities such as constructing, installing, setting up, adjusting, inspecting, modifying, and maintaining and/or servicing equipment. These activities may include lubrication, cleaning, or unjamming of equipment and making adjustments or tool changes.

Normal production operations The utilization of a machine or equipment to perform its intended production functions.

Servicing and/or maintenance Workplace activities such as constructing, installing, setting up, adjusting, inspecting, modifying, and maintaining and/or servicing machines or equipment. These activities include lubrication, cleaning or unjamming of machines or equipment and making adjustments or tool changes, where the employee may be exposed to the **unexpected** energization or startup of the equipment or release of hazardous energy.

Setting up Any work performed to prepare a machine or equipment to perform its normal production operation.

Tagout - The placement of a tagout device on an energy isolating device, in accordance with an established procedure, to indicate that the energy isolating device and the equipment being controlled may not be operated until the tagout device is removed.

Tagout device - A prominent warning device, such as a tag and a means of attachment, which can be securely fastened to an energy isolating device in accordance with an established procedure, to indicate that the energy isolating device and the equipment being controlled may not be operated until the tagout device is removed.

5.0 GENERAL INFORMATION REGARDING LOCKOUT AND TAGOUT DEVICES

- Locks, tags, chains, wedges, key blocks, adapter pins, self-locking fasteners, or other hardware shall be provided for isolating, securing or blocking of machines or equipment from energy sources.
- Lockout and tagout devices must be identified for such purpose and must not be used for any other purpose.
- Lockout and tagout devices must indicate the identity of the employee applying the devices.
- Lockout and tagout devices must be standardized within each office or site. All padlocks utilized as lockout devices must be the same color. This color must be different than the padlock colors used for all other purposes. All tags utilized as tagout devices must be red, white, and black and must clearly indicate that the operation or movement of energy isolating devices from the "safe", "off", or "closed" position is prohibited. Examples of tags are: "Danger: Do Not Operate", "Danger: Do Not Start", and "Danger: Do Not Start This Motor". Lockout and tagout devices shall be standardized within the facility in at least one of the following criteria: Color; shape; or size; and additionally, in the case of tagout devices, print and format shall be standardized.
- No Golder employee should attempt to operate any switch, valve, or other energy isolation device that is locked or tagged out.
- If an energy isolating device is not capable of being locked out, Golder shall utilize a tagout system only.
- When a tagout device is used on an energy isolating device which is capable of being locked out, the tagout device shall be attached at the same location that the lockout device would have been attached, and the employer shall demonstrate that the tagout program will provide a level of safety equivalent to that obtained by using a lockout program.
- Lockout and tagout devices shall be capable of withstanding the environment to which they are exposed for the maximum period of time that exposure is expected.
- Tagout devices shall be constructed and printed so that exposure to weather conditions or wet and damp locations will not cause the tag to deteriorate or the message on the tag to become illegible.
- Tags shall not deteriorate when used in corrosive environments such as areas where acid and alkali chemicals are handled and stored.
- Lockout devices shall be substantial enough to prevent removal without the use of excessive force or unusual techniques, such as with the use of bolt cutters or other metal cutting tools.
- Tagout devices, including their means of attachment, shall be substantial enough to prevent inadvertent or accidental removal. Tagout device attachment means shall be of a non-reusable type, attachable by hand, self-locking, and non-releasable with a minimum unlocking strength of no less than 50 pounds and having the general design and basic characteristics of being at least equivalent to a one-piece, all environment-tolerant nylon cable tie.

6.0 LOCKOUT/TAGOUT PROCEDURES

The procedures presented in this program must be followed at all times to ensure that equipment is isolated from all power sources and is locked and/or tagged out of service before employees perform any work.

6.1 Preparation for Shutdown

Identify the energy sources and how to disconnect and control them. In preparation for lockout/tagout, a survey must be conducted to locate and identify all isolating devices necessary to safely lock and/or tag the energy source. More than one energy source (electrical, hydraulic, pneumatic, chemical, thermal, or others) may be involved. Hydraulic sources involve pressurized hydraulic oil lines and fittings. Pneumatic energy sources include compressed air tanks, lines, valves, and fittings. Chemical sources include pressurized corrosives such as acids and caustics.

Before an authorized employee shuts down equipment, the authorized employee shall have knowledge of the type and the amount of the energy to be controlled and the methods and means to control the energy.

6.2 Equipment Shutdown

Employee Notification

The authorized employee must notify all affected employees (employees whose job it is to operate the equipment or work in the area where electrical power is being locked out or tagged out) before the application of lockout/tagout devices. The authorized employee must know the type and number of energy sources used and how to safely control them.

Machine or Equipment Shutdown

If the equipment is operating, shut it down in a normal manner or in the manner stated in the site specific health and safety plan, if different from the normal manner.

6.3 Equipment and Electrical Isolation

Disengagement of the Telemetry System

Disengage the telemetry system, if present, by unplugging the phone jack.

Equipment Isolation

Physically locate and operate the switch, valve or other energy isolating device(s) so that the equipment is isolated from its energy source(s). Apply adequate hardware (locks, chains, wedges, blocks, adaptor pins, self-locking fasteners, etc.) to keep it in that position.

Electrical Isolation and Lockout

Find the circuit breaker that corresponds to the equipment to be locked out and switch it off. If this circuit breaker cannot be located, find the main power switch and turn it off. Ensure that all electrical power to the lockout area has been cut by testing with a voltmeter that all circuits, leads, lights, and outlets are dead. Once power has been cut, apply lockout/tagout devices to the control panel(s) to prevent unauthorized entry into the panel(s) allowing access to the switch(es) controlling electrical power to the equipment.

6.4 Application of Lockout/Tagout Devices

Lockout/Tagout Device Application

Authorized employees must lockout and tagout the energy isolating devices with assigned individual locks and tags. Lockout devices are applied so that they will hold the energy isolating devices in a "safe", "off", or "closed" (for valves) position. When more than one authorized employee is working on the same equipment, a lockout hasp that can accommodate multiple locks (one for each employee) must be used. The tagout devices that are used must clearly indicate that the operation or movement of energy isolating devices from the "safe", "off", or "closed" position is prohibited. When tags cannot be directly attached to the energy isolating device, they shall be located as close as safely possible to the device and be immediately obvious to anyone attempting to operate the device.

Tagout Application

Energy that cannot be controlled with a lock must be tagged and must have at least one additional safeguard to prevent start up. The tagout system must provide a level of safety equivalent to that obtained by using a lockout program.

6.5 Control of Energy

After the lockout/tagout devices have been applied, all potentially stored or residual energy (such as springs, flywheels, hydraulics, air, gas, steam, water pressure, etc.) must be released or restrained by methods such as blocking, repositioning, bleeding down, etc.

6.6 Verification of Isolation

Prior to beginning work on equipment that has been locked and/or tagged out, and after ensuring that no personnel are exposed, the authorized employee must verify the isolation of the equipment. This verification could entail the following:

- Verifying that the circuit breaker or main disconnect switch cannot be moved to the "on" position.
- Turning the equipment switches on and off.
- Testing for live parts with a voltmeter.
- Releasing any stored energy in capacitors.
- Checking for pressure or fluid flow.
- Verifying that critical valves are closed before or after a process operation.
- Ensuring that mechanisms under spring tension, pneumatic or hydraulic pressure, or suspended mechanisms or parts that cycle by gravity to a lower position (stored energy) are clamped, blocked, relieved, or otherwise secured prior to work that could expose the employee to injury.

DANGER: RETURN OPERATING CONTROLS TO THE "SAFE" OR "OFF" POSITION AFTER THE TEST!

The equipment is now locked and/or tagged out. Maintenance or servicing may now be performed.

7.0 LOCKOUT/TAGOUT DEVICE REMOVAL ACTIVITIES.

After the maintenance or servicing of the equipment is completed and before the lockout and/or tagout devices are removed and energy restored, the following sequence of activities MUST be completed by the authorized employee.

7.1 Equipment

Check the work area to ensure that the equipment is intact, unnecessary items (such as tools) has been removed, and guards have been re-installed.

7.2 Employees

Notify affected employees that the lockout/tagout devices are about to be removed and energy restored. Ensure that all employees around the equipment are safely positioned or removed from the area.

7.3 Removal of Lockout/Tagout Devices by the authorized employee who placed the devices

Remove each lockout/tagout device from every energy source and restore energy to the equipment. Monitor the equipment for any abnormal operating conditions. If any additional work is necessary, de-energize the equipment and reapply energy control measures as discussed previously.

7.4 Removal of Lockout/Tagout devices by someone other than the authorized employee who placed the devices.

It is the responsibility of the authorized employee to remove his/her lock at the end of the workday. If an authorized employee forgets to remove his/her lock before leaving the worksite, the immediate supervisor/project manager must:

- Call the authorized employee to verify the employee has left the worksite and inform him/her that their lock is being removed.
- Lockout tagout devices may not be removed unless the responsible supervisor is present and authorizes removal. The immediate supervisors hold a master key.
- The supervisor must make all reasonable attempts to contact the employee and inform him/her that their lock has been removed. If the authorized employee cannot be contacted, and the supervisor has verified that the employee who applied the device is not at the facility, the energy to the equipment may be restored after performing an inspection of the equipment that has been locked out. The supervisor must then ensure that the authorized employee is made aware of the removal before he/she resumes works.
- After completion of the inspection and the equipment is found to be in safe working order, the equipment may be restored.
- The abandoned lock procedure form found in Appendix B must also be filled out and filed by the immediate supervisor.

As noted above, jobs that overlap shifts are to be held in lockout tagout status with a designated supervisors lock.

7.5 Equipment Specific Lockout Tagout Procedures

The purpose of the Equipment Specific Lockout Tagout Procedures are to determine what equipment can pose a hazard if an unexpected release of energy occurs, the type and magnitude of the energy source, the location of the energy isolating devices, and the means by which to isolate the energy.

The supervisor of an authorized employee and/or the authorized employee must complete the Equipment Specific Lockout Tagout Forms found in Appendix B. All equipment specific lockout tagout forms must be located in an easily accessible area or posted directly on the equipment to be serviced. For each piece or type of equipment the energy source assessment will determine:

- The type and magnitude of each energy source;
- The type and magnitude of each stored energy source and;
- Machine specific instructions on how to lockout the piece of equipment.

The Equipment Specific Lockout Tagout Procedures must be updated when:

- New equipment has been installed;
- New energy sources have been added to a facility or to individual pieces of equipment;
- The magnitude of an energy source changes or;
- The designated isolation points are changed.

Equipment Specific Lockout Tagout Procedures are not required when all of the following elements exist:

- The machine or equipment has no potential for stored or residual energy, or for reaccumulation of stored energy after shut down, which could endanger employees.
- The machine or equipment has a single energy source that can be readily identified and isolated and the isolation and locking out of that energy source will completely deenergize and deactivate the machine or equipment.
- The machine or equipment is isolated from that energy source and locked out during servicing or maintenance.
- A single lockout device will achieve a locked-out condition.
- The lockout device is under the exclusive control of the authorized employee performing the servicing or maintenance.
- The servicing or maintenance does not create hazards for other employees.

8.0 SPECIAL WRITTEN LOCKOUT/TAGOUT PROCEDURES

Written lockout/tagout procedures <u>are required</u> for equipment and processes:

- with more than one energy source;
- with potential for residual or stored energy or re-accumulation of stored energy after shut down; or
- that has caused electrical shock or other injury during maintenance.

Examples include remediation systems with multiple breaker panels or systems with electrical energy, compressed air, or stored liquids. A lockout/tagout procedure is also required for any piece of equipment operated by electrical energy that is also equipped with a back-up battery or capacitor(s) storing residual energy.

Examples of equipment lockout/tagout which do not require formal written procedures include remediation equipment that can be completely de-energized by one main breaker which have no other energy sources that are not isolated by the single lockout at the main breaker and single plug equipment. Lockout/tagout is still a required practice during maintenance or servicing of this equipment, but a written procedure is not needed.

An OSHA sample lockout/tagout procedure can be found in **Appendix B**. This procedure (or an equivalent procedure) must be tailored specifically for each system and posted on site or maintained with the site health and safety plan (HASP). Health and safety staff should be contacted if any additional special lockout/tagout procedures are required.

9.0 SPECIAL SITUATIONS

9.1 Temporary Removal of Lockout/Tagout Devices

In situations where lockout/tagout devices must be temporarily removed from the isolating device and the machine energized to test or achieve correct positioning, the following sequence shall be followed:

1. Clear the machine of tools and materials.
2. Safely position or remove employees from the area.
3. Remove the lockout/tagout device.
4. Energize and proceed with the test or repositioning.
5. De-energize all systems and re-apply energy control measures in accordance with procedures set forth in this written document.

9.2 Group Lockout/Tagout

If more than one individual is required to lockout/tagout equipment, the following procedure shall be implemented to provide protection to all employees. Each authorized employee shall place his/her own lockout/tagout device on the energy isolating device. If the energy isolating device cannot accept multiple locks and/or tags, attach a multiple lockout device. Each employee shall then use his/her own lock and/or tag to secure the multiple lockout device. As each person no longer needs to maintain his/her lockout and/or tagout protection, that person will remove his/her lock and/or tag from the multiple lockout device.

9.3 Personnel Changes or Lockout/Tagout Over More Than One Shift

If a personnel change occurs or a lockout/tagout procedure extends into the following work shift, the authorized employee(s) coming on site will complete lockout/tagout procedures before the authorized

employee(s) who originally placed the lock(s) and/or tag(s) on the equipment remove them. If the equipment is to remain idle until the return of the original authorized employee(s), no exchange of lockout/tagout devices is required.

10.0 ADDITIONAL CONSIDERATIONS IN THE LOCKOUT/TAGOUT PROCEDURE

10.1 Training and Retraining

All technical employees shall be made aware of the lockout/tagout program and its importance to the safety of all Golder employees. Golder's policy is to train all field technicians (authorized employees) initially on lockout/tagout procedures and annually thereafter. Other field operations staff such as scientists, engineers, and project managers receive affected employee training. The HSC, who is responsible for this training, shall ensure that each authorized and affected employee has received this training initially and at a minimum annually thereafter.

Retraining is required when there is a change in equipment or job assignment, or if new hazards are introduced to the work site. Retraining may be necessary if during inspection there are deviations from or inadequacies in the employee's knowledge or use of the procedures.

Certification records including the employee's name and dates of training will be kept on file in the employee's training file. Training compliance will also be tracked by the Health and Safety Coordinator and National Health and Safety Leader.

10.2 Equipment Connected To Electricity By Plug And Cord

When being serviced, equipment connected to electricity by plug and cord must be unplugged. The plug must be in sight and in close proximity to the authorized employee at all times. If this is not possible, an appropriate lockout/tagout device shall be attached to the plug to prevent it from being connected to an outlet.

10.3 Facilities in Shutdown Mode

All systems that are not currently operating, and which will be left in that condition at least until the next visit by a Golder employee, shall be locked out in accordance with this procedure.

11.0 EVALUATING PROGRAM EFFECTIVENESS

A. Health and Safety field audits are conducted at Golder sites. Use of energy isolating devices is observed when applicable. Employee acceptance of this program and use of appropriate lockout/tagout devices are integral to the program's success. Employee comments are solicited regarding this program and the use of energy isolating devices.

B. In the case of an accident or a near miss despite a lockout/tagout procedure, the HSC will investigate and correct the procedure as required to prevent future mishaps. The HSC will complete an Incident/Injury/Illness Report and forward it to the National Health and Safety Leader for review.

APPENDIX A

OSHA'S ENERGY LOCKOUT/TAGOUT STANDARD

SCOPE, APPLICATION AND PURPOSE

1910.147(a)(1) Scope

1910.147(a)(1)(i) This standard covers the servicing and maintenance of machines and equipment in which the **unexpected** energization or start up of the machines or equipment, or release of stored energy could cause injury to employees. This standard establishes minimum performance requirements for the control of such hazardous energy.

1910.147(a)(1)(ii) This standard does not cover the following:
1910.147(a)(1)(ii)(A) Construction, agriculture and maritime employment;
1910.147(a)(1)(ii)(B) Installations under the exclusive control of electric utilities for the purpose of power generation, transmission and distribution, including related equipment for communication or metering; and
1910.147(a)(1)(ii)(C) Exposure to electrical hazards from work on, near, or with conductors or equipment in electric utilization installations, which is covered by Subpart S of this part; and
1910.147(a)(1)(ii)(D) Oil and gas well drilling and servicing.

1910.147(a)(2) Application

1910.147(a)(2)(i) This standard applies to the control of energy during servicing and/or maintenance of machines and equipment.
1910.147(a)(2)(ii) Normal production operations are not covered by this standard (See Subpart O of this Part). Servicing and/or maintenance which takes place during normal production operations is covered by this standard only if:
1910.147(a)(2)(ii)(A) An employee is required to remove or bypass a guard or other safety device; or
1910.147(a)(2)(ii)(B) An employee is required to place any part of his or her body into an area on a machine or piece of equipment where work is actually performed upon the material being processed (point of operation) or where an associated danger zone exists during a machine operating cycle.

Note: **Exception to paragraph (a)(2)(ii):** Minor tool changes and adjustments, and other minor servicing activities, which take place during normal production operations, are not covered by this standard if they are routine, repetitive, and integral to the use of the equipment for production, provided that the work is performed using alternative measures which provide effective protection (See Subpart O of this Part).
1910.147(a)(2)(iii) This standard does not apply to the following:
1910.147(a)(2)(iii)(A) Work on cord and plug connected electric equipment for which exposure to the hazards of unexpected energization or start up of the equipment is controlled by the unplugging of the

equipment from the energy source and by the plug being under the exclusive control of the employee performing the servicing or maintenance.

1910.147(a)(2)(iii)(B) Hot tap operations involving transmission and distribution systems for substances such as gas, steam, water or petroleum products when they are performed on pressurized pipelines, provided that the employer demonstrates that-

1910.147(a)(2)(iii)(B)(1) continuity of service is essential;

1910.147(a)(2)(iii)(B)(2) shutdown of the system is impractical; and

1910.147(a)(2)(iii)(B)(3) documented procedures are followed, and special equipment is used which will provide proven effective protection for employees.

1910.147(a)(3) Purpose

1910.147(a)(3)(i) This section requires employers to establish a program and utilize procedures for affixing appropriate lockout devices or tagout devices to energy isolating devices, and to otherwise disable machines or equipment to prevent unexpected energization, start up or release of stored energy in order to prevent injury to employees.

1910.147(a)(3)(ii) When other standards in this part require the use of lockout or tagout, they shall be used and supplemented by the procedural and training requirements of this section.

1910.147(b) Definitions applicable to this section.

Affected employee. An employee whose job requires him/her to operate or use a machine or equipment on which servicing or maintenance is being performed under lockout or tagout, or whose job requires him/her to work in an area in which such servicing or maintenance is being performed.

Authorized employee. A person who locks out or tags out machines or equipment in order to perform servicing or maintenance on that machine or equipment. An affected employee becomes an authorized employee when that employee's duties include performing servicing or maintenance covered under this section.

Capable of being locked out. An energy isolating device is capable of being locked out if it has a hasp or other means of attachment to which, or through which, a lock can be affixed, or it has a locking mechanism built into it. Other energy isolating devices are capable of being locked out, if lockout can be achieved without the need to dismantle, rebuild, or replace the energy isolating device or permanently alter its energy control capability.

Energized. Connected to an energy source or containing residual or stored energy.

Energy isolating device. A mechanical device that physically prevents the transmission or release of energy, including but not limited to the following: A manually operated electrical circuit breaker; a disconnect switch; a manually operated switch by which the conductors of a circuit can be disconnected from all ungrounded supply conductors, and, in addition, no pole can be operated independently; a line valve; a block; and any similar device used to block or isolate energy. Push buttons, selector switches and other control circuit type devices are not energy isolating devices.

Energy source. Any source of electrical, mechanical, hydraulic, pneumatic, chemical, thermal, or other energy.

Hot tap. A procedure used in the repair, maintenance and services activities which involves welding on a piece of equipment (pipelines, vessels or tanks) under pressure, in order to install connections or appurtenances. It is commonly used to replace or add sections of pipeline without the interruption of service for air, gas, water, steam, and petrochemical distribution systems.

Lockout. The placement of a lockout device on an energy isolating device, in accordance with an established procedure, ensuring that the energy isolating device and the equipment being controlled cannot be operated until the lockout device is removed.

Lockout device. A device that utilizes a positive means such as a lock, either key or combination type, to hold an energy isolating device in the safe position and prevent the energizing of a machine or equipment. Included are blank flanges and bolted slip blinds.

Normal production operations. The utilization of a machine or equipment to perform its intended production function.

Servicing and/or maintenance. Workplace activities such as constructing, installing, setting up, adjusting, inspecting, modifying, and maintaining and/or servicing machines or equipment. These activities include lubrication, cleaning or unjamming of machines or equipment and making adjustments or tool changes, where the employee may be exposed to the **unexpected** energization or startup of the equipment or release of hazardous energy.

Setting up. Any work performed to prepare a machine or equipment to perform its normal production operation.

Tagout. The placement of a tagout device on an energy isolating device, in accordance with an established procedure, to indicate that the energy isolating device and the equipment being controlled may not be operated until the tagout device is removed.

Tagout device. A prominent warning device, such as a tag and a means of attachment, which can be securely fastened to an energy isolating device in accordance with an established procedure, to indicate that the energy isolating device and the equipment being controlled may not be operated until the tagout device is removed.

1910.147(c) General -

1910.147(c)(1) Energy control program. The employer shall establish a program consisting of energy control procedures, employee training and periodic inspections to ensure that before any employee performs any servicing or maintenance on a machine or equipment where the unexpected energizing, startup or release of stored energy could occur and cause injury, the machine or equipment shall be isolated from the energy source and rendered inoperative.

1910.147(c)(2) Lockout/tagout

1910.147(c)(2)(i) If an energy isolating device is not capable of being locked out, the employer's energy control program under paragraph (c)(1) of this section shall utilize a tagout system.

1910.147(c)(2)(ii) If an energy isolating device is capable of being locked out, the employer's energy control program under paragraph (c)(1) of this section shall utilize lockout, unless the employer can demonstrate that the utilization of a tagout system will provide full employee protection as set forth in paragraph (c)(3) of this section.

1910.147(c)(2)(iii) After January 2, 1990, whenever replacement or major repair, renovation or modification of a machine or equipment is performed, and whenever new machines or equipment are installed, energy isolating devices for such machine or equipment shall be designed to accept a lockout device.

1910.147(c)(3) Full employee protection

1910.147(c)(3)(i) When a tagout device is used on an energy isolating device which is capable of being locked out, the tagout device shall be attached at the same location that the lockout device would have been attached, and the employer shall demonstrate that the tagout program will provide a level of safety equivalent to that obtained by using a lockout program.

1910.147(c)(3)(ii) In demonstrating that a level of safety is achieved in the tagout program which is equivalent to the level of safety obtained by using a lockout program, the employer shall demonstrate full compliance with all tagout-related provisions of this standard together with such additional elements as are necessary to provide the equivalent safety available from the use of a lockout device. Additional means to be considered as part of the demonstration of full employee protection shall include the implementation of additional safety measures such as the removal of an isolating circuit element, blocking of a controlling switch, opening of an extra disconnecting device, or the removal of a valve handle to reduce the likelihood of inadvertent energization.

1910.147(c)(4) Energy control procedure

1910.147(c)(4)(i) Procedures shall be developed, documented and utilized for the control of potentially hazardous energy when employees are engaged in the activities covered by this section.

Note: Exception: The employer need not document the required procedure for a particular machine or equipment, when all of the following elements exist: (1) The machine or equipment has no potential for stored or residual energy or reaccumulation of stored energy after shut down which could endanger employees; (2) the machine or equipment has a single energy source which can be readily identified and isolated; (3) the isolation and locking out of that energy source will completely deenergize and deactivate the machine or equipment; (4) the machine or equipment is isolated from that energy source and locked out during servicing or maintenance; (5) a single lockout device will achieve a locker-out condition; (6) the lockout device is under the exclusive control of the authorized employee performing the servicing or maintenance; (7) the servicing or maintenance does not create hazards for other employees; and (8) the employer, in utilizing this exception, has had no accidents involving the unexpected activation or reenergization of the machine or equipment during servicing or maintenance.

1910.147(c)(4)(ii) The procedures shall clearly and specifically outline the scope, purpose, authorization, rules, and techniques to be utilized for the control of hazardous energy, and the means to enforce compliance including, but not limited to, the following:

1910.147(c)(4)(ii)(A) A specific statement of the intended use of the procedure;

1910.147(c)(4)(ii)(B) Specific procedural steps for shutting down, isolating, blocking and securing machines or equipment to control hazardous energy;

1910.147(c)(4)(ii)(C) Specific procedural steps for the placement, removal and transfer of lockout devices or tagout devices and the responsibility for them; and

1910.147(c)(4)(ii)(D) Specific requirements for testing a machine or equipment to determine and verify the effectiveness of lockout devices, tagout devices, and other energy control measures.

1910.147(c)(5) Protective materials and hardware

1910.147(c)(5)(i) Locks, tags, chains, wedges, key blocks, adapter pins, self-locking fasteners, or other hardware shall be provided by the employer for isolating, securing or blocking of machines or equipment from energy sources.

1910.147(c)(5)(ii) Lockout devices and tagout devices shall be singularly identified; shall be the only devices(s) used for controlling energy; shall not be used for other purposes; and shall meet the following requirements:

1910.147(c)(5)(ii)(A) Durable

1910.147(c)(5)(ii)(A)(1) Lockout and tagout devices shall be capable of withstanding the environment to which they are exposed for the maximum period of time that exposure is expected.

1910.147(c)(5)(ii)(A)(2) Tagout devices shall be constructed and printed so that exposure to weather conditions or wet and damp locations will not cause the tag to deteriorate or the message on the tag to become illegible.

1910.147(c)(5)(ii)(A)(3) Tags shall not deteriorate when used in corrosive environments such as areas where acid and alkali chemicals are handled and stored.

1910.147(c)(5)(ii)(B) Standardized. Lockout and tagout devices shall be standardized within the facility in at least one of the following criteria: Color; shape; or size; and additionally, in the case of tagout devices, print and format shall be standardized.

1910.147(c)(5)(ii)(C) Substantial

1910.147(c)(5)(ii)(C)(1) Lockout devices. Lockout devices shall be substantial enough to prevent removal without the use of excessive force or unusual techniques, such as with the use of bolt cutters or other metal cutting tools.

1910.147(c)(5)(ii)(C)(2) Tagout devices. Tagout devices, including their means of attachment, shall be substantial enough to prevent inadvertent or accidental removal. Tagout device attachment means shall be of a non-reusable type, attachable by hand, self-locking, and non-releasable with a minimum unlocking strength of no less than 50 pounds and having the general design and basic characteristics of being at least equivalent to a one-piece, all environment-tolerant nylon cable tie.

1910.147(c)(5)(ii)(D) Identifiable. Lockout devices and tagout devices shall indicate the identity of the employee applying the device(s).

1910.147(c)(5)(iii) Tagout devices shall warn against hazardous conditions if the machine or equipment is energized and shall include a legend such as the following: **Do Not Start. Do Not Open. Do Not Close. Do Not Energize. Do Not Operate.**

1910.147(c)(6) Periodic inspection

1910.147(c)(6)(i) The employer shall conduct a periodic inspection of the energy control procedure at least annually to ensure that the procedure and the requirements of this standard are being followed.

1910.147(c)(6)(i)(A) The periodic inspection shall be performed by an authorized employee other than the ones(s) utilizing the energy control procedure being inspected.

1910.147(c)(6)(i)(B) The periodic inspection shall be conducted to correct any deviations or inadequacies identified.

1910.147(c)(6)(i)(C) Where lockout is used for energy control, the periodic inspection shall include a review, between the inspector and each authorized employee, of that employee's responsibilities under the energy control procedure being inspected.

1910.147(c)(6)(i)(D) Where tagout is used for energy control, the periodic inspection shall include a review, between the inspector and each authorized and affected employee, of that employee's responsibilities under the energy control procedure being inspected, and the elements set forth in paragraph (c)(7)(ii) of this section.

1910.147(c)(6)(ii) The employer shall certify that the periodic inspections have been performed. The certification shall identify the machine or equipment on which the energy control procedure was being utilized, the date of the inspection, the employees included in the inspection, and the person performing the inspection.

1910.147(c)(7) Training and communication

1910.147(c)(7)(i) The employer shall provide training to ensure that the purpose and function of the energy control program are understood by employees and that the knowledge and skills required for the safe application, usage, and removal of the energy controls are acquired by employees. The training shall include the following:

1910.147(c)(7)(i)(A) Each authorized employee shall receive training in the recognition of applicable hazardous energy sources, the type and magnitude of the energy available in the workplace, and the methods and means necessary for energy isolation and control.

1910.147(c)(7)(i)(B) Each affected employee shall be instructed in the purpose and use of the energy control procedure.

1910.147(c)(7)(i)(C) All other employees whose work operations are or may be in an area where energy control procedures may be utilized, shall be instructed about the procedure, and about the prohibition relating to attempts to restart or reenergize machines or equipment which are locked out or tagged out.

1910.147(c)(7)(ii) When tagout systems are used, employees shall also be trained in the following limitations of tags:

1910.147(c)(7)(ii)(A) Tags are essentially warning devices affixed to energy isolating devices, and do not provide the physical restraint on those devices that is provided by a lock.

1910.147(c)(7)(ii)(B) When a tag is attached to an energy isolating means, it is not to be removed without authorization of the authorized person responsible for it, and it is never to be bypassed, ignored, or otherwise defeated.

1910.147(c)(7)(ii)(C) Tags must be legible and understandable by all authorized employees, affected employees, and all other employees whose work operations are or may be in the area, in order to be effective.

1910.147(c)(7)(ii)(D) Tags and their means of attachment must be made of materials which will withstand the environmental conditions encountered in the workplace.

1910.147(c)(7)(ii)(E) Tags may evoke a false sense of security, and their meaning needs to be understood as part of the overall energy control program.

1910.147(c)(7)(ii)(F) Tags must be securely attached to energy isolating devices so that they cannot be inadvertently or accidentally detached during use.

1910.147(c)(7)(iii) Employee retraining.

1910.147(c)(7)(iii)(A) Retraining shall be provided for all authorized and affected employees whenever there is a change in their job assignments, a change in machines, equipment or processes that present a new hazard, or when there is a change in the energy control procedures.

1910.147(c)(7)(iii)(B) Additional retraining shall also be conducted whenever a periodic inspection under paragraph (c)(6) of this section reveals, or whenever the employer has reason to believe that there are deviations from or inadequacies in the employee's knowledge or use of the energy control procedures.

1910.147(c)(7)(iii)(C) The retraining shall reestablish employee proficiency and introduce new or revised control methods and procedures, as necessary.

1910.147(c)(7)(iv) The employer shall certify that employee training has been accomplished and is being kept up to date. The certification shall contain each employee's name and dates of training.

1910.147(c)(8) Energy isolation. Lockout or tagout shall be performed only by the authorized employees who are performing the servicing or maintenance.

1910.147(c)(9) Notification of employees. Affected employees shall be notified by the employer or authorized employee of the application and removal of lockout devices or tagout devices. Notification shall be given before the controls are applied, and after they are removed from the machine or equipment.

1910.147(d) Application of control. The established procedures for the application of energy control (the lockout or tagout procedures) shall cover the following elements and actions and shall be done in the following sequence:

1910.147(d)(1) Preparation for shutdown. Before an authorized or affected employee turns off a machine or equipment, the authorized employee shall have knowledge of the type and magnitude of the energy, the hazards of the energy to be controlled, and the method or means to control the energy.

1910.147(d)(2) Machine or equipment shutdown. The machine or equipment shall be turned off or shut down using the procedures established for the machine or equipment. An orderly shutdown must be utilized to avoid any additional or increased hazard(s) to employees as a result of the equipment stoppage.

1910.147(d)(3) Machine or equipment isolation. All energy isolating devices that are needed to control the energy to the machine or equipment shall be physically located and operated in such a manner as to isolate the machine or equipment from the energy source(s).

1910.147(d)(4) Lockout or tagout device application

1910.147(d)(4)(i) Lockout or tagout devices shall be affixed to each energy isolating device by authorized employees.

1910.147(d)(4)(ii) Lockout devices, where used, shall be affixed in a manner to that will hold the energy isolating devices in a "safe" or "off" position.

1910.147(d)(4)(iii) Tagout devices, where used, shall be affixed in such a manner as will clearly indicate that the operation or movement of energy isolating devices from the "safe" or "off" position is prohibited.

1910.147(d)(4)(iii)(A) Where tagout devices are used with energy isolating devices designed with the capability of being locked, the tag attachment shall be fastened at the same point at which the lock would have been attached.

1910.147(d)(4)(iii)(B) Where a tag cannot be affixed directly to the energy isolating device, the tag shall be located as close as safely possible to the device, in a position that will be immediately obvious to anyone attempting to operate the device.

1910.147(d)(5) Stored energy

1910.147(d)(5)(i) Following the application of lockout or tagout devices to energy isolating devices, all potentially hazardous stored or residual energy shall be relieved, disconnected, restrained, and otherwise rendered safe.

1910.147(d)(5)(ii) If there is a possibility of reaccumulation of stored energy to a hazardous level, verification of isolation shall be continued until the servicing or maintenance is completed, or until the possibility of such accumulation no longer exists.

1910.147(d)(6) Verification of isolation. Prior to starting work on machines or equipment that have been locked out or tagged out the authorized employee shall verify that isolation and deenergization of the machine or equipment have been accomplished.

1910.147(e) Release from lockout or tagout. Before lockout or tagout devices are removed and energy is restored to the machine or equipment, procedures shall be followed and actions taken by the authorized employee(s) to ensure the following:

1910.147(e)(1) The machine or equipment. The work area shall be inspected to ensure that nonessential items have been removed and to ensure that machine or equipment components are operationally intact.

1910.147(e)(2) Employees

1910.147(e)(2)(i) The work area shall be checked to ensure that all employees have been safely positioned or removed.

1910.147(e)(2)(ii) After lockout or tagout devices have been removed and before a machine or equipment is started, affected employees shall be notified that the lockout or tagout device(s) have been removed.

1910.147(e)(3) Lockout or tagout devices removal. Each lockout or tagout device shall be removed from each energy isolating device by the employee who applied the device. **Exception to paragraph (e)(3):** When the authorized employee who applied the lockout or tagout device is not available to remove it, that device may be removed under the direction of the employer, provided that specific procedures and training for such removal have been developed, documented and incorporated into the employer's energy control program. The employer shall demonstrate that the specific procedure provides equivalent safety to the removal of the device by the authorized employee who applied it. The specific procedure shall include at least the following elements:

1910.147(e)(3)(i) Verification by the employer that the authorized employee who applied the device is not at the facility:

1910.147(e)(3)(ii) Making all reasonable efforts to contact the authorized employee to inform him/her that his/her lockout or tagout device has been removed; and

1910.147(e)(3)(iii) Ensuring that the authorized employee has this knowledge before he/she resumes work at that facility.

1910.147(f) Additional requirements

1910.147(f)(1) Testing or positioning of machines, equipment or components thereof. In situations in which lockout or tagout devices must be temporarily removed from the energy isolating device and the machine or equipment energized to test or position the machine, equipment or component thereof, the following sequence of actions shall be followed:

1910.147(f)(1)(i) Clear the machine or equipment of tools and materials in accordance with paragraph (e)(1) of this section;

1910.147(f)(1)(ii) Remove employees from the machine or equipment area in accordance with paragraph (e)(2) of this section;

1910.147(f)(1)(iii) Remove the lockout or tagout devices as specified in paragraph (e)(3) of this section;

1910.147(f)(1)(iv) Energize and proceed with testing or positioning;

1910.147(f)(1)(v) Deenergize all systems and reapply energy control measures in accordance with paragraph (d) of this section to continue the servicing and/or maintenance.

1910.147(f)(2) Outside personnel (contractors, etc.)

1910.147(f)(2)(i) Whenever outside servicing personnel are to be engaged in activities covered by the scope and application of this standard, the on-site employer and the outside employer shall inform each other of their respective lockout or tagout procedures.

1910.147(f)(2)(ii) The on-site employer shall ensure that his/her employees understand and comply with the restrictions and prohibitions of the outside employer's energy control program.

1910.147(f)(3) Group lockout or tagout

1910.147(f)(3)(i) When servicing and/or maintenance is performed by a crew, craft, department or other group, they shall utilize a procedure which affords the employees a level of protection equivalent to that provided by the implementation of a personal lockout or tagout device.

1910.147(f)(3)(ii) Group lockout or tagout devices shall be used in accordance with the procedures required by paragraph (c)(4) of this section including, but not necessarily limited to, the following specific requirements:

1910.147(f)(3)(ii)(A) Primary responsibility is vested in an authorized employee for a set number of employees working under the protection of a group lockout or tagout device (such as an operations lock);

1910.147(f)(3)(ii)(B) Provision for the authorized employee to ascertain the exposure status of individual group members with regard to the lockout or tagout of the machine or equipment and

1910.147(f)(3)(ii)(C) When more than one crew, craft, department, etc. is involved, assignment of overall job-associated lockout or tagout control responsibility to an authorized employee designated to coordinate affected work forces and ensure continuity of protection; and

1910.147(f)(3)(ii)(D) Each authorized employee shall affix a personal lockout or tagout device to the group lockout device, group lockbox, or comparable mechanism when he or she begins work, and shall remove those devices when he or she stops working on the machine or equipment being serviced or maintained.

1910.147(f)(4) Shift or personnel changes. Specific procedures shall be utilized during shift or personnel changes to ensure the continuity of lockout or tagout protection, including provision for the orderly transfer of lockout or tagout device protection between off-going and oncoming employees, to minimize exposure to hazards from the unexpected energization or start-up of the machine or equipment, or the release of stored energy.

APPENDIX B

EQUIPMENT SPECIFIC PROCEDURE
FOR
GOLDER ASSOCIATES

Date Developed _____

Machine Identification

General Description: _____

_____

Manufacturer: _____

_____

Model Number _____

Serial Number* _____

_____

** If more than one piece of same equipment, list all serial numbers.*

Location of equipment: _____

_____

Operator Controls

The types of controls available to the operator need to be determined. This should help identify energy sources and lockout capacity for the equipment.

List types of operator controls: _____

_____

_____

_____

_____

_____

_____

_____

Energy Sources

The energy sources, such as electrical, steam, hydraulic, pneumatic, natural gas, stored energy, present on this equipment are:

ENERGY SOURCE	LOCATION	Lockable		Type lock or block needed
		Yes	No	

Shutdown Procedures

List the steps in order necessary to shut down and de-energize the equipment. Be specific. For stored energy, be specific about how the energy will be dissipated or restrained.

Procedure: _____

_____

Lock Type & Location: _____

_____

How Will De-energized State Be Verified? _____

_____

_____

_____

_____

NOTIFY ALL AFFECTED EMPLOYEES WHEN THIS PROCEDURE IS IN APPLICATION.

Start Up Procedures

List the steps in order necessary to reactivate (energize) the equipment. Be specific.

Procedure: _____

_____

_____

_____

Energy Source Activated: _____

_____

_____

_____

_____

NOTIFY ALL AFFECTED EMPLOYEES WHEN THIS PROCEDURE IS IN APPLICATION.

Procedures For Operations and Service/Maintenance

List those operations where the procedures above do not apply [See 29 CFR 1910.147 (a)(2)]. Alternate measures which provide effective protection must be developed for these operations. Job Safety Analysis is one method of determining appropriate measures.

Operation Name: _____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Affected and Authorized Employees

List each person affected by this procedure and those authorized to use this procedure.

AFFECTED EMPLOYEES	
Name	**Job Title**

AUTHORIZED EMPLOYEES	
Name	**Job Title**

Approved by Date

Approved by Date

APPENDIX D

COMMUNITY AIR MONITORING PLAN

COMMUNITY AIR MONITORING PLAN

A world of capabilities delivered locally

APPENDIX D

COMMUNITY AIR MONITORING PLAN (CAMP)

Review Avenue Development Properties
Long Island City, Queens, New York

Review Avenue Development I
37-30 Review Avenue
(BCA # 241089)

Review Avenue Development II
37-80 Review Avenue
(BCA # 241005)

Submitted To: Cresswood Environmental Consultants, LLC
380 Lexington Avenue
Room 2020
New York, NY 10168-0002

Submitted By: Golder Associates Inc.
744 Broad Street, 25th Floor
Newark, NJ 07102 USA

November 2011 **023-6151.002**

Golder Associates

1.0 INTRODUCTION

This Community Air Monitoring Program (CAMP) was prepared by Golder Associates Inc. (Golder), on behalf of Cresswood Environmental Consultants, LLC (Cresswood), to satisfy a requirements of the Remedial Work Plan (RWP) prepared for the Review Avenue Development II property (RAD II property) located at 37-80 Review Avenue in Long Island City, New York, and Review Avenue Development I property (RAD I property) located at 37-30 Review Avenue in Long Island City, New York, collectively referred to as the site.

The information presented in this CAMP is consistent with the guidelines for a CAMP and fugitive dust/particulate monitoring provided in Appendices 1A and 1B in *DER-10 Technical Guidance for Site Investigation and Remediation* (DER-10). The CAMP developed by Environmental Liability Management, LLC (ELM) in 2008 during the interim remedial measure (IRM) has been updated to reflect the remedial action presented in the RWP.

The CAMP is intended to provide an added layer of protection to the surrounding communities and onsite personnel who are not directly involved with intrusive work. The CAMP is not intended to address action levels for worker respiratory protection that may be required inside an exclusion zone. Specific information on levels for worker respiratory protection is provided in the project specific health and safety plan (HASP).

The CAMP will be implemented at the site during the construction activities associated with the remedial action outlined in the RWP. The selected Remedial Action (RA) Contractor (Remediation Contractor) will be required to fully comply with this plan. The Remedial Contractor will be responsible for the implementation of the CAMP and will have direct communication with all RA subcontractors, the site's tenants, and adjacent property owner (or tenants) to ensure that corrective measures take place at appropriate times to control generation or migration of fugitive dust or soil vapors.

Based on previous investigations and intrusive activities conducted at the RAD II property, volatile organic compounds (VOCs) and particulates have been identified as contaminants of potential concern relevant to the CAMP. Based on prior experience there also is a potential for nuisance odors that could be detected by on-site receptors outside of the remediation work areas, and adjacent offsite receptors.

The CAMP provides for monitoring of the ambient air for VOCs and particulates that are at the downwind perimeter of each designated work area, referred to as exclusion zones, during intrusive activities. Intrusive activities may include, but not be limited to, installation of installing monitoring or recovery wells, excavation for building foundations, installation of underground piping for conveyance of liquids extracted from recovery wells and for stormwater management systems on the RAD II property, and grading of

existing on-site materials prior to installation of a remediation cap (soil or asphalt). Periodic monitoring will also be performed during non-intrusive activities, such as monitoring well sampling.

The CAMP is presented in the following five (5) sections:

- 1.1 VOC Monitoring Approach
- 1.2 Particulate Monitoring Approach, Response Levels and Actions
- 1.3 Metrological Monitoring Approach
- 1.4 Available Suppression Techniques
- 1.5 Reporting

1.1 VOC Monitoring Approach

A conservative action level consistent with NYSDOH guidance will be implemented while monitoring for VOCs. Total VOC concentrations in the ambient air will be monitored at the upwind and downwind perimeters of the exclusion zone(s) during all intrusive work. The positioning of the monitoring equipment will be located at temporary locations around the perimeter of the exclusion zones. The specific locations for monitoring will be chosen on a daily basis based on site logistics, meteorological events/wind direction, and the designated exclusion zone location and configuration.

The monitoring work will include the use of a MiniRAE 2000 photo ionization detector (PID) or equivalent. The monitoring equipment will be calibrated at least once daily following the manufacturer's recommendation. A minimum of two (2) monitors will be set up daily at the perimeter of the exclusion zone(s). The equipment will include audible alarms to indicate the exceedences of the action levels for the VOC monitoring listed in Table 1 and discussed below.

Based on a 15-minute running average, the monitor will alarm at the levels specified below, and the following specific actions will occur:

1. If the ambient air concentration of total organic vapors at the downwind perimeter of the work area or exclusion zone exceeds 5 parts per million (ppm) peak above background, or 1 ppm above background for the 15-minute average, or greater than 10% LEL, work activities must be temporarily halted and monitoring continued. If the total organic vapor level readily decreases (per instantaneous readings) below 5 ppm over background, work activities can resume with continued monitoring.
2. If total organic vapor levels at the downwind perimeter of the work area or exclusion zone reaches a peak in excess of 5 ppm over background, or 1 ppm over background sustained for over 15 minutes, work activities must be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps, work activities can resume provided that the total organic vapor level 200 feet downwind of the exclusion zone or half the distance to the nearest potential receptor or residential/commercial structure, whichever is less - but in no case less than 20 feet, is below 1 ppm over background for the 15-minute average.

3. If the organic vapor level is above 25 ppm or above 10% LEL within the work area, activities must be shutdown.

All 15-minute readings must be recorded and be available for State (DEC and NYSDOH) personnel to review. Instantaneous readings, if any, used for decision purposes should also be recorded.

During non-intrusive activities, periodic monitoring of VOC and LEL concentrations will be conducted utilizing a PID. VOC and LEL concentrations will be measured and recorded at the start of each day and at the end of each workday.

1.2 Particulate Monitoring, Response Levels and Actions

Particulate concentrations in the ambient air will be monitored continuously at the upwind and downwind perimeters of the exclusion zone(s) during all ground intrusive work. The positioning of the monitoring equipment will be located at temporary locations around the perimeter of the exclusion zones. The specific locations for monitoring will be chosen on a daily basis based on site logistics, meteorological events/wind direction, and the designated exclusion zone location and configuration.

The monitoring will be performed using real-time monitoring equipment capable of measuring particulate matter less than 10 micrometers in size (PM-10) and capable of integrating over a period of 15-minute (or less) for comparison to the airborne particulate action levels (as defined below and summarized in Table 1). Monitoring equipment will be Thermo Scientific pDR-1500 monitor or equivalent satisfying minimum performance standards identified in Appendix 1B in DER-10. A minimum of one (1) upwind and one (1) downwind monitor will be deployed each day. The data logging averaging period will be set for 15-minutes with the time and date stamp recording. Alarm averaging will be set at 150 micrograms per cubic meter ($\mu g/m^3$) per 15-minute period. The equipment will include an audible alarm to indicate the exceedance of this alert levels. In addition, fugitive dust migration will be visually assessed during all intrusive work activities.

Based on a 15-minute running average, the monitor will alarm at the levels specified below, and the following specific actions will occur:

- If the downwind PM-10 particulate level is 150 $\mu g/m^3$ for the 15-minute period (i.e., the "alert" limit, then the upwind background level will be promptly confirmed. If the downwind level is greater than 100 $\mu g/m^3$ above the background level (i.e., the "action" limit), or if airborne dust is observed leaving the work area from the disturbance areas on a continued basis, then dust suppression techniques must be employed. Work may continue with dust suppression techniques provided that action level is not exceeded and provided that no visible dust generated from site disturbance is migrating from the work area.
- If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are greater than the action limit over a 15-minute period , work must be stopped, a re-evaluation of activities initiated, and dust suppression techniques modified. Work can

resume provided that the dust suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to less than the action limit and in preventing visible dust migration.

All 15-minute readings will be recorded and be available for review by NYSDEC and NYSDOH. Records will include documentation of suppression techniques associated with monitoring data, when suppression techniques are employed.

1.3 Meteorological Monitoring

Meteorological data consists of wind speed, wind direction, temperature, barometric pressure, and relative humidity. At a minimum, a full set of Meteorological parameters will be measured and recorded at the start of each day, noon of each day, and at the end of each workday. Wind direction readings will be utilized to position the VOC and particulate monitoring equipment in appropriate upwind and downwind locations. A Davis Corporation wireless instrument station or equivalent will be used to measure and log the meteorological data.

1.4 Available Suppression Techniques

During intrusive activities, potable water (mist) or vapor suppression foam will be applied to areas where the generation of vapors cannot be controlled to below action levels by other means to mitigate the potential for odors, VOCs, and particulates to be released into the air at unacceptable levels. Potable water misting via dedicated hose will be utilized as a daily site control measure to mitigate the potential for particulate/dust released into non-contaminated Site areas and roadways. Excavation methods and material staging and loading methods will be continually evaluated and modified (as necessary) to alleviate the potential for odor, VOC, and particulate releases.

1.5 Reporting

All recorded monitoring data will be downloaded and field logged daily, including Action Limit Reports (if any) and daily CAMP monitoring location plans. All records will be maintained onsite for NYSDEC and NYSDOH to review. The results of the CAMP monitoring will be submitted to the NYSDEC in monthly CAMP data summary reports that will contain all of the CAMP data collected during the month, daily monitoring station location maps, and copies of the month's Action Limit Reports (if any). A description of the CAMP-related activities will also be included in the Monthly Progress Report submitted to the NYSDEC. Additionally, all CAMP monitoring records will be included in the overall report that will be submitted to the NYSDEC. If work stoppage is necessitated by inability to practically control fugitive emissions to below the action limit, the NYSDEC will be notified within 24 hours of the work stoppage.

Table 1: Community Air Monitoring Action Levels

PARAMETER	RANGE	ACTION REQUIRED
Total Organic Vapors	0 ppm to <1 ppm above background at perimeter	Normal operations continue breathing zone monitoring.
	>5 ppm peak above background at perimeter	Work activates will be halted and monitoring will be continued. If instantaneous readings steadily decrease, work may resume.
	>25 ppm above background in work area	Work activates will be halted and the source of vapors will be identified. Corrective actions will be taken to abate emissions and monitoring will be continued.
Particulates	<150 µg/m^3 at downwind perimeter	Normal operations.
	>150 µg/m^3 average sustained for more than 15 minutes at downwind perimeter	Collect upwind perimeter reading for comparison with downwind reading.
	>100 µg/m^3 above upwind background, or visible dust migrating from disturbance area beyond perimeter	Employ dust suppression techniques.
	Dust suppression cannot control downwind levels to <100 µg/L compared with upwind	Work activities will be halted and corrective actions taken.

At Golder Associates we strive to be the most respected global group of companies specializing in ground engineering and environmental services. Employee owned since our formation in 1960, we have created a unique culture with pride in ownership, resulting in long-term organizational stability. Golder professionals take the time to build an understanding of client needs and of the specific environments in which they operate. We continue to expand our technical capabilities and have experienced steady growth with employees now operating from offices located throughout Africa, Asia, Australasia, Europe, North America and South America.

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APPENDIX E

LNAPL AND GROUNDWATER MONITORING PLAN

MONITORING PLAN

APPENDIX E

LNAPL AND GROUNDWATER MONITORING PLAN

Review Avenue Development Properties
Long Island City, Queens, New York

Review Avenue Development I
37-30 Review Avenue
(BCA # 241089)

Review Avenue Development II
37-80 Review Avenue
(BCA # 241005)

Submitted By: Golder Associates Inc.
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November 2011 **023-6151.002**

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Golder Associates

Table of Contents

List of Tables

List of Figures

1.0 INTRODUCTION

The Record of Decision (ROD) for the site specified that the remedy operate until the remedial objectives have been achieved or until the NYSDEC determines that continued operation is technically impracticable or not feasible. The NYSDEC also acknowledged in the ROD that some untreated hazardous waste may remain at the site, and therefore, a long-term monitoring program will be instituted. This monitoring program would facilitate evaluation of the effectiveness of the area wide LNAPL recovery system, as a component of the operation, maintenance, and monitoring of the remedial program. This LNAPL and Groundwater Monitoring Plan fulfills the ROD requirement to institute a long term monitoring program. Additional ROD requirements are addressed in the remedial workplan prepared for the Review Avenue Development II property (RAD II property) and Review Avenue Development I property (RAD I property).

This LNAPL and groundwater monitoring plan takes the following site-specific conditions into consideration (as outlined in the ROD and the RI/FS):

- LNAPL sources were removed nearly 30 years ago when the site was decommissioned in 1982.
- The LNAPL is viscous, weathered, and heterogeneous, and consists predominantly of long-chain, high boiling point and low solubility hydrocarbons.
- The LNAPL mass appears to be stable and to some extent naturally contained to the site.
- The low solubility of LNAPL constituents and the ongoing natural attenuation of these constituents in groundwater are effectively mitigating potential chemical impacts to groundwater from LNAPL. Further, groundwater is not used as a source of drinking water. Any LNAPL impacts on groundwater (which have been minimal to date) do not pose a threat via the drinking water pathway. Many of the chemicals detected can be attributable to background and/or upgradient sources (e.g, MTBE, TCE and metals). Based on the contaminant fate and transport evaluations performed for the Remedial Investigation, groundwater at the site does not threaten the designated use of Newtown Creek.

Because the NYSDEC-selected remedy focuses on remediation of the site through the removal of recoverable LNAPL, this LNAPL and groundwater monitoring plan focuses on evaluating the effectiveness of LNAPL removal over time. Therefore, while periodic groundwater quality assessment is included, more frequent evaluation of apparent LNAPL thicknesses over time comprises the primary component of the remedial effectiveness monitoring program.

2.0 LNAPL MONITORING PROGRAM

The program proposed herein addresses monitoring during the implementation of the area-wide LNAPL extraction system. LNAPL monitoring after the termination of area-wide recovery will be addressed in the proposal to terminate operation of the area-wide LNAPL recovery operation.

The apparent LNAPL thickness in a total of 25 LNAPL monitoring wells will be monitored during the remediation (refer to Table E-1). No LNAPL samples from monitoring wells will be collected for laboratory analysis during the LNAPL monitoring program. The following LNAPL monitoring wells will be included in the LNAPL monitoring network[1]:

- RAD I: GAL-10, GAL-11, GAL-12, GAL-13, GAL-18, GAL-21, GAL-22, GAL-23, GAL-24, GAL-32 and MW-4R
- RAD II: GAL-01RR, GAL-02R, GAL-03R, GAL-04, GAL-05R, GAL-06, GAL-07, GAL-08, GAL-09, GAL-16R, GAL-29, GAL-30 and GAL-31
- Review Ave (off-site and upgradient): GAGW-04

The LNAPL monitoring well locations are shown on Figure E-1. It is anticipated that one new LNAPL monitoring well will be needed to west of Building No. 1, this well will be designated GAL-32. The need and exact location of GAL-32 will be determined after installation of the LNAPL extractions wells in this area. LNAPL monitoring wells designated with an "R" suffix are wells that will be replaced as a result of damage sustained during prior site remediation or development activities. GAL-32 and the "R" wells will be constructed using the same methods and materials previously approved by NYSDEC for other LNAPL monitoring wells installed at the site. At each monitoring point, an oil-water interface probe will be used to measure the apparent LNAPL thickness and the groundwater/LNAPL interface in accordance with the schedule shown on Table E-1.

All other LNAPL monitoring wells installed on RAD I and RAD II during previous remedial investigations that will not be used during the LNAPL monitoring program will be closed by tremie-grouting with a cement/bentonite grout and sealed with cement at the surface after removing the surface casing in accordance with NYSDEC-approved procedures. Well closures will be performed at the time that new LNAPL monitoring wells are installed prior to full-scale remedy implementation.

[1] Replacement wells GAL-01R, GAL03R, and GAL-05R will be installed prior to full-scale remediation. Off-site wells GAL-27 and GAL-28 will be monitored annually . These wells are located on the South Capasso property and will be used as LNAPL sentinel wells. Historically LNAPL has not been detected at these wells.

3.0 GROUNDWATER MONITORING PROGRAM

The groundwater monitoring program will consist of a subset of groundwater monitoring wells that were monitored during the RI. Groundwater quality in a total of seven (7) groundwater monitoring wells, as shown on Figure E-1, will be monitored. It is anticipated that the following monitoring wells will be included in the groundwater monitoring network:

- RAD I: GAGW-08
- RAD II: GAGW-02, GAGW-05R (replacing damaged GAGW-05D), and GAGW-06I
- South Capasso (downgradient) (if accessible): GAGW-09S and GAGW-09D
- Review Ave (upgradient): GAGW-04D

The groundwater samples will be analyzed for the following Target Compound List (TCL)/Target Analyte List (TAL) parameters during the first year of remediation:

- TCL Volatile Organic Compounds (VOCs): USEPA Method No. 624/8260B;
- TCL Semi-Volatile Organic Compounds (SVOCs): USEPA Method No. 625/8270C; and,
- TAL Metals: USEPA Method Nos. 200/6000/7000 Series.

Groundwater monitoring will be performed semi-annually for the first year of area-wide LNAPL recovery and annually thereafter until area-wide LNAPL recovery is terminated. The need for continuing groundwater monitoring after termination of area-wide LNAPL recovery, and any sampling proposed thereafter, will be addressed in the proposal to terminate area-wide LNAPL recovery based on previously collected data. All field activities will be completed in a manner consistent with the approved RI/FS Work Plan and subsequent Work Plans for the RI. Prior to groundwater sampling, groundwater levels will be collected from each of the wells referencing MSL datum, and the data will be tabulated relative to prior measurements and the interpreted groundwater contour maps developed during the RI will be updated to reflect the more recently collected data.

Prior to starting the groundwater monitoring program and beginning area-wide LNAPL recovery, well GAGW-05 will be abandoned in accordance with NYSDEC regulations and a replacement well will be installed with the same construction details as prior well GAGW-05. In addition, existing well GAGW-02 will be redeveloped to remove silt accumulation. Attempts will be made to gain access to downgradient wells GAGW-09S and GAGW-09D on South Capasso. Wells GAGW-02 (after redevelopment), GAGW-05R, GAGW-09S and GAGW-09D will be sampled in a synoptic event, and data reported to NYSDEC and compared with the April 2011 groundwater data collected from other wells.

All other previously installed groundwater monitoring wells that will not be used for the proposed monitoring program will be closed by tremie-grouting with a cement/bentonite grout and sealed with

cement at the surface after removing the surface casing in accordance with NYSDEC-approved procedures. These well closures will be performed during repair or replacement of the wells that will be used for future monitoring.

4.0 REPORTING

During the area-wide LNAPL remediation, a LNAPL and groundwater monitoring report will be prepared annually to summarize the results. These monitoring reports will be submitted as part of Operation and Maintenance (O&M) of the area-wide LNAPL recovery. In these reports, information related to LNAPL distribution and groundwater quality will be presented. The progress reports will also provide conclusions and recommendations for changes in the overall LNAPL and groundwater monitoring network, and be used to support any proposals to terminate area-wide LNAPL recovery.

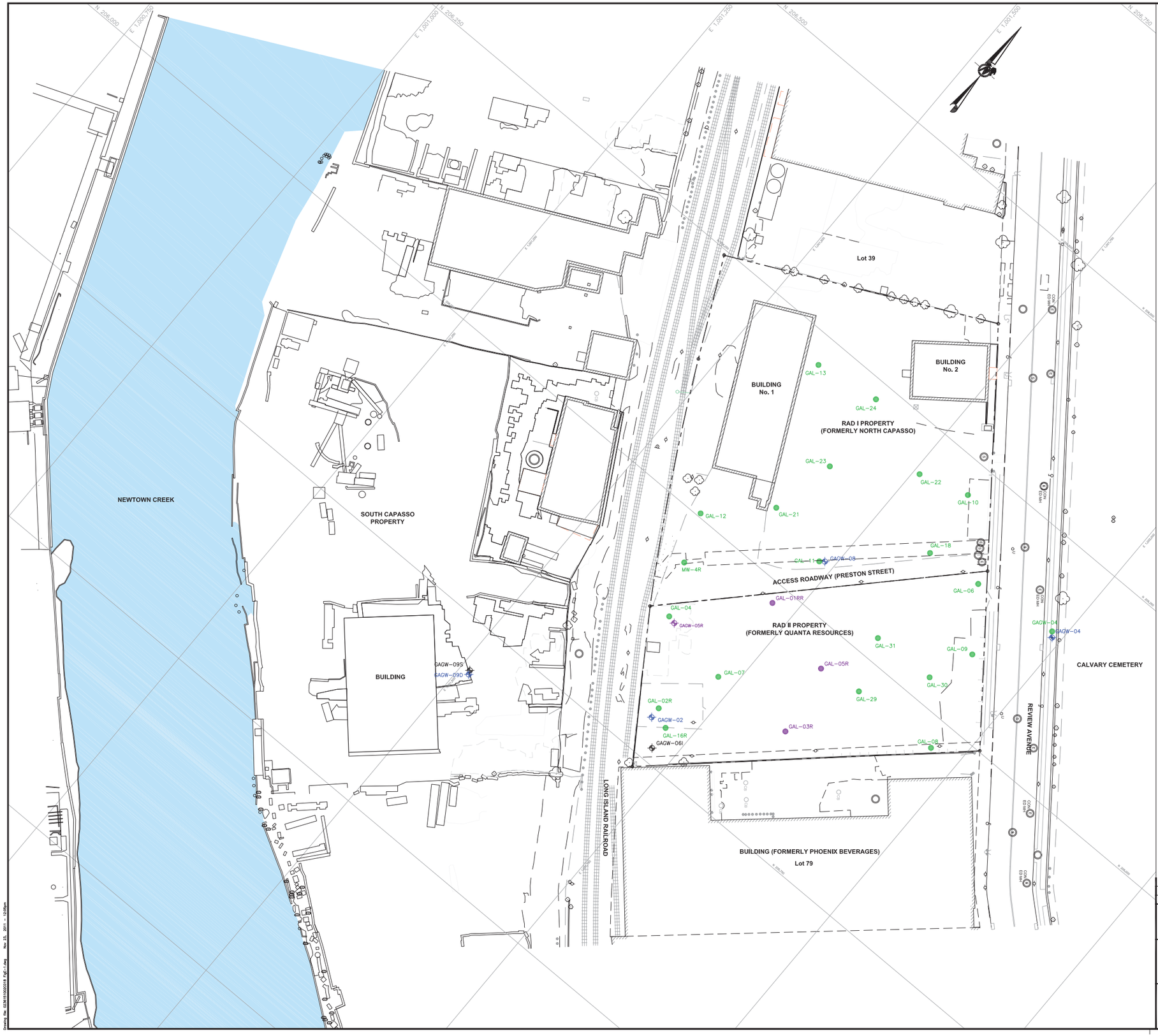
Table E-1
Long Term LNAPL Remediation Monitoring Program
Review Avenue Development I and II
Long Island City
Queens County, New York

Monitoring Point ID	Location	Schedule	Rationale
Baseline LNAPL Monitoring			
GAL-10, GAL-11, GAL-12, GAL-13, GAL-18, GAL-21, GAL-22, GAL-23, GAL-24, GAL-32[1] and MW-4R	RAD I	2 Events prior to Start-Up	Measure apparent LNAPL thickness
GAL-01RR[1], GAL-02R, GAL-03R[1], GAL-04, GAL-05R[1], GAL-06, GAL-07, GAL-08, GAL-09, GAL-16R, GAL-29, GAL-30 and GAL-31	RAD II	2 Events prior to Start-Up	Measure apparent LNAPL thickness
VER and Single Phase LNAPL Recovery Wells	RAD I & II	2 Events prior to Start-Up	Measure apparent LNAPL thickness
GAGW-04	Review Ave	2 Events prior to Start-Up	Measure apparent LNAPL thickness
Remediation LNAPL Monitoring - Year 1			
GAL-010, GAL-11, GAL-12, GAL-13, GAL-18, GAL-21, GAL-22, GAL-23, GAL-24, GAL-32[1] and MW-4R	RAD I	Monthly	Measure apparent LNAPL thickness
GAL-01RR[1], GAL-02R, GAL-03R[1], GAL-04, GAL-05R[1], GAL-06, GAL-07, GAL-08, GAL-09, GAL-16R, GAL-29, GAL-30 and GAL-31	RAD II	Monthly	Measure apparent LNAPL thickness
GAGW-04	Review Ave	Semi-Annual	Measure apparent LNAPL thickness
Subset (6 wells) of the Single Phase LNAPL Recovery Wells[2]	RAD I & II	Semi-Annual	Measure apparent LNAPL thickness
Remediation LNAPL Monitoring - Year 2+			
GAL-010, GAL-11, GAL-12, GAL-13, GAL-18, GAL-21, GAL-22, GAL-23, GAL-24, GAL-32[1] and MW-4R	RAD I	Quarterly	Measure apparent LNAPL thickness
GAL-01RR[1], GAL-02R, GAL-03R[1], GAL-04, GAL-05R[1], GAL-06, GAL-07, GAL-08, GAL-09, GAL-16R, GAL-29, GAL-30 and GAL-31	RAD II	Quarterly	Measure apparent LNAPL thickness
GAGW-04	Review Ave	Semi-Annual	Measure apparent LNAPL thickness
Subset (6 wells) of the Single Phase LNAPL Recovery Wells[2]	RAD I & II	Annual	Measure apparent LNAPL thickness

Notes:

[1] LNAPL monitoring wells GAL-01R, GAL-03, and GAL-05 are no longer present. Replacement wells will be installed during installation of the VER and single phase LNAPL recovery wells. GAL-32 is a new well

[2] Six single phase LNAPL wells will be shut down for one week two times to measure the apparent LNAPL thickness. One week is required to allow for the wells to reach equilibrium.



LEGEND

- LNAPL MONITORING WELL (GOLDER ASSOCIATES 2003/2004/2005/2008) (SEE REFERENCE 2)
- SHALLOW GROUNDWATER MONITORING WELL (GOLDER ASSOCIATES 2004) (SEE REFERENCE 2)
- DEEP GROUNDWATER MONITORING WELL (GOLDER ASSOCIATES 2003/2004) (SEE REFERENCE 2)
- PROPOSED LNAPL MONITORING WELL (NEW OR REPLACEMENT)
- PROPOSED DEEP GROUNDWATER MONITORING WELL (REPLACEMENT)
- CONCRETE SURVEY MONUMENT
- REVIEW AVENUE DEVELOPMENT PROPERTY BOUNDARY (SEE REFERENCE 1)
- RAILROAD
- FENCE LINE
- EASEMENT

NOTES

1.) FT-MSL - FEET MEAN SEA LEVEL

2. MONITORING WELL GAGW-05R, GAL-01RR, GAL-03R AND GAL-05R ARE PROPOSED REPLACEMENT WELLS. WELLS WILL BE PLACED IN CLOSE PROXIMITY OF ORIGINAL WELLS USING SURVEY COORDINATES OF THE ORIGINAL WELLS.

3. AN ALTERNATIVE MONITORING WELL NETWORK MAY REQUIRED BASED ON FUTURE REDEVELOPMENT ACTIVITIES AND AGENCY APPROVAL.

REFERENCES

1.) BASE MAP TAKEN AND PROPERTY BOUNDARY FROM DIGITAL FILE 2148-DELIVERY-2.dwg, ENTITLED "BOUNDARY AND TOPOGRAPHIC PLAN, BLOCK 312 LOTS 41 & 69, 37-80 REVIEW AVENUE, PREPARED FOR: GOLDER ASSOCIATES, LOCATED IN: LONG ISLAND CITY, QUEENS, N.Y. PROVIDED BY GEOD CORPORATION, DATED JUNE 10, 2011.

2.) EXISTING WELL COORDINATES TAKEN FROM A MICROSOFT EXCEL FILE Quanta Samples and Wells.xls, 2148A 8-23-04.xls, 2148A 4-11-05.xls, 2340 MONITORING WELLS.xls AND Monitoring Wells from 5-23-2011.xls PROVIDED BY GEOD CORP.

3.) RAD II PROPERTY - BLOCK 312, LOT 69; BCA# C241005.

4.) RAD I PROPERTY - BLOCK 312, LOT 41; BCA# C241089.

40 0 40 80
SCALE FEET

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW

PROJECT
REVIEW AVENUE DEVELOPMENT
BROWNFIELD CLEANUP PROGRAM
REMEDIAL ACTION WORK PLAN FOR SITES C241005 & C241089
QUEENS COUNTY, NEW YORK

TITLE
GROUNDWATER AND LNAPL LONG TERM MONITORING PROGRAM MONITORING WELL PLAN

Golder Associates
Philadelphia USA

PROJECT No.	023-6151002		FILE No.	0236151002C018	
DESIGN	AGE	07/2011	SCALE	AS SHOWN	REV. 0
CADD	YPW	11/2011			
CHECK	KGK	11/2011			
REVIEW	RES	11/2011			

FIGURE E-1

Drawing No. 0236151002018 Fig E-1.dwg Nov 23, 2011 - 12:06pm

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