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December 14, 2012

Ms. Dilan Roe
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1131 Harbor Bay Parkway, Suite 250
Alameda, CA 94501-6577

Subject: **Draft Feasibility Study and Corrective Action Plan**
Crown Chevrolet Cadillac Isuzu
7544 Dublin Boulevard and 6707 Golden Gate Drive
Dublin, California
Fuel Leak Case No. RO0003014

Dear Ms. Roe:

Enclosed please find the *Draft Feasibility Study and Corrective Action Plan* for the Crown Chevrolet Cadillac Isuzu site at 7544 Dublin Boulevard and 6707 Golden Gate Drive, in Dublin, California (Fuel Leak Case No. RO0003014, GeoTracker Global ID T10000001616). This report was prepared by AMEC Environment & Infrastructure, Inc. (AMEC), on behalf of Crown Chevrolet Cadillac Isuzu.

I declare under penalty of perjury that the information and/or recommendations contained in the attached document or report is true and correct to the best of my knowledge.

Please contact me at (925) 984-1426 or Avery Patton of AMEC at 510-663-4154 if you have any questions regarding this Work Plan.

Sincerely yours,

Terri Costello

Terri Costello
Betty J. Woolverton Trust

Attachment: Draft Feasibility Study and Corrective Action Plan

cc: Tondria Hendrix, Zurich North American Insurance
Thomas L. Vormbrock, Rimkus Consulting Group, Inc.
Susan Gallardo, AMEC Environment & Infrastructure, Inc.

Draft Feasibility Study and Corrective Action Plan
Crown Chevrolet Cadillac Isuzu
7544 Dublin Boulevard and 6707 Golden Gate Drive
Dublin, California

Prepared for:
Crown Chevrolet, Dublin, California

Prepared by:
AMEC, Oakland, California

December 2012

Project OD10160070

DRAFT FEASIBILITY STUDY AND CORRECTIVE ACTION PLAN

Crown Chevrolet Cadillac Isuzu
7544 Dublin Boulevard and 6707 Golden Gate Drive
Dublin, California
Fuel Leak Case No. RO0003014

December 14, 2012
Project OD10160070

This report was prepared by the staff of AMEC Environment & Infrastructure, Inc., under the professional supervision of Avery Patton, PG, and Susan Gallardo, PE. The findings, recommendations, specifications, and/or professional opinions presented in this report were prepared in accordance with generally accepted professional geology and engineering practices, and within the scope of the project. There is no other warranty, either express or implied.

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DRAFT FEASIBILITY STUDY AND CORRECTIVE ACTION PLAN

Crown Chevrolet Cadillac Isuzu
7544 Dublin Boulevard and 6707 Golden Gate Drive
Dublin, California

1.0 INTRODUCTION

AMEC Environment & Infrastructure, Inc. (AMEC), has prepared this *Draft Feasibility Study and Corrective Action Plan* (FS/CAP) on behalf of the Betty J. Woolverton Trust and Crown Chevrolet Cadillac Isuzu (collectively, Crown) for the properties located at 7544 Dublin Boulevard and 6707 Golden Gate Drive in Dublin, California (the site; Figure 1). The purpose of the FS/CAP is to evaluate and compare remedial alternatives for addressing soil vapor impacts at the site and to describe the implementation of the selected corrective action. Alameda County Environmental Health ("ACEH") has requested that an FS/CAP report be submitted in December 2012.

This FS/CAP includes sections covering the following topics:

- A summary of the conceptual site model (CSM).
- A screening of corrective action technologies.
- An evaluation of corrective action alternatives that could be used to reduce potential risk to future site occupants and construction workers.
- A description of the implementation of the selected corrective action.
- A discussion of the corrective action monitoring program.

Additionally, as requested by ACEH, this document includes a discussion of other considerations related to minimizing the possibility of environmental impacts to on-site soil that could occur during potential future site redevelopment activities.

The activities and time frames presented within this FS/CAP have been adjusted to fit a currently proposed site redevelopment (e.g., excavation activities discussed herein are proposed to be coordinated with building demolition). Should site redevelopment not occur as planned, portions of this FS/CAP may not be applicable.

2.0 BACKGROUND

Background regarding the site, including prior investigations and remediation, is presented in the following sections.

2.1 SITE HISTORY

The site was developed in 1968 as Crown Chevrolet, a car dealership with auto body shops, on land that appears to have been used for agricultural purposes. At that time, the three main site buildings (Buildings A, B, and C) were constructed. Building A was later expanded. Building D was reportedly constructed in 1994. Operations as a car dealership and auto body shop continued from 1968 through the present, although operations have been significantly reduced in the past several years. No operations are currently being conducted in the northern portion of the north parcel of the site at this time. The site originally consisted of one approximately 6.33-acre parcel, but was divided into north (4.97-acre) and south (1.36-acre) parcels in approximately 2000, when a new street, St. Patrick Way, was constructed. The facility operations discussed above were conducted on the north parcel; the south parcel was used for vehicle parking.

A 10,000-gallon gasoline underground storage tank (UST) and a 1,000-gallon waste oil UST were previously located immediately to the south of Building B. The USTs reportedly were replaced in the 1980s with a 1,000-gallon gasoline UST and a 1,000-gallon waste oil UST in approximately the same locations and upgraded in 1998 with spill containment devices.

Removal of these USTs was conducted in November 2012 by ENGEO, Inc. (ENGEO), on behalf of the site owner and under the regulatory oversight of ACEH (the UST removal will be documented in a report to be issued to ACEH in December 2012). As indicated by ENGEO, soil samples were collected from stockpiled excavated soil and the base of UST excavations. Samples were analyzed for total petroleum hydrocarbons (TPH), polychlorinated biphenyls (PCBs), semivolatile organic compounds (SVOCs), and/or selected metals. Metals were reportedly detected at background concentrations considered typical for the Dublin area. TPHd was reportedly detected in two samples at low concentrations relative to environmental screening levels (ESLs), published by the California Regional Water Quality Control Board, San Francisco Bay Region (Regional Water Board; Regional Water Board, 2008). None of the other analytes were detected. Based on these results, it does not appear that there are any significant impacts associated with the USTs. However, ACEH has not reviewed the UST removal report; it is possible that additional action will be required with regard to the area of the former USTs. Additional action, should it be necessary, is not addressed in this FS/CAP.

2.2 INVESTIGATIONS

Multiple investigations have been conducted at the site; these investigations have been performed to address regulatory concerns as well as in support of transactional and potential redevelopment activities. Previous investigations conducted at the site are documented in the following reports:

- March 16, 2009—Basics Environmental, Inc. (Basics), *Limited Phase II Environmental Site Sampling Report* (Basics, 2009).
- April 4, 2011—AMEC, *Revised Soil and Groundwater Investigation Report* (AMEC, 2011a).

- January 7, 2011—Ninyo & Moore, *Limited Phase II Environmental Site Assessment* (Ninyo & Moore, 2011a).
- September 16, 2011—Ninyo & Moore, *Additional Phase II Environmental Site Assessment* (Ninyo & Moore, 2011b).
- September 27, 2011—AMEC*, Soil, Groundwater, and Soil Vapor Investigation Report* (AMEC, 2011c).
- October 19, 2012—AMEC, *Soil, Groundwater, and Soil Vapor Investigation Report* (AMEC, 2012b).

Locations of samples collected during the previous investigations are shown on Figure 2. Select samples collected during these investigations have been analyzed for volatile organic compounds (VOCs), TPH, metals, polynuclear aromatic hydrocarbons (PAHs), PCBs, and glycols. A complete summary of data collected at the site is presented in AMEC's October 2012 investigation report. Based on the previous sample results, two primary environmental impacts related to the presence of VOCs were identified.

First, VOCs, primarily tetrachloroethene (PCE) and trichloroethene (TCE), have been detected in shallow groundwater and soil vapor throughout the northern portion of the north parcel. Biodegradation byproducts (e.g., cis-1,2-dichloroethene) are also present in groundwater and vapor, but at lower concentrations relative to PCE and TCE and below their respective ESLs, published by the California Regional Water Quality Control Board, San Francisco Bay Region (Regional Water Board; Regional Water Board, 2008). An exception is that vinyl chloride has been detected in soil vapor at concentrations above its ESL. Based on the results of the most recent investigation (August 2012), the source of PCE (and hence its degradation products) in groundwater is off site.

Second, chlorobenzenes and related compounds (e.g., 1,2-dichlorobenzene and 1,4-dichlorobenzene) have been detected in soil, groundwater, and soil vapor at a former sump and a former front-end alignment pit (F.E. Pit) within Building B.

In addition to these primary impacts, a low concentration (relative to the ESL) of PCE has been detected in soil vapor in the northeastern corner of the south parcel. No PCE has been detected above its reporting limit in groundwater in this area and no facility operations, other than vehicle parking, were conducted in the south parcel. Based on these results, no mitigation appears necessary for the south parcel at this time.[1]

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[1] For transactional and redevelopment purposes, we understand that the potential buyer/developer plans to conduct additional soil, groundwater, and soil vapor investigation activities for the south parcel to confirm the absence of impacts, and that the findings of these activities will be reported by the potential buyer/developer to ACEH.

2.3 REMEDIATION

Remedial activities were performed in October 2011 at the former sump and F.E. Pit within Building B. The remediation effort included removing a total of 432 tons of VOC-affected soil, concrete, and pea gravel from the former sump and pit excavations and approximately 5,600 gallons of VOC-affected water from the sump excavation. It was not possible to excavate beneath the existing building walls, and some impacted soil remains beneath them (AMEC, 2011e).

2.4 DEVELOPMENT PLANS

Site redevelopment is tentatively planned for the north and south parcels. Specifically, the north parcel is tentatively planned for development of 314 homes (multi-unit structures) and 17,000 square feet of retail space. The south parcel is tentatively planned for development as 76 units of affordable veterans' and other affordable housing. Note that it is intended that the south parcel, although currently part of the site from a legal and regulatory standpoint, will be subdivided from the north parcel in the near future.

3.0 SITE CONCEPTUAL MODEL FOR REMEDIATION

AMEC’s October 2012 investigation report includes a detailed discussion of the site conceptual model (SCM). The SCM is provided in Table 1, and various environmental issues at the site are discussed below in the context of the updated SCM, including the following:

- Site geology and hydrogeology
- PCE and TCE in groundwater and soil vapor in the northern portion of the north parcel.
- Chlorobenzenes and related constituents in soil and groundwater in the vicinity of the former sump and pit.

3.1 GEOLOGY AND HYDROGEOLOGY

Subsurface investigation findings for the site indicate that subsurface materials consist primarily of finer-grained deposits (clays, sandy clays, silts, and sandy silts) with interbedded sand lenses from ground surface to approximately 20 feet below ground surface (bgs). These units are underlain by approximately 15 to 20 feet of lean clay (with varying amounts of sand, but with no documented coarse lenses). Beneath the thick layer of lean clay is an interval of lean clay interbedded with sand and/or gravel lenses (from approximately 35.5 to 52 feet bgs), followed by another interval of lean clay to approximately 54 to 58 feet bgs, where an apparently continuous zone of clayey sand is encountered to the total depth logged at the site (60.5 feet bgs). A cone penetrometer technology test indicated that even coarser materials (interbedded with finer-grained materials) are present from approximately 60 to 75 feet bgs.

Groundwater is first encountered at the site between approximately 9 and 15 feet bgs, within discontinuous sand and/or gravel lenses that are a few inches to several feet thick, and also within the sandy clays that are present at similar depths. Due to the high clay content of the soil, saturated soil has not been encountered in some borings. There is likely a complex alluvial system in which groundwater (and chemical) movement primarily occurs in channel-like deposits of varying widths and thicknesses. The direction of the lateral hydraulic gradient (only measured in the northern portion of the north parcel) was to the east in September 2012 (Figure 3) and the magnitude of the lateral hydraulic gradient was approximately 0.00290 foot per foot at that time.

Additional detail about regional geology and hydrogeology is provided in Table 1.

3.2 PCE AND TCE IN NORTHERN PORTION OF NORTH PARCEL

PCE, TCE, and some biodegradation byproducts have been detected in groundwater and soil vapor in the northern portion of the north parcel. The highest concentrations of PCE in shallow groundwater are at the western property boundary, near the northwest corner of the site (Figure 4). As discussed above, groundwater flow direction is to the east (Figure 3), indicating that the source of PCE is off site to the west; however, the specific source of chlorinated VOCs is not known at this time.

A mass-in-place estimate was performed using data presented in the October 2012 investigation report (AMEC, 2012b). A conservative estimate was developed based on the highest reported VOC concentrations in groundwater and soil vapor, the estimated horizontal and vertical extent of VOC impacts, and the estimated physical characteristics of the affected water-bearing zone and vadose zone. The VOC mass is estimated to be approximately 3.9 pounds in groundwater and 0.3 pounds in soil vapor. In place mass estimate calculations are presented in Table 2.

The distributions of PCE and TCE are discussed by media (groundwater, soil vapor, and soil) in the following sections.

3.2.1 Groundwater

Groundwater impacts at concentrations greater than ESLs extend across the northern portion of the north parcel, extending approximately 180 to 230 feet south of the northern property boundary. The impacted water-bearing zone appears to be from approximately 10 feet bgs to approximately 20 feet bgs, based on the depth to groundwater and the presence of 15 to 20 feet of lean clay encountered at approximately 20 feet bgs. Deeper groundwater samples, collected from water-bearing zones at approximately 40 and 60 feet bgs, were non-detect for all VOCs (with the exception of several acetone detections that are believed to be false positives due to laboratory contamination).

PCE concentrations are highest along the western property boundary (up to 210 micrograms per liter [µg/L]), while TCE concentrations in groundwater are highest at the northeast corner of the site (up to 60 µg/L). The area with higher TCE concentrations was historically impacted by the Montgomery Ward release of TPHg, and it is likely that the TPHg acted as a source of organic carbon that stimulated the biological reduction of PCE in that area.

As part of this feasibility study, in order to evaluate the potential for future biological reduction, AMEC collected two groundwater samples in October 2012 from wells MP-01-1 (near the western property boundary) and MW-02 (near the northeastern portion of the site), and tested the samples for the *Dehalococcoides (Dhc)* bacteria. *Dhc* is the only known bacteria capable of sequential dechlorination of PCE to the inert compounds ethene and ethane (Maymo-Gatell et. al., 1997). The water samples also were analyzed for the electron receptors sulfate and nitrate. Field measurements recorded at the time of sampling included dissolved oxygen (DO) levels and oxidation reduction potential (ORP). The results of the analyses, which are presented in Appendix A, are as follows:

- *Dhc* was not present in either sample at or above laboratory quantifiable limits.
- DO levels stabilized at approximately 0.25 milligram per liter [mg/L] and ORP was negative. The results of these analyses indicate potentially favorable conditions for reductive dechlorination.
- Nitrate was not detected in the sample from MW-01, but was detected at 10 mg/L in the sample from MP-01-1. Sulfate was detected in both samples (at 42 mg/L in the sample from MW-01 and at 71 mg/L in the sample from MP-01-1).

These results are discussed further in Section 6.4.1, below.

3.2.2 Soil Vapor

Soil vapor is impacted by PCE, TCE, and vinyl chloride at concentrations greater than ESLs in the northern portion of the north parcel, extending approximately 200 to 230 feet south from the northern property boundary (Figure 5). In the northwest corner of the site, PCE concentrations generally correlate spatially with the higher concentrations of PCE in groundwater (Figures 4 and 5), but vary somewhat from the spatial distribution of this constituent in groundwater in the northeast corner of the site. This may indicate that shallow soil vapor transport is at least partially via on-site subsurface utilities, and not solely from volatilization from groundwater at the site. Additionally, utility lines within the nearby streets may provide a conduit for some of the vapors to enter the subsurface at the site. Where nested soil vapor samples were collected (along the eastern property boundary), concentrations of PCE and TCE in soil vapor samples collected are higher in the deeper (8 feet bgs) samples than the shallower (4 feet bgs) samples, confirming that volatilization from groundwater is a contributor to the VOC concentrations in soil vapor at the site.

The spatial distributions of PCE and TCE in shallow soil vapor (i.e., 1 to 4 feet bgs) are similar to each other (Figures 4 and 5), with the exception that only minimal TCE is present north and west of Building A. Within the vicinity of the on-site sewer line and along the eastern property boundary, TCE is present at elevated concentrations relative to PCE (and some vinyl chloride is present), suggesting that natural degradation of PCE is occurring in the unsaturated zone.

PCE was also detected in soil vapor along the floor drain lateral to the sewer line within Building B and in a vapor sample collected from within the former front-end alignment pit in Building B (this pit has since been removed), indicating that PCE may have been used within Building B and that minor releases may have contributed, in part, to the PCE detected in soil vapor beneath Building B. However, PCE is present at non-detectable to very low concentrations in groundwater in this area, suggesting that vapor transport along site utilities likely is a primary contributor to PCE in soil vapor beneath Building B.

3.2.3 Soil

PCE and TCE have been detected at low concentrations in soil samples collected north of and beneath Building A, but it is believed that these detections represent PCE and TCE in the vapor phase, and/or PCE and TCE present in the saturated zone (depending on the sample depth) and not a source of PCE or TCE in soil.

3.3 VOCS IN SOIL VAPOR IN THE SOUTH PARCEL

Several groundwater and soil vapor samples have been collected in the south parcel (Figure 6). Low levels of PCE (i.e., significantly less than the ESL) are present in soil vapor at approximately 5 feet bgs in the northwest corner of the south parcel. PCE was not detected in the groundwater sample collected in this area, and PCE is not present in the groundwater sample or soil vapor samples collected in the eastern portion of the south parcel. No auto servicing activities are known to have been conducted in this area, which was historically used as a parking lot. The low concentrations of PCE in soil vapor in the south parcel may be related to transport via subsurface utilities within Golden Gate Drive and/or Saint Patrick Way. Additional sampling is planned to further evaluate the extent of the presence of PCE in soil vapor in the south parcel.

3.4 CHLOROBENZENES AND RELATED CONSTITUENTS WITHIN BUILDING B

Chlorobenzenes and related constituents were released to the subsurface at a former sump and former F.E. Pit within Building B (Figures 7 through 9). Remediation was conducted at these areas in 2011; however, as discussed above, in Section 2.3, some impacted soil remains.

At the former sump, chlorobenzenes and petroleum-related constituents were present in soil and shallow groundwater at concentrations greater than ESLs. Most of the mass in soil was removed by soil excavation, which extended to a depth of approximately 16 feet bgs, in 2011. VOC concentrations in soil samples collected approximately 3 feet horizontally from the sump excavation sidewalls were less than ESLs, although some constituents were detected at concentrations greater than ESLs in confirmation samples from the excavation sidewalls

(Figure 7). Soil samples have not been collected from the base of the excavation (approximately 16 feet bgs), but, based on the decreasing concentrations with depth (e.g., chlorobenzene was detected at 90,000 micrograms per kilogram [µg/kg] at 3 feet bgs, 26,000 µg/kg at 6.5 feet bgs, and 6,500 µg/kg at 11.5 feet bgs), it is believed that soil is not significantly impacted deeper than the bottom depth of the excavation.

At the F.E. Pit, similar constituents were present in soil at concentrations greater than ESLs. The 2011 excavation removed impacted soil to 12 feet bgs and VOC concentrations were less than ESLs in a soil sample collected from the bottom of the excavation (however, TPHd was detected at a concentration slightly greater than the ESL). Similar to the former sump, some impacted soil remains in place at the sidewalls of the excavation, although VOC concentrations in soil samples collected approximately 3 feet horizontally from the sump excavation sidewalls (from angled borings) were less than ESLs (Figure 8).

The presence of VOCs in groundwater at concentrations above ESLs (e.g., benzene, chlorobenzene, and 1,2-dichlorobenzene) appears to be limited to within approximately 15 feet of the former sump (Figure 9). VOCs were not detected at concentrations greater than ESLs in groundwater samples collected beneath the F.E. Pit. VOCs were not detected in deeper groundwater samples collected downgradient of the former sump.

Soil vapor sampling was conducted in the vicinity of the former sump and former front-end alignment pit in Building B prior to remediation. Some concentrations of PCE, benzene, and 1,4-dichlorobenzene in soil vapor were greater than their respective ESLs during pre-remediation sampling. However, post-remediation soil vapor sampling has not been conducted.

4.0 CORRECTIVE ACTION OBJECTIVES

As discussed above, the identified constituents of concern (COCs) at the site are PCE, TCE, and breakdown products (e.g., vinyl chloride in soil vapor) in the northern portion of the north parcel; and chlorobenzenes and related constituents in the vicinity of the former sump and F.E. Pit.

Corrective action objectives (CAOs) are media-specific goals for protecting human health and the environment. The results of the site investigations indicate the potential for chemical exposure to future site occupants via soil, groundwater, and soil vapor that contain VOCs at concentrations that are higher than applicable risk screening criteria. Therefore, we have developed both absolute CAOs and functional CAOs.

Based on the findings of the investigations and the stated rationale, the absolute and functional CAOs for the protection of human health and the environment are the following (functional CAOs as bullets beneath each absolute CAO):

1. Mitigate potential vapor intrusion risks to future site occupants.
    - Confirm via 20 years of indoor air monitoring that concentrations of COCs are below applicable indoor air screening levels (e.g., ESLs).
    - Obtain temporal shallow groundwater data for four years.
    - Comply with institutional controls (ICs) regarding property use, mitigation measures, and monitoring.
2. Mitigate potential exposure to future construction and maintenance workers to VOC-impacted soil vapor, and groundwater.
    - Comply with a site management plan, which will provide guidance for worker protection and safety measures to be employed during site construction and maintenance.
3. Remediate identified residual source material in the vicinity of the former sump and F.E. Pit.
    - Remove residual impacted soil to the extent that COC concentrations in confirmation samples collected from the sidewalls of the excavation are less than ESLs for shallow soil in a residential land use scenario, where groundwater is considered a potential drinking water resource.

As noted in Section 2.0, the presence of PCE and TCE in groundwater and, as a consequence, in soil vapor at the site, originates from an off-site source. As such, protection of the environment by way of minimizing the possibility for vertical migration of VOC-impacted groundwater, or by reducing concentrations of COCs in groundwater to less than drinking water screening levels, is not an objective of this FS/CAP. Exposure to groundwater based on a drinking water scenario is considered an incomplete pathway, as potable water at the site is municipally-supplied at this time and will continue to be in the foreseeable future.

5.0 CORRECTIVE ACTION TECHNOLOGY SCREENING

Corrective action technologies were identified based on their ability to effectively achieve the objectives described above. Technologies were comparatively evaluated and screened on the basis of applicability to site conditions, effectiveness, implementability, and relative cost. A brief description of each technology and the results of the screening are presented in Table 3. The remediation technologies retained for evaluation and consideration in remedial alternatives include the following:

Soil:

- Excavation for the residual source material in the vicinity of the former sump and F.E. Pit

Groundwater:

- Permeable reactive barrier for control of PCE plume migration onto the site and remediation of impacted groundwater

- In-situ bioremediation for remediation of PCE- and TCE- impacted groundwater

Soil Vapor:

- Vapor barrier for vapor intrusion mitigation
- Sub-slab depressurization for vapor intrusion mitigation

In addition, administrative controls retained include long-term site management and ICs.

6.0 CORRECTIVE ACTION ALTERNATIVES

Following the identification and screening process, as presented in Table 3, the retained technologies were combined into alternatives to be evaluated relative to one another. Each alternative is cumulative; Alternative 2 incorporates the activities proposed in Alternative 1, Alternative 3 incorporates Alternative 2, and so on. Note that the remedial alternatives presented below are designed to fit a currently-proposed site redevelopment; these alternatives may not be applicable in their entirety should the currently-proposed redevelopment not proceed. However, to meet the CAOs, it is likely that some action could be required for future use of the northern portion of the north parcel, where there are soil vapor and groundwater impacts. Additionally, it is intended that the south parcel will be subdivided from the north parcel in the near future. As such the discussion of corrective actions are focused and intended to apply as stated.

The alternatives are identified as follows:

- Alternative 1—Soil excavation/disposal, groundwater monitoring, and long-term site management and ICs.
- Alternative 2—Vapor barrier and sub-slab depressurization, plus soil excavation/disposal, groundwater monitoring, and long-term site management and ICs.
- Alternative 3—Permeable reactive barrier with zero-valent iron (ZVI), plus vapor barrier and sub-slab depressurization, soil excavation/disposal, groundwater monitoring, and long-term site management and ICs.
- Alternative 4—In-situ bioremediation, permeable reactive barrier with ZVI, vapor barrier and sub-slab depressurization, soil excavation/disposal, groundwater monitoring, and long-term site management and ICs.

A “no action” alternative is normally included as a baseline for comparison to other alternatives. However, the no action alternative was not considered an appropriate remedial option, because the no action alternative will not effectively achieve the CAOs.

6.1 ALTERNATIVE 1—SOIL EXCAVATION/DISPOSAL, GROUNDWATER MONITORING, AND LONG-TERM SITE MANAGEMENT AND INSTITUTIONAL CONTROLS

This alternative consists of the removal and off-site disposal of soil impacted by TPH (diesel and motor oil range) and VOCs (benzene, chlorobenzene, and dichlorobenzene) at the former sump and F.E. Pit (Figures 7 and 8). As described above, some impacted soil remains in place following previous remedial activities due to inaccessibility beneath the existing buildings. The proposed excavation extents are presented on Figure 10. The horizontal excavation extents are estimated based on the locations of soil samples where VOC and TPH concentrations were less than residential ESLs; the actual horizontal extents will be based on the results of confirmation sample analyses. The vertical extent will be the same as that during the prior remedial activities (i.e., 16 feet bgs at the former sump and 12 feet bgs at the former F.E. Pit). Due to the proposed depth of the sump excavation, groundwater will most likely be encountered during the remedial activities. Accumulated groundwater in the proposed sump excavation will be removed to the extent possible and stored in a temporary holding tank. Based on analytical results for groundwater that was accumulated, sampled, and discharged during the previous excavation activities at the sump and F.E. Pit, it is expected that groundwater removed from the excavation(s) will meet discharge requirements for disposal to the on-site sanitary sewer.

As noted in Section 3.2.2, the presence of chlorinated VOCs in soil vapor (primarily PCE) correlates spatially with the higher concentrations of these VOCs in groundwater beneath the site, although vapor transport appears to be partially via on-site utilities and not entirely from volatilization from groundwater. To monitor concentration trends in groundwater, and by association, possible concentration trends in soil vapor, groundwater monitoring will be conducted in the northern portion of the site. On-site groundwater monitoring will occur for a period of four years via the current groundwater monitoring wells and new groundwater monitoring wells to be installed during property redevelopment. It is anticipated that this four-year period will be adequate to confirm that groundwater with higher PCE concentrations is not migrating onto the site, and that the concentrations are stable or decreasing through natural attenuation processes such as dispersion, dilution, volatilization, and/or biodegradation. Current on-site groundwater monitoring wells will be decommissioned prior to site redevelopment and new replacement wells will be installed to continue monitoring groundwater conditions at the site. Monitoring and reporting will continue quarterly for a period of two years and annually for the remaining two years. Proposed on-site groundwater monitoring well locations are shown on Figure 11.

Long-term site management and ICs will be implemented as administrative restrictions on the use of the property. Site management and ICs are intended to prevent inappropriate activities and use of the property, with consideration of potential risk from existing soil vapor and groundwater impacts. For this alternative, a Site Management Plan (SMP) will be developed that presents guidelines for health and safety, soil management, and groundwater management if subsurface work is conducted at the site. The site owner will have responsibility for implementation of the SMP. Additionally, a deed restriction will be placed on the property to prevent the use of groundwater across the site.

6.2 ALTERNATIVE 2—VAPOR BARRIER AND SUB-SLAB DEPRESSURIZATION, SOIL EXCAVATION/DISPOSAL, GROUNDWATER MONITORING, AND LONG-TERM SITE MANAGEMENT AND INSTITUTIONAL CONTROLS

This alternative consists of Alternative 1 plus the installation of a vapor barrier and sub-slab depressurization (SSD) system. The vapor barrier and SSD system will be installed in the northern portion of the north parcel beneath buildings (excluding parking structures) with footprints above groundwater and/or soil vapor impacts, and will extend at least 100 feet beyond the known impacts (i.e., PCE and TCE in groundwater and potential impacted soil vapor at the former sump and F.E. Pit); based on the currently-proposed redevelopment, the vapor barrier and SSD system extends approximately 190 feet beyond the currently impacted groundwater to provide continuity beneath the footprint of the structures (Figure 12a). As an additional mitigation measure, backfill areas for subsurface utilities will be constructed so as to minimize the possibility of creating preferential pathways for vapor migration.

The California Department of Toxic Substances Control (DTSC) has indicated that vapor intrusion mitigation is not intended to be a sole remedial alternative for a site contaminated by volatile chemicals. However, as stated in Section 4.0 of the October 2011 Vapor Intrusion Mitigation Advisory (VIMA) (DTSC, 2011a), where source removal is impracticable, the use of engineering methods may be the most feasible long-term response action. Additionally, as stated in Section 2.3.1 of the VIMA document, if a soil vapor plume originates from an off-site source, incorporating vapor intrusion mitigation into a building may be the only viable option, especially if the off-site source is regional in nature and remediation of off-site sources is impractical or not achievable in the near future.

Section 2.2 of the VIMA document also states the following:

> "Vapor intrusion mitigation is intended to minimize entry of volatile chemicals from the subsurface into the indoor air of overlying buildings. Vapor intrusion mitigation is not intended to be a sole remedial alternative for a volatile chemical contaminated site. For most sites in this risk range, remediation will be required to address the subsurface source of vapor contamination. However, based on site-specific considerations, mitigation may become the long-term measure, especially where removal of volatile chemicals may not be technically feasible (such as where the volatile chemical source is located off-site)."

Based on the rationale provided by DTSC, the use of vapor mitigation system would be considered appropriate for the site.

The vapor barrier will consist of a cold, spray-applied asphaltic emulsion membrane installed between two protective high-density polyethylene/polypropylene bonded geotextiles constructed beneath new building foundation slabs. The vapor barrier prevents impacted soil vapor from entering the building that might otherwise pass through various pathways, such as expansion joints, utility penetrations, or cracks in the slab. The spray-applied membrane has a thickness of approximately 60 to 80 dry mil (one dry mil is equal to 1/1000 inch).

In addition to the vapor barrier, a SSD system will be installed beneath the spray-applied membrane to build negative pressure in the sub-slab zone (i.e., to create a slight vacuum in the area beneath the building) and extract soil vapors for venting to the atmosphere. The U.S. EPA has defined a passive SSD system as “a system designed to achieve lower sub-slab air pressure relative to indoor air pressure by use of a vent pipe routed through the conditioned space of a building and venting to the outdoor air, thereby relying solely on the convective flow of air upward in the vent to draw air from beneath the slab” (U.S. EPA, 2008). The passive SSD will consist of perforated pipe or pre-fabricated low-profile (flat), three-dimensional vent cores for sub-slab soil vapor collection laid within the base rock beneath the building’s foundation. The collection piping will then connect to a series of risers that direct extracted soil vapor to the outside of the building. The SSD vacuum will be produced using passive wind turbines mounted on exhaust stacks located above the building roof line, away from windows and air supply intakes. The resulting sub-slab negative pressure inhibits soil vapor from flowing into the building, by creating a preferential pathway toward the outside.

Based on the extent of VOC impacts in soil vapor and groundwater, the vapor barrier and SSD system will be installed under approximately 50,100 square feet (sf) of building area. The proposed extent of the vapor barrier and SSD system and conceptual designs are presented on Figures 12a and 12b.

It should be noted that, as currently proposed, buildings with residential use at ground level are not located over the highest-concentration part of the groundwater plume (Figure 12a). The far northern portion of the site, where concentrations are highest, is planned for ground-level retail use (where commercial/industrial ESLs would be applicable) with apartments on the second floor and above, and for hardscape, landscaping, and a parking structure. Farther south, some of the ground-level apartments are located above groundwater with concentrations currently in the 5 to 20 µg/L concentration range. Soil vapor concentrations above this portion of the plume are expected to be lower than measured during recent investigations once the subsurface utilities between current Buildings A and D have been removed.

The results of sampling in the south parcel (i.e., south of St. Patrick Way) did not indicate a significant impact to soil vapor (PCE concentrations in soil vapor were less than ESLs), and VOCs were not detected in groundwater in this area. Should the results of additional soil vapor sampling planned to be conducted in the south parcel indicate that vapor intrusion mitigation is needed, a vapor barrier and/or SSD system may be installed beneath future buildings in that portion of the site.

Monitoring of the effectiveness of the vapor barrier will be conducted for a period of 20 years (post-building construction and commissioning) via indoor air monitoring. Monitoring of the SSD will be conducted for a period of five years following building construction and commissioning via riser vapor sampling monitoring.

The SMP and ICs will include elements related to the presence, protection, and requirements of the vapor barrier.

6.3 ALTERNATIVE 3—PRB (ZVI), VAPOR BARRIER AND SUB-SLAB DEPRESSURIZATION, SOIL EXCAVATION/DISPOSAL, GROUNDWATER MONITORING, AND LONG-TERM SITE MANAGEMENT AND INSTITUTIONAL CONTROLS

This alternative consists of Alternative 2 plus the implementation of a permeable reactive barrier (PRB) for treatment of impacted groundwater migrating onto the site along the western and northern property boundaries (however, the PRB does not directly mitigate vapor intrusion risk).

The PRB will consist of a trench filled with reactive material in the saturated zone for groundwater to pass through. The PRB will use zero-valent iron (ZVI) metal, Fe(0), as the reactive media. Treatment of the chlorinated VOCs in groundwater takes place in the form of abiotic reductive dehalogenation through reactions at the surfaces of the Fe(0) particles. Chlorinated ethenes, such as PCE and TCE, are reduced due to electron transfers from the iron to the halocarbon at the iron surface. The result of the halocarbon reduction is ethene or ethane (U.S. EPA, 1998).

The PRB will be installed along the northwestern boundary of the north parcel. The proposed PRB is approximately 200 feet long and 1.5 feet wide, with an anticipated total depth of 20 ft bgs. The bottom 12 feet of the trench will be filled with a mixture of granular ZVI and clean quartz sand, followed by clean fill to the ground surface. The conceptual location of the PRB is presented on Figure 13.

As noted in Section 3.2, the source of PCE onto the site is not known at this time. There is no current or known historic nearby source; discharges of water containing PCE (e.g., from dry cleaners) into the sanitary sewer have been prohibited since 1995 (personal communication with Ananthan Kanagasundaram of the City of Dublin on November 15, 2012). An evaluation based on a range of potential hydraulic conductivities and resulting groundwater velocity suggests the source is likely more than 10 years old (and possibly several decades old).

Based on assumptions described above, it is unlikely that PCE concentrations in groundwater would increase over time (except for the unlikely scenario that the source is very distant and the highest concentrations in groundwater have yet to reach the site). However, because the source of PCE is not known, it cannot be definitively ascertained that concentrations of PCE in groundwater migrating onto the site will not increase with time, and, if such increases occur, concentrations of PCE and other VOCs in soil vapor likely also would increase. The purpose of the PRB is to prevent PCE concentrations in groundwater beneath the site from possibly increasing. However, it should be noted that if the off-site source of PCE is identified, characterized, and remediated, concentrations of PCE would decline over time and preclude the need for installation of a PRB. Further, the vapor barrier/SSD system would be in place to effectively mitigate an increase in vapor concentrations, should they occur.

The PRB will effectively reduce PCE concentrations in site groundwater immediately downgradient of the barrier; however, it is unlikely to affect the concentrations of VOCs in groundwater through most of the impacted area in the foreseeable future, as groundwater movement appears to be slow (based on clayey lithology and a relatively flat gradient).

6.4 ALTERNATIVE 4—IN-SITU BIOREMEDIATION, PRB (ZVI), VAPOR BARRIER AND SUB-SLAB DEPRESSURIZATION, SOIL EXCAVATION/DISPOSAL, GROUNDWATER MONITORING, AND LONG-TERM SITE MANAGEMENT AND INSTITUTIONAL CONTROLS

Alternative 4 consists of remedial elements presented in Alternative 3 and additional implementation of an in-situ bioremediation program to provide treatment of impacted groundwater within the north parcel. The following two alternative approaches are presented for the implementation of a bioremediation option:

- Alternative 4a – Implementation of a bioremediation program prior to site redevelopment; or
- Alternative 4b – Implementation of a bioremediation program following site redevelopment, but with the infrastructure required for this option being installed during site redevelopment.

The details for implementation of Alternative 4a and 4b are presented below. However, prior to discussing alternatives, a brief evaluation of site conditions with respect to the implementation of a bioremediation program is presented.

6.4.1 Site Conditions with Respect to Implementation of Bioremediation

Bioremediation of chlorinated volatile organic compounds (CVOCs), such as PCE, occurs through the process known as reductive dechlorination. In this process chlorine atoms are sequentially removed from the parent compound and replaced by hydrogen atoms. The exchange of the chlorine and hydrogen atoms is facilitated by certain bacteria under suitable environmental conditions.

As discussed above in Section 3.2.1, as part of the feasibility study, AMEC collected two groundwater samples from monitoring wells MP-01-1 and MW-02, and tested the samples for the *Dhc* bacteria. *Dhc* was not present in either sample at or above laboratory quantifiable limits, but dissolved oxygen levels are below 1 mg/L, which is generally considered to be anaerobic (oxygen deficient) and favorable for reductive dechlorination processes. ORP, which is a measure of electron availability in aqueous environments, was measured as negative in both wells, and within the range of pE (electron activity) values that would facilitate reductive dechlorination.

Limited data regarding bio-nutrients is available for the site. Regarding electron receptors, nitrate was found to be present in monitoring well MP01-1 and was not detected in monitoring well MW-02. Notably, nitrate was not found in the area where TPH impacts to groundwater from the historical Montgomery Ward release were formerly present and where TCE is present at higher concentrations than elsewhere at the site, suggesting that some bioattenuation likely occurred in this area, depleting this electron receptor.

Based on the above, the following modifications to site conditions will be required to successfully implement a bioremediation program.

1. Addition of an organic substrate to foster and maintain current reductive groundwater conditions and supply an electron donor in the reductive dechlorination process, with the VOCs acting as the terminal electron acceptor.
2. Addition of the *Dhc* bacteria to provide an organism capable of the complete reductive dechlorination of the PCE.
3. Addition of essential bio-nutrients (nitrogen, phosphate, and trace metal compounds) to help maintain an effective and healthy microbial population.

6.4.2 Description of Alternative 4a

As Alternative 4a, in-situ bioremediation will be conducted prior to redevelopment, and represents a one-time effort to mitigate VOCs in groundwater. The following steps will be performed to implement the program:

1. Inject carbon substrate and bio-nutrients in groundwater to create a favorable reductive environment for the *Dhc* bacteria.
2. Allow time for carbon substrate and bio-nutrients to disperse and impact the environment. As time is critical in this option, a low-carbon organic substrate will be used (e.g., lactate).
3. Inject *Dhc* bio-augmentation cultures to inoculate groundwater.
4. Monitor bioremediation system performance through collection of groundwater samples, as specified in Alternative 1.

The carbon substrate would be emplaced using direct-push drilling technology at each location indicated on Figure 14. For three to six months following the injection, the carbon substrate would be allowed to disperse, break down, and create an anaerobic environment. Upon monitoring to determine that favorable conditions had been achieved (typically by an indication of iron or sulfate reducing conditions) for *Dhc* bacteria to reduce CVOCs; the *Dhc* culture would be injected into the impacted area. However, the fine-grained nature of the subsurface lithology limits the possibility of successfully targeting and delivering bacteria and nutrients.

Successful implementation is often judged by the formation of ethane and/or ethene. However, the reduced groundwater conditions created by a one-time application of a carbon substrate typically will last between one to three years, depending on site conditions and the type of carbon substrate used. As such, a one-time bioremediation implementation likely would not be sufficient to provide complete remediation of groundwater impacts, and incomplete remediation could result in the formation of vinyl chloride, which is more toxic than PCE and TCE.

6.4.3 Description of Alternative 4b

As Alternative 4b, a bioremediation system would be installed during redevelopment to allow for multiple applications over time of bioremediation amendments to the subsurface. The following steps would be performed to implement the program:

1. Install injection wells at critical locations across the site.
2. Construct a permanent treatment facility during redevelopment, which would contain a bio-amendment/nutrient holding tank, injection pumps, sensors, valves and a distribution manifold.
3. Add *Dhc* bio-augmentation culture to bio-amendment/nutrient holding tank.
4. Monitor bioremediation system performance, and repeat injection of bio-amendments as required to maintain and optimize system performance.

The treatment facility will consist of amendment mixing and bio-amendment/nutrient holding tanks, dosage meters, injection pumps, pressure gauges, sensor, a distribution manifold, and support appurtenances. The construction of the treatment facility, conveyance piping, and injection well installation would need to be coordinated with site redevelopment activities. Permanent injection wells will be installed both perpendicular to and along the axis of the plume with respect to the groundwater flow gradient, as possible relative to the currently-proposed redevelopment footprint. However, because of the fine-grained nature of the material beneath the site, it may not be possible to adequately space or have an adequate number of injection points to adequately distribute bio-nutrients and *Dhc* augmentation culture. A series of conveyance pipes would be installed to connect the injection wells to the treatment facility.

Bio-nutrients will first be injected into the subsurface to establish optimal conditions for reductive chlorination. A *Dhc* bio-augmentation culture will be added to the injectant mix and delivered to the subsurface. The bioremediation system will be monitored over time and amendment adjustments made to optimize remedial performance.

Implementation of Alternative 4b would involve considerable coordination with site redevelopment and, substantial ongoing operation and maintenance of the in-situ bioremediation process. It is uncertain whether a system could be coordinated with the development that would adequately deliver bio-nutrients and bacterial culture to the subsurface. As such, implementation of Alternative 4b is considered to be an extensive burden on a future property owner/manager, and this alternative is not retained for further consideration.

7.0 EVALUATION CRITERIA FOR ALTERNATIVE SCREENING

The corrective action alternatives were screened based on three primary evaluation criteria and one secondary criterion. The three primary evaluation criteria used to evaluate the alternatives were: effectiveness, implementability, and cost. A fourth evaluation criterion used to evaluate the alternatives was sustainability. The evaluation criteria are described in the following sections.

7.1 EFFECTIVENESS

Effectiveness is evaluated based on the proven reliability of the corrective action technology to achieve the corrective active objectives for the site, including its relative short-and long-term effectiveness and permanence, as well as reduction in toxicity, mobility, and volume of the constituents of concern.

7.2 IMPLEMENTABILITY

Implementability is assessed by considering the following qualities:

- Technical feasibility, including the ability to construct and operate the alternative and the ability to monitor remedial effectiveness.
- Administrative feasibility, including regulatory acceptance and the ability to obtain other needed approvals and permits.
- Availability of project-related goods and services.

7.3 COST

Preliminary engineering cost estimates were developed for the corrective action alternatives based on experience with similar projects and on the projected remedial implementation time frames associated with each alternative. The cost estimates for each alternative are presented in Appendix B.

It should be noted that some remedial activities, such as soil excavation and PRB installation, assume implementation after demolition of existing buildings, foundations, and asphalt/concrete surfaces has taken place at the site. However, demolition is a redevelopment activity and costs for such activities are not accounted for in the cost estimates presented.

7.4 SUSTAINABILITY

Sustainability of each remedial alternative is assessed by considering the following:

- Waste minimization
- Water conservation
- Energy savings

- Local economy boost
- Greenhouse gas emissions
- Stakeholder satisfaction

The evaluation of each corrective action alternative relative to these criteria is presented in Table 4 and discussed further below.

7.6 EVALUATION OF ALTERNATIVES AND COMPARATIVE ANALYSIS

The alternatives are evaluated and compared below according to the aforementioned three primary evaluation criteria of effectiveness, implementability, and cost; and the fourth criterion of sustainability.

Alternative 1 would potentially meet the CAOs in the short term. Direct exposure to contaminated soil will be eliminated by the removal of remaining impacted soil at the former sump and F.E. Pit. Exposure to soil vapor and groundwater during subsurface activities will be mitigated by implementation of a SMP. However, long-term protection against potential vapor intrusion concerns is not adequately addressed by Alternative 1. Therefore, Alternative 1, which has an order-of-magnitude cost of approximately $0.5 million, is rejected as a remedial alternative for the site.

Alternative 2 provides the short-term benefits of Alternative 1 and also provides long-term mitigation of potential vapor intrusion risks. The alternative is easily implementable during redevelopment and provides long-term protection relative to the potential for vapor intrusion; the SSD system passively creates a negative pressure such that VOCs in vapor will discharge via the system to the atmosphere. Monitoring will be conducted to confirm the effectiveness of the action, and a SMP and ICs will be in place so the long-term implementation of the alternative is assured. It also represents a more sustainable approach relative to Alternatives 3 and 4. The order-of-magnitude cost for Alternative 2, including operations and maintenance, is approximately $1.4 million.

Alternative 3 builds further onto Alternative 2 by mitigating the potential for additional impacted groundwater to migrate onto the site. The installation of the PRB would prevent concentrations of PCE from increasing; however, the PRB does not directly contribute to the mitigation of VOCs in soil vapor, except to the extent that it prevents higher concentration groundwater, and by extension, higher soil vapor concentrations that could result, from coming onto the site. The installation of the PRB likely will reduce PCE concentrations in site groundwater immediately downgradient of the barrier; however, it is unlikely to affect the concentrations of VOCs in groundwater through most of the impacted area in the foreseeable future, as groundwater movement appears to be slow (based on clayey lithology and a relatively flat gradient). The PRB is a passive remedial technology and is sustainable as a long-term approach. However, the installation of the PRB will consume significant resources in the short term, making it less sustainable than Alternative 2. The order-of-magnitude cost for Alternative 3 is approximately $2.2 million.

Alternative 4a is designed to mitigate VOC concentrations in on-site groundwater; however, it is highly uncertain that it could be effective in either the short-or long-term, given the limited time frame to implement a bio-augmentation and nutrient injection program. The fine-grained nature of the subsurface lithology limits the possibility of successfully targeting and delivering bacteria and nutrients. This alternative has the highest estimated implementation cost and there is not sufficient time to perform a pilot test to confirm the technology's potential effectiveness. Due to the increased resources required for the enhanced bioremediation implementation, Alternative 4a is less sustainable than Alternative 3. The order-of-magnitude cost for Alternative 4a is approximately $2.9 million.

7.7 RECOMMENDED CORRECTIVE ACTION ALTERNATIVE

Based on the comparative analysis, Alternative 2 represents the most effective, implementable, and cost-effective alternative to meet the CAOs, and is recommended as the corrective action measure for the site. Implementation of Alternative 2 can be accomplished with minimal disruption to the site development schedule, represents the second least expensive alternative, and is sustainable.

8.0 CORRECTIVE ACTION PLAN

The selected alternative, Alternative 2, will consist of excavation of remaining soil impacts in the vicinity of the former sump and F.E. Pit, installation and monitoring of replacement groundwater monitoring wells, and installation of a vapor barrier and sub-slab depressurization system beneath future buildings (excluding parking structures) with footprints within the impacted groundwater plume, as depicted on Figures 10, 11, 12a, and 12b.

The corrective action consists of the following pre-development, development, and post-development site activities:

- Following demolition of Building B and prior to site redevelopment, excavation and off-site disposal of approximately 60 in-place cubic yards (cy) of remaining impacted soil in the vicinity of the former sump and dewatering of encountered groundwater (pre-development).
- Following demolition of Building B and prior to site redevelopment, excavation and off-site disposal of approximately 40 in-place cy of remaining impacted soil in the vicinity of the former F.E. Pit (pre-development).
- Destruction of existing groundwater monitoring wells (pre-development).
- Installation of a vapor barrier and sub-slab depressurization system beneath proposed buildings overlying the existing groundwater plume (during development).
- Installation of replacement groundwater wells (during development).

- Implementation of long-term site management and ICs (post-development).
- Implementation of a remedial monitoring plan (including a sampling and analysis plan for groundwater, indoor air, and vapor from SSD, and a monitoring schedule).

Although proposed replacement groundwater monitoring well locations are presented in this FS/CAP (Figure 11), final well locations will be determined based on final site development plans and in coordination with ACEH.

Likewise, final extent of the vapor barrier and layout of the SSD collection system will be based on the finalized building design and will be coordinated with the building designers (e.g. architects).

8.1 PRE-IMPLEMENTATION ACTIVITIES

Prior to implementing the CAP elements, design documents that will require approval by various agencies, including ACEH, and permitting activities will be initiated.

8.1.2 Design Documents

The following work plans will be prepared and submitted to the ACEH and other agencies, as applicable.

Excavation Work Plan – The excavation work plan will detail the methodology, permits, extents, soil and groundwater handling and disposal procedures, confirmation sampling, and analytical methods related to the additional soil removal in the areas of the former sump and F.E. Pit.

Well Destruction and Well Installation Work Plan(s) – prior to proceeding with well destruction and installation activities, a work plan will be submitted that presents well locations and details methodologies, permits, and material handling and disposal procedures for ACEH's review and approval. A single work plan that addresses both well destruction and future installation, or separate work plans can be submitted, depending on the requirements of the ACEH.

Vapor Intrusion Mitigation System O&M Plan(s) - Final design plans for the installation and construction of the vapor barrier and the sub-slab depressurization system will be prepared as part of the construction drawings to obtain necessary building permits from the City of Dublin. Prior to submittal of the permit documents, copies of the construction drawings relevant to the installation of the vapor barrier and SSD will be furnished to ACEH for review and approval.

8.2.2 – Permitting and Notifications

In order to conduct the remedial activities and install the corrective measures, the following permits and/or notifications may be required:

Sump and F.E. Pit Excavations

- Soil excavation permit from the City of Dublin, Building & Safety Division
- Industrial Wastewater Discharge Permit from the Dublin San Ramon Services District (DSRSD)
- Soil Excavation Notice to the Bay Area Air Quality Management District (BAAQMD)
- ACEH approval of Excavation Work Plan

Groundwater Monitoring Well Destruction and Installation

- Well destruction and well construction permits from Zone 7 Water Agency
- ACEH approval of Well Destruction and Well Installation Work Plan(s)

Vapor Barrier and SSD Installation

- Building construction permit from the City of Dublin, Building & Safety Division
- Permit exemption from the BAAQMD for SSD (the SSD system is expected to qualify for an exemption under Regulations 2, Section 2-1-103 [BAAQMD, 2012] for a source with pollutant emissions of less than 10 lbs/day and less than 150 lbs/year
- ACEH approval of vapor barrier and SSD system design

Institutional Controls

- ACEH approval of additional documents created to manage future risk, including the SMP and covenants restricting use of the property

8.2.3 Utility Location

Prior to conducting soil removal and well destruction and installation activities, subsurface utilities will be marked with white paint, and Underground Service Alert will be contacted at least 48 hours in advance of beginning work, in accordance with California law. A private utility locator will also evaluate the excavation and proposed well locations for underground utilities.

8.3.2 Health and Safety Plan

Soil excavation, well destruction, and well installation activities will be conducted under a site-specific health and safety plan (HSP) and similar to that submitted for previous site work (AMEC, 2011d). The HSP will include health and safety precautions for known and potential physical and chemical hazards anticipated for the field effort. A map of the route to the nearest hospital and information regarding constituents of concern will also be included in the HSP. The HSP will be distributed to all members of the field team.

The installation of the vapor barrier and SSD are part of the building construction. As such, the installation of the vapor intrusion mitigation system will be conducted under the HSP for general site construction, as prepared by the site developer.

8.4 SOIL EXCAVATION/DISPOSAL (SUMP AND F.E. PIT)

Excavation of the remaining impacted soil at the former sump and F.E. Pit, estimated to be a total of 100 cy, will be conducted using a slot-cutting method similar to the one used during the previous excavation effort (AMEC, 2011e). It is currently anticipated that the excavations will extend to 16 feet bgs and 12 feet bgs for the former sump and F.E. Pit, respectively. Excavation will proceed until no staining is observed and the results of confirmation samples indicate that concentrations of petroleum-related constituents and VOCs are below their respective residential screening levels.

Slot cutting will allow for removal of soil in thin slices to minimize the amount of exposed vertical surface and avoid the need to install traditional shoring. The maximum width of each vertical excavation trench will be 1.5 feet. As during the previous work, each trench will be backfilled with a mixture of sand and cement (a slurry) and allowed to cure for a minimum of 24 hours before adjacent slots can be excavated (if needed). Excavated soil will be temporarily stockpiled on site and subsequently disposed of off-site at an approved facility. It is assumed that the excavated soil will be disposed of off-site at a Class II (non-hazardous waste) facility, based on the prior remedial activities. Excavations will be conducted under the same health and safety protocols set forth in the previously submitted *Environmental Health and Safety Plan, Sump Remediation and Soil Excavation and Disposal* (AMEC, 2011c).

Groundwater encountered during the excavation will be removed, to the extent possible, from the open excavation trench prior to backfilling. Extracted groundwater will be containerized on site pending disposal in a steel storage tank. The extracted groundwater will be profiled and it is expected to meet discharge requirements set forth in the previously issued Industrial Waste Discharge Permit No. 11012 used during the previous groundwater disposal events. Permit No. 11012 will be renewed, or a new permit will be obtained from the Dublin San Ramon Services District, as necessary. Extracted groundwater will be discharged to the Dublin San Ramon Services District Publicly Owned Treatment Works (POTW).

8.5 MONITORING WELL DESTRUCTION AND INSTALLATION

The seven existing groundwater monitoring wells will be destroyed prior to site redevelopment. Groundwater wells will be destroyed in accordance with Zone 7 Water Agency well destruction requirements and will include overdrilling and/or pressure grouting.

Five shallow groundwater monitoring wells will be installed to monitor concentrations of constituents of concern in the first encountered water-bearing zone. The locations of the replacement groundwater monitoring wells and the timing of installation will be coordinated with the site redevelopment. The locations of the proposed groundwater monitoring wells are shown on Figure 11, based on current redevelopment plans; however, the final number and location of the replacement wells will be determined in consultation with ACEH.

The monitoring wells will be installed using hollow-stem auger or other appropriate drilling methodology. The monitoring wells will be constructed within an up-to-8.25-inch-diameter borehole using up to 2-inch-diameter, schedule 40 polyvinyl chloride (PVC) blank well casing and 5 feet of slotted (0.010-inch slots) well screen. The monitoring wells will be screened within the first-encountered water-bearing unit. Based on previous depth-to-groundwater data, we anticipate that the wells will be installed to a total depth of between 15 and 22 feet bgs.

The annular space between the well screen and borehole in each well will be backfilled with an appropriately sized sand filter pack. The filter sand in each well will be placed such that the top of the filter sand is approximately 1 foot above the screened interval. Approximately 2 feet of bentonite chips will then be placed above the filter sand and will be allowed to hydrate in place. The remaining annular space above the hydrated bentonite chips will be sealed using neat cement or a cement/bentonite grout mixture and concrete (for setting the well box). The wells will be completed at the surface using flush-mounted, traffic-rated boxes. A locking, watertight plug will be placed in the top of the casing at each well.

The groundwater monitoring wells will be constructed in accordance with the appropriate state (DWR, 1991) and Zone 7 Water Agency requirements.

The new groundwater monitoring wells will be developed no sooner than 48 hours after the construction of the wells. The monitoring wells will be developed by a combination of bailing, surging, and purging until the water is relatively visibly clear and field parameters (e.g., dissolved oxygen, oxidation/reduction potential, temperature, pH, and specific conductance) are relatively stable and the water becomes relatively clear and free of solids. .

The groundwater monitoring wells will be installed by a California-licensed C-57 contractor and under the direct supervision of a California-licensed Professional Geologist. A continuous core of soil will be collected at each well location for lithologic logging. Lithology will be described using the visual-manual procedures of the ASTM International Standard D 2488 for guidance, which is based on the Unified Soil Classification System (USCS). Recovered soil will be screened for the presence of volatile organic compounds using a photoionization detector (PID). The PID readings will be recorded on the lithologic logs prepared for each boring. Field observations of the presence of any staining or odor will also be recorded.

8.6 VAPOR BARRIER AND SUB-SLAB DEPRESSURIZATION SYSTEM

The general components of the vapor barrier/SSD system are described below, and schematically presented on Figures 12a and 12b. Long-term operations and maintenance of the system also is described below.

8.6.1 Vapor Barrier and Sub-Slab Depressurization System Installation

The vapor barrier and SSD system will be installed during the construction of the building foundation. Currently, the footprints of two proposed buildings and part of a third building are within the identified extent of the groundwater plume, as shown on Figure 12a. The vapor barrier and SSD system will be installed beneath the two retail/apartment buildings along Dublin Boulevard and partially beneath the apartment building surrounding the recreational courtyard. The vapor intrusion and SSD system beneath the apartment building will extend approximately 190 feet beyond the identified edge of the on-site plume. The 190-foot extension is in excess of the 100-foot lateral distance criteria set forth by the Department of Toxics Substance Control (DTSC) and California Environmental Protection Agency (Cal/EPA) for determining if buildings are candidates for vapor intrusion (DTSC and Cal/EPA, 2012). The main components of the vapor barrier and SSD are described below.

Base Layer/Fabric – The base layer will consist of non-woven polypropylene or high density polyethylene (HDPE), a heat-bonded geotextile installed between the ground and the spray-applied membrane. The fabric will serve as the base layer for the application of the spray-applied membrane and separates the membrane from soil substrate.

Spray-Applied Membrane – The spray-applied membrane will consist of a single course, high-build, polymer-modified asphaltic emulsion. The emulsion is water based and spray-applied at ambient temperatures. The membrane is non-toxic and odorless (CETCO, 2012a), and typically applied to a nominal dry thickness of 60 to 80 dry mil (1 mil equals 1/1000 inch). Commercially available spray-applied membranes include Liquid Boot® by CETCO® and Geo-Seal® by Land Science Technologies™. The integrity of the spray-applied membrane will be tested by smoke testing during construction. Smoke will be pumped under the membrane for a specific period of time and under specific pressure. Holes or breaches in the membrane detected during the testing, if any, will be patched by additional membrane application.

Plumbing, electrical, mechanical, and structural items planned to be placed under or through the membrane will be positively secured in their proper positions and appropriately protected prior to membrane application. Special care will also be taken to apply the membrane appropriately at penetration points per the manufacturer’s specifications.

Protection Layer/Fabric – The protection layer is similar to the base fabric and will consist of non-woven polypropylene or high density polyethylene (HDPE) geotextile installed between the spray-applied membrane and the building slab. The protection fabric is used to enhance the curing of the membrane and increase puncture resistance. In addition, the protection fabric provides adhesion protection and remains attached to the underslab of the building. The adhesion ensures that the membrane will remains in place even during potential soil settlement (CETCO, 2012b).

Soil Vapor Collection System – The soil vapor collection system will consist of pre-fabricated, low-profile (flat), three-dimensional vent cores wrapped in non-woven, needle-punched filter fabric. The collection vents will be fabricated of HDPE. The vapor collection system will be installed directly on the subgrade and beneath the vapor barrier. The collection system will collect gas vapors and direct them to the conveyance and discharge system.

Passive Soil Vapor Conveyance/Discharge System – The soil vapor conveyance/discharge system will consist of vent risers connected to the soil vapor collection system at selected sub-slab locations. The vent risers are piping typically made of polyvinyl chloride (PVC) or HDPE. The vent risers will be routed from beneath the slab to the roof of the building through an interior wall or on the outside of the building (Figure 12b). Each individual riser will be equipped with a wind-driven turbine fan that creates a negative pressure to convey the soil vapor from beneath the slab to the top of the riser. Extracted soil vapors will be discharged to the atmosphere. Risers will be equipped with sampling ports that allow the periodic monitoring and sampling of the extracted vapor.

Although the currently proposed passive SSD system is expected to effectively mitigate the potential for vapor intrusion,, the SSD system will be designed and installed with features that will allow for conversion to an active SSD system (i.e., with motor-driven fans), should that be necessary in the future. The determination to convert to an active system will be based on the results of the proposed indoor and SSD monitoring presented in Section 10.0.

8.6.2 Vapor barrier and SSD System Operation and Maintenance

The vapor barrier, once properly installed beneath the building slab, will not require maintenance, unless re-construction in some areas of the structures encroaches or inadvertently damages the barrier. This possibility will be addressed in the SMP, which will be distributed to all contractors involved in subsurface work. The SSD system is expected to operate continuously and will require minimal maintenance. Expected maintenance of the SSD will include inspection of the risers and wind-driven turbine fans, lubrication (as necessary) of the turbine fans, and replacement of any potential worn/damaged equipment. System monitoring will be conducted as discussed in Section 9.1.

As recommended in Section 7.2 of the VIMA document, an Operations and Maintenance (O&M) Plan will be developed before the system is started up. The O&M Plan will include a monitoring program that will evaluate the efficacy and performance of the system on an ongoing basis. The goal of the O&M Plan is to confirm that the vapor mitigation system is operating on a continuous basis as designed and in accordance with the manufacturer’s specifications. The O&M plan will contain information on the O&M of the system, including the following:

- regular inspection and maintenance procedures,
- compliance sampling procedures,
- assessment procedures for site conditions/uses to confirm vapor mitigation system will not be compromised,

- equipment specifications and manuals,
- contact information,
- monitoring and sampling procedure forms, and
- permits.

8.7 INSTITUTIONAL CONTROLS

Institutional controls will be implemented for the north parcel to supplement engineering controls; Based on the investigative findings, it is not contemplated at this time that ICs are necessary for the south parcel. However, pending the results of additional planned sampling on this parcel, it may be necessary to develop ICs that are specifically applicable to this area of the site.

The ICs will provide legal and administrative controls and methods for dissemination of information to minimize risk during property development, future below ground construction and maintenance, and long-term site use. Prior to site development, an IC Plan will be prepared to set forth the general requirements and necessary controls dictated by property restrictions or contractual agreements (e.g., leases) The IC Plan will be developed in consultation with and approval by the ACEH. It is anticipated that documents implementing ICs will include the following:

- Land use covenants (LUCs) and activity use limitations (AULs); which document legal and regulatory requirements for the site.
- Site management plan, which provides for communication primarily with contractors who will be constructing and maintaining the site
- Lease documents that include codes, covenants, and restrictions (CCRs), which serve as the primary communication tool for site residents and businesses.

As currently planned, the site development will consist of mixed use multi-unit structures housing commercial and residential spaces. To minimize contact with impacted media, the recorded land use covenants and the CCRs for the site will prohibit use of groundwater and alteration, disturbance, or removal of any component of the vapor barrier/SSD system and its associated components. Additional components of both the LUCs/AULs and the CCRs likely will include:

- Notification to the City of Dublin Community Development Department, Building Safety Division (Dublin Building Department) of the vapor mitigation system, and the potential “flagging” of the property such that ACEH would be notified if building permits were issued (to prevent impacting the vapor mitigation system);
- Prohibition of construction activities that could encounter/breach the vapor mitigation system without the express knowledge of ACEH and the Dublin Building Department, including utility repair or installation;
- Right of access to the property for ACEH to inspect, monitor, and perform other related activities pertaining to the vapor mitigation system;

- Right of access to the property for the person responsible for implementing the O&M activities relative to the vapor mitigation system; and
- The provision to maintain inspection and monitoring records associated with the vapor mitigation system.

This documentation will be maintained at the site address by the property manager or designated representative and will be recorded at the Alameda County Clerk-Recorder's Office.

In addition, the IC Plan will include activities to maintain the integrity of the remedy, ongoing O&M, and record compliance with the ICs. Activities might include annual inspections of the property and remedy, and associated reporting.

The SMP that will be prepared as an element of the long-term site management and will include a discussion of environmental conditions within the north parcel and the mitigation elements, including the vapor barrier/SSD system and monitoring wells that must be maintained and protected during site maintenance. Additionally, the SMP will include general procedures for health and safety, soil and groundwater management, and notification and documentation requirements for subsurface work or activities that have the potential to breach the vapor barrier. The SMP will be submitted to ACEH for its review and approval. The SMP will be maintained on site.

8.8 REPORTING

Following implementation of the components of the corrective action, it is anticipated that the following reports will be submitted to ACEH:

- Completion Reports – Excavation Completion Report and Monitoring Well Destruction and Installation Reports
- Vapor barrier/SSD system as-built drawings and field installation documentation (e.g. – results of smoke testing), and
- Monitoring reports (ongoing, as described below)

9.0 CORRECTIVE ACTION MONITORING

The performance of the corrective action will be evaluated by conducting SSD system monitoring and indoor air monitoring. Additionally, as proposed for the corrective action, groundwater monitoring also will be conducted to observe potential concentration trends for impacted groundwater entering and within the site.

9.1 VAPOR BARRIER AND SSD MONITORING

The primary objective of vapor barrier and SSD system monitoring is to confirm that the remedial system functions as designed. Vapor barrier monitoring will be conducted via indoor air sampling and SSD monitoring will be conducted via direct sampling of the extracted soil vapor.

9.1.1 Indoor Air Sampling

Indoor air monitoring will be conducted for a proposed period of 20 years at the following frequency:

- Semiannually for years 1 through 3, and
- Annually for years 4 through 20.

The proposed period of 20 years is expected to be sufficient to demonstrate the long-term efficacy of the remedy. However, additional monitoring could be conducted depending on previous results.

During the first three years, indoor air sampling will be conducted during two seasons; late summer/early autumn and late winter/early spring. Air samples will be collected from typical vapor intrusion pathways, such as bathrooms, kitchens, and other identifiable potential points of entry. Air samplers will be situated in the breathing zone (3 to 5 feet off the floor) and air samples will be integrated samples typically collected over a 24-hour period using laboratory-provided SUMMA™ canisters or over a similar or longer period of time using sorbent tubes. At year four, the sampling frequency will be reduced to annual assuming that previous results indicate the system has been operating as designed. The annual collection season (summer/early autumn or late winter/early spring) will be determined by the results of the prior semiannual sampling events (i.e., it will occur during the season when prior sampling results were highest).

The indoor air samples will be analyzed for the presence of VOCs using U.S. EPA Method TO-15 (or the currently approved method at the time of sampling).

9.1.2 SSD System Sampling

Samples of the extracted soil vapor will be collected from sampling ports installed at each of the vent risers. SSD vent riser sampling will be conducted for a proposed period of five years at the following frequency:

- Monthly for year one, and
- Quarterly for years two through five.

The proposed period of five years is expected to be sufficient to demonstrate the long-term effectiveness of the remedy. However, additional monitoring could be conducted depending on previous results.

Samples collected from each vent will be analyzed for VOCs using U.S. EPA Method TO-15 (or the currently approved method at the time of sampling). Additional operational parameters may be collected from the riser, such as flow rate, temperature, and riser vent vacuum to determine a vapor extraction rate.

9.2 GROUNDWATER MONITORING

Groundwater monitoring will be conducted to monitor VOC plume stability and/or attenuation. Groundwater monitoring is expected to be conducted on the replacement groundwater wells for a period of approximately four years after installation of the well and at a frequency as follows:

- Quarterly for the first two years, and
- Annually for the third and fourth year.

It is expected that the proposed groundwater monitoring time frame will be sufficient to demonstrate VOC concentration trends at the site.

Groundwater sampling will be conducted using similar sampling protocols as those used to sample of the existing groundwater wells in September 2012 (AMEC, 2012a). The collected water samples will be analyzed for the VOCs using U.S. EPA Method 8260B (or the currently approved method at the time of sampling)

9.4 SITE INSPECTIONS AND REPORTING

The site inspections will be arranged by the site owner and will be conducted to observe and document the integrity and maintenance of the corrective action, including observation of roof turbines, auditing of on-site maintenance and monitoring records, and confirming that required on-site documentation is available (e.g., copy of the SMP). The site inspections will be conducted until such time that all ICs are terminated with approval of ACEH. Following each site inspection, the site owner (or designated inspection entity) will provide ACEH with a site inspection report and IC compliance certificate indicating that all IC objectives have been maintained.

For the purpose of the FS/CAP, a period of 20 years has been proposed for the implementation of the site inspections and reporting with the following frequency:

- Semiannually for years 1 and 2,
- Annually for years 3 and 4, and
- Every five years for year 5 through 20.

Should any action inconsistent with IC restrictions be discovered during the site inspection, the owner and/or designated inspection entity will notify ACEH. A written explanation will be submitted to the ACEH that describes the nature of the specific, inconsistent action, and the efforts or measures that have been or will be taken to correct the action. The associated time frame to correct the inconsistent action also will be provided.

10.0 FINANCIAL ASSURANCE

An appropriate financial instrument will be obtained to assure ACEH of implementation and maintenance of the proposed corrective action. The details of this financial assurance will be worked out by project proponent and ACEH as mitigation and monitoring plans are finalized and approved.

11.0 CORRECTIVE ACTION COMPLETION

This section describes the proposed protocols to demonstrate the completion of corrective actions in order to request No Further Action (NFA) status from ACEH for the site. NFA status will be requested from ACEH when the following activities are completed at the site:

1. Completion of excavation of impacted soil in the vicinity of the former sump and F.E. Pit,
2. Confirmation of effective soil vapor mitigation via the vapor barrier and SSD
3. Agreement with ACEH that adequate groundwater monitoring has been completed to establish concentration trends.

Completion of the corrective action at the sump and F.E. Pit will be demonstrated via soil confirmation sampling conducted during the excavation activities. Confirmation sample results will be compared against residential ESLs. If the confirmation sample results are below the residential ESLs, the excavation will be backfilled and excavated soil will be appropriately disposed of off site and, at that time, the corrective action will be deemed complete.

Completion of the soil vapor intrusion corrective action will be demonstrated via indoor air monitoring during the initial five years of operation. Indoor air monitoring results will be compared against Regional Water Board ambient/indoor air ESLs (Regional Water Board, 2008) for evaluation of indoor air. The vapor intrusion corrective action (vapor barrier and SSD) will be deemed effective if concentrations of constituents of concern in indoor air are below their respective screening levels and are due to vapor intrusion, versus indoor sources. Should implementation of an active SSD system be required, the performance period to demonstrate effectiveness of the active SSD system will be another five years from the date of system commissioning.

A recommendation to discontinue groundwater monitoring will be made when concentrations of PCE in groundwater are deemed stable or decreasing. Groundwater monitoring will be conducted, at a minimum, for four years, as set forth in the proposed corrective action. If plume stability has not been established at the conclusion of the proposed monitoring period, the necessity to continue groundwater monitoring will be discussed with ACEH.

Upon completion and confirmation of the effectiveness of the corrective actions, the site owner will request that ACEH grant NFA status for the site.

10.2 POST–NFA MONITORING

Additional indoor air monitoring and site inspections will continue following corrective action completion and NFA status. Presently, indoor air monitoring is proposed to be conducted for

20 years. The continuation of the indoor air monitoring program will be evaluated every five years (after issuance of the NFA) and in coordination with ACEH. Should ACEH concur that indoor air monitoring and/or site inspections are no longer necessary, the post-NFA monitoring activities will cease.

11.0 OTHER REDEVELOPMENT CONSIDERATIONS

As discussed throughout this FS/CAP, site redevelopment will involve demolition of the existing site buildings. Subsurface utilities will also be removed prior to redevelopment. Separate from addressing known subsurface VOC impacts through a site management plan, demolition activities will be conducted so as to consider possible impacts that have not yet been discovered, and to minimize the possibility of causing subsurface contamination during demolition.

Prior to decommissioning the existing facility, a Facility Closure and Demolition Plan will be prepared by a qualified contractor. The specific activities associated with demolition and facility closure will be presented in this plan, which will be submitted to ACEH for its review. ACEH is the Certified Uniform Program Agency (CUPA) with jurisdiction over the City of Dublin; therefore, the plan will be prepared in accordance with ACEH requirements.

To facilitate the preparation of the demolition plan, a Hazardous Materials Mitigation Report will be prepared. Site reconnaissance will be performed to assess and document hazardous materials and petroleum products that may be present at the site,. An inventory will be made of sumps, pits, or other underground structures that may remain at the site.

Additionally, a building materials survey will be performed by appropriate licensed personnel. The survey will focus on inventory, sampling, and analysis of suspect building materials, including, but not limited to, lead-based paint, asbestos-containing building materials, fluorescent light ballasts, and thermostats. Subsurface conduits or portions thereof that exist above the ground surface or finished floor will be sampled as accessible and as appropriate depending on material type (e.g., transite pipe). The results of the site reconnaissance and building materials survey will be presented in a final report, which will be provided to a licensed abatement contractor(s). The abatement of suspected hazardous materials will be performed prior to site demolition activities, and materials will be transported and disposed of in an appropriate manner based on the specific type of material. Requisite permits, monitoring, and reporting will be performed in association with the abatement procedures as appropriate in accordance with BAAQMD and California Occupational Safety and Health Association (Cal-OSHA) guidelines.

During facility demolition, an environmental professional will be on site on a full-time basis during activities that result in ground disturbance or the removal of hardscape, slabs, subsurface piping, or other similar features. Sampling will be conducted beneath the slabs of

Buildings B and C immediately following slab removal, and beneath process and drain line piping (e.g., sewer drain line, UST piping) that is removed. Samples also will be collected at areas where field observations indicate potential impacted soil, and at other locations to be identified in the field. It is anticipated that a minimum of five samples will be collected beneath each building, and that samples will be collected beneath piping at one per 20 linear feet, or, depending on field observations, at joints or locations where impacts appear to have occurred.

In the event that unanticipated features are encountered (e.g., sumps, product lines), such facilities will be observed for the presence of suspected petroleum products or hazardous materials. If present, these features will be removed, containerized, and subsequently sampled for characterization for disposal purposes. Following analysis, such materials would be transported and disposed of in an appropriate manner by appropriately licensed personnel. Additionally, adjacent soil (i.e., base materials and sidewalls) will be sampled for the presence of potential contamination following DTSC protocols (the analytical suite will be dependent on the former use of the feature. If suspected asbestos-containing materials (e.g., transite pipe) are encountered, an appropriately licensed professional will sample suspect material for subsequent analysis. Such materials would be removed, transported, and disposed of in an appropriate manner, pending the results of the analysis.

If sampling and analysis is required, ACEH personnel will be notified, and documentation of sampling activities, analysis results, and recommendations and conclusions will be prepared. The specific details of sampling, observation, and notification to be performed during site redevelopment will be presented in the SMP, which will be prepared as details of site demolition and redevelopment are developed. Additionally, records pertaining to transport and disposal of the aforementioned petroleum products and hazardous materials will be provided to ACEH in report format.

12.0 IMPLEMENTATION SEQUENCE AND SCHEDULE

The following steps provide an outline for implementing the corrective action, and the approximate commencement date of activities and estimated durations (if applicable), are as follows.[2] Other related site activities are included, as needed.

1. Submission of work plan for additional sampling in the south parcel (December 20, 2012).
2. ACEH approval of work plan for additional sampling in the south parcel (January 7, 2013).
3. Investigation in south parcel (begins January 28, 2013, duration of 2 days to 1 week).

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[2] These timeframes are estimated based on professional experience and proposed site redevelopment schedule, and are subject to change.

4. Submission of report documenting investigation in south parcel to ACEH (February 28, 2013).

North Parcel:

1. Submission of report documenting UST removal (December 20, 2012).
2. ACEH approval of FS/CAP (by December 28, 2012).
3. Preparation and distribution of a fact sheet regarding the proposed corrective action, and public comment period (begins January 7, 2013, approximate duration of 30 days).
4. Finalization of FS/CAP (begins February 7, 2013, duration of one week).
5. Preparation of excavation and well destruction/installation work plans and permit acquisition (January 1, 2013, approximate duration of three months).
6. Quarterly groundwater sampling of existing wells and reporting (first event in February 2013)
7. Preparation of SMP (begins February; SMP submitted by April 2013)
8. Preparation of final O&M and IC Plans (begins February 2013, plans submitted July 2013).
9. General site demolition activities, well destructions, and soil excavation (begins June 2013, approximate duration of one month).
10. Preparation of final building construction plans, including vapor barrier and SSD design (begins March 2013, approximate duration of six months).
11. Building construction, installation of vapor barrier and SSD, and replacement groundwater wells (begins approximately March 2014, duration of approximately 18 months).
12. SSD system startup and shakedown (begins approximately one month after building completion, duration of one month).
13. Preparation of final corrective action completion reports (begins immediately after installation of remedy, duration of approximately 60 days).
14. System operation and performance monitoring (begins approximately one month after building completion, duration of 5 years for SSD and 20 years for vapor barrier).
15. Request NFA status from ACEH (begins approximately four to five years following commencement of operation and performance monitoring).

13.0 REFERENCES

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TABLES

TABLE 1

SITE CONCEPTUAL MODEL

Crown Chevrolet Cadillac Isuzu
7544 Dublin Boulevard and 6707 Golden Gate Drive
Dublin, California

CSM Element	CSM Sub-Element	Description	Potential Data Gap(s)
Geology and Hydrogeology	Regional	The site is in the northwest portion of the Livermore Valley, which consists of a structural trough within the Diablo Range and contains the Livermore Valley Groundwater Basin (referred to as “the Basin”).[1] Several faults traverse the Basin, which act as barriers to groundwater flow, as evidenced by large differences in water levels between the upgradient and downgradient sides of these faults.[1] The Basin is divided into 12 groundwater basins, which are defined by faults and non-water-bearing geologic units.[2] The hydrogeology of the Basin consists of a thick sequence of fresh-water-bearing continental deposits from alluvial fans, outwash plains, and lacustrine environments to up to approximately 5,000 feet bgs.[1] Three defined fresh-water bearing geologic units exist within the Basin: Holocene Valley Fill (up to approximately 400 feet bgs in the central portion of the Basin), the Plio-Pleistocene Livermore Formation (generally between approximately 400 and 4,000 feet bgs in the central portion of the Basin), and the Pliocene Tassajara Formation (generally between approximately 250 and 5,000 or more feet bgs).[2] The Valley Fill units in the western portion of the Basin are capped by up to 40 feet of clay.[1] Within the immediate vicinity of the site, the depth to groundwater has been measured in shallow monitoring wells from approximately 7.4 to 18 feet bgs. Groundwater movement, as evaluated at the former Montgomery Ward site (7575 Dublin Boulevard), which is located north of the site, is reported to be to the east. An investigation at Quest Laboratory (6511 Golden Gate Drive), which is immediately south of the site, identified groundwater movement to the north, toward the site. Later measurements indicated groundwater flow to the southeast.	None
	Site	***Geology:*** Borings advanced at the site indicate that subsurface materials consist primarily of finer-grained deposits (clay, sandy clay, silt, and sandy silt) with interbedded sand lenses to approximately 20 feet below ground surface (bgs). Lean clays (with varying amounts of sand, but with no documented coarse lenses) are present from shallower than 20 feet bgs to depths ranging from to 35.5 to 43 feet bgs. An interval of lean clays interbedded with sand and/or gravel lenses is present from approximately 35.5 to 52 feet bgs, followed by another interval of lean clays to approximately 54-58 feet bgs, where an apparently continuous zone of clayey sands is encountered to the total depth logged (60.5 feet bgs). A cone penetrometer technology test indicated that even coarser materials (interbedded with finer-grained materials) are present from approximately 60 to 75 feet bgs. The lithology documented at the site is similar to that reported at other nearby sites, specifically the former Montgomery Ward site (7575 Dublin Boulevard), the former Quest Laboratory site (6511 Golden Gate Drive), the Shell Service Station site (11989 Dublin Boulevard), and the Chevron site (7007 San Ramon Road).	None
		Hydrogeology: Three water-bearing zones have been encountered at the site, as follows: • Groundwater is first encountered between approximately 9 and 15 feet bgs, within discontinuous sand and/or gravel lenses that are a few inches to several feet thick, and also within the sandy clays that are present at similar depths. Due to the high clay content of the soil, saturated soil has not been encountered in some borings (however, it was possible to collect grab groundwater samples from these borings by leaving them open overnight). There is likely a complex alluvial system in which groundwater (and chemical) migration primarily occurs in channel-like deposits of varying widths and thicknesses, versus within continuous horizontal continuous layers. The direction of the lateral hydraulic gradient (only measured in the northern portion of the north parcel) was to the east in September 2012 (Figure 4). • Groundwater is generally next encountered between approximately 35.5 and 52 feet bgs within thin (i.e. several inches to several feet thick), discontinuous sand and/or gravel lenses. The water-bearing zone does not appear to be significant, but does appear to be hydrogeologically separated from the water-bearing zones above and below. The direction of the lateral hydraulic gradient was not calculated for this water-bearing zone. • A third water-bearing zone is present from approximately 58 feet bgs to 75 feet bgs, the total depth drilled. This appears to be a significant water-bearing zone, based on the CPT log at the site and information from nearby sites. The direction of the lateral hydraulic gradient (only measured in the northern portion of the north parcel) appears to be to the northeast; however, the wells are located close to an east-west trending line, making it difficult to gauge the precise direction of groundwater movement (Figure 5). Downward hydraulic gradients were calculated between all three water-bearing zones (and at the former Montgomery Ward site, to the north). The calculated magnitude of the vertical hydraulic gradient was significantly greater than that of the horizontal gradients; however, disparate head measurements can indicate the lack of vertical flow. If it were possible for water to flow between one water-bearing zone and another, the hydrostatic pressure would begin to equilibrate and head measurements would be more similar. This conclusion is also supported by the lack of detections of constituents of concern in deeper groundwater and the thickness of the clay layers between the water-bearing zones.	No temporal data are available for groundwater flow directions.
Surface Water Bodies	--	The closest surface water bodies are culverted creeks. Martin Canyon Creek flows from a gully west of the site, enters a culvert north of the site, and then bends to the south, passing approximately 1,000 feet east of the site before flowing into the Alamo Canal. Dublin Creek flows from a gully west of the site, enters a culvert approximately 750 feet south of the site, and then joins Martin Canyon Creek approximately 750 feet southeast of the site.	None
Nearby Wells	--	A well survey was requested from the California Department of Water Resources in August 2012 and Zone 7 Water Agency in October 2012 in order to identify water-producing, monitoring, cathodic protection, and dewatering wells in the vicinity of the site. No water-producing wells were identified within 1/4 mile of the site. The nearest water-producing wells are located approximately 1/3 mile to the east and 1/2 mile northwest and southeast of the site.	None

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Dublin, California

CSM Element	CSM Sub-Element	Description	Potential Data Gap(s)
Constituents of Concern	--	Constituents of concern have been identified by comparing analytical results to ESLs for residential land use and for groundwater that is considered a current or potential drinking water source.[3] PCE and TCE have been identified as the primary constituents of concern at the site; these constituents have been detected in soil, groundwater and soil vapor in the northern portion of the site. Biodegradation byproducts (e.g., cis-1,2-DCE and trans-1,2-DCE) have also been detected in groundwater, but at lower concentrations relative to PCE and TCE and below their respective ESLs. Vinyl chloride has been detected in soil vapor at concentrations above its ESL. In the northern portion of the site, benzene and ethylbenzene have been detected in soil vapor at concentrations above their respective ESLs. Chlorobenzene and related constituents, and to a lesser extent, benzene, are present in soil, groundwater, and soil vapor above ESLs at a former sump and/or former front-end alignment pit in Building B. Groundwater and soil vapor concentrations in this area are expected to decline following excavation of impacted soil in October 2011. The Crown Chevrolet case was initially opened as a leaking underground fuel tank case, based on an investigation performed by Basics Environmental in 2009 that identified TPHd and TPHmo in groundwater at concentrations exceeding their respective ESLs in eight of nine grab groundwater samples collected, suggesting widespread TPHd and TPHmo impacts to groundwater at the site. However, as discussed in AMEC's April 2011 report, sampling conducted by AMEC in 2010 to delineate the extent of impacts did not detect any TPHd and TPHmo in groundwater, other than two TPHd detections below the reporting limit. Additional sampling conducted at the site has confirmed the absence of TPHd and TPHmo impacts (TPHd detections from groundwater samples within the sump excavation are not likely representative of diesel, according to the analytical laboratory). Two underground storage tanks were removed in October 2012; all analytical results reportedly were non-detect for petroleum hydrocarbons, with the exception of some very low TPHd concentrations (significantly less than the ESL). Groundwater samples have also been analyzed for TPHg throughout the site, and TPHg has only been detected above ESLs in shallow groundwater in the vicinity of the sump; however, these detections are judged to be representative of VOCs quantified by the TPHg analysis. TPHg was also detected in one groundwater sample collected from the third water-bearing zone (i.e., approximately 60 feet bgs) at a concentration less than its ESL, which may be related to the historical Montgomery Ward release (TPHg also detected at very low concentrations in borings SB-01 and SB-02 in the northern portion of the site, likely also related to the historical Montgomery Ward release). While groundwater elevation data indicate that groundwater flow in the deepest water-bearing zone is to the northeast, as discussed above, the limited data make it difficult to evaluate the precise groundwater flow direction.	None
Potential Sources	On-site	The north parcel of the site has been used as a car dealership with an auto body and service center since approximately 1968, when the site was developed from vacant land. Prior to 1968, site use appears to have been agricultural, based on a review of available historical aerial photographs. The south parcel of the site has reportedly only been used for vehicle storage. Building A has reportedly only been used as a showroom. Operations within Building B included automobile servicing (likely including parts cleaning). A hazardous materials storage area was formerly present within Building B, on top of a former front-end alignment pit, where remediation was conducted. Building C has been used as an auto body shop (including painting). A portion of the southern parking lot within the north parcel was designated on historical maps as "bulk storage." Based on the minor detections of PCE in soil vapor (in an area where groundwater is not impacted) beneath a drain line in Building B and in groundwater beneath the former sump in Building B, it is possible that a limited amount of PCE entered the subsurface at the sump or via drain line from the sump within Building B. However, the data do not indicate that the PCE in groundwater north of Building A is related to its potential historical use within Building B. Additionally, a subsurface utility survey was performed in September 2012, which did not indicate the presence of any sewer line connections between north of Building A that might have acted as a conduit for PCE from Building B to the area of higher concentrations in groundwater. There is no likely source in Building A. Investigation performed within and downgradient of Building C (including the former "bulk storage" area) indicates that there are no significant impacts from activities in this area.	None
		Two USTs (one 1,000-gallon gasoline and one 1,000-gallon waste oil) are present just south of Building B). The USTs appear to have been replaced in the 1980s and upgraded in 1998. Data collected in the vicinity of the USTs prior to and during UST removal reportedly indicate that there are no significant impacts to soil and groundwater from the USTs.	None

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Dublin, California

CSM Element	CSM Sub-Element	Description	Potential Data Gap(s)
Potential Sources	Off-site, PCE	Four currently operating dry cleaners have been identified west (upgradient) of the Crown site, including Crow Canyon Cleaners at 7272 San Ramon Road, which has a known groundwater contamination issue (however, that site is approximately 0.5 mile from the Crown site and groundwater at the site has limited impact with a maximum PCE concentration of 23 µg/L). Two of the other identified dry cleaners, VIP Quality Cleaners at 7214 Regional Street and "Dry Clean 1 Hour" at 7257 Regional Street, are slightly closer to the Crown site (approximately 0.3 mile west); however, there are no documented releases at these two properties. These three properties appear to be served by sewers that flow north, away from the Crown site, but any potential releases from these dry cleaners or sewers serving them could have impacted groundwater moving toward the Crown site. The fourth dry cleaner, 1-800-DryClean of Dublin at 7172 Regional Street, may be served by a sewer line that flows south, toward the Crown site. No currently operating or historical dry cleaners have been identified south of Dublin Boulevard (i.e., west-southwest of the highest PCE concentrations) at this time. It should be noted that discharges of water containing PCE into (e.g., from dry cleaners) into the sanitary sewer have been prohibited since 1995 (personal communication with Anathan Kanagasundaram of the City of Dublin on November 15, 2012). The site is located within a commercial/industrial area, and several vehicle-maintenance related shops are located south of the site; these facilities appear to be served by a sewer that flows north along the western edge of the Crown site. Other such facilities are located west of the site. It is possible that PCE was released to the subsurface upgradient of the site via the sewer line. However, if a release were from an automobile-related source, it is likely that other fuel-related VOCs would be present as well (only PCE and TCE are present in groundwater at the upgradient property boundary of the Crown site).	A specific off-site source of PCE is not known at this time.
	Off-site, Fuels	***Quest Laboratory:*** The former Quest Laboratory site is located adjacent to the Crown Chevrolet property (south of the south parcel). The site was developed as a biomedical laboratory in 1982, and a 2,000-gallon underground fuel storage tank (of unknown contents) was installed at that time. The tank and associated piping were removed in 1989; limited petroleum hydrocarbon impacts were found in soil. Groundwater samples collected in 2004 indicated that TPHg and TPHd were present in groundwater at concentrations up to 5,100 and 64,000 µg/L, respectively, in a boring advanced at the former tank location, adjacent to the Crown site. Three groundwater monitoring wells were installed in 2009 to depths of 20 to 25 feet bgs in the vicinity of the former tank, and were monitored quarterly for one year. TPHg and TPHd were only detected during the first monitoring event, at maximum concentrations of 140 and 89 µg/L, respectively. One round of groundwater measurements indicated groundwater flow was to the north; subsequent measurements indicated groundwater flow was to the east-southeast. The case was closed, in April 2012, with the caveat that ACEH be notified of any potential changes to land use. The facility is currently owned by Safeway, Inc. Groundwater samples collected on the Crown property near the former Quest fuel tank did not indicate that impacts from the tank extend to the Crown site. ***Montgomery Ward*** : The former Montgomery Ward site is located across Dublin Boulevard from the Crown Chevrolet property (to the north). A gasoline fuel release was noted in 1988 from one of three 10,000-gallon gasoline USTs at the site. Total petroleum hydrocarbons were detected in soil samples nearby at concentrations up to 2,180 mg/kg. The USTs were removed in 1989, and some soil excavation conducted at that time. 1,350 gallons of free product were reportedly also removed. A groundwater extraction and treatment system began operating in 1990. Monitoring wells were installed at the Montgomery Ward property in 1992, as well as in the northern portion of the Crown site and at the property adjacent to Crown to the east in 1993. TPHg was detected in groundwater at the Montgomery Ward site at concentrations up to 100,000 µg/L in 1993. During the final groundwater monitoring event in 1996, TPHg was detected in a well at the northern boundary of the Crown property at 280 µg/L, with a historical maximum detection of 24,000 µg/L. As the case involved a leaking UST, groundwater was not tested for chlorinated solvents; however, in 1994, a selected number of grab groundwater samples collected at a property immediately east of the Crown site were tested for VOCs (including PCE) by U.S. EPA Method 8260, and no VOCs were detected.	None
Potential Presence of DNAPL	--	As the data indicate that the source of PCE is west of the site, it is not likely that there would be separate-phase product (i.e., DNAPL) in soil or groundwater at the site. Additionally, the detected concentrations of VOCs in groundwater at the site are not indicative of the presence of DNAPL.	None
Nature and Extent of Environmental Impacts	Extent in Soil, PCE and TCE	PCE and TCE have been detected in soil samples collected north of Buildings A and B and beneath Building A. All concentrations are less than their respective ESLs for residential shallow soil, applicable to groundwater considered to be a potential source of drinking water (ESLs of 370 and 460 µg/kg for PCE and TCE, respectively). PCE has been detected at concentrations up to 48 µg/kg in unsaturated soil in the vicinity of the highest PCE concentrations in groundwater and soil vapor (i.e., north of Building A). It is likely that these PCE detections represent PCE in the vapor phase and not a source of PCE in soil. PCE and TCE were detected in deeper soil samples (between 12.5 and 14.5 feet bgs) at concentrations up to 36 and 13 µg/kg, respectively (in the same area of the site). These soil samples were generally located within the saturated zone and it is likely that the detected concentrations represent PCE and TCE in groundwater. Soil was screened during advancement of the direct-push probe approximately every 1 to 4 feet using a PID; readings in most borings north of Building A and near the on-site sewer lateral were 0 ppm. No PID readings in this area indicated the presence of VOC impacts to soil.	None
	Extent in Soil, TPHg	Soil from the far northern and northeastern portions of the north parcel was also screened using a PID; readings up to 306 ppm (in boring MW-02) were recorded near the top of the zone of saturation in borings SB-01, SB-02, SB-37, SB-46, MW-02, and MP-02. Soil samples were collected from the depths of the PID readings at SB-01, SB-02, SB-46, and MW-02. TPHg was detected in those samples at concentrations up to 13 mg/kg. Samples were not collected from SB-37 and MP-02, but it is likely that TPHg is also present in soil at comparable depths in those borings. There is no likely on-site source of TPHg in the vicinity of the borings, but TPHg has been detected at low concentrations in groundwater in the northern portion of the site (i.e., SB-01 and SB-02). The former Montgomery Ward fuel release site was located northwest of the borings in which TPHg was detected. Groundwater was historically impacted by TPHg and BTEX at and downgradient of the Montgomery Ward site, extending to the east-southeast through the Crown Chevrolet site. The TPHg detected in soil at the Crown site is likely a remnant of historical Montgomery Ward contamination that remained in soil in the capillary fringe after most of the TPHg impacts had attenuated.	None

TABLE 1

SITE CONCEPTUAL MODEL

Crown Chevrolet Cadillac Isuzu
7544 Dublin Boulevard and 6707 Golden Gate Drive
Dublin, California

CSM Element	CSM Sub-Element	Description	Potential Data Gap(s)
Nature and Extent of Environmental Impacts	Extent in Soil, Chlorobenzenes	Chlorobenzenes and petroleum-related constituents were detected in soil in the vicinity of the former sump and former front-end alignment pit at concentrations greater than their respective ESLs; soil remediation was performed in 2011. Currently inaccessible impacted soil remains in place under existing building foundation walls; concentrations of some constituents are greater than ESLs.	Soil samples have been collected to a total depth of 11.5 feet bgs pre-remediation and 8 feet bgs post-remediation beneath the sump. The remediation consisted of soil excavation to a depth of 16 feet bgs. No soil samples were collected at the base of the excavation because the soil was saturated; there is currently no data confirming the absence of significant impacts to soil beneath the sump.
	Extent in Soil, TPHho and PCBs	TPHho (at concentrations greater than the residential ESL) was detected in soil sample SB-20-11 near a hydraulic lift east of the former front-end alignment pit in Building B (an elevated concentration of TPHho also was detected in soil sample SB-25-8; this sample location subsequently was excavated). Analysis for PCBs was performed on 13 samples, which were collected in the vicinity of hydraulic lifts within Building B. One PCB, Aroclor 1242, was detected in a soil sample collected at location NM-B-5 just north of the pit in Building B; however, the concentration of Aroclor 1242 at this location was an order of magnitude lower than its ESL. No other PCBs were detected in soil samples (however, the reporting limits for PCBs in 1 sample of the 13 samples analyzed were above the ESL).	None
Nature and Extent of Environmental Impacts	Extent in Shallow Groundwater, PCE and TCE	Grab groundwater and monitoring well data are available for VOCs throughout the northern portion of the site, including beneath Building A. PCE and TCE are present in groundwater in the northern parking lot at concentrations greater than their respective ESLs that consider groundwater to be a current or potential drinking water resource (the ESL is 5 µg/L for both PCE and TCE) (Figure 6). The highest concentrations of PCE in groundwater are at the western (upgradient) property boundary (with concentrations in this area range up to 210 µg/L). Concentrations decline to the north, east, and south. At the eastern (downgradient) property boundary, concentrations of PCE in shallow groundwater are approximately 25% of the concentrations at the upgradient property boundary (concentrations at the eastern property boundary are up to 58 µg/L). TCE is present at higher concentrations relative to PCE in the northeast corner of the site; cis- and trans-1,2-DCE also were detected in some groundwater samples in this area (at concentrations below their respective ESLs). The area where TCE concentrations are higher (and PCE concentrations lower) was historically impacted by the Montgomery Ward release of TPHg. It is likely that the TPHg acted as a source of organic carbon and stimulated the biological reduction of PCE in that area. As part of the feasibility study, AMEC collected two groundwater samples from monitoring wells MP-01-1 and MW-02, and tested the samples for the *Dehalococcoides* (*Dhc*) bacteria, nitrate, and sulfate, and assessed field parameters. *Dhc* was not present in either sample, but dissolved oxygen levels stabilized below 1 mg/L, which is generally considered to be anaerobic (oxygen deficient) and favorable for reductive dechlorination processes. ORP which is a measure of electron availability in aqueous environments, was measured as negative in both wells, and within the range of pE (electron activity) values that would facilitate reductive dechlorination. Regarding electron receptors, nitrate was found to be present in monitoring well MP01-1 and was not detected in monitoring well MW-02. Notably, nitrate was not found in the area where TPH impacts to groundwater from the historical Montgomery Ward release were formerly present and where TCE in present at higher concentrations than elsewhere at the site, suggesting that some bioattenuation likely occurred in this area, depleting this electron receptor. With the exception of two shallow grab groundwater samples (from Basics boring B8 and monitoring well MW-03, both located at the former sump) in which PCE was detected at 9.6 µg/L and 9.3 µg/L, respectively, only low concentrations of PCE (less than 5 µg/L) were detected in shallow groundwater in the vicinity of the former sump and former front-end alignment pit. These detections are isolated to a small area and may represent a minor release of PCE to groundwater from the sump.	No temporal data are available for groundwater concentrations.
	Extent in Shallow Groundwater, Chlorobenzenes	Chlorobenzenes and related constituents are present in shallow groundwater at concentrations greater than ESLs in the vicinity of the former sump within Building B (where soil remediation was conducted in 2011). The presence of these constituents (e.g., benzene and chlorobenzene) in groundwater appears to be limited to an area within approximately 15 feet of the former sump. Chlorobenzene, the primary VOC detected at the sump, was not detected in the only groundwater sample that has been collected from newly installed monitoring well MW-03. These constituents were not detected above ESLs in groundwater samples collected at the former front-end alignment pit in Building B.	No temporal data are available for MW-03.
	Extent in Shallow Groundwater, TPH	TPHho (at a concentration greater than its ESL) was detected in an unfiltered groundwater sample (SB-20) collected near one hydraulic lift east of the former front-end alignment pit in Building B; however, no TPHho was detected in a filtered groundwater sample from the same location. The unfiltered sample result is likely representative of TPHho sorbed onto soil particles, as TPHho was also detected in soil at 11 feet bgs at this location. The reporting limits for TPHho (and TPHd and TPHmo) in groundwater are greater than the respective ESLs for these constituents. However, no TPH was detected at the laboratory's method detection limit for the filtered samples. While concentrations less than the laboratory reporting limit are estimated, the absence of detections indicates that dissolved TPHd, TPHmo, and TPHho are not present.	None

TABLE 1

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CSM Element	CSM Sub-Element	Description	Potential Data Gap(s)
Nature and Extent of Environmental Impacts	Extent in Shallow Groundwater, Chromium	Total chromium was detected above the residential ESL at one location (SB-06), but dissolved concentrations in the vicinity were less than the ESL.	None
Nature and Extent of Environmental Impacts	Extent in Deeper Groundwater	Groundwater samples have been collected from two deeper water-bearing zones at six locations in the northern portion of the north parcel, including just downgradient of the former sump within Building B. The samples were collected from what appear to be discontinuous sand and gravel lenses at approximately 40 feet bgs and/or from a more significant water-bearing unit at approximately 60 feet bgs (actual sample depths/screen intervals varied based on the lithology encountered in each boring). No PCE, TCE, chlorobenzenes, or other VOCs were detected in any of the deeper groundwater samples, with the exception of several acetone detections that are believed to be false positives due to laboratory contamination. TPHg was detected in the third water-bearing zone of monitoring well MP-04 (at the eastern/downgradient property boundary) at a concentration less than its ESL. TPHg was not present in the up- or cross-gradient deeper groundwater samples, nor is TPHg a constituent of concern in shallow groundwater at the site. The TPHg may be related to the historical Montgomery Ward release; while groundwater elevation data indicate that groundwater flow in that water-bearing zone is to the northeast, as discussed above, the limited deeper groundwater elevation data make it difficult to evaluate the precise groundwater flow direction.	The middle (approximately 40 feet bgs) port of multi-port monitoring well MP-02 did not produce sufficient water to collect a sample during the only monitoring event conducted to date. However, sufficient data is available from nearby deep wells that this is not a significant data gap.
Nature and Extent of Environmental Impacts	Extent in Soil Vapor, PCE, TCE, and Vinyl Chloride in North Parcel	PCE, TCE, vinyl chloride, and some related breakdown products, are present in soil vapor in the northern portion of the north parcel (Figure 10). PCE, TCE, and vinyl chloride concentrations are greater than residential ESLs for evaluation of potential vapor intrusion concerns (410, 1,200, and 31 μg/m^3, respectively [Table E-2]) in some areas. The highest concentrations of PCE and TCE detected in soil vapor (up to a maximum concentration of 35,000 μg/m^3 at location SV-22) were in the vicinity of higher concentrations of PCE in groundwater (north of Building A). Vinyl chloride was also detected in soil vapor at concentrations greater than the ESL, but was limited to the north-central area of the north parcel (borings SG-03, SG-04, and SV-23). The spatial distributions of PCE and TCE in shallow soil vapor (i.e., 1 to 4 feet bgs) are similar, but they vary somewhat from the spatial distribution of these constituents in groundwater. This may indicate that shallow soil vapor transport is attributable, in part, to transport via on-site subsurface utilities, and not solely from volatilization from groundwater at the site. Additionally, utility lines within the nearby streets may provide a conduit for some of the vapors to enter the subsurface at the site. Concentrations of PCE and TCE in soil vapor samples collected from nested vapor monitoring points along the eastern property boundary are higher in the deeper (8 feet bgs) samples than the shallower (4 feet bgs) samples, indicating that volatilization from groundwater is a contributor to the VOC concentrations in soil vapor at the site. PCE was also detected along the floor drain lateral to the sewer line within Building B and in a sample collected from within the former front-end alignment pit in Building B (this pit has since been removed), indicating that PCE may have been used within Building B and may have contributed, in part, to the PCE detected in soil vapor beneath Building B. However, note that PCE, where detected, is present at only low concentrations in groundwater in this area, suggesting that vapor transport along site utilities likely contributes to PCE in soil vapor beneath Building B.	None
	Extent in Soil Vapor, PCE in South Parcel	PCE is present in soil vapor at concentrations ranging from 48 to 94 μg/m^3 (approximately an order of magnitude less than the ESL) in the northwestern corner of the south parcel. No auto servicing activities are known to have been conducted in this area, which was historically used as a parking lot. PCE was not detected in the groundwater sample collected in this area. PCE is not present in groundwater or soil vapor samples collected in the eastern portion of the south parcel. The low levels of PCE in soil vapor are likely related to transport via subsurface utilities within Golden Gate Drive and/or Saint Patrick Way.	None
	Extent in Soil Vapor, Benzene	Benzene and ethylbenzene have been detected in shallow soil vapor (i.e., collected from 1.5 to 5 feet bgs) north of Buildings A and B at concentrations exceeding their respective ESLs (84 μg/m^3 for benzene and 980 μg/m^3 for ethylbenzene). Benzene concentrations generally ranged from 90 to 160 μg/m^3, with one concentration of 1,300 μg/m^3 detected in the shallowest soil vapor sample (from a depth of 1.5 to 2 feet bgs at location SV-16) in the northeastern portion of the north parcel. Ethylbenzene concentrations were greater than the ESL at two locations, up to a maximum concentration of 1,300 μg/m^3 at location SV-16. These constituents were not detected in corresponding soil and groundwater samples, and there was not a visible pattern to the soil vapor sample concentrations in plan view. Concentrations of benzene and ethylbenzene in soil vapor samples collected from nested vapor monitoring points along the eastern property boundary are less in the deeper (8 feet bgs) samples than the shallower (4 feet bgs) samples. Based on the lack of a known source, lack of a spatial pattern to the detections, and the higher concentrations in the shallower samples, the presence of these constituents may be related to the long-term use of the area as a parking lot.	None
	Extent in Soil Vapor, Former Sump and Pit	Soil vapor sampling was conducted in the vicinity of the former sump and former front-end alignment pit in Building B prior to remediation, and some concentrations of PCE, benzene, and 1,4-dichlorobenzene were greater than their respective ESLs at that time. Soil vapor concentrations in this area are expected to decline following excavation of impacted soil in October 2011.	Post-remediation soil vapor concentrations are not known.
Migration Pathways	Potential Conduits	Figure 2 shows the known locations of on-site utilities, including sanitary sewer laterals, water, gas, and electrical lines, based on a geophysical survey conducted in September 2012. Based on the spatial distribution of PCE in groundwater (Figure 6), it does not appear that PCE was released to the subsurface via the on-site sewer lateral or any other subsurface utilities in the northern parking lot. However, based on the distribution of PCE in soil vapor (Figure 7), it appears that these facilities could act as conduits for vapor migration throughout the site.	None

TABLE 1

SITE CONCEPTUAL MODEL

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CSM Element	CSM Sub-Element	Description	Potential Data Gap(s)
Potential Receptors/Risk	On-site	Potable water at the site currently is provided via municipal supply and will continue to be in the foreseeable future. As such, direct contact to groundwater is not contemplated. Receptors at the site could include the following: • Current worker via vapor intrusion to indoor air, • Future construction worker via soil, groundwater, and soil vapor, • Future resident via vapor intrusion to indoor air, and/or • Future maintenance worker via soil and soil vapor.	Based on evaluation of the data relative to ESLs, it is likely that some risk for longer-term site occupants exists.
Potential Receptors/Risk	Off-site	Potential receptors in the vicinity include: • Nearby water-producing wells to the east and northeast • Concrete-lined Dublin Creek and Martin Canyon Creek	Potential risk to receptors in the surrounding area is unknown. The impacts to groundwater and soil vapor are attributed to an off-site source; therefore, potential impacts and risks to the surrounding areas have not been evaluated.

Note

1. California Department of Water Resources, 2006, California's Groundwater, Bulletin 118, Livermore Valley Groundwater Basin, January 20.
2. California Department of Water Resources, 1974, Evaluation of Ground Water Resources: Livermore and Sunol Valleys, Bulletin 118-2, June.
3. California Regional Water Quality Control Board, San Francisco Bay Region, 2008, Screening For Environmental Concerns at Sites With Contaminated Soil and Groundwater, May.
4. AMEC, 2011, Revised Soil and Groundwater Investigation Report, Crown Chevrolet Cadillac Isuzu, 7544 Dublin Boulevard and 6707 Golden Gate Drive, Dublin, California, April 4.
5. U.S. Environmental Protection Agency, 1992, Quick Reference Fact Sheet entitled "Estimating Potential for Occurrence of DNAPL at Superfund Sites," January.
6. Pankow, J., et al, 1996, Dense chlorinated solvents in groundwater: background and history of the problem: in Pankow D. and Cherry J. (eds.), Dense Chlorinated Solvents and other DNAPLs in Groundwater, Waterloo Press, Portland, Ore., Ch. 1, pp. 1-52.

Abbreviations

bgs = below ground surface
cis-1,2-DCE = cis-1,2-dichloroethene
trans-1,2-DCE = trans-1,2-dichloroethene
DNAPL = dense non-aqueous phase liquid
ESLs = Environmental Screening Levels
mg/kg = milligrams per kilogram
PCE = tetrachloroethene
PCBs = polychlorinated biphenyls
PID = photoionization detector
ppm = parts per million
ppmv = parts per million by volume
TCE = trichloroethene
TPHd = total petroleum hydrocarbons as diesel
TPHg = total petroleum hydrocarbons as gasoline
TPHho = total petroleum hydrocarbons as hydraulic oil
TPHmo = total petroleum hydrocarbons as motor oil
µg/kg = micrograms per kilogram
µg/L = micrograms per liter
$\mu g/m^3$ = micrograms per cubic meter

TABLE 2

MASS IN-PLACE ESTIMATES

Crown Chevrolet Cadillac Isuzu
7544 Dublin Boulevard and 6707 Golden Gate Drive
Dublin, California

Mass In Soil Vapor

Estimated soil vapor contaminant mass (assumes impacted area = 80,000 sf x 10 feet thick, 50% porosity)

Impacted Zone						
Width (ft)	*Length (ft)*	*Thickness (ft)*	*Porosity*	*Area (sf)*	*Pore Volume (cf)*	*Pore Volume (m^3)*
200	400	10	0.5	80,000	400,000	11,328

	Reported Concentrations (µg/L)													
Contaminant	*SV-24*	*SV-23*	*SV-22*	*SG-03*	*SG-02*	*SG-04*	*SV-12*	*SV-13*	*SG-01*	*SV-16*	*SV-14*	*Average*	*Mass - Kg*	*Mass - lbs*
PCE	9.6	2.3	35	17	4.9	1.4	0.054	7.3	0.58	0.4	0.79	7.21	0.082	0.180
TCE	0.41	9.1	0.033	3.2	0.065	5.8	0.3	12	0.02	0.027	8.3	3.57	0.040	0.089
VC	0.0052	0.51	0.0052	0.091	0.0055	0.13	0.0052	0.5	0.003	0.0052	0.5	0.16	0.002	0.004
													Total =	0.269

Dissolved Mass

Estimated groundwater contaminant mass (assumes impacted area = 80,000 sf x 12 feet thick, 50% porosity)

Impacted Zone						
Width (feet)	*Length (feet)*	*Thickness (feet)*	*Porosity*	*Area (sf)*	*Pore Volume (cf)*	*Pore Volume (liters)*
200	400	12	0.5	80,000	480,000	13,592,088

	Reported Concentrations (mg/L)																
Contaminant	*SB-33*	*SB-34*	*SB-35*	*SB-38*	*B-39*	*SB-40*	*SB-42*	*MP-01-1*	*MP-03-1*	*MW-01*	*MP-02-1*	*NM-B-28*	*SB-02*	*NM-B-26*	*Average*	*Mass - Kg*	*Mass - lbs*
PCE	0.13	0.21	0.17	0.1	0.14	0.16	0.14	0.12	0.12	0.16	0.0016	0.016	0.015	0.0017	0.106	1.4	3.2
TCE	0.00057	0.0025	0.00058	0.002	0.002	0.0005	0.0005	0.0005	0.0064	0.0013	0.019	0.048	0.06	0.056	0.014	0.2	0.4
																Total =	3.60

Soil Vapor Mass		**0.27**	
Dissolved Mass		**3.60**	
	Total	**3.87**	**lbs**

Notes

1. All reported concentrations and thicknesses as presented in the *Soil, Groundwater, and Soil Vapor Investigation Report* (AMEC, 2012). Reported concentrations for non-detected results are shown as the laboratory reporting limit.
2. 1 kg = 2.2 lbs
3. 1 cf = 28.32 liters = 7.43 gallons

Abbreviations

-- = not used in calculation
cf = cubic feet
kg = kilograms
lbs = pounds
µg/L = micrograms per liter

mg/L = milligrams per liter
PCE = tetrachloroethene
sf = square feet
TCE = trichloroethene
VC = vinyl chloride

TABLE 3

SCREENING OF CORRECTIVE ACTION TECHNOLOGIES

Crown Chevrolet Cadillac Isuzu
7544 Dublin Boulevard and 6707 Golden Gate Drive
Dublin, California

Technology	Description	Effectiveness	Implementability	Relative Cost	Retain for Detailed Evaluation?
Monitored Natural Attenuation (MNA)	MNA relies on natural processes to achieve corrective action objectives. These processes may include biodegradation, sorption, dispersion and dilution, chemical reactions, and/or volatilization. In order to consider MNA, it must first be verified that subsurface conditions are suitable for the attenuation processes, especially bioremediation; it also requires monitoring to verify progress.	*Potentially effective if combined with other remedial technologies* Natural attenuation appears to have occurred (with the presence of a carbon source) at the site as described in the *Soil, Groundwater, and Soil Vapor Investigation Report,*[1] with the reduction of PCE and increased in TCE concentrations at the northeast corner of the site. The slow rate of natural attenuation observed to date (i.e., high concentrations of PCE relative to TCE and other breakdown products) indicates that MNA will not be effective in the short term. With respect to the long-term effectiveness, slow, natural attenuation may occur, but PCE and TCE concentrations in groundwater are expected to remain constant for a substantial time period.	*Easy to Implement* MNA requires only monitoring to verify progress; therefore, implementation is not complex. Agency and community acceptance of this method alone may be low. The materials and services needed to implement MNA are readily available.	Low	No
Groundwater Extraction and Treatment (GWET)	GWET involves the physical removal of impacted groundwater from the subsurface, followed by above ground treatment. Once treated, groundwater is discharged either to the sanitary sewer under permit from the POTW or to a storm drain under NPDES permit.	*Can be effective under medium to high permeability subsurface conditions* GWET could be effective in the short- and long term in providing a hydraulic barrier to VOC migration onto the site. Groundwater extraction is a well-proven technology for hydraulic containment. Additionally, GWET could be effective in the short-term and long-term in removing PCE and TCE in groundwater. However, due to mostly low-permeability lithology at the site (mostly lean clays), closely spaced groundwater extraction wells would be required to effectively remove VOC-impacted water.	*Moderate to Difficult to Implement* Personnel and equipment are generally available for implementation; however, specialized design work is required. Discharging treated water may require extensive permitting. Implementation will require extensive operation, maintenance and administrative effort.	High	No

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[1] AMEC, 2012. Soil, Groundwater, and Soil Vapor Investigation Report, 7544 Dublin Boulevard and 6707 Golden Gate Drive, Dublin, California. October 19

TABLE 3

SCREENING OF CORRECTIVE ACTION TECHNOLOGIES

Crown Chevrolet Cadillac Isuzu
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Dublin, California

Technology	Description	Effectiveness	Implementability	Relative Cost	Retain for Detailed Evaluation?
In-Situ Bioremediation (Aerobic)	Aerobic *in-situ* bioremediation is accomplished by introducing oxygen and/or other substrates to the subsurface. Oxygen could be introduced at the site by installing diffusive oxygen emitters in the subsurface or by injecting oxygen-enhanced water. Diffusive oxygen emitters consist of coiled silicone tubing that can be lowered into a well. The tubing is pressurized with oxygen, resulting in a slow, continuous release of oxygen to the subsurface.	*Not effective* The COCs at the site are not amenable to aerobic biodegradation.	*Moderate to Implement* Personnel and equipment are generally available for implementation; however, specialized design work is required.	High	No
Enhanced In-Situ Bioremediation (Anaerobic)	Anaerobic *in-situ* bioremediation involves introducing an electron donor and/or bacterial amendment to the treatment area to create strongly reducing conditions and foster contaminant biodegradation. PCE and TCE have been shown to be degraded by appropriate bacteria (e.g. Dhc) under highly reducing conditions. Electron donor addition would likely occur by injecting substrate (e.g., lactate) into the target treatment zone. Recirculation would potentially be used to more effectively distribute the injected substrate throughout the treatment area.	*Potentially effective* The site groundwater chemistry appears to be favorable for reductive dechlorination. The COCs at the site are amenable to anaerobic biodegradation and *in-situ* bioremediation. Anaerobic biodegradation of PCE by Dhc bacteria could potentially result in the complete breakdown of PCE to ethene; however, if the breakdown was not complete, vinyl chloride could be produced. Effective implementation of the technology would be difficult to assess without a pilot treatability study to determine full site-wide implementation. Consistent delivery of amendments would require closely spaced injection points and possible permanent infrastructure for additional amendment delivery post site development.	*Moderate to Difficult to Implement* Personnel and equipment are generally available for implementation; however, specialized design work is required for long term implementation.	Medium to High (dependent on time frame and infrastructure required for implementation)	Yes

TABLE 3

SCREENING OF CORRECTIVE ACTION TECHNOLOGIES

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Dublin, California

Technology	Description	Effectiveness	Implementability	Relative Cost	Retain for Detailed Evaluation?
Permeable Reactive Barrier (PRB) using Zero-Valent Iron	A PRB is a trench filled with a reactive media that will remediate groundwater as it flows through (assuming an adequate residence time). For chlorinated VOCs, the PRB would use zero-valent iron (ZVI), Fe(0), as the reactive media. Treatment of the COCs takes place in the form of abiotic reductive dehalogenation through reactions at the surfaces of Fe(0) particles. PCE and TCE and are reduced due to electron transfers from the iron to the halocarbon at the iron surface.	*Potentially effective* Can be used to manage COC flux from the off-site source area and partially effective to reduce VOC concentrations on-site as treated water migrates across the site. The migrating groundwater COCs at the site are amenable via the ZVI PRB. The long-term effectiveness of various available ZVI may require bench scale testing to determine product with higher treatment capabilities and longevity.	*Moderate to Implement* The ZBI PRB would be moderate to construct with minimal operation and maintenance post construction. The equipment and materials necessary for installation are commercially available, and the permitting complexity is low to moderate.	Medium	Yes
In Situ Chemical Oxidation (ISCO)—Liquid-Based Injection	ISCO involves injecting chemical oxidants (e.g., persulfate or hydrogen peroxide) into the subsurface where they oxidize contaminants *in situ*. Oxidants are typically injected using temporary direct-push points or permanent injection wells.	*Potentially effective if proper subsurface delivery of the chemical oxidant can be accomplished* The COCs at the site are potentially amenable to oxidation reactions, and ISCO could potentially be an effective means of reducing constituent concentrations in the source area. However, there can be challenges in the delivery of the oxidant, unfavorable side reactions, and effectiveness can be limited by complexities in site geochemistry.	*Difficult to Implement* Due to mostly low-permeability lithology at the site, many closely-spaced injection points would be needed to cover the plume area, and repeated injections would likely be necessary, resulting in high cost. Personnel and equipment are generally available for implementation; however, specialized design work is required. The chemical oxidant injection system may require extensive permitting.	High	No

TABLE 3

SCREENING OF CORRECTIVE ACTION TECHNOLOGIES

Crown Chevrolet Cadillac Isuzu
7544 Dublin Boulevard and 6707 Golden Gate Drive
Dublin, California

Technology	Description	Effectiveness	Implementability	Relative Cost	Retain for Detailed Evaluation?
Excavation/Disposal (Former Sump and Front-End Alignment Pit [F.E. Pit] Areas)	Excavation represents the physical removal and off-site disposal of the impacted soil. This remedial action eliminates the source of any groundwater contamination from the constituents currently present in the soil.	*Effective for removing impacted soil* Excavation has been proven effective to address TPH and VOC impacts to soil at the sump and F.E. Pit areas, as detailed in the *Remediation Report.*[2] This technology is effective in both the short- and long-terms.	*Easy to Implement* Excavation of remaining TPH and VOC impacted soil at the sump and F.E. Pit areas can be accomplished using the same excavation techniques utilized during the initial remedial action.	Low (based on identified remaining sump and F.E. Pit soil impacts)	Yes
Soil Vapor Extraction (SVE)	SVE involves applying a vacuum (negative pressure) that induces subsurface vapor flow through soil in the vadose zone to reduce the mass of contaminants in soil. The induced negative pressure volatilizes COCs adsorbed to soil particles. The COCs are then carried with the induced subsurface flow and treated above ground using a treatment system (e.g., granulated activated carbon, thermal oxidation).	*Effective for removal of VOCs; not effective for denser hydrocarbons such a motor oil range compounds* Although SVE would be an effective treatment for the remaining chlorobenzene and dichlorobenzene impacts at the former sump and F.E. Pit, SVE would not be effective for the treatment of the heavier hydrocarbon–impacted soil at the F.E. Pit. SVE would not be effective for chlorinated VOCs in soil vapor, as no source for these constituents is present in soil at the site.	*Easy to Implement* Personnel and equipment are generally available for implementation; however, specialized design work is required. Implementation of SVE for the small areas identified with remaining soil impacts would not result in a favorable cost/benefit ratio when compared to the excavation approach.	Moderate	No
Vapor Barrier	A vapor barrier involves the use of high density polyethylene (HDPE) sheets or sprayed-applied asphaltic emulsions placed beneath new building foundations. The applied vapor barrier prevents vapors from entering the building by sealing typical soil vapor pathways such as expansion joints, slab cracks, and utility penetrations.	*Effective in controlling vapor intrusion into new buildings* Although effective on its own over both the short-and long-term for the control of minor soil vapor impacts, the vapor barrier would be used in combination with a sub-slab depressurization system for additional protection.	*Easy to Implement* Personnel and equipment are generally available for implementation; however, specialized design work is required. Implementation of the remedy would take place during a site development.	Low	Yes

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[2] AMEC, 2011. Remediation Report, Crown Chevrolet Cadillac Isuzu, 7544 Dublin Boulevard and 6707 Golden Gate Drive, Dublin, California. December.

TABLE 3

SCREENING OF CORRECTIVE ACTION TECHNOLOGIES

Crown Chevrolet Cadillac Isuzu
7544 Dublin Boulevard and 6707 Golden Gate Drive
Dublin, California

Technology	Description	Effectiveness	Implementability	Relative Cost	Retain for Detailed Evaluation?
Sub-Slab Depressurization (SSD)	SSD involves the installation of vapor collection piping underneath a building to create negative pressure and extract accumulated soil vapors beneath the building foundations. Extracted soil vapors are vented to the atmosphere. Depending on extracted concentrations, extracted soil vapors might require pre-treatment prior to discharge to atmosphere.	*Effective in controlling vapor intrusion into new buildings* Although effective on its own for the control of minor soil vapor impacts, the use of a SSD system is typically used in combination with a vapor barrier for additional protection. A SSD is an effective mitigation measure in the long term, as the negative pressures induced by the system create a convective flow of air upward through the system to draw air from beneath the slab and vent it to the outdoors.	*Easy to Implement* Personnel and equipment are generally available for implementation; however, specialized design work is required. Implementation of the remedy would take place during a site development.	Moderate	Yes
Institutional Controls (ICs) and Long-Term Site Management	ICs and long-term site management are administrative and legal restrictions implemented and/or imposed on the property to minimize the human exposure to contamination and protect the integrity and stability of the remedy. ICs might include deed restrictions on the use of the soil and groundwater, scheduled inspections of the remedy, site management plans, Codes, Covenants and Restrictions (CCRs) as a legal document that remains in place with the property, and review of compliance with any covenant restricting the use of the property, among others.	*Effective as a supplement to engineering controls to facilitate short- and long-term management of risk by preventing and limiting exposure to COCs*	*Easy to Implement* Personnel and equipment are generally available for implementation. Enforcement of ICs is effective at the site until such time the site is deemed as requiring no further action.	Low to Moderate	Yes

Abbreviations

CCRs = codes, covenants, and restrictions
COC = contaminant of concern
Dhc = Dehalococcoides
F.E. Pit = front end alignment pit
GWET = groundwater extraction and treatment
HDPE = high density polyethylene
ICs = institutional controls
ISCO = in-situ chemical oxidation
MNA = monitored natural attenuation
MTBE = methyl tertiary butyl ether
NPDES = National Pollutant Discharge Elimination System
PCE = tetrachloroethene
POTW = publicly owned treatment works
SSD = sub-slab depressurization
SVE = soil vapor extraction
TBA = tertiary butyl alcohol
TCE = trichloroethylene
TPH = total petroleum hydrocarbons
VOC = volatile organic compounds
ZVI = zero valent iron

TABLE 4

EVALUATION OF REMEDIAL ALTERNATIVES

Crown Chevrolet Cadillac Isuzu
7544 Dublin Boulevard and 6707 Golden Gate Drive
Dublin, California

	Feasibility Evaluation Criteria								
	Overall Protection of Human Health and Environment (Corrective Action Objectives)			**Effectiveness**			**Implementability**	**Cost**	**Sustainability**
				Short-Term Effectiveness	**Long-Term Effectiveness and Permanence**	**Reduction in Toxicity, Mobility, and Volume**			
Corrective Action Alternative	**Mitigate Vapor Intrusion Risk to Future Site Occupants**	**Mitigate Potential Exposure to Future Construction and Maintenance Workers**	**Remediate Residual Source Material in the Vicinity of the Former Sump and F.E. Pit**	**Risk Associated with Alternative Implementation and Risk Reduction in Short Term due to Alternative Implementation**	**Reduction of COCs or Mitigation of Health Risks to Reduce Long-Term Reliance on O&M**	**COC Distribution and Concentration**	**Technical Feasibility, Engineering Services, Materials, Approvals, and Permits**	**Estimated Total Cost**	**Water Conservation, Energy Saving, Waste and GHG Minimization, Local Economy Boost, and Stakeholder Satisfaction**
Alternative 1 Soil excavation/ disposal, groundwater monitoring, long-term site management and institutional controls	**No** No action is taken to remediate or mitigate vapor concentrations from PCE-impacted groundwater at the site.	**Yes** A SMP will be prepared to provide health and safety guidance during subsurface intrusive activities.	**Yes** Impacted soil at the former sump and F.E. Pit will be removed.	Alternative 1 implementation poses relatively low risk associated with soil removal and future subsurface work at the site. Alternative 1 does actively reduce soil impacts, but does not remove VOCs from impacted GW or prevent possible vapor intrusion.	Alternative 1 does not reduce the extent and concentrations of VOCs in site GW, and does not provide mitigation against possible vapor intrusion concerns, except to the extent that institutional controls will control future site use in the northern portion of the site and prevent the use of groundwater.	Alternative 1 effectively reduces or eliminates the presence of soil impacts at the former sump and F.E. Pit. Alternative 1 does not reduce VOC concentrations in GW or soil vapor.	Materials and engineering services are readily available. Regulatory approvals and discharge permits for implementation of the proposed remedial alternative are expected to be readily obtainable. Services to implement institutional controls are expected to be readily obtainable.	$500,000	***Sustainable*** *:* Relatively limited excavation will generate soil that will require disposal off site. Requires long-term monitoring involving travel to the site, which produces greenhouse gas emissions as well as waste from sampling activities.
Alternative 2 Vapor barrier and sub-slab depressurization, plus soil excavation/ disposal, groundwater monitoring, long-term site management and institutional controls	**Yes** A vapor barrier and SSD will effectively mitigate intrusion of VOC-impacted vapor to newly-constructed structures. The SSD creates a negative pressure, venting impacted vapors to the atmosphere. Monitoring will be used to determine the effectiveness of the corrective action. A SMP, long-term monitoring, and institutional controls will be in place to assure the long-term implementation of the alternative.	**Yes** A SMP will be prepared to provide health and safety guidance during subsurface intrusive activities.	**Yes** Impacted soil at the former sump and F.E. Pit will be removed.	Alternative 2 implementation poses relatively low risks associated with subsurface work at the site. Alternative 2 does actively reduce soil impacts and mitigates vapor intrusion but does not remove VOCs from impacted GW.	Alternative 2 provides long term protection against vapor intrusion, but does not reduce the extent and concentrations of VOCs in site GW.	Alternative 2 effectively reduces or eliminates the presence of soil impacts at the former sump and F.E. Pit and mitigates soil vapor intrusion. Alternative 2 does not reduce VOC concentrations in GW.	Materials and engineering services are readily available. Regulatory approvals and discharge permits for implementation of the proposed remedial alternative are expected to be readily obtainable. Services to implement institutional controls are expected to be readily obtainable.	$1,400,000	***Sustainable*** *:* Relatively limited excavation will generate soil that will require disposal off site. Requires long-term monitoring involving travel to the site, which produces greenhouse gas emissions as well as waste from sampling activities. Installation of the vapor barrier is material- and equipment- intensive and will produce GHG emissions in the short term.

TABLE 4

EVALUATION OF REMEDIAL ALTERNATIVES

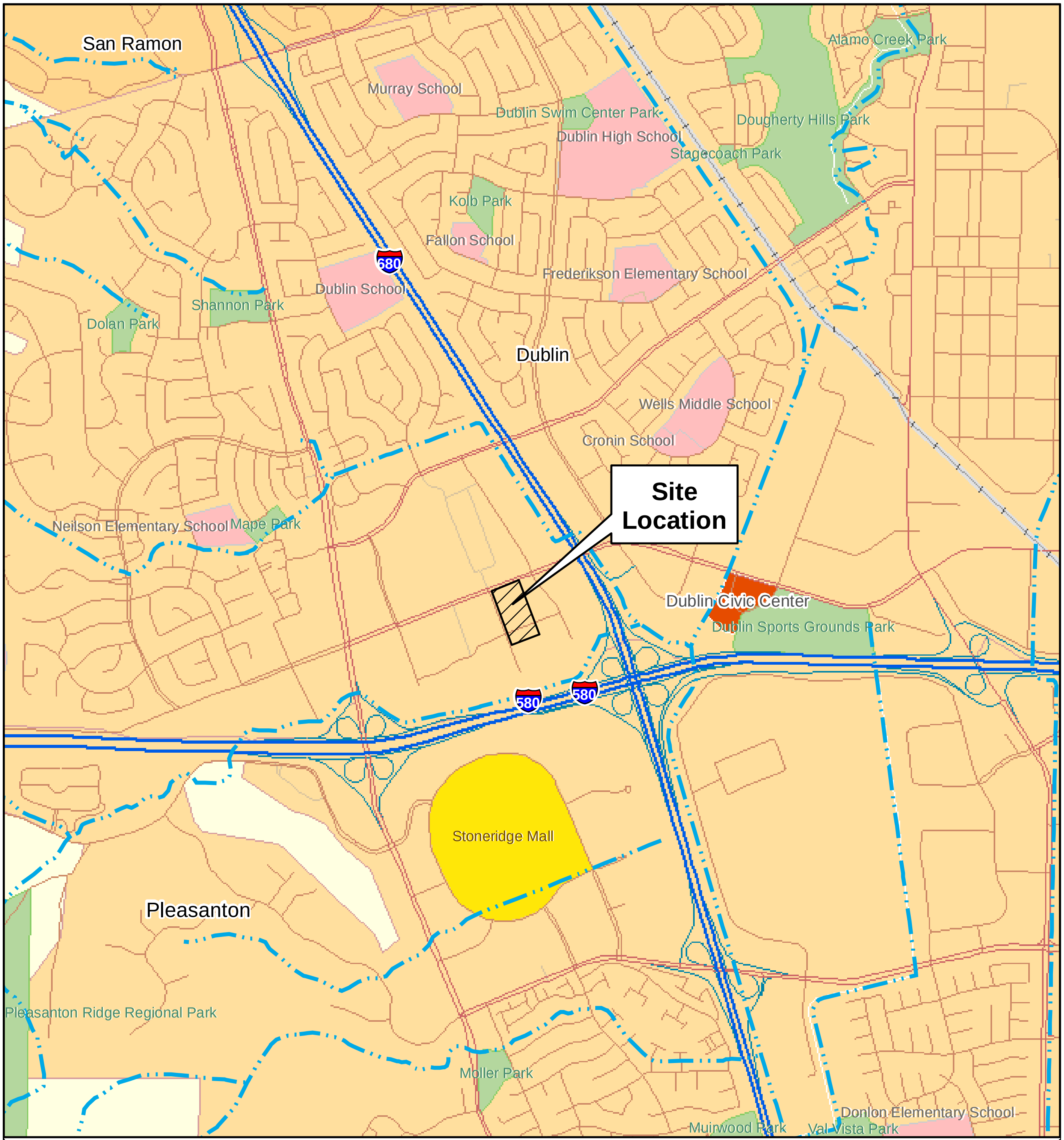
Crown Chevrolet Cadillac Isuzu
7544 Dublin Boulevard and 6707 Golden Gate Drive
Dublin, California

	Feasibility Evaluation Criteria								
				Effectiveness					
	Overall Protection of Human Health and Environment (Corrective Action Objectives)			Short-Term Effectiveness	Long-Term Effectiveness and Permanence	Reduction in Toxicity, Mobility, and Volume	Implementability	Cost	Sustainability
Corrective Action Alternative	Mitigate Vapor Intrusion Risk to Future Site Occupants	Mitigate Potential Exposure to Future Construction and Maintenance Workers	Remediate Residual Source Material in the Vicinity of the Former Sump and F.E. Pit	Risk Associated with Alternative Implementation and Risk Reduction in Short Term due to Alternative Implementation	Reduction of COCs or Mitigation of Health Risks to Reduce Long-Term Reliance on O&M	COC Distribution and Concentration	Technical Feasibility, Engineering Services, Materials, Approvals, and Permits	Estimated Total Cost	Water Conservation, Energy Saving, Waste and GHG Minimization, Local Economy Boost, and Stakeholder Satisfaction
Alternative 3 Permeable reactive barrier with zero-valent iron, plus vapor barrier and sub-slab depressurization, soil excavation/disposal, groundwater monitoring, and long-term site management and institutional controls	**Yes** The vapor barrier and SSD effectively mitigate vapor intrusion concerns. The PRB does not directly contribute to the mitigation of vapor intrusion risks, except to the extent that it prevents the possibility of higher-concentration groundwater from entering the site. Further, the vapor barrier/SSD system would be in place to effectively mitigate an increase in vapor concentrations, should they occur.	**Yes** A SMP will be prepared to provide health and safety guidance during subsurface intrusive activities.	**Yes** Impacted soil at the former sump and F.E. Pit will be removed.	Alternative 3 implementation poses low risks associated with subsurface work at the site. Alternative 3 does actively reduce soil impacts and mitigates vapor intrusion, but does not remove VOCs across the site from impacted GW in the short term. It would, however, mitigate VOC concentrations in groundwater near the PRB in the short term, and prevent any potential higher-concentration groundwater from entering the site.	Alternative 3 provides long term protection against vapor intrusion and long term protection against increases in VOCs concentrations in site GW, but likely will not reduce the extent and concentrations of existing VOCs in site GW. Although this alternative prevents higher-concentration groundwater from entering the site, it does not directly contribute to the mitigation of vapor intrusion, which will be effectively mitigated by the vapor barrier/SSD system.	Alternative 3 effectively reduces or eliminates the presence of soil impacts at the former sump and F.E. Pit and mitigates soil vapor intrusion. Alternative 3 does prevent future increases of VOC concentrations in GW, but does not address existing VOC concentrations in GW in a reasonable amount of time.	Materials and engineering services are readily available. Regulatory approvals and discharge permits for implementation of the proposed remedial alternative are expected to be readily obtainable. Services to implement institutional controls are expected to be readily obtainable.	$2,220,000	***Moderately Sustainable*:** Installation of the PRB will generate additional soil that will have to be disposed of off site. Installation of the PRB and substrate is equipment intensive and will produce greenhouse gas emissions in the short term. However, a PRB is a passive, low-maintenance alternative that is sustainable in the long-term.
Alternative 4a In-situ bioremediation, permeable reactive barrier with zero-valent iron, vapor intrusion barrier and sub-slab depressurization, soil excavation/disposal, groundwater monitoring, and long-term site management and institutional controls	**Yes** The vapor barrier and SSD effectively mitigate vapor intrusion concerns. The *in situ* bioremediation, if effective, would reduce VOC concentrations in groundwater, such that reliance on the vapor barrier/SSD system is not necessary.	**Yes** A SMP will be prepared to provide health and safety guidance during subsurface intrusive activities.	**Yes** Impacted soil at the former sump and F.E. Pit will be removed.	Alternative 4a implementation poses low risks associated with subsurface work at the site. Alternative 4a does actively reduce soil impacts and mitigates vapor intrusion. However, it is uncertain that this alternative, which would require nutrient injection and bio-augmentation over a limited time frame, could effectively reduce VOC concentrations in the short term.	Alternative 4a provides long term protection against vapor intrusion and long term protection against increases in VOC concentrations in site GW. It is uncertain, given the limited time frame over which to inject nutrients and bio-augment site groundwater, that this alternative would be effective in the long term.	Alternative 4a effectively reduces or eliminates the presence of soil impacts at the former sump and F.E. Pit, mitigates soil vapor intrusion, and has the potential to reduce VOC concentrations in GW. However it is uncertain that an *in situ* program over a limited time frame could be effective at the site.	Materials and engineering services are readily available. Regulatory approvals and discharge permits for implementation of the proposed remedial alternative are expected to be readily obtainable. Services to implement institutional controls are expected to be readily obtainable.	$2,910,000	***Moderately Sustainable*:** Installation of the PRB will generate additional soil that will have to be disposed of off site. Installation of the PRB and substrate is equipment intensive and will produce greenhouse gas emissions in the short term. However, a PRB is a passive, low-maintenance alternative that is sustainable in the long-term.

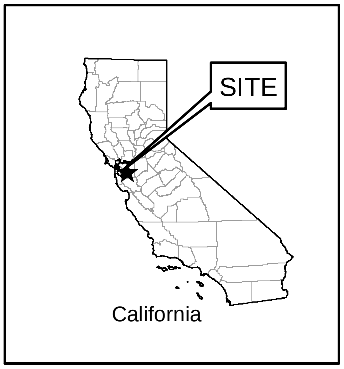
Abbreviations

COC = constituent of concern	IC = institutional control	SMP = site management plan	VI = vapor intrusion
F.E. Pit = Front End Alignment Pit	PRB = permeable reactive barrier	SSD = sub-slab depressurization	VOC = volatile organic compound
GW = groundwater			

FIGURES



Street map from ESRI, 2007.



SITE LOCATION MAP
Crown Chevrolet Cadillac Isuzu
7544 Dublin Boulevard and 6707 Golden Gate Drive
Dublin, California

By: AWP	Date: 12/14/2012	Project No. OD10160070
amec		Figure 1

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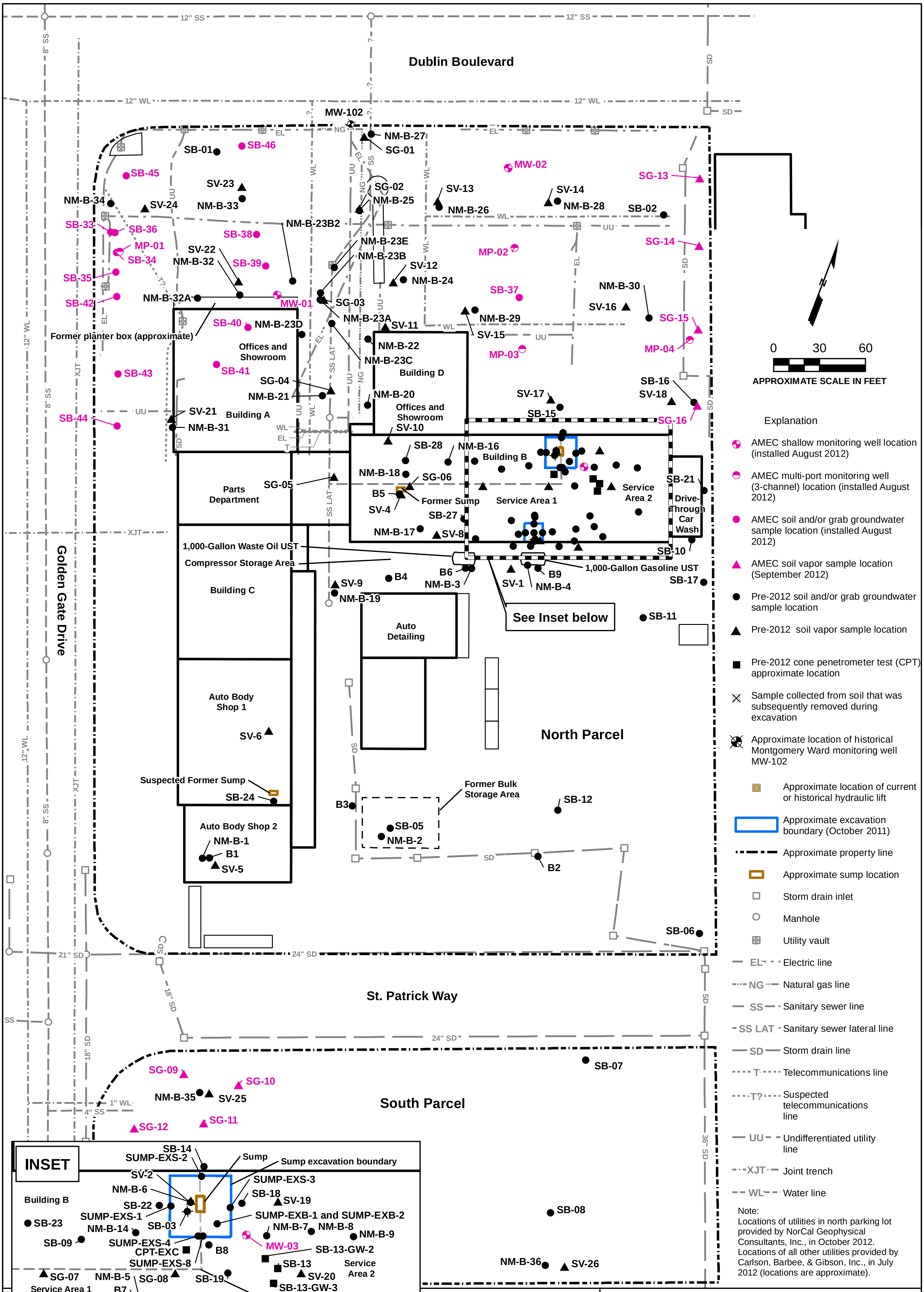


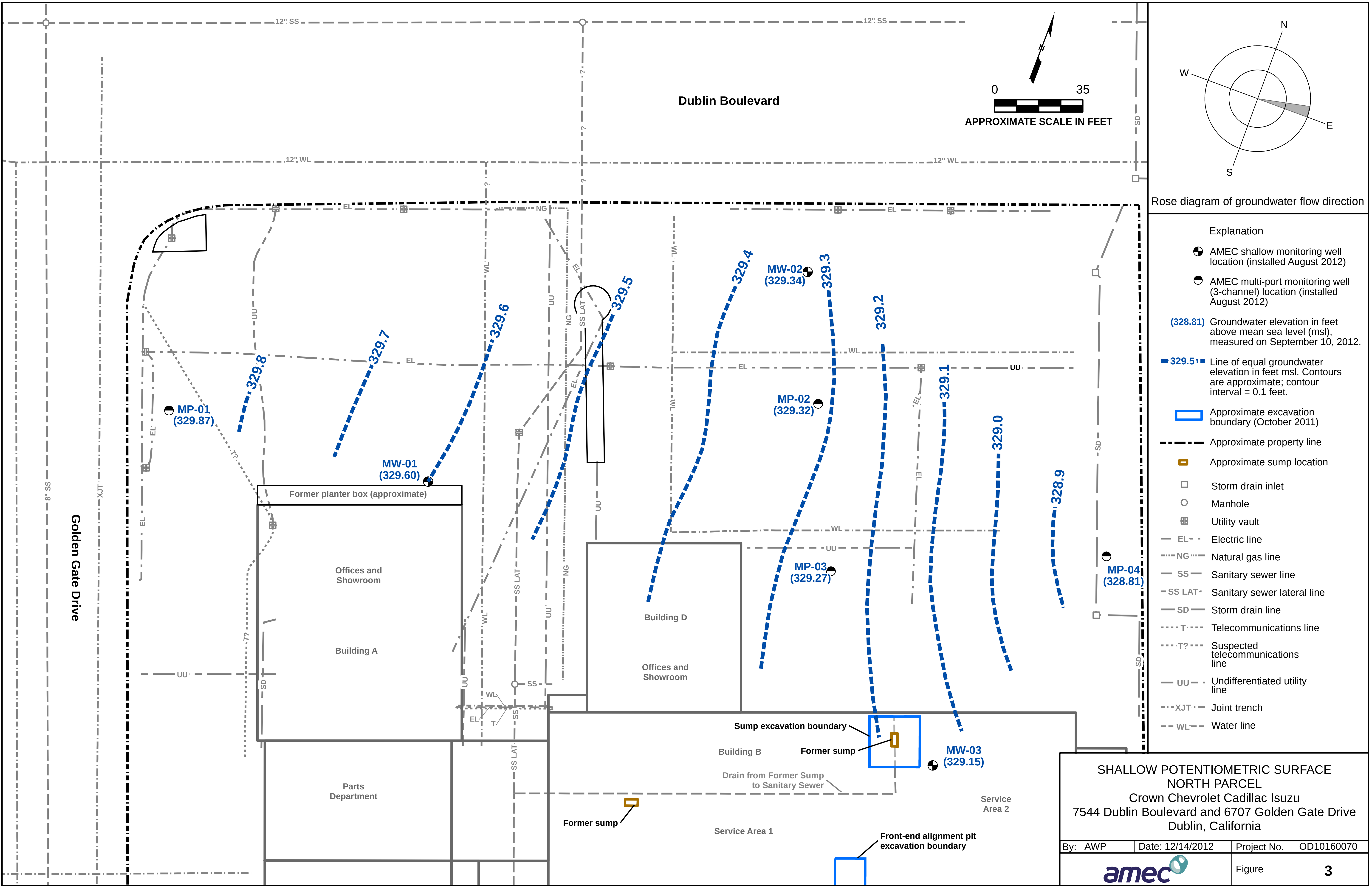
Explanation

◒	AMEC shallow monitoring well location (installed August 2012)
◓	AMEC multi-port monitoring well (3-channel) location (installed August 2012)
●	AMEC soil and/or grab groundwater sample location (installed August 2012)
▲	AMEC soil vapor sample location (September 2012)
●	Pre-2012 soil and/or grab groundwater sample location
▲	Pre-2012 soil vapor sample location
■	Pre-2012 cone penetrometer test (CPT) approximate location
✕	Sample collected from soil that was subsequently removed during excavation
⊗	Approximate location of historical Montgomery Ward monitoring well MW-102
▨	Approximate location of current or historical hydraulic lift
▭	Approximate excavation boundary (October 2011)
-·-·-	Approximate property line
▭	Approximate sump location
□	Storm drain inlet
○	Manhole
⊞	Utility vault
— EL- · -	Electric line
-··-NG-··-	Natural gas line
— SS —	Sanitary sewer line
- SS LAT -	Sanitary sewer lateral line
— SD —	Storm drain line
····T····	Telecommunications line
····T?····	Suspected telecommunications line
— UU — -	Undifferentiated utility line
-·-XJT-·-	Joint trench
— WL— -	Water line

Note:
Locations of utilities in north parking lot provided by NorCal Geophysical Consultants, Inc., in October 2012.
Locations of all other utilities provided by Carlson, Barbee, & Gibson, Inc., in July 2012 (locations are approximate).

SITE PLAN AND SAMPLE LOCATIONS
Crown Chevrolet Cadillac Isuzu
7544 Dublin Boulevard and 6707 Golden Gate Drive
Dublin, California

By: AWP	Date: 12/14/2012	Project No. OD10160070
amec		Figure 2



SHALLOW POTENTIOMETRIC SURFACE
NORTH PARCEL
Crown Chevrolet Cadillac Isuzu
7544 Dublin Boulevard and 6707 Golden Gate Drive
Dublin, California

By: AWP	Date: 12/14/2012	Project No.	OD10160070
amec		Figure	3

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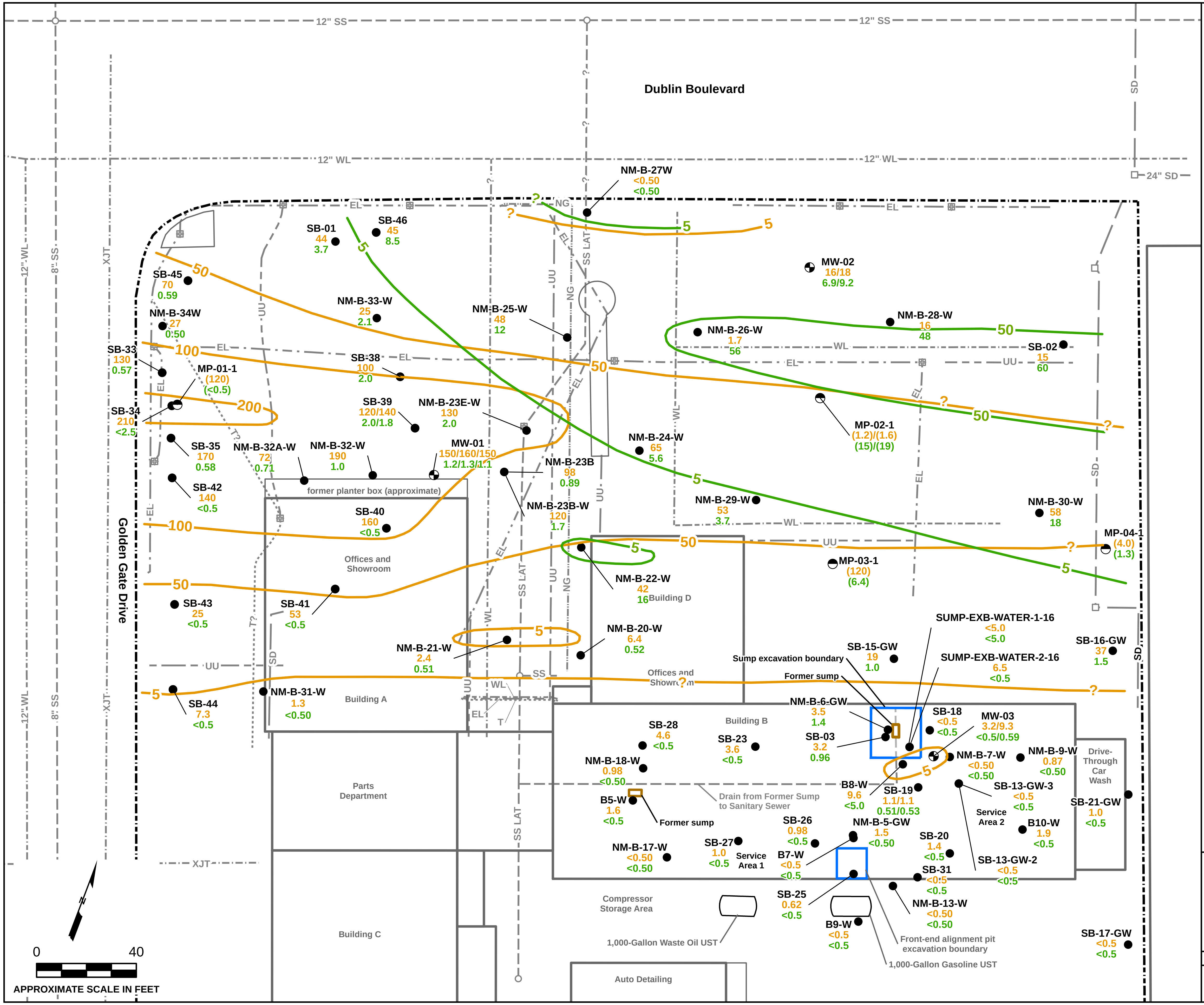

Explanation

50 — Approximate line of equal PCE concentration

50 — Approximate line of equal TCE concentration

MW-01 ← Well/Boring ID
150/160/150 ← PCE concentration in µg/L
1.2/1.3/1.1 ← TCE concentration in µg/L
Grab groundwater sample
Duplicate data

Drinking Water ESLs (µg/L)	
PCE	5.0
TCE	5.0

◐	Shallow monitoring well location
◓	Multi-port monitoring well (3-channel) location
●	Soil and/or grab groundwater sample location
▭	Approximate excavation boundary (October 2011)
—·—·—	Approximate property line
▬	Approximate sump location
☐	Storm drain inlet
○	Manhole
⊞	Utility vault
– · EL · –	Electric line
···NG···	Natural gas line
– SS –	Sanitary sewer line
– SS LAT –	Sanitary sewer lateral line
— SD —	Storm drain line
····T····	Telecommunications line
····T?····	Suspected telecommunications line
— UU · —	Undifferentiated utility line
·–XJT–·	Joint trench
– – WL · –	Water line

Note:
Results, shown in parenthesis, from multi-port wells were not used in contouring, due to the small screen interval.

Abbreviations:
ESL = environmental screening level
PCE = tetrachloroethene
TCE = trichloroethene
UST = underground storage tank
µg/L = micrograms per liter
< = not detected at laboratory reporting limit indicated

PCE AND TCE IN SHALLOW GROUNDWATER
NORTH PARCEL
Crown Chevrolet Cadillac Isuzu
7544 Dublin Boulevard and 6707 Golden Gate Drive
Dublin, California

By: AWP	Date: 12/14/2012	Project No. OD10160070
amec		Figure 4

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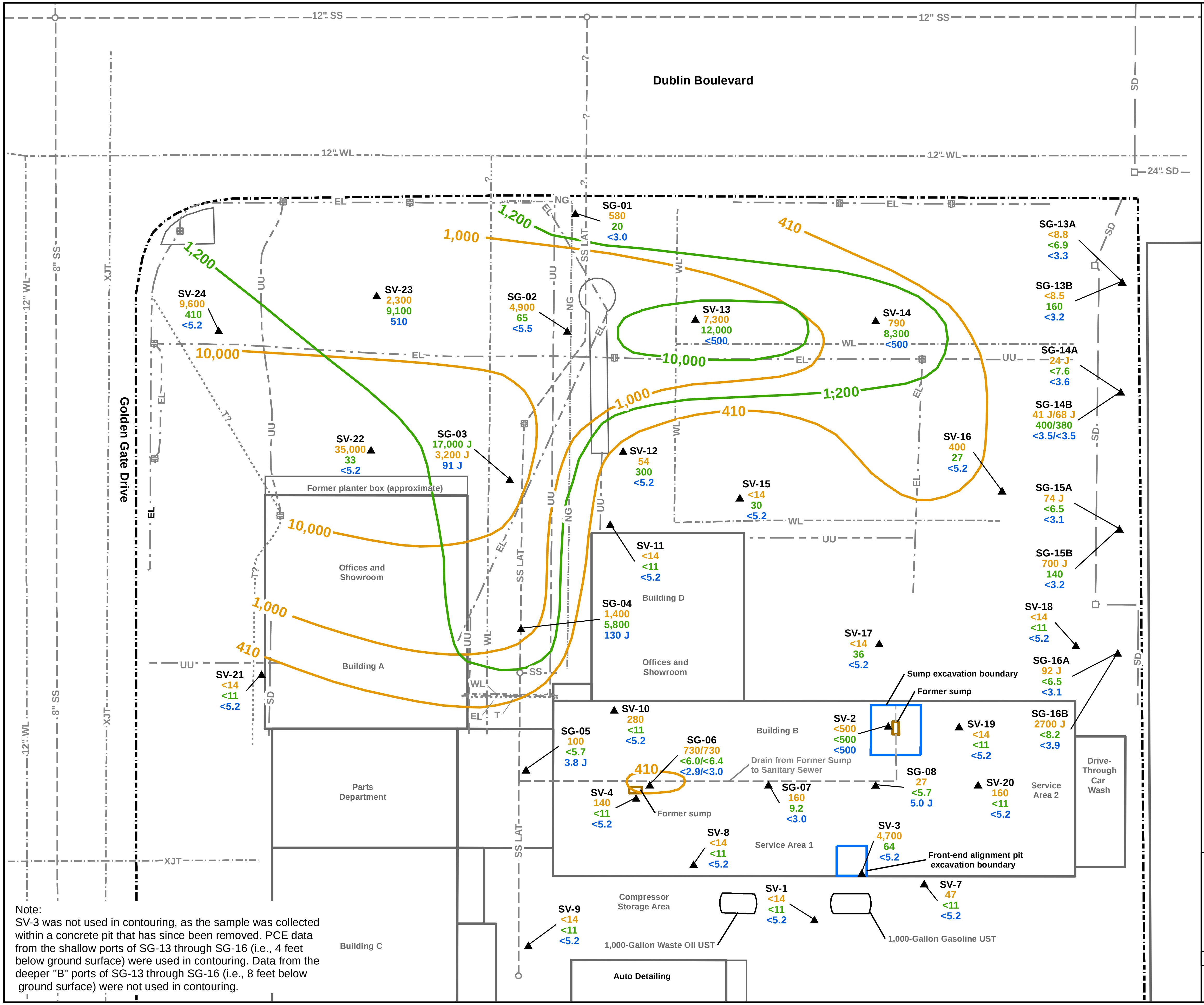

Note:
SV-3 was not used in contouring, as the sample was collected within a concrete pit that has since been removed. PCE data from the shallow ports of SG-13 through SG-16 (i.e., 4 feet below ground surface) were used in contouring. Data from the deeper "B" ports of SG-13 through SG-16 (i.e., 8 feet below ground surface) were not used in contouring.

Explanation

—410— Approximate line of equal PCE concentration

—1,200— Approximate line of equal TCE concentration

SG-14B ◄ Well/Boring ID
41 J/68 J ◄ PCE concentration in µg/m^3
400/380 ◄ TCE concentration in µg/m^3
<3.5/<3.5 ◄ VC concentration in µg/m^3
"A" indicates sample from 4 feet bgs; "B" indicates sample from 8 feet bgs.
Duplicate data

Soil Vapor ESLs (µg/m3)	
PCE	410
TCE	1,200
Vinyl chloride	31

▲ Soil vapor sample location
▭ Approximate excavation boundary (October 2011)
— · — Approximate property line
▬ Approximate sump location
□ Storm drain inlet
○ Manhole
⊞ Utility vault
— · EL · — Electric line
—··NG··— Natural gas line
— SS — Sanitary sewer line
—SS LAT— Sanitary sewer lateral line
— SD — Storm drain line
····T····· Telecommunications line
····T?···· Suspected telecommunications line
— UU · — Undifferentiated utility line
—·XJT·— Joint trench
— WL — Water line

Abbreviations:
bgs = below ground surface
ESL = environmental screening level
PCE = tetrachloroethene
TCE = trichloroethene
UST = underground storage tank
VC = vinyl chloride
µg/m^3 = micrograms per cubic meter
< = not detected at laboratory reporting limit indicated
J = estimated value

0 40
APPROXIMATE SCALE IN FEET

PCE, TCE, AND VINYL CHLORIDE IN SOIL VAPOR
NORTH PARCEL
Crown Chevrolet Cadillac Isuzu
7544 Dublin Boulevard and 6707 Golden Gate Drive
Dublin, California

By: AWP | Date: 12/14/2012 | Project No. OD10160070

amec

Figure 5

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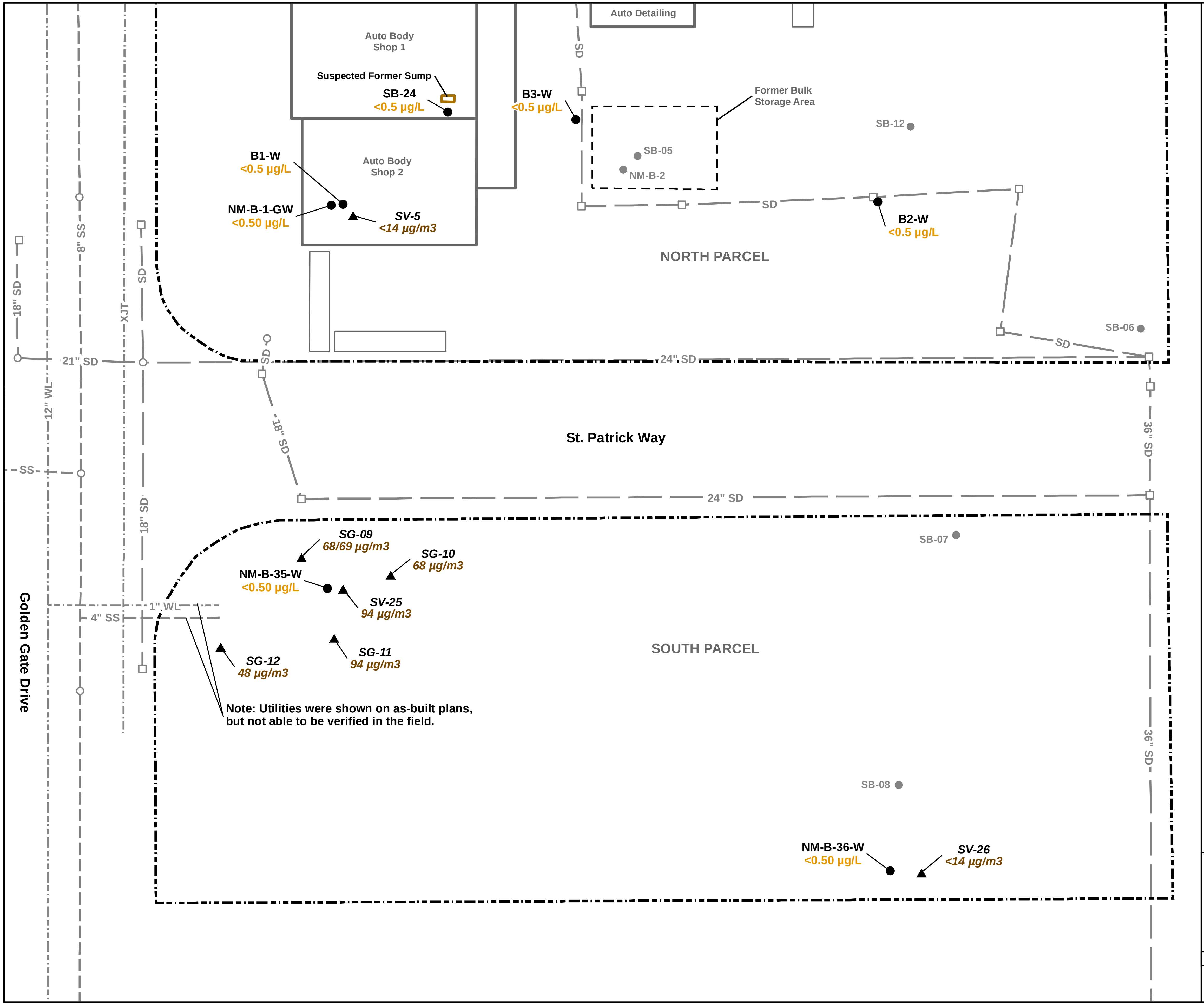

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Explanation

● Soil and/or grab groundwater sample location

▲ Soil vapor sample location

Soil Vapor Data:
SG-10 ← Well/Boring ID
<68 µg/m^3 ← PCE concentration in micrograms per cubic meter (µg/m^3)

Soil Vapor ESL (µg/m3)	
PCE	410

Groundwater Data:
NM-B-35-W ← Well/Boring ID
<0.50 µg/L ← PCE concentration in micrograms per liter (µg/L)

Drinking Water ESL (µg/L)	
PCE	5.0

Approximate property line

□ Storm drain inlet

○ Manhole

SS Sanitary sewer line

SD Storm drain line

XJT Joint trench

WL Water line

Abbreviations:
ESL = environmental screening level
PCE = tetrachloroethene
< = not detected at laboratory reporting limit indicated

0 40
APPROXIMATE SCALE IN FEET

PCE IN GROUNDWATER AND SOIL VAPOR
SOUTH PARCEL

Crown Chevrolet Cadillac Isuzu
7544 Dublin Boulevard and 6707 Golden Gate Drive
Dublin, California

By: AWP	Date: 12/14/2012	Project No. OD10160070
amec		Figure 6

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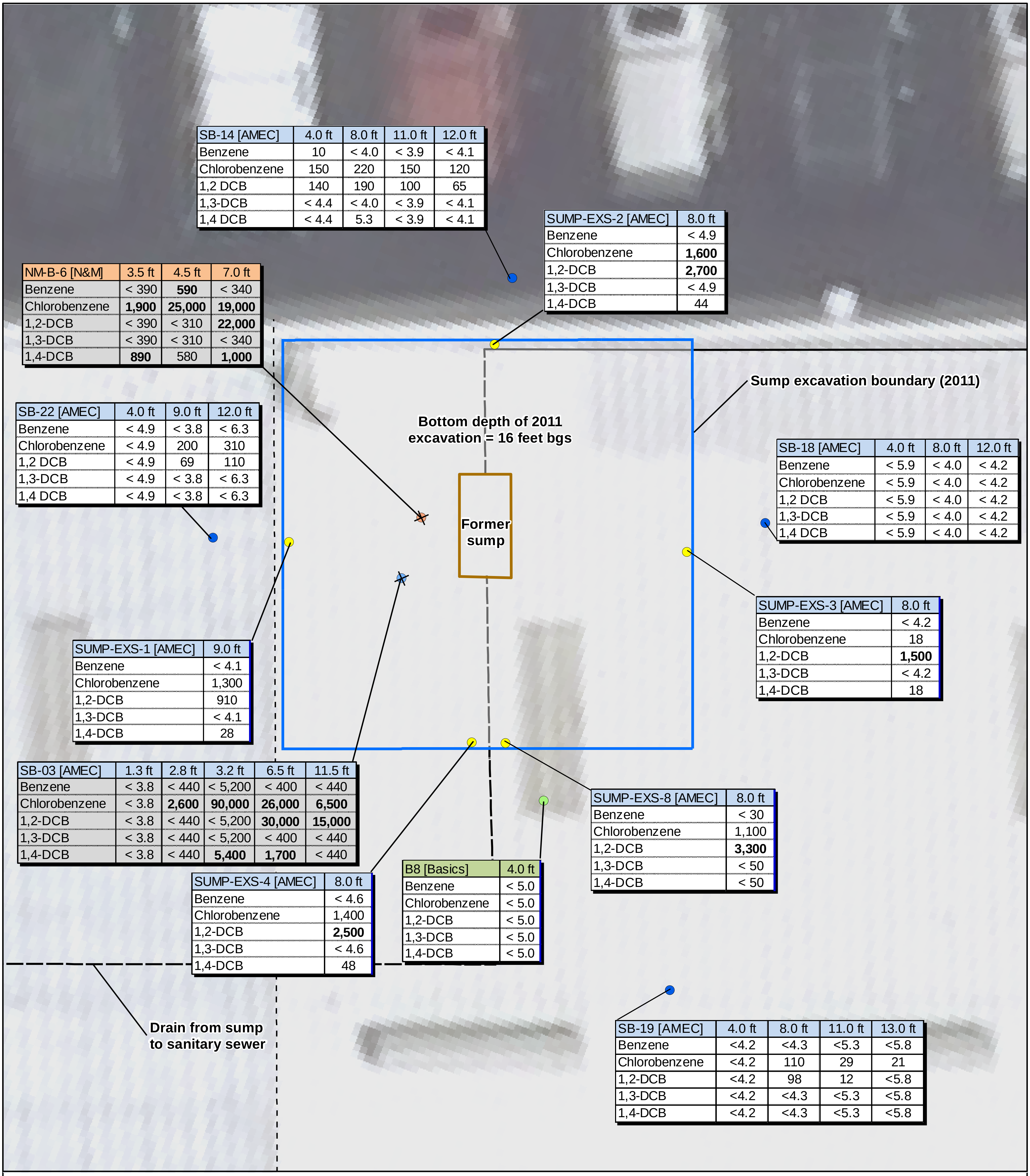

SB-14 [AMEC]	4.0 ft	8.0 ft	11.0 ft	12.0 ft
Benzene	10	< 4.0	< 3.9	< 4.1
Chlorobenzene	150	220	150	120
1,2 DCB	140	190	100	65
1,3-DCB	< 4.4	< 4.0	< 3.9	< 4.1
1,4 DCB	< 4.4	5.3	< 3.9	< 4.1

SUMP-EXS-2 [AMEC]	8.0 ft
Benzene	< 4.9
Chlorobenzene	**1,600**
1,2-DCB	**2,700**
1,3-DCB	< 4.9
1,4-DCB	44

NM-B-6 [N&M]	3.5 ft	4.5 ft	7.0 ft
Benzene	< 390	**590**	< 340
Chlorobenzene	**1,900**	**25,000**	**19,000**
1,2-DCB	< 390	< 310	**22,000**
1,3-DCB	< 390	< 310	< 340
1,4-DCB	**890**	580	**1,000**

SB-22 [AMEC]	4.0 ft	9.0 ft	12.0 ft
Benzene	< 4.9	< 3.8	< 6.3
Chlorobenzene	< 4.9	200	310
1,2 DCB	< 4.9	69	110
1,3-DCB	< 4.9	< 3.8	< 6.3
1,4 DCB	< 4.9	< 3.8	< 6.3

SB-18 [AMEC]	4.0 ft	8.0 ft	12.0 ft
Benzene	< 5.9	< 4.0	< 4.2
Chlorobenzene	< 5.9	< 4.0	< 4.2
1,2 DCB	< 5.9	< 4.0	< 4.2
1,3-DCB	< 5.9	< 4.0	< 4.2
1,4 DCB	< 5.9	< 4.0	< 4.2

SUMP-EXS-3 [AMEC]	8.0 ft
Benzene	< 4.2
Chlorobenzene	18
1,2-DCB	**1,500**
1,3-DCB	< 4.2
1,4-DCB	18

SUMP-EXS-1 [AMEC]	9.0 ft
Benzene	< 4.1
Chlorobenzene	1,300
1,2-DCB	910
1,3-DCB	< 4.1
1,4-DCB	28

SB-03 [AMEC]	1.3 ft	2.8 ft	3.2 ft	6.5 ft	11.5 ft
Benzene	< 3.8	< 440	< 5,200	< 400	< 440
Chlorobenzene	< 3.8	**2,600**	**90,000**	**26,000**	**6,500**
1,2-DCB	< 3.8	< 440	< 5,200	**30,000**	**15,000**
1,3-DCB	< 3.8	< 440	< 5,200	< 400	< 440
1,4-DCB	< 3.8	< 440	**5,400**	**1,700**	< 440

SUMP-EXS-8 [AMEC]	8.0 ft
Benzene	< 30
Chlorobenzene	1,100
1,2-DCB	**3,300**
1,3-DCB	< 50
1,4-DCB	< 50

SUMP-EXS-4 [AMEC]	8.0 ft
Benzene	< 4.6
Chlorobenzene	1,400
1,2-DCB	**2,500**
1,3-DCB	< 4.6
1,4-DCB	48

B8 [Basics]	4.0 ft
Benzene	< 5.0
Chlorobenzene	< 5.0
1,2-DCB	< 5.0
1,3-DCB	< 5.0
1,4-DCB	< 5.0

SB-19 [AMEC]	4.0 ft	8.0 ft	11.0 ft	13.0 ft
Benzene	<4.2	<4.3	<5.3	<5.8
Chlorobenzene	<4.2	110	29	21
1,2-DCB	<4.2	98	12	<5.8
1,3-DCB	<4.2	<4.3	<5.3	<5.8
1,4-DCB	<4.2	<4.3	<5.3	<5.8

Explanation

- ● AMEC soil and/or grab groundwater sample location (October 19-28, 2011)
- ● AMEC soil and/or grab groundwater sample location (May 16-July 26, 2011)
- ● AMEC soil and/or grab groundwater sample location (September 27-29, 2010)
- ● Ninyo & Moore soil and/or grab groundwater sample location (December 16, 2010)
- ● Basics Environmental soil and/or grab groundwater sample location (February 24-25, 2009)
- ☒ Sample collected from soil that was subsequently removed during excavation
- ☐ Approximate excavation boundary (2011)
- - - - Interior building wall
- ─── Approximate location of above-ground drain line
- — — Approximate location of below-ground drain line

Sampler
Sample ID – B8 [Basics]; 4.0 ft – Sample depth (bgs)
Constituent; Concentration (µg/kg)

B8 [Basics]	4.0 ft
Benzene	< 5.0
Chlorobenzene	< 5.0
1,2-DCB	< 5.0
1,3-DCB	< 5.0
1,4-DCB	< 5.0

Soil ESLs (µg/kg)	
Benzene	44
Chlorobenzene	1,500
1,2-DCB	1,100
1,3-DCB	7,400
1,4-DCB	590

Notes:
1. Analytes shown on this figure were detected in at least one soil sample above their ESLs. Results shown in **bold** exceed their respective ESLs. Although gasoline range organics (GRO) were detected in samples SB-03-3.2 and NM-B-6 above the GRO ESL, the GRO values reported are likely due to the presence of non-gasoline VOCs in the samples; therefore, they are not reported here.
2. Shading indicates that the sample was collected from soil that was subsequently removed during excavation.
3. For clarity, borings not advanced adjacent to the 2011 excavation areas, or with samples not analyzed for target constituents, are not shown on this figure.

0 2.5 5
Feet

Abbreviations:
1,2-DCB = 1,2-dichlorobenzene
1,3-DCB = 1,3-dichlorobenzene
1,4-DCB = 1,4-dichlorobenzene
Basics = Basics Environmental, Inc.
bgs = below ground surface
ESLs = Environmental Screening Levels
F.E. Pit = Front-end alignment pit
µg/kg = micrograms per kilogram
N&M = Ninyo & Moore
< = not detected above the laboratory reporting limit shown
VOCs = volatile organic compounds

SELECTED VOCs IN SOIL
FORMER SUMP AREA
Crown Chevrolet Cadillac Isuzu
7544 Dublin Boulevard and 6707 Golden Gate Drive
Dublin, California

By: AWP	Date: 12/14/2012	Project No. OD10160070
amec		Figure 7

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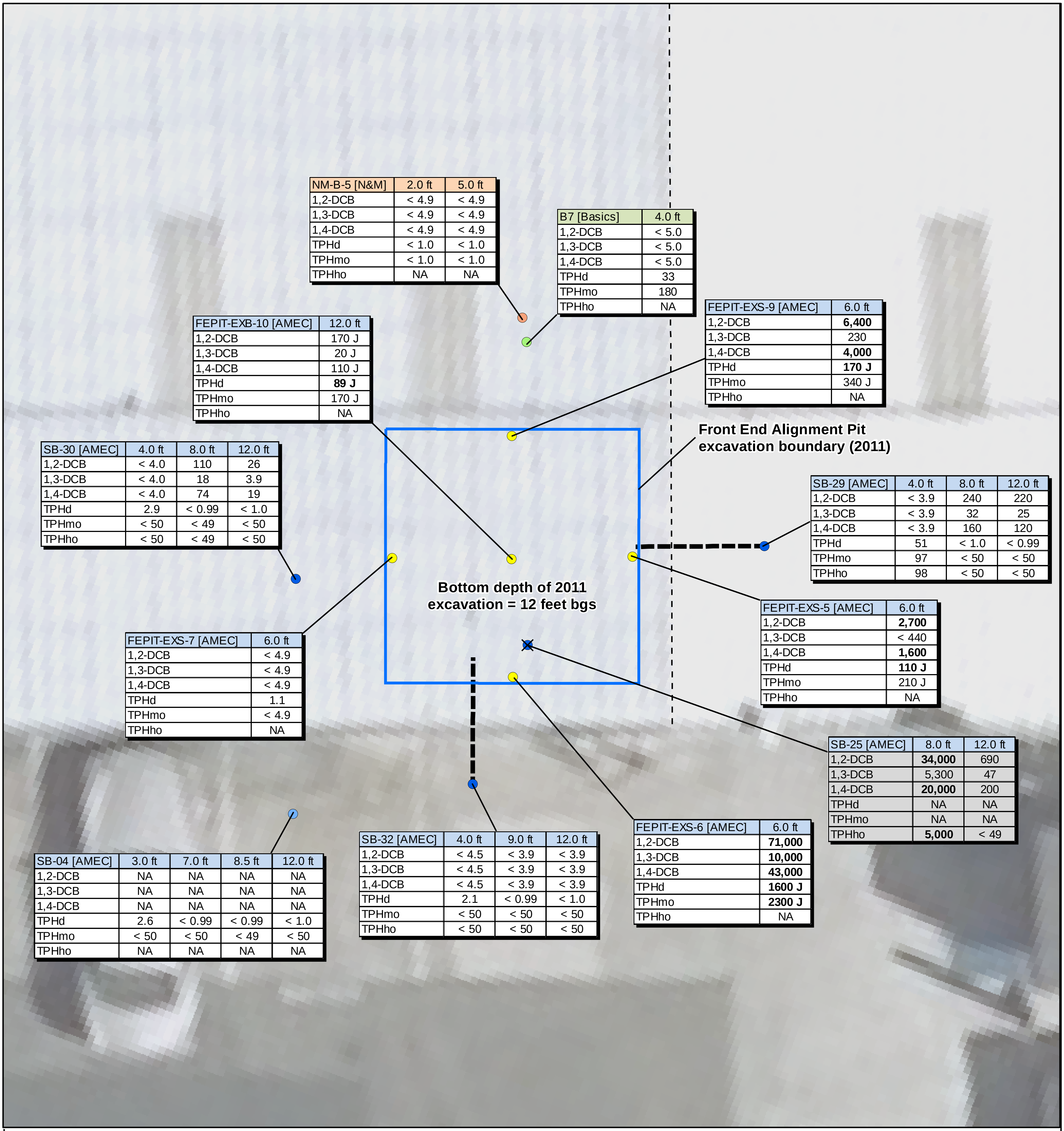


NM-B-5 [N&M]	2.0 ft	5.0 ft
1,2-DCB	< 4.9	< 4.9
1,3-DCB	< 4.9	< 4.9
1,4-DCB	< 4.9	< 4.9
TPHd	< 1.0	< 1.0
TPHmo	< 1.0	< 1.0
TPHho	NA	NA

B7 [Basics]	4.0 ft
1,2-DCB	< 5.0
1,3-DCB	< 5.0
1,4-DCB	< 5.0
TPHd	33
TPHmo	180
TPHho	NA

FEPIT-EXB-10 [AMEC]	12.0 ft
1,2-DCB	170 J
1,3-DCB	20 J
1,4-DCB	110 J
TPHd	**89 J**
TPHmo	170 J
TPHho	NA

FEPIT-EXS-9 [AMEC]	6.0 ft
1,2-DCB	**6,400**
1,3-DCB	230
1,4-DCB	**4,000**
TPHd	**170 J**
TPHmo	340 J
TPHho	NA

SB-30 [AMEC]	4.0 ft	8.0 ft	12.0 ft
1,2-DCB	< 4.0	110	26
1,3-DCB	< 4.0	18	3.9
1,4-DCB	< 4.0	74	19
TPHd	2.9	< 0.99	< 1.0
TPHmo	< 50	< 49	< 50
TPHho	< 50	< 49	< 50

SB-29 [AMEC]	4.0 ft	8.0 ft	12.0 ft
1,2-DCB	< 3.9	240	220
1,3-DCB	< 3.9	32	25
1,4-DCB	< 3.9	160	120
TPHd	51	< 1.0	< 0.99
TPHmo	97	< 50	< 50
TPHho	98	< 50	< 50

FEPIT-EXS-5 [AMEC]	6.0 ft
1,2-DCB	**2,700**
1,3-DCB	< 440
1,4-DCB	**1,600**
TPHd	**110 J**
TPHmo	210 J
TPHho	NA

FEPIT-EXS-7 [AMEC]	6.0 ft
1,2-DCB	< 4.9
1,3-DCB	< 4.9
1,4-DCB	< 4.9
TPHd	1.1
TPHmo	< 4.9
TPHho	NA

SB-25 [AMEC]	8.0 ft	12.0 ft
1,2-DCB	**34,000**	690
1,3-DCB	5,300	47
1,4-DCB	**20,000**	200
TPHd	NA	NA
TPHmo	NA	NA
TPHho	**5,000**	< 49

SB-04 [AMEC]	3.0 ft	7.0 ft	8.5 ft	12.0 ft
1,2-DCB	NA	NA	NA	NA
1,3-DCB	NA	NA	NA	NA
1,4-DCB	NA	NA	NA	NA
TPHd	2.6	< 0.99	< 0.99	< 1.0
TPHmo	< 50	< 50	< 49	< 50
TPHho	NA	NA	NA	NA

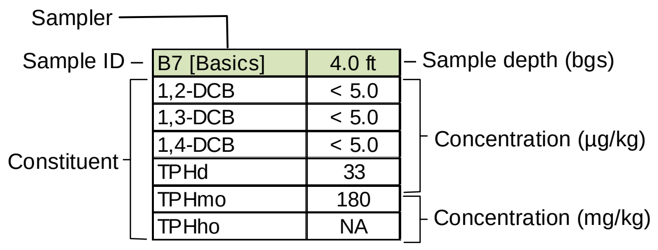
SB-32 [AMEC]	4.0 ft	9.0 ft	12.0 ft
1,2-DCB	< 4.5	< 3.9	< 3.9
1,3-DCB	< 4.5	< 3.9	< 3.9
1,4-DCB	< 4.5	< 3.9	< 3.9
TPHd	2.1	< 0.99	< 1.0
TPHmo	< 50	< 50	< 50
TPHho	< 50	< 50	< 50

FEPIT-EXS-6 [AMEC]	6.0 ft
1,2-DCB	**71,000**
1,3-DCB	**10,000**
1,4-DCB	**43,000**
TPHd	**1600 J**
TPHmo	**2300 J**
TPHho	NA

Explanation

●	AMEC soil and/or grab groundwater sample location (October 19-28, 2011)
●	AMEC soil and/or grab groundwater sample location (May 16-July 26, 2011)
●	AMEC soil and/or grab groundwater sample location (September 27-29, 2010)
●	Ninyo & Moore soil and/or grab groundwater sample location (December 16, 2010)
●	Basics Environmental soil and/or grab groundwater sample location (February 24-25, 2009)
☒	Sample collected from soil that was subsequently removed during excavation
☐	Approximate excavation boundary (2011)
▬ ▬ ▬	Approximate path of angled boring
- - - -	Interior building wall

Notes:
1. Analytes shown on this figure were detected in at least one soil sample above their ESLs. Results shown in **bold** exceed their respective ESLs.
2. Shading indicates that the sample was collected from soil that was subsequently removed during excavation.
3. The sample chromatographic patterns did not match the laboratory's standards for diesel and motor oil.
4. For clarity, borings not advanced adjacent to the 2011 excavation areas, or with samples not analyzed for target constituents, are not shown on this figure.

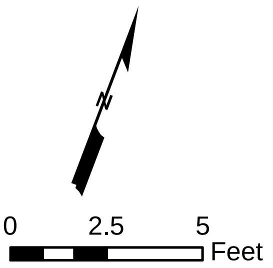


B7 [Basics]	4.0 ft
1,2-DCB	< 5.0
1,3-DCB	< 5.0
1,4-DCB	< 5.0
TPHd	33
TPHmo	180
TPHho	NA

Soil ESLs	
1,2-DCB	1,100
1,3-DCB	7,400
1,4-DCB	590
TPHd	83
TPHmo	370
TPHho	370

µg/kg
(mg/kg

Abbreviations:
1,2-DCB = 1,2-dichlorobenzene
1,3-DCB = 1,3-dichlorobenzene
1,4-DCB = 1,4-dichlorobenzene
Basics = Basics Environmental, Inc.
bgs = below ground surface
ESLs = Environmental Screening Levels
FEP = front end alignment pit
µg/kg = micrograms per kilogram
mg/kg = milligrams per kilogram
N&M = Ninyo & Moore
NA = not analyzed
< = not detected above the laboratory reporting limit shown
J = The analyte was positively identified, and the associated numerical value is the approximate concentration of the analyte in the sample
TPH = total petroleum hydrocarbons
TPHd = TPH quantified as diesel
TPHmo = TPH quantified as motor oil
TPHho = TPH quantified as hydraulic oil
VOCs = volatile organic compounds



TPH AND SELECTED VOCs IN SOIL
FRONT END ALIGNMENT PIT AREA
Crown Chevrolet Cadillac Isuzu
7544 Dublin Boulevard and 6707 Golden Gate Drive
Dublin, California

By: AWP	Date: 12/14/2012	Project No. OD10160070
amec		Figure 8

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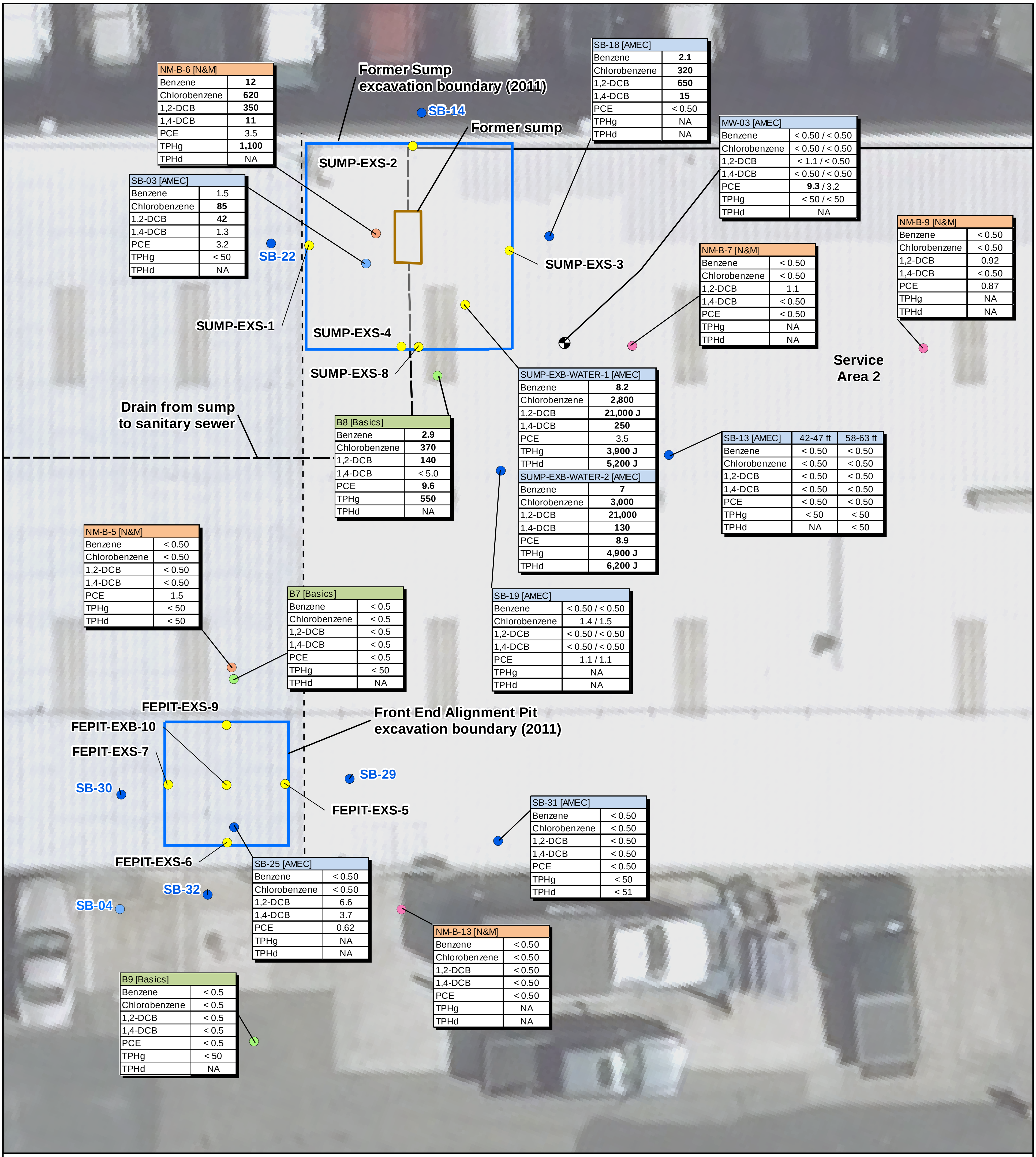


NM-B-6 [N&M]	
Benzene	**12**
Chlorobenzene	**620**
1,2-DCB	**350**
1,4-DCB	**11**
PCE	3.5
TPHg	**1,100**
TPHd	NA

SB-03 [AMEC]	
Benzene	1.5
Chlorobenzene	**85**
1,2-DCB	**42**
1,4-DCB	1.3
PCE	3.2
TPHg	< 50
TPHd	NA

SB-18 [AMEC]	
Benzene	**2.1**
Chlorobenzene	**320**
1,2-DCB	**650**
1,4-DCB	**15**
PCE	< 0.50
TPHg	NA
TPHd	NA

MW-03 [AMEC]	
Benzene	< 0.50 / < 0.50
Chlorobenzene	< 0.50 / < 0.50
1,2-DCB	< 1.1 / < 0.50
1,4-DCB	< 0.50 / < 0.50
PCE	**9.3** / 3.2
TPHg	< 50 / < 50
TPHd	NA

NM-B-9 [N&M]	
Benzene	< 0.50
Chlorobenzene	< 0.50
1,2-DCB	0.92
1,4-DCB	< 0.50
PCE	0.87
TPHg	NA
TPHd	NA

NM-B-7 [N&M]	
Benzene	< 0.50
Chlorobenzene	< 0.50
1,2-DCB	1.1
1,4-DCB	< 0.50
PCE	< 0.50
TPHg	NA
TPHd	NA

SUMP-EXB-WATER-1 [AMEC]	
Benzene	**8.2**
Chlorobenzene	**2,800**
1,2-DCB	**21,000 J**
1,4-DCB	**250**
PCE	3.5
TPHg	**3,900 J**
TPHd	**5,200 J**
SUMP-EXB-WATER-2 [AMEC]	
Benzene	**7**
Chlorobenzene	**3,000**
1,2-DCB	**21,000**
1,4-DCB	**130**
PCE	**8.9**
TPHg	**4,900 J**
TPHd	**6,200 J**

B8 [Basics]	
Benzene	**2.9**
Chlorobenzene	**370**
1,2-DCB	**140**
1,4-DCB	< 5.0
PCE	**9.6**
TPHg	**550**
TPHd	NA

SB-13 [AMEC]	42-47 ft	58-63 ft
Benzene	< 0.50	< 0.50
Chlorobenzene	< 0.50	< 0.50
1,2-DCB	< 0.50	< 0.50
1,4-DCB	< 0.50	< 0.50
PCE	< 0.50	< 0.50
TPHg	< 50	< 50
TPHd	NA	< 50

NM-B-5 [N&M]	
Benzene	< 0.50
Chlorobenzene	< 0.50
1,2-DCB	< 0.50
1,4-DCB	< 0.50
PCE	1.5
TPHg	< 50
TPHd	< 50

B7 [Basics]	
Benzene	< 0.5
Chlorobenzene	< 0.5
1,2-DCB	< 0.5
1,4-DCB	< 0.5
PCE	< 0.5
TPHg	< 50
TPHd	NA

SB-19 [AMEC]	
Benzene	< 0.50 / < 0.50
Chlorobenzene	1.4 / 1.5
1,2-DCB	< 0.50 / < 0.50
1,4-DCB	< 0.50 / < 0.50
PCE	1.1 / 1.1
TPHg	NA
TPHd	NA

SB-31 [AMEC]	
Benzene	< 0.50
Chlorobenzene	< 0.50
1,2-DCB	< 0.50
1,4-DCB	< 0.50
PCE	< 0.50
TPHg	< 50
TPHd	< 51

SB-25 [AMEC]	
Benzene	< 0.50
Chlorobenzene	< 0.50
1,2-DCB	6.6
1,4-DCB	3.7
PCE	0.62
TPHg	NA
TPHd	NA

NM-B-13 [N&M]	
Benzene	< 0.50
Chlorobenzene	< 0.50
1,2-DCB	< 0.50
1,4-DCB	< 0.50
PCE	< 0.50
TPHg	NA
TPHd	NA

B9 [Basics]	
Benzene	< 0.5
Chlorobenzene	< 0.5
1,2-DCB	< 0.5
1,4-DCB	< 0.5
PCE	< 0.5
TPHg	< 50
TPHd	NA

Explanation

◕	AMEC shallow monitoring well location (installed August 2012)
●	AMEC grab groundwater sample location (October 19-28, 2011)
●	AMEC grab groundwater sample location (May 16-July 26, 2011)
●	AMEC grab groundwater sample location (September 27-29, 2010)
●	Ninyo & Moore grab groundwater sample location (August 10-12, 2011)
●	Ninyo & Moore grab groundwater sample location (December 16, 2010)
●	Basics Environmental soil and/or grab groundwater sample location (February 24-25, 2009)
▭	Approximate excavation boundary (2011)
- - - -	Interior building wall
———	Approximate location of above-ground drain line
— — —	Approximate location of below-ground drain line

Notes:

1. Analytes shown on this figure were detected in at least one sample above their respective ESLs in this portion of the site. Results shown in **bold** exceed their respective ESLs. Although 1,2,4-trichlorobenzene was detected in the two sump excavation water samples (SUMP-EXB-WATER-1 and -2) above the ESL, this constituent was not detected in any other sample and these results are not presented here.
2. Reported TPHd results for samples collected by AMEC are from groundwater samples that were filtered prior to analysis.
3. Reported TPHd results for samples collected by Ninyo & Moore are from groundwater samples that were not filtered prior to analysis.
4. Duplicate samples were analyzed for SUMP-EXB-WATER-1 and SUMP-EXB-WATER-2. The highest detected concentration is reported in the data box.
5. Samples were collected from first-encountered groundwater unless a depth (in feet below ground surface) is indicated.
6. For clarity, borings not advanced adjacent to the 2011 excavation areas, or with samples not analyzed for target constituents, are not shown on this figure.

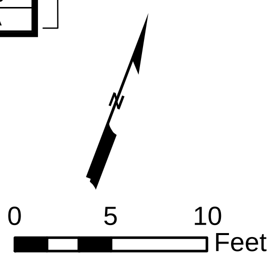
Abbreviations:

1,2-DCB = 1,2-dichlorobenzene
1,4-DCB = 1,4-dichlorobenzene
Basics = Basics Environmental, Inc.
ESLs = Environmental Screening Levels
FEPIT = front end alignment pit
µg/L = micrograms per liter
N&M = Ninyo & Moore
NA = not analyzed
< = not detected above the laboratoryreporting limit shown
PCE = tetrachloroethene
TPH = total petroleum hydrocarbons
TPHg = TPH quantified as diesel
TPHd = TPH quantified as gasoline
J = The analyte was positively identified, and the associated numerical value is the approximate concentration of the analyte in the sample
VOCs = volatile organic compounds

Sampler
Sample ID –
Constituent
Concentration (µg/L)

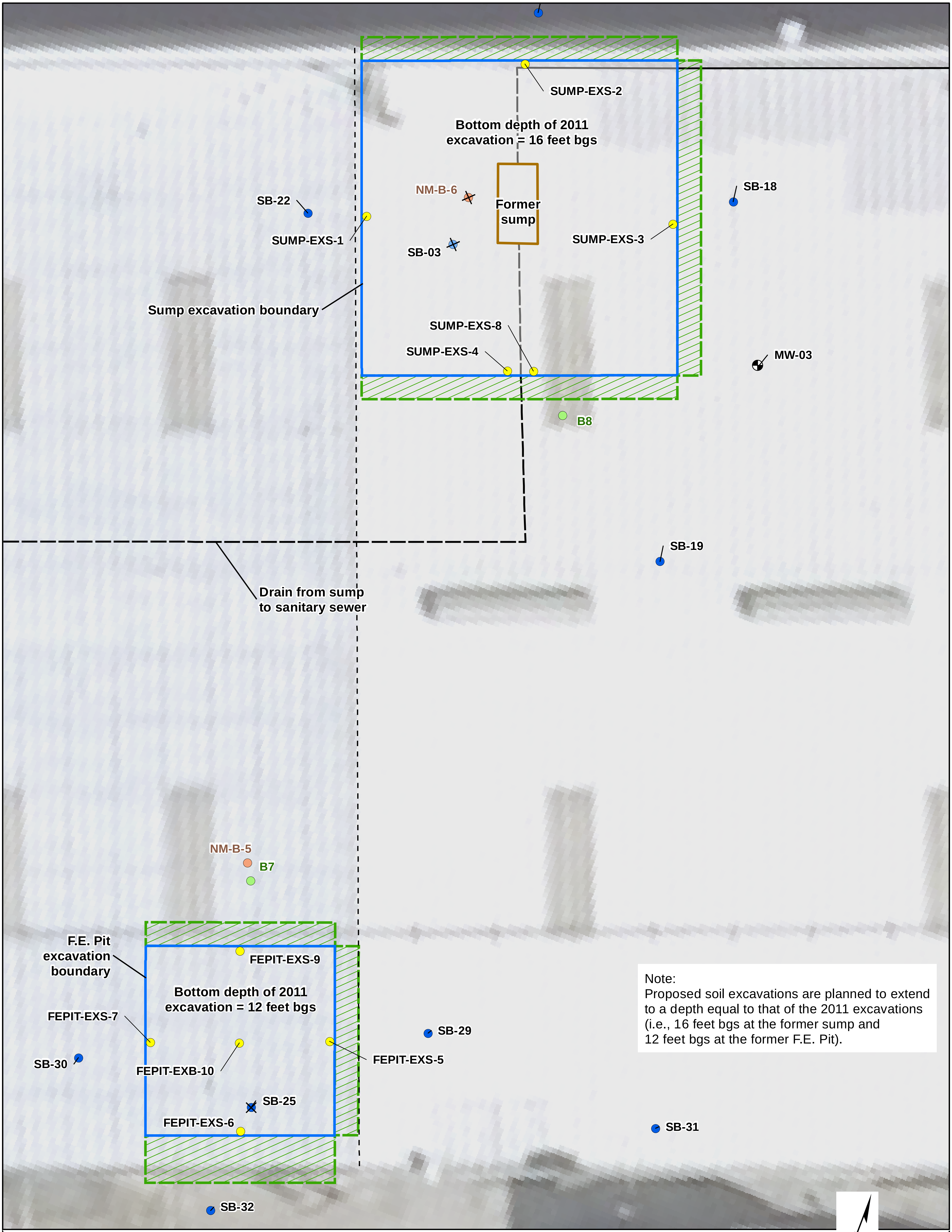
B8 [Basics]	
Benzene	**2.9**
Chlorobenzene	**370**
1,2-DCB	**140**
1,4-DCB	< 5.0
PCE	**9.6**
TPHg	**550**
TPHd	NA

Drinking Water ESLs (µg/L)	
Benzene	1.0
Chlorobenzene	25
1,2-DCB	10
1,4-DCB	5.0
PCE	5.0
TPHg	100
TPHd	100



TPH AND SELECTED VOCs IN GROUNDWATER
FORMER SUMP AND
FRONT END ALIGNMENT PIT AREAS
Crown Chevrolet Cadillac Isuzu
7544 Dublin Boulevard and 6707 Golden Gate Drive
Dublin, California

By: AWP	Date: 12/14/2012	Project No. OD10160070
amec		Figure 9



Note:
Proposed soil excavations are planned to extend to a depth equal to that of the 2011 excavations (i.e., 16 feet bgs at the former sump and 12 feet bgs at the former F.E. Pit).

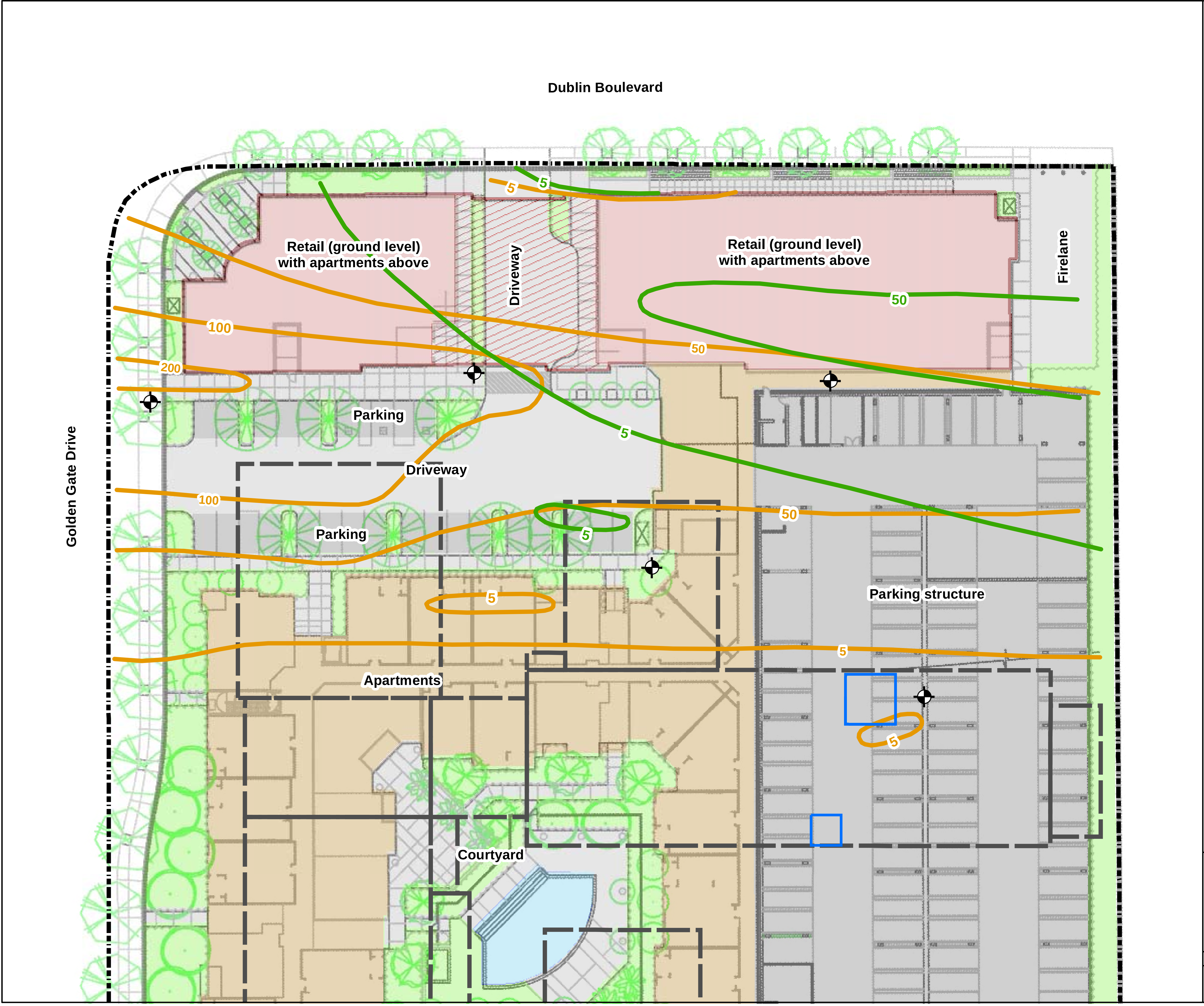
Explanation

- ◐ AMEC shallow monitoring well location (installed August 2012)
- 🟡 AMEC soil and/or grab groundwater sample location (October 19-28, 2011)
- 🔵 AMEC soil and/or grab groundwater sample location (May 16-July 26, 2011)
- ● AMEC soil and/or grab groundwater sample location (September 27-29, 2010)
- 🟠 Ninyo & Moore soil and/or grab groundwater sample location (December 16, 2010)
- 🟢 Basics Environmental soil and/or grab groundwater sample location (February 24-25, 2009)
- ✕ Sample collected from soil that was subsequently removed during excavation
- ▨ Proposed soil excavation area
- ☐ Approximate excavation boundary (2011)
- - - - - Interior building wall
- ——— Approximate location of above-ground drain line
- — — Approximate location of below-ground drain line

Note:
For clarity, borings not advanced adjacent to the 2011 excavation areas, or with samples not analyzed for target constituents, are not shown on this figure.

PROPOSED SOIL EXCAVATION AREAS
Crown Chevrolet Cadillac Isuzu
7544 Dublin Boulevard and 6707 Golden Gate Drive
Dublin, California

By: AWP	Date: 12/14/2012	Project No.	OD10160070
amec		Figure	10



Explanation

⌖ Proposed shallow groundwater monitoring well location

┈ Approximate redevelopment property line

▭ Proposed buildings

—50— Approximate line of equal PCE concentration (µg/L)

—50— Approximate line of equal TCE concentration (µg/L)

-·-·- Approximate existing property line

▭ Existing buildings

▭ Approximate excavation boundary (October 2011)

Abbreviations:
PCE = tetrachloroethene
TCE = trichloroethene
µg/L = micrograms per liter

0 40
APPROXIMATE SCALE IN FEET

Source: Proposed development plans provided by Architects Orange, of Orange, California, on October 19, 2012.

PROPOSED GROUNDWATER MONITORING
WELL LOCATIONS
Crown Chevrolet Cadillac Isuzu
7544 Dublin Boulevard and 6707 Golden Gate Drive
Dublin, California

By: AWP	Date: 12/14/2012	Project No.	OD10160070
amec		Figure	11

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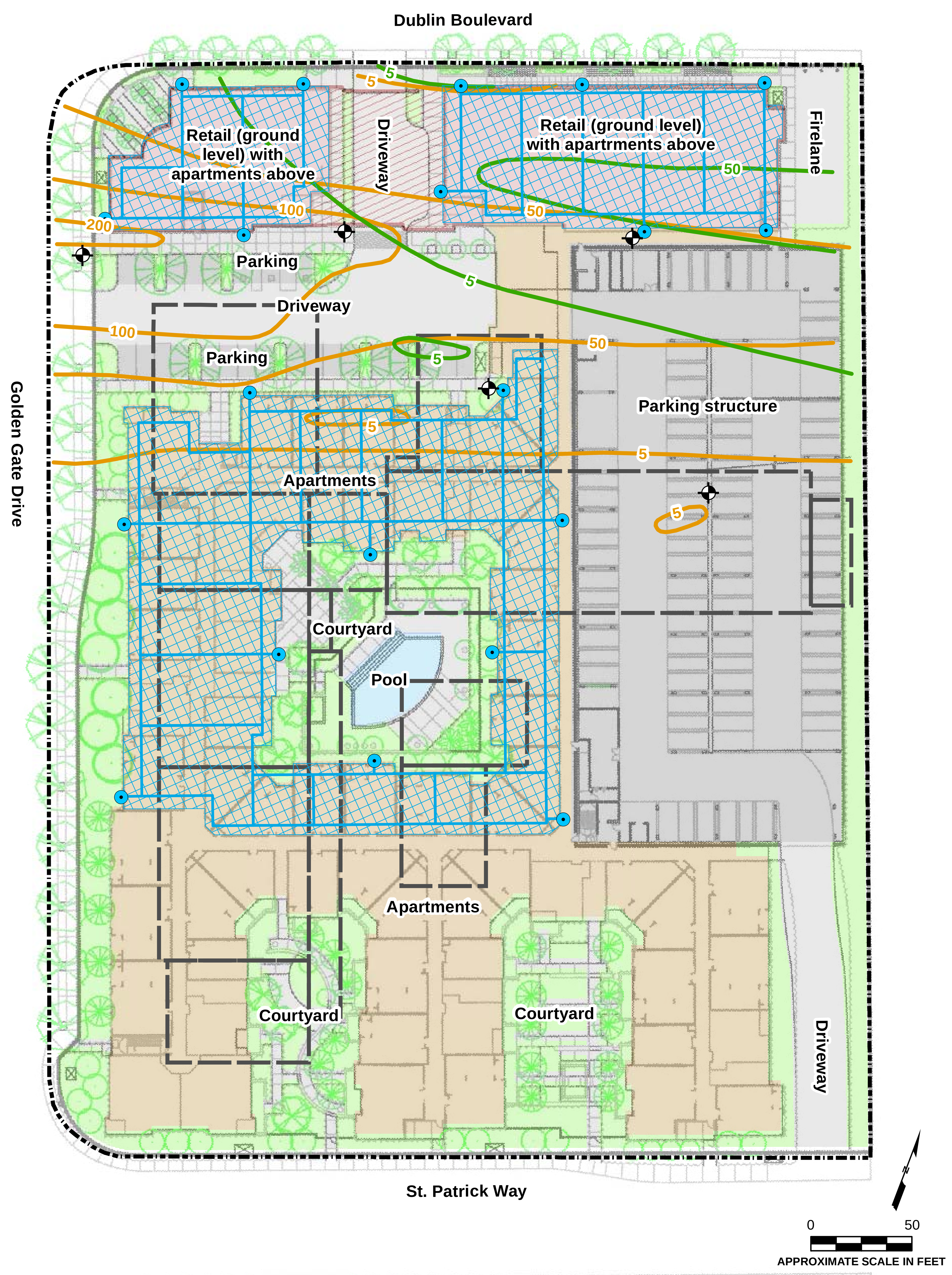


Explanation

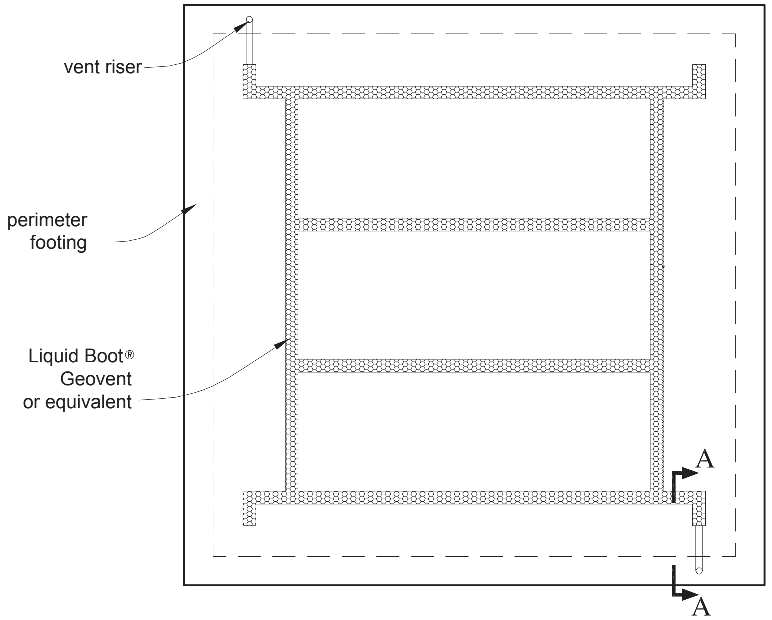
- ▨ Proposed soil vapor barrier
- ● Proposed riser location
- ☐ Proposed SSD system layout
- ⌖ Proposed shallow groundwater monitoring well location
- — Approximate redevelopment property line
- ☐ Proposed buildings
- —50— Approximate line of equal PCE concentration (µg/L)
- —50— Approximate line of equal TCE concentration (µg/L)
- —·— Approximate existing property line
- ☐ Existing buildings

Abbreviations:
PCE = tetrachloroethene
TCE = trichloroethene
SSD = sub-slab depressurization
µg/L = micrograms per liter

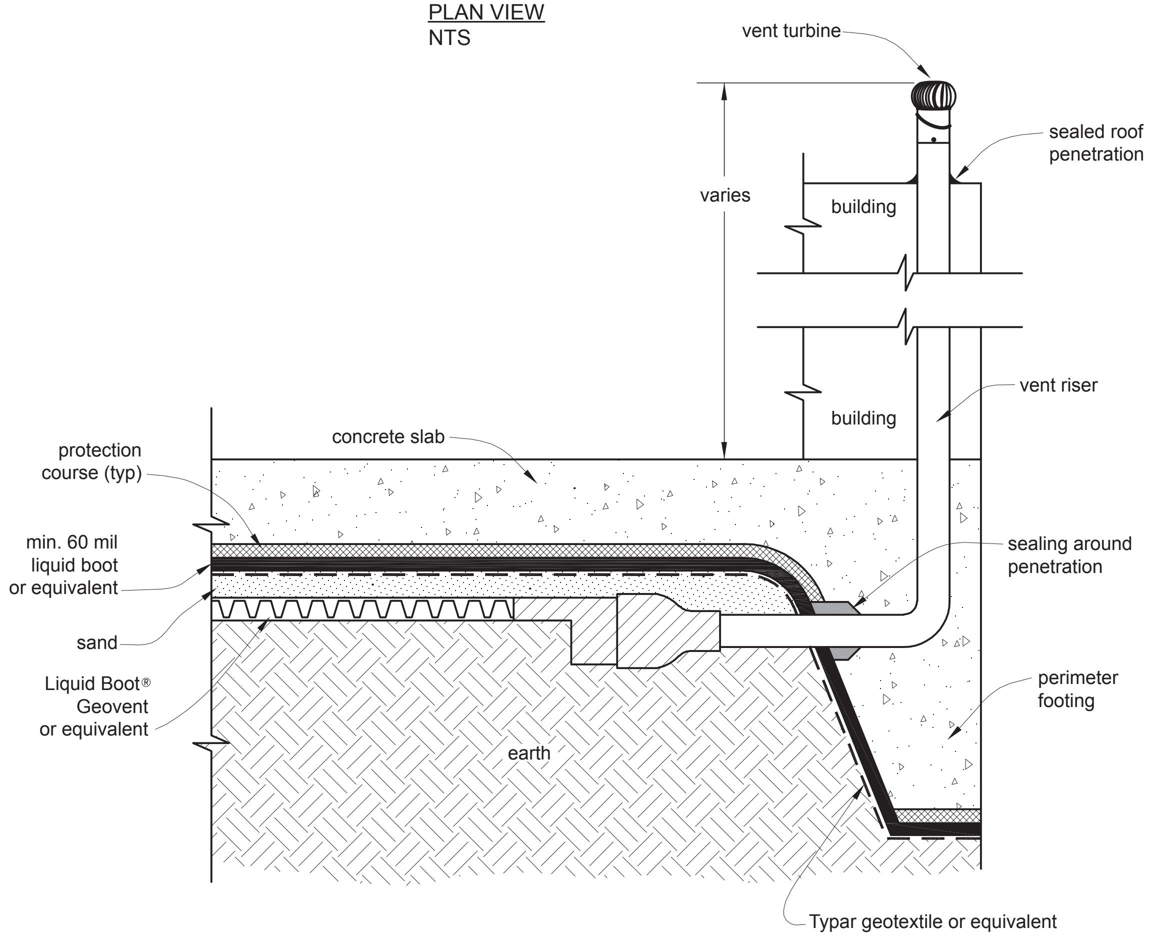
Source: Proposed development plans provided by Architects Orange, of Orange, California, on October 19, 2012.

PROPOSED VAPOR BARRIER
AND SSD LOCATIONS
Crown Chevrolet Cadillac Isuzu
7544 Dublin Boulevard and 6707 Golden Gate Drive
Dublin, California

By: AWP	Date: 12/14/2012	Project No. OD10160070
amec		Figure 12a

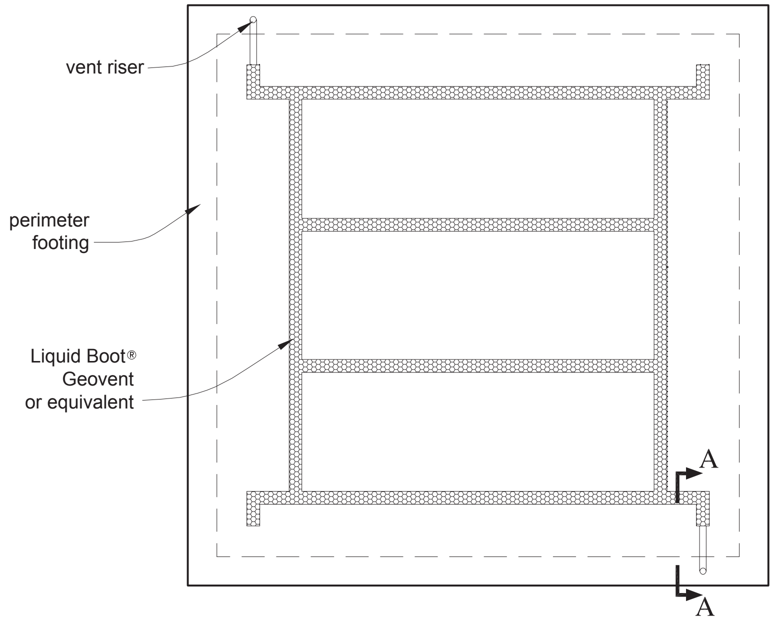


PLAN VIEW
NTS

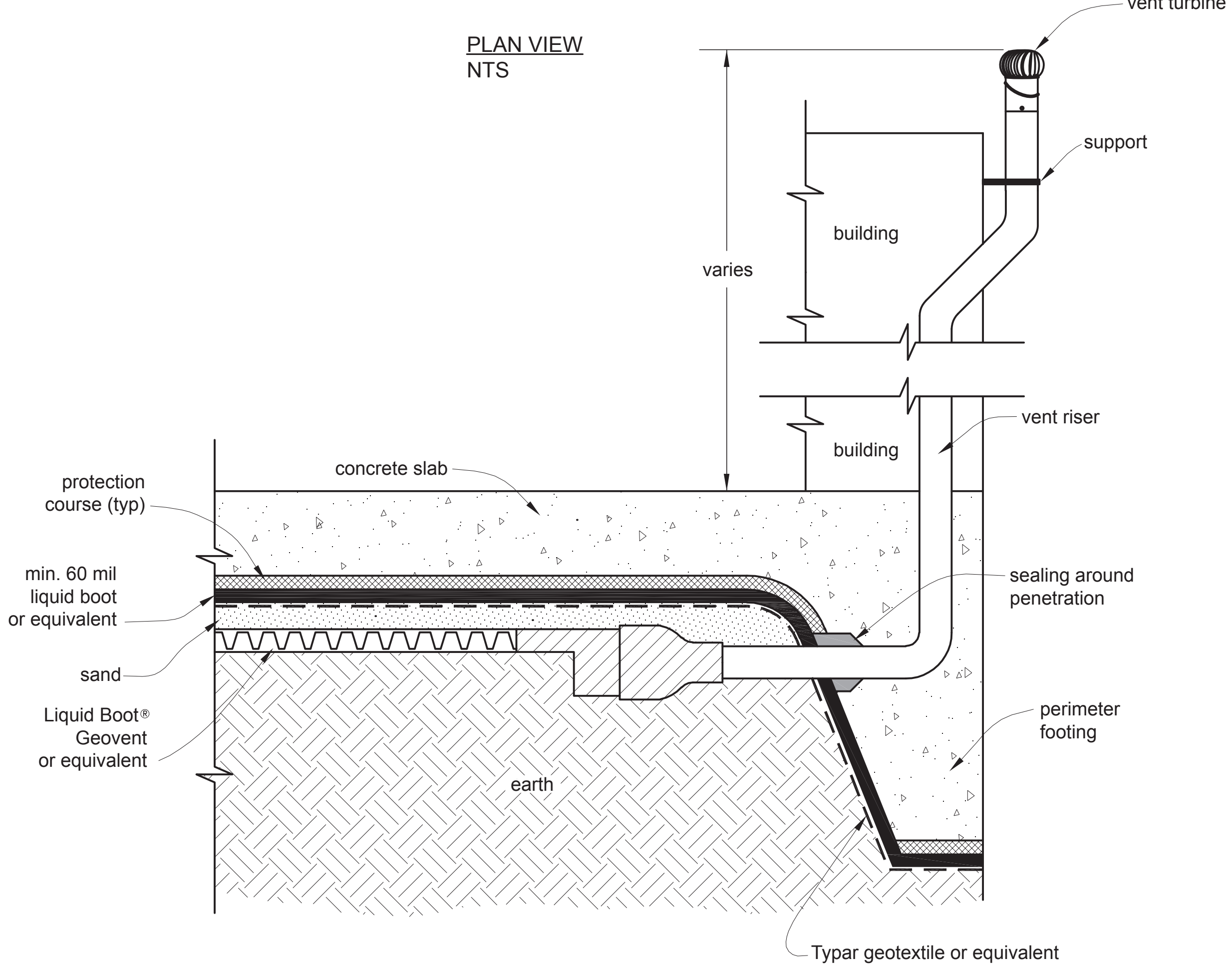


SECTION A-A'
NTS

VERTICAL VENT OPTION



PLAN VIEW
NTS



SECTION A-A'
NTS

ANGLED VENT OPTION

Abbreviations:
NTS = not to scale
SSD = sub-slab depressurization system

CONCEPTUAL VAPOR BARRIER AND
SDD COMPONENTS
Crown Chevrolet Cadillac Isuzu
7544 Dublin Boulevard and 6707 Golden Gate Drive
Dublin, California

By: AA
Date: 12/14/2012
Project No. OD10160070
amec
Figure **12b**

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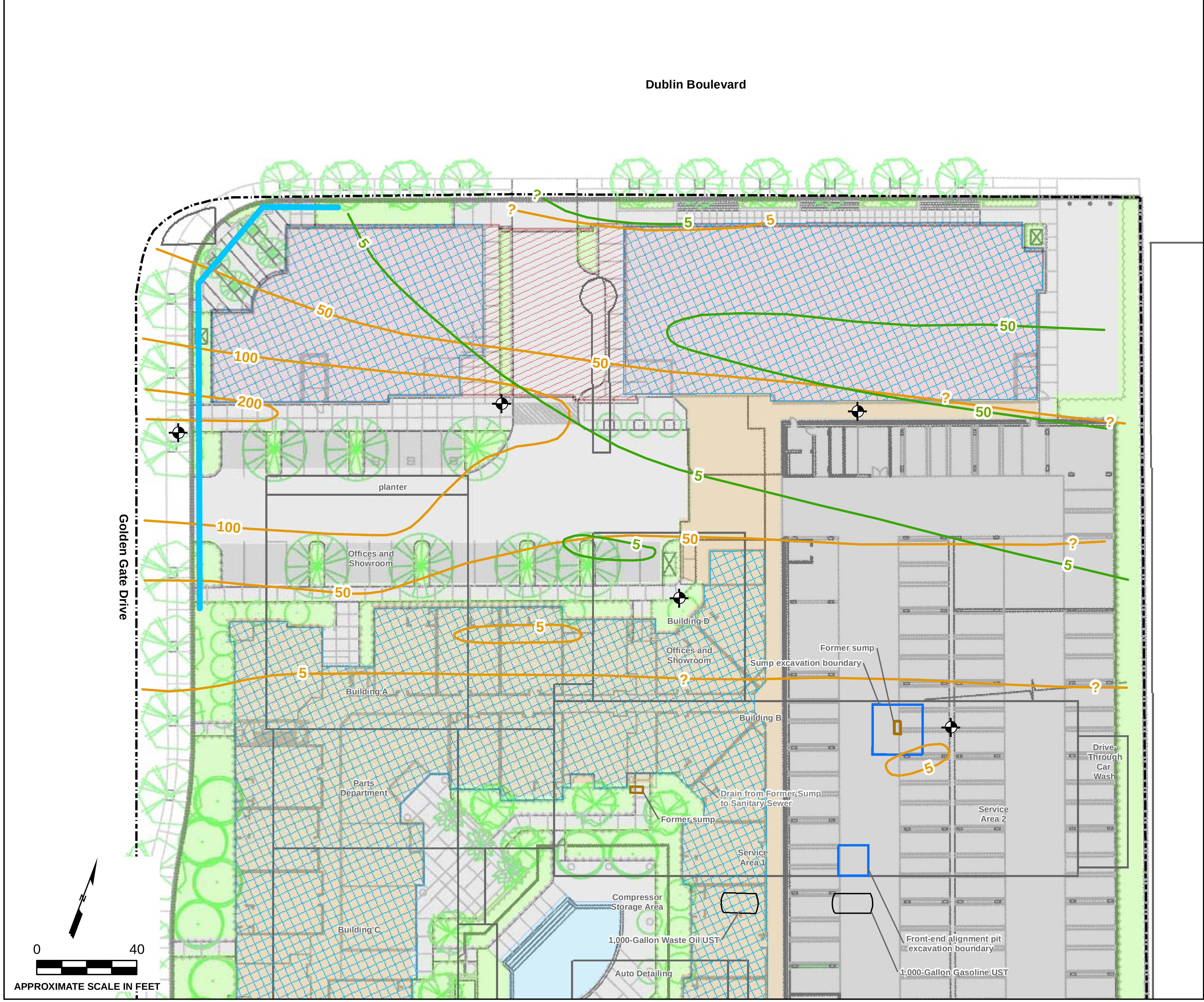

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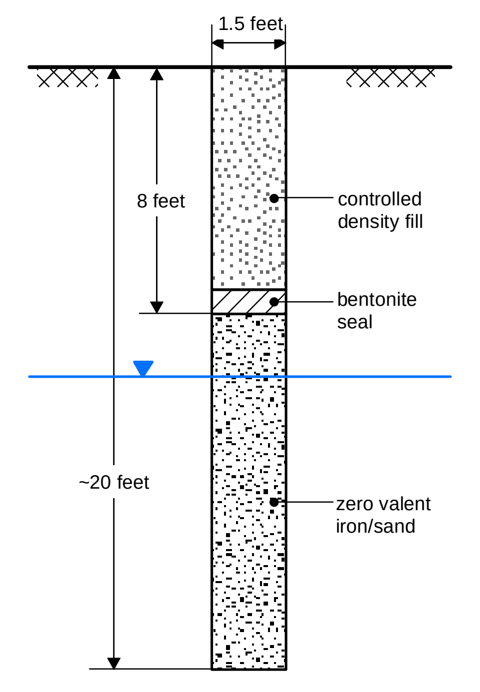


Conceptual permeable reactive barrier cross section (not to scale)

Explanation

▬	Proposed location of permeable reactive barrier
▨	Proposed soil vapor barrier
—50—	Approximate line of equal PCE concentration
—50—	Approximate line of equal TCE concentration
⌖	Proposed shallow groundwater monitoring well location
☐	Approximate excavation boundary (October 2011)
—·—·—	Approximate existing property line
——	Approximate redevelopment property line
▬	Approximate sump location

Drinking Water ESLs (µg/L)	
PCE	5.0
TCE	5.0

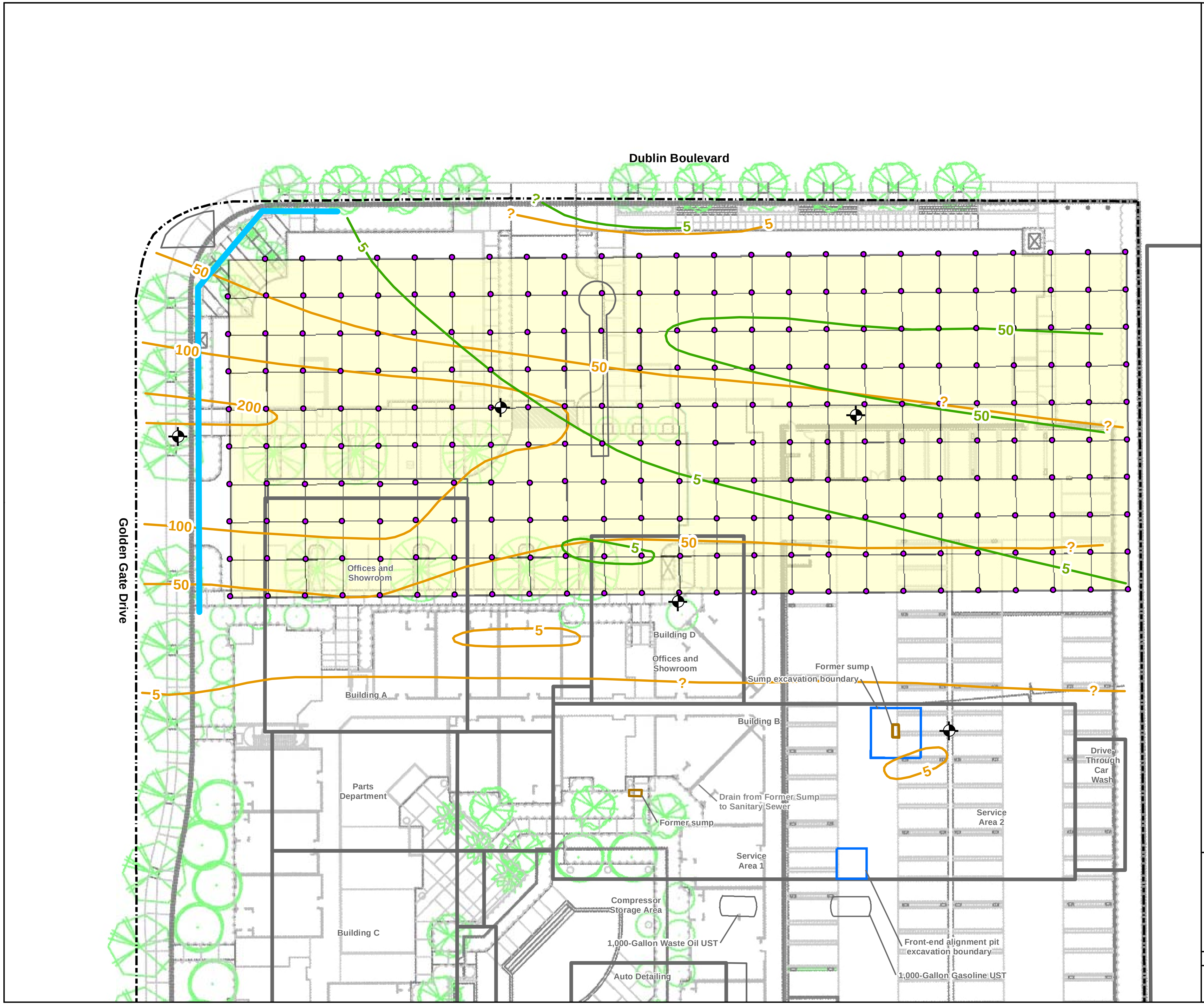
Abbreviations:
ESL = environmental screening level
PCE = tetrachloroethene
TCE = trichloroethene
UST = underground storage tank
µg/L = micrograms per liter

Source: Proposed development plans provided by Architects Orange, of Orange, California, on October 19, 2012.

CONCEPTUAL PERMEABLE REACTIVE BARRIER LOCATION

Crown Chevrolet Cadillac Isuzu
7544 Dublin Boulevard and 6707 Golden Gate Drive
Dublin, California

By: AWP	Date: 12/14/2012	Project No. OD10160070
amec		Figure 13



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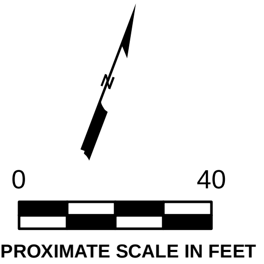

Explanation

● Proposed bioremediation injection location

⌖ Proposed shallow groundwater monitoring well location

▬ Proposed location of permeable reactive barrier

—50— Approximate line of equal PCE concentration

—50— Approximate line of equal TCE concentration

☐ Approximate excavation boundary (October 2011)

-·-·- Approximate property line

▭ Approximate sump location

Drinking Water ESLs (µg/L)	
PCE	5.0
TCE	5.0

Abbreviations:
ESL = environmental screening level
PCE = tetrachloroethene
TCE = trichloroethene
UST = underground storage tank
µg/L = micrograms per liter

Source: Proposed development plans provided by Architects Orange, of Orange, California, on October 19, 2012.

CONCEPTUAL BIOREMEDIATION INJECTION LOCATIONS

Crown Chevrolet Cadillac Isuzu
7544 Dublin Boulevard and 6707 Golden Gate Drive
Dublin, California

By: AWP	Date: 12/14/2012	Project No. OD10160070
amec		Figure 14

APPENDIX A

Bioremediation Assessment Data

FIELD FORMS

AMEC Geomatrix

WELL SAMPLING RECORD

Well ID: MP-01
Sample ID: MP01-12
Duplicate ID:
Project and Task No.: ~~0014860012.08S.GC &~~
~~0014860012.02V.GC~~ 0D10160070.00006
Project Name: ~~NEW~~ Crown Chevrolet
Date: 10/26/12
Method of Purging: Low flow with peristaltic pump
Method of Sampling: Peristaltic pump

Initial Depth to Water: 13.74
Depth to Water after Sampling:
Total Depth to Well:
Well Diameter: CMT-1
Intake/Sample Depth: 17.5
Total Volume Removed:
Sampled By: RDP

Time	Rate (mL/min)	Temp. (°C)	pH (units)	Specific Electrical Conductance (µS/cm)	Water Level (btoc)	ORP	DO	Remarks (color, turbidity, and sediment)
1530	100	22.36	7.12	1601	-	-145.2	4.18	clear
1135	"	22.29	6.74	1606		-132.4	1.35	"
1140	60	22.10	6.64	15,84		-126.5	0.58	"
1145	"	21.89	6.65	1537		-114.4	0.44	"
1150	"	21.75	6.66	1487		-111.3	0.37	
1155	"	21.73	6.68	1449		-118.3	0.31	
1200	"	21.71	6.71	1434		-114.0	0.30	
1210	"	21.82	6.77	1421		-112.9	0.22	
1215		21.79	6.77	1416		-103.1	0.22	
1220		21.79	6.77	1414		-104.7	0.21	
		sample						

pH CALIBRATION (choose two)				
Buffer Solution	pH 4.0	pH 7.0	pH 10.0	
Temperature C				
Instrument Reading				

Model or Unit No.:

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION			
KCL Solution (µS/cm=µmhos/cm)			
Temperature C			
Instrument Reading			

Model or Unit No.:

Notes:

Equipment blank sample taken *PRIOR* to purging & well sample: YES__ NO__

1/4-inch disposable tubing with intake at mid screen level weighted with deconed (alconox and clean water rinse) weight at the end of tubing attached with silicon tape: YES__

YSI with flow through cell used to measure water parameters until stable: YES__

Low flow method (flow rate less than 500mL/min and drawdown does not exceed 1 foot below initial): YES__

AMEC Geomatrix

WELL SAMPLING RECORD

Well ID: MW-02

Sample ID: MW02-102612

Duplicate ID:

Project and Task No.: ~~0014860012.02S.00 0~~ ~~0014860012.02V.CC~~ 0D10160070.00006

Project Name: ~~NEW~~ Crown Chevrolet

Date: 10/26/12

Method of Purging: Low flow with peristaltic pump

Method of Sampling: Peristaltic pump

Initial Depth to Water: 11.04

Depth to Water after Sampling: 11.04

Total Depth to Well:

Well Diameter: 3/4" pre-pack

Intake/Sample Depth: 17.5

Total Volume Removed: 6 1/2 liters

Sampled By: RDP

Time	Rate (mL/min)	Temp. (°C)	pH (units)	Specific Electrical Conductance (μS/cm)	Water Level (btoc)	ORP	DO	Remarks (color, turbidity, and sediment)
0950	120	21.84	7.11	816	11.61	51.4	1.1	clear
0955	"	21.90	7.13	788	"	41.6	0.69	"
1000	"	21.92	7.12	776	"	25.4	0.41	"
1005	160	21.97	7.11	766	11.89	11.3	0.29	"
1010	175	21.99	7.11	764	11.90	8.5	0.37	"
1015	"	21.96	7.11	759	"	-69.5	0.23	"
1020	"	21.98	7.10	757	"	-49.8	0.23	"
1025	"	21.98	7.10	756	"	-49.6	0.23	
	sample							

pH CALIBRATION (choose two)

Buffer Solution	**pH 4.0**	**pH 7.0**	**pH 10.0**	
Temperature C				
Instrument Reading				

Model or Unit No.:

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION

KCL Solution (μS/cm=μmhos/cm)			
Temperature C			
Instrument Reading			

Model or Unit No.:

Notes:

Equipment blank sample taken *PRIOR* to purging & well sample: YES__ NO__

1/4-inch disposable tubing with intake at mid screen level weighted with deconed (alconox and clean water rinse) weight at the end of tubing attached with silicon tape: YES__

YSI with flow through cell used to measure water parameters until stable: YES__

Low flow method (flow rate less than 500mL/min and drawdown does not exceed 1 foot below initial): YES__

LABORATORY ANALYTICAL REPORTS

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TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

ANALYTICAL REPORT

TestAmerica Laboratories, Inc.
TestAmerica Pleasanton
1220 Quarry Lane
Pleasanton, CA 94566
Tel: (925)484-1919

TestAmerica Job ID: 720-45596-1
Client Project/Site: Crown Chevrolet

For:
AMEC Environment & Infrastructure, Inc.
2101 Webster Street, 12th Floor
Oakland, California 94612

Attn: Avery Patton

Onieka Howard

Authorized for release by:
11/2/2012 4:53:08 PM
Onieka Howard
Project Manager I
onieka.howard@testamericainc.com

Designee for

Afsaneh Salimpour
Project Manager I
afsaneh.salimpour@testamericainc.com

This report has been electronically signed and authorized by the signatory. Electronic signature is intended to be the legally binding equivalent of a traditionally handwritten signature.

Results relate only to the items tested and the sample(s) as received by the laboratory.

Table of Contents

Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
☼	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CNF	Contains no Free Liquid
DL, RA, RE, IN	Indicates a Dilution, Reanalysis, Re-extraction, or additional Initial metals/anion analysis of the sample
EDL	Estimated Detection Limit
EPA	United States Environmental Protection Agency
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
ND	Not detected at the reporting limit (or MDL or EDL if shown)
PQL	Practical Quantitation Limit
QC	Quality Control
RL	Reporting Limit
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)

Case Narrative

Job ID: 720-45596-1

Laboratory: TestAmerica Pleasanton

Narrative

Job Narrative
720-45596-1

Comments
No additional comments.

Receipt
The samples were received on 10/26/2012 2:47 PM; the samples arrived in good condition, properly preserved and, where required, on ice. The temperature of the cooler at receipt was 5.7º C.

Except:

The container label for the following sample(s) did not match the information listed on the Chain-of-Custody (COC):MW02-10261. The container labels list MW01-102612. The COC lists MW02-102612.

General Chemistry
No analytical or quality issues were noted.

Detection Summary

Client: AMEC Environment & Infrastructure, Inc.
Project/Site: Crown Chevrolet

TestAmerica Job ID: 720-45596-1

Client Sample ID: MW02-102612

Lab Sample ID: 720-45596-1

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Sulfate	42		10		mg/L	10		300.0	Total/NA

Client Sample ID: MP01-1-102612

Lab Sample ID: 720-45596-2

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Nitrate as NO3	10		1.0		mg/L	1		300.0	Total/NA
Sulfate	71		10		mg/L	10		300.0	Total/NA

General Chemistry

Client Sample ID: MW02-102612
Date Collected: 10/26/12 10:25
Date Received: 10/26/12 14:47
Lab Sample ID: 720-45596-1
Matrix: Water

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Nitrate as NO3	ND		1.0		mg/L			10/26/12 18:38	1
Sulfate	**42**		10		mg/L			10/26/12 18:56	10

Client Sample ID: MP01-1-102612
Date Collected: 10/26/12 12:20
Date Received: 10/26/12 14:47
Lab Sample ID: 720-45596-2
Matrix: Water

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Nitrate as NO3	**10**		1.0		mg/L			10/26/12 19:13	1
Sulfate	**71**		10		mg/L			10/26/12 19:30	10

QC Sample Results

Client: AMEC Environment & Infrastructure, Inc.
Project/Site: Crown Chevrolet

TestAmerica Job ID: 720-45596-1

Method: 300.0 - Anions, Ion Chromatography

Lab Sample ID: MB 720-124087/4
Matrix: Water
Analysis Batch: 124087

Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Sulfate	ND		1.0		mg/L			10/26/12 18:04	1

Lab Sample ID: LCS 720-124087/5
Matrix: Water
Analysis Batch: 124087

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Sulfate	10.0	9.75		mg/L		98	90 - 110

Lab Sample ID: 720-45596-A-2 MS
Matrix: Water
Analysis Batch: 124087

Client Sample ID: MP01-1-102612
Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
Sulfate	71		100	170		mg/L		99	80 - 120

Lab Sample ID: 720-45596-A-2 MSD
Matrix: Water
Analysis Batch: 124087

Client Sample ID: MP01-1-102612
Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Sulfate	71		100	170		mg/L		99	80 - 120	0	20

Lab Sample ID: MB 720-124088/4
Matrix: Water
Analysis Batch: 124088

Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Nitrate as NO3	ND		1.0		mg/L			10/26/12 18:04	1

Lab Sample ID: LCS 720-124088/5
Matrix: Water
Analysis Batch: 124088

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Nitrate as NO3	10.0	10.1		mg/L		101	90 - 110

Lab Sample ID: 720-45596-A-2 MS
Matrix: Water
Analysis Batch: 124088

Client Sample ID: 720-45596-A-2 MS
Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
Nitrate as NO3	ND		100	112		mg/L		102	80 - 120

Lab Sample ID: 720-45596-A-2 MSD
Matrix: Water
Analysis Batch: 124088

Client Sample ID: 720-45596-A-2 MSD
Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Nitrate as NO3	ND		100	112		mg/L		102	80 - 120	0	20

General Chemistry

Analysis Batch: 124087

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
720-45596-1	MW02-102612	Total/NA	Water	300.0	
720-45596-2	MP01-1-102612	Total/NA	Water	300.0	
720-45596-A-2 MS	MP01-1-102612	Total/NA	Water	300.0	
720-45596-A-2 MSD	MP01-1-102612	Total/NA	Water	300.0	
LCS 720-124087/5	Lab Control Sample	Total/NA	Water	300.0	
MB 720-124087/4	Method Blank	Total/NA	Water	300.0	

Analysis Batch: 124088

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
720-45596-1	MW02-102612	Total/NA	Water	300.0	
720-45596-2	MP01-1-102612	Total/NA	Water	300.0	
720-45596-A-2 MS	720-45596-A-2 MS	Total/NA	Water	300.0	
720-45596-A-2 MSD	720-45596-A-2 MSD	Total/NA	Water	300.0	
LCS 720-124088/5	Lab Control Sample	Total/NA	Water	300.0	
MB 720-124088/4	Method Blank	Total/NA	Water	300.0	

Lab Chronicle

Client Sample ID: MW02-102612

Lab Sample ID: 720-45596-1

Date Collected: 10/26/12 10:25

Matrix: Water

Date Received: 10/26/12 14:47

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	300.0		10	124087	10/26/12 18:56	MJK	TAL SF
Total/NA	Analysis	300.0		1	124088	10/26/12 18:38	MJK	TAL SF

Client Sample ID: MP01-1-102612

Lab Sample ID: 720-45596-2

Date Collected: 10/26/12 12:20

Matrix: Water

Date Received: 10/26/12 14:47

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	300.0		10	124087	10/26/12 19:30	MJK	TAL SF
Total/NA	Analysis	300.0		1	124088	10/26/12 19:13	MJK	TAL SF

Laboratory References:

TAL SF = TestAmerica Pleasanton, 1220 Quarry Lane, Pleasanton, CA 94566, TEL (925)484-1919

Certification Summary

Client: AMEC Environment & Infrastructure, Inc. TestAmerica Job ID: 720-45596-1
Project/Site: Crown Chevrolet

Laboratory: TestAmerica Pleasanton

All certifications held by this laboratory are listed. Not all certifications are applicable to this report.

Authority	Program	EPA Region	Certification ID	Expiration Date
California	State Program	9	2496	01-31-14

Method Summary

Method	Method Description	Protocol	Laboratory
300.0	Anions, Ion Chromatography	MCAWW	TAL SF

Protocol References:

MCAWW = "Methods For Chemical Analysis Of Water And Wastes", EPA-600/4-79-020, March 1983 And Subsequent Revisions.

Laboratory References:

TAL SF = TestAmerica Pleasanton, 1220 Quarry Lane, Pleasanton, CA 94566, TEL (925)484-1919

Sample Summary

Client: AMEC Environment & Infrastructure, Inc.
Project/Site: Crown Chevrolet

TestAmerica Job ID: 720-45596-1

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
720-45596-1	MW02-102612	Water	10/26/12 10:25	10/26/12 14:47
720-45596-2	MP01-1-102612	Water	10/26/12 12:20	10/26/12 14:47

CHAIN-OF-CUSTODY RECORD

720-45596

OAK 17605

PROJECT NAME: Crown Chevrolet

DATE: 10·26·12 PAGE 1 OF 1

PROJECT NUMBER: OD1016070.6006

LABORATORY NAME: Test America

CLIENT INFORMATION:

REPORTING REQUIREMENTS: 141877

RESULTS TO: Avery Patton

LABORATORY ADDRESS:

TURNAROUND TIME: Standard

SAMPLE SHIPMENT METHOD: hand

LABORATORY CONTACT:

LABORATORY PHONE NUMBER:

GEOTRACKER REQUIRED YES [✓ NO]

SITE SPECIFIC GLOBAL ID NO.

SAMPLERS (SIGNATURE): RDavid Pearson

ANALYSES

DATE	TIME	SAMPLE NUMBER	* Sulfate	* Nitrate	CONTAINER TYPE AND SIZE	Soil (S), Water (W), Vapor (V), or Other (O)	Filtered	Preservative Type	Cooled	MS/MSD	No. of Containers	ADDITIONAL COMMENTS
10-26-12	1025	MW02-102612	X	X		W		–	X		1	
I	1220	MP01-1-102612	X	X		W		–	X		1	

RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME
SIGNATURE: RDavid Pearson PRINTED NAME: RDavid Pearson COMPANY: Amec	10/26/12	1447	SIGNATURE: John Mullen PRINTED NAME: Mullen COMPANY: ~~[illegible]~~ Amin	10/26/12	1447
SIGNATURE: PRINTED NAME: COMPANY:			SIGNATURE: PRINTED NAME: COMPANY:		
SIGNATURE: PRINTED NAME: COMPANY:			SIGNATURE: PRINTED NAME: COMPANY:		

TOTAL NUMBER OF CONTAINERS: 2

SAMPLING COMMENTS: * by EPA 300.0

5.7°c

2101 Webster Street, 12th Floor
Oakland, California 94612-3066
Tel 510.663.4100 Fax 510.663.4141

amec

Login Sample Receipt Checklist

Client: AMEC Environment & Infrastructure, Inc.

Job Number: 720-45596-1

Login Number: 45596

List Source: TestAmerica Pleasanton

List Number: 1

Creator: Apostol, Anita

Question	Answer	Comment
Radioactivity wasn't checked or is </= background as measured by a survey meter.	N/A	
The cooler's custody seal, if present, is intact.	N/A	
Sample custody seals, if present, are intact.	N/A	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	True	
There are no discrepancies between the containers received and the COC.	False	
Samples are received within Holding Time.	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	N/A	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is <6mm (1/4").	True	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	

SiREM
Leading Science · Lasting Solutions

130 Research Lane, Ste 2
Guelph ON N1G 5G3
(519) 822-2265

Certificate of Analysis: Gene-Trac® *Dehalococcoides* Assay

Customer: Avery Patton, AMEC

Project: Crown Chevrolet

Customer Reference: OD10160070.00006

SiREM Reference: S-2653

Report Date: 14-Nov-12

Data Files: iQ5-GBA-QPCR-0042
MyiQ-DHC-QPCR-0951
MyiQ-DB-DHC-QPCR-0325

Table 1: Test Results

Customer Sample ID	SiREM Sample ID	Sample Collection Date	Sample Matrix	Percent Dhc [*]	*Dehalococcoides* Enumeration/Liter [**]
MW02	DHC-8714	26-Oct-12	Groundwater	NA	3 x 10^3 U
MP01-1	DHC-8715	26-Oct-12	Groundwater	NA	3 x 10^3 U

Notes:

[*] Percent *Dehalococcoides* (Dhc) in microbial population. This value is calculated by dividing the number of Dhc 16S ribosomal ribonucleic acid (rRNA) gene copies by the total number of bacteria as estimated by the mass of DNA extracted from the sample. Range represents normal variation in Dhc enumeration.

[**] Based on quantification of Dhc 16S rRNA gene copies. Dhc are generally reported to contain one 16S rRNA gene copy per cell; therefore, this number is often interpreted to represent the number of Dhc cells present in the sample.

J The associated value is an estimated quantity between the method detection limit and quantitation limit.
U Not detected, associated value is the quantification limit.
B Analyte was also detected in the method blank.
NA Not applicable as *Dehalococcoides* not detected and/or quantifiable DNA not extracted from the sample.
I Sample inhibited the test reaction based on inability to PCR amplify extracted DNA with universal primers.
E Extracted genomic DNA was not detected in sample.

Analyst: Kela Bartle
Kela Bartle, B.Sc.
Laboratory Technician

Approved: Ximena Druar
Ximena Druar, B.Sc.
Genetic Testing Coordinator

Table 2: Detailed Test Parameters, Gene-Trac Test Reference S-2653

Customer Sample ID	MW02	MP01-1
SiREM Dhc Sample ID	DHC-8714	DHC-8715
Date Received	31-Oct-12	31-Oct-12
Sample Temperature	4 ºC	4 ºC
Filtration Date	1-Nov-12	1-Nov-12
Volume Used for DNA Extraction	500 mL	500 mL
DNA Extraction Date	9-Nov-12	9-Nov-12
DNA Concentration in Sample (extractable)	1113 ng/L	1391 ng/L
PCR Amplifiable DNA	Detected	Detected
Dhc qPCR Date Analyzed	12-Nov-12	12-Nov-12
Laboratory Controls (see Table 3)	Passed	Passed
Comments	- -	- -

Notes:

Refer to Table 3 for detailed results of controls.

°C = degrees Celsius

DNA = Deoxyribonucleic acid

PCR = polymerase chain reaction

qPCR = quantitative PCR

Dhc = Dehalococcoides

ng/L = nanograms per liter

mL = milliliters

Table 3: Experimental Control Results, Gene-Trac Test Reference S-2653

Laboratory Control	Analysis Date	Control Description	Spiked Dhc 16S rRNA Gene Copies per Liter	Recovered Dhc 16S rRNA Gene Copies per Liter	Comments
Positive Control Low Concentration	12-Nov-12	qPCR with KB1 genomic DNA (CSLD-0588)	8.4×10^4	9.6×10^4	- -
Positive Control High Concentration	12-Nov-12	qPCR with KB1 genomic DNA (CSHD-0588)	1.2×10^7	1.2×10^7	- -
DNA Extraction Blank	12-Nov-12	DNA extraction sterile water (FB-1800)	0	2.6×10^3 U	- -
Negative Control	12-Nov-12	Tris Reagent Blank (TBD-0548)	0	2.6×10^3 U	- -

Notes:

Dhc = *Dehalococcoides*

DNA = Deoxyribonucleic acid

qPCR = quantitative PCR

16S rRNA = 16S ribosomal ribonucleic acid

U Not detected, associated value is the quantification limit.

S-2653

OAK 17606

CHAIN-OF-CUSTODY RECORD

PROJECT NAME: Crown Chevrolet

DATE: 10-26-12 PAGE 1 OF 1

PROJECT NUMBER: 0D10160070.00006

LABORATORY NAME: SiREm

CLIENT INFORMATION:

REPORTING REQUIREMENTS:

RESULTS TO: Avery Patton

LABORATORY ADDRESS:

TURNAROUND TIME: standard

SAMPLE SHIPMENT METHOD: Fed-Ex

LABORATORY CONTACT: Phil

LABORATORY PHONE NUMBER: 866-251-1727

GEOTRACKER REQUIRED YES [✓ NO]

SITE SPECIFIC GLOBAL ID NO.

SAMPLERS (SIGNATURE): RDavid Pearson

DATE	TIME	SAMPLE NUMBER	ANALYSES * Dhc	CONTAINER TYPE AND SIZE	Soil (S), Water (W), Vapor (V), or Other (O)	Filtered	Preservative Type	Cooled	MS/MSD	No. of Containers	ADDITIONAL COMMENTS
10-26-12	1025	MW02-102612	X	1liter poly	W			X		1	
1	1220	MP01-1-102612	X	1	W			X		1	

RDP

RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME
SIGNATURE: RDavid Pearson PRINTED NAME: RDavid Pearson COMPANY: Amec	10/29/12	0720	SIGNATURE: Kela Bartle PRINTED NAME: Kela Bartle COMPANY: SiREM	10/31/12	14:40
SIGNATURE: PRINTED NAME: COMPANY:			SIGNATURE: PRINTED NAME: COMPANY:		
SIGNATURE: PRINTED NAME: COMPANY:			SIGNATURE: PRINTED NAME: COMPANY:		

TOTAL NUMBER OF CONTAINERS: 2

SAMPLING COMMENTS:

*Dehalococcoides testing using Gene-Trac

2101 Webster Street, 12th Floor
Oakland, California 94612-3066
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amec

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Guelph ON N1G 5G3
(519) 822-2265

SiREM Technical Note 1.5:

Guidelines for Interpretation of Gene-Trac® Test Results

This document provides technical background information and guidelines for interpreting the results for the following Gene-Trac® assays:

(1) Gene-Trac® Dhc
(2) Gene-Trac® VC
(3) Gene-Trac® Dhb

SiREM Technical Note 1.4 - *Quantitative Gene-Trac® Assay Test Procedure and Reporting Overview* provides detailed information on Gene-Trac® test procedures and reporting. Explanation of data qualifiers and commonly used notes is provided as Appendix A. Table 1 provides a brief interpretation for some common scenarios, more detailed interpretation information is provided in the following sections.

Table 1: Common Gene-Trac® Test Result Scenarios and Interpretation

Gene-Trac® Dhc (*Dehalococcoides*)	**Gene-Trac® VC (*vcrA*)**	**Gene-Trac® Dhb (*Dehalobacter*)**	**Interpretation**
>1 x10^7/L	**>1 x10^7/L**	Not Analyzed	Complete dechlorination to ethene likely as Dhc high and *vcrA* high
1 x10^7/L	**Not Detected**	Not Analyzed	VC accumulation possible as *vcrA* negative
Not Detected	**Not Detected**	Not Analyzed	Dhc negative/ lack of dechlorination or *cis*-DCE accumulation likely
Not Analyzed	Not Analyzed	**1 x10^6/L**	Dhb positive,potential for biodegradation of 1,1,1-TCA, 1,2-DCA, carbon tetrachloride and chloroform, PCE and TCE to *cis*-DCE
Not Analyzed	Not Analyzed	**Not Detected**	Biodegradation of 1,1,1-TCA, carbon tetrachloride and chloroform not expected as Dhb negative

Gene-Trac® Dhc -Total *Dehalococcoides* Test

Background:

Gene-Trac® Dhc is a quantitative PCR (qPCR) test for total *Dehalococcoides* (Dhc) microbes that targets Dhc specific sequences of the 16S ribosomal ribonucleic acid (rRNA) gene, a gene commonly used to indentify microbes. Dhc are the only known microorganisms capable of complete dechlorination of chloroethenes (i.e., tetrachloroethene, trichloroethene, cis-1,2-dichloroethene [cis-DCE] and vinyl chloride) to non-toxic ethene. Gene-Trac® Dhc may also be used to assess the in situ growth of Dhc containing bioaugmentation cultures such as KB-1®.

Negative Gene-Trac® Dhc Test Results (U qualified)

A non-detect in the Gene-Trac® Dhc assay (e.g., 4,000U) indicates that Dhc were not detected in the sample. The absence of Dhc is frequently associated with a lack of complete dechlorination or incomplete dechlorination of chlorinated ethenes. Where Dhc are absent the accumulation of cis-DCE is commonly observed, particularly after addition of electron donors. Bioaugmentation with Dhc containing cultures, such as KB-1®, is commonly used to improve bioremediation performance at sites that lack an indigenous Dhc population.

Positive Gene-Trac® Dhc Test Results

The detection of Dhc has been correlated with the complete biological dechlorination of chlorinated ethenes to ethene at contaminated sites (Hendrickson et al., 2002). A positive Gene-Trac® Dhc test indicates that Dhc DNA was detected in the sample and is encouraging for dechlorination of chlorinated ethenes to ethene. Note not all Dhc are capable of conversion of vinyl chloride to ethene; this capability can be determined by the Gene-Trac® VC test (see Section 2) which is commonly performed as a follow-on analysis after positive Gene-Trac® Dhc tests. In most cases Dhc must be present at sufficient concentrations in order for significant dechlorination to be observed, guidelines for expected impacts at various Dhc concentrations are indicated below.

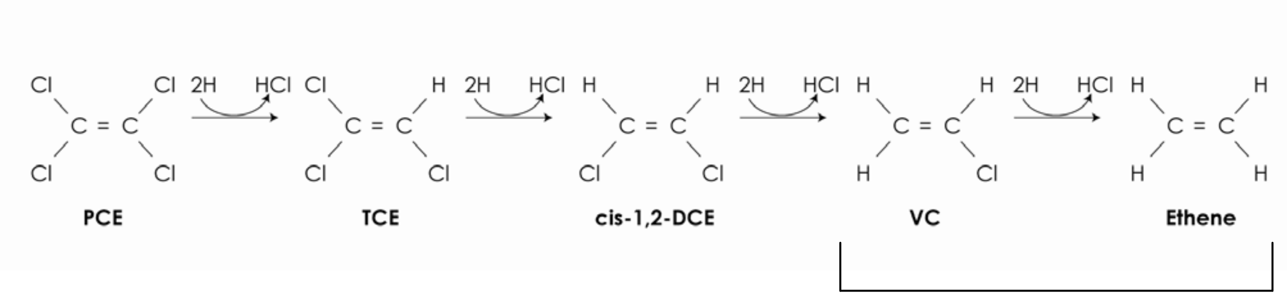
> **Values of 10^4 Dhc gene copies per liter (or lower):** indicates that the sample contains low concentrations of Dhc which may indicate that site conditions are suboptimal for high rates of dechlorination. Increases in Dhc concentrations at the site may be possible if conditions are optimized (e.g., electron donor addition).
>
> **Values of 10^5-10^6 Dhc gene copies per liter:** indicates the sample contains moderate concentrations of Dhc which may, or may not, be associated with observable dechlorination activity (i.e., detectable ethene).
>
> **Values at or above 10^7 Dhc gene copies per liter:** indicates that the sample contains high concentrations of Dhc that are often associated with high rates of dechlorination (Lu et al., 2006) and the production of ethene.
>
> **Values of 10^9 Dhc gene copies per liter** are generally the highest observed for groundwater samples with rare exceptions.

Gene-Trac® VC- Vinyl Chloride Reductase (*vcrA*) Test

Background

Gene-Trac® VC is a qPCR test for the vinyl chloride reductase (*vcrA*) gene that codes for a Dhc enzyme that converts (VC) to ethene, a critical step in reductive dechlorination of chlorinated ethenes. Gene-Trac® VC is commonly used where Gene-Trac® Dhc test results are positive to confirm that the Dhc detected are capable of complete dechlorination to ethene.#

The vinyl chloride reductase gene (*vcrA)* (Müller et al., 2004) produces an enzyme that is found in many (but not all) Dhc and is reported to be the most common identified VC reductase in the environment (van der Zaan et al., 2010).



Key activity of vinyl chloride reductase vcrA gene/enzyme

Interpretation of Gene-Trac® VC Results

Detect in Gene-Trac® VC Test

A detect in the Gene-Trac® VC test indicates that a Dhc population has the *vcrA* gene and the prospects for complete dechlorination to ethene are good. As a minimal requirement, *vcrA* copies exceeding 10^5/L combined with observed increases over time (i.e., cell growth) are required for robust VC dechlorination (van der Zaan et al., 2010). Also the guidelines for detection of ethene provided under Gene-Trac® Dhc are conservative for interpretation of Gene-Trac® VC (i.e., > 1 x10^7 gene copies/L indicate a high likelihood of detection of ethene). In one study, more than 90% of samples where *vcrA* enumeration exceeded 1 x10^7 gene copies/L had detectable ethene (Dennis, 2009). In cases where *vcrA* gene copies are lower the likelihood of detectable ethene decreases.

Non-Detect in Gene-Trac® VC Test (U qualified)

A non-detect in the Gene-Trac® VC test indicates that *vcrA* gene sequences in the sample are below the detection limit of the assay (typically 4 x 10^3 *vcrA* gene copies/L). This indicates VC accumulation (VC stall) is possible. Note negative Gene-Trac® VC test results do not indicate with 100% certainty that a VC-stall will occur as there are other vinyl chloride reductase genes, such as *bvcA* (van der Zaan et al., 2010) that also convert VC to ethene.

Comparing Gene-Trac® VC and Gene-Trac® Dhc Test Results

Sites may contain different types of Dhc populations. At some sites the Dhc population is homogenous while other sites have Dhc populations that are mixtures of different types of Dhc. This can lead to differing results for Gene-Trac® Dhc and Gene-Trac® VC.

In many cases, the numerical results of Gene-Trac® VC test are identical to those obtained in the Gene-Trac® Dhc test, indicating that the entire Dhc population contains the *vcrA* gene. In other cases, Gene-Trac® VC results may differ significantly (i.e., more than an order or magnitude) from the total Dhc for a number of reasons.

Table 3 provides some common scenarios for Gene-Trac® VC and Gene-Trac® Dhc test results. In general, where Gene-Trac® VC results are non-detect, or significantly lower than Gene-Trac® Dhc, accumulation of VC is more likely.

Table 2: Interpretation of Gene-Trac® VC in Relation to Gene-Trac® Dhc

Gene-Trac® Dhc (16S rRNA gene copies/ L)	**Gene-Trac® VC (*vcr*A gene copies/L)**	**Results Summary**	**Interpretation**	**Potential Site Implications**
2 x 10^8 /L	3 x 10^8/L	Total Dhc and *vcrA* are ~the same (within 3-fold)	Entire Dhc population has *vcrA* gene	Potential for complete dechlorination high. VC stall unlikely-sites with *vcr*A above 1x10^7/L typically have detectable ethene
1 x 10^8/L	Non-detect	Total Dhc high; *vcrA* non-detect	High concentration of Dhc and entire population lacks the *vcrA* gene	Likelihood for VC accumulation high as *vcrA* non-detect
1 x 10^8/L	1 x 10^6 /L	Total Dhc is significantly higher (100 fold) than *vcrA*	*Dhc* population consists of different types, some with the *vcrA* gene (~1%) and some without (~99%)	VC-accumulation possible; Dhc/*vcrA* proportions may change over course of remediation
1 x 10^6/L	1 x 10^8/L	*vcrA* orders of magnitude higher than Dhc	Significantly higher *vcrA* may indicate the presence of populations of non-Dhc microorganisms with *vcrA* like genes	Potential for VC-stall likely low

Gene-Trac® Dhb-Total *Dehalobacter* Test

Gene-Trac® Dhb is a qPCR test targeting the 16S rRNA gene sequences unique to *Dehalobacter* (Dhb). Dhb are implicated in the biodegradation of 1,1,1-trichloroethane (to chloroethane), 1,1,2-trichloroethane and 1,2-dichloroethane to ethene (Grostern and Edwards, 2006) and chloroform (to dichloromethane) (Grostern et al., 2010) as well as incomplete dechlorination of PCE and TCE to cis-DCE (Holliger et al.,1998). Gene-Trac® Dhb may also be used as a tool to assess the impact of bioaugmentation with the KB-1® Plus cultures which contain high concentrations of Dhb.

Positive Gene-Trac® Dhb Test Results (Detects)

A positive Gene-Trac® Dhb indicates that a member of the *Dehalobacter* (Dhb) genus was detected in the sample. The detection of Dhb indicates that some or all of the dechlorination activities attributed to Dhb may be present at the subject site. Increasing concentrations of Dhb are indicative of increased potential to degrade some or all of these compounds.

Note: the Gene-Trac® Dhb test will not differentiate the type of Dhb*;* therefore, observations of the specific biodegradation pathways and end products based on chemical analytical methods in conjunction with Gene-Trac® Dhb will increase the interpretability of Gene-Trac® Dhb results.

Note: Dhb have been reported to contain multiple copies (up to 4 per cell) of the 16S rRNA gene (Grostern and Edwards, 2008). This means that, unlike Dhc, there is not a 1:1 ratio between the 16S rRNA gene copy and the number of Dhb cells in a sample. Calculating the number of Dhb cells requires dividing the Gene-Trac® Dhb test result by the 16S rRNA gene copy number (often 3-4 copies/cell).

Non-detect Gene-Trac® Dhb Results (U qualified)

In cases where Gene-Trac® Dhb is not detected (e.g., 4,000U) this indicates that *Dehalobacter* species were not identified in the sample and that anaerobic reductive dechlorination of 1,1,1-TCA, 1,1,2-TCA, 1,2-DCA or chloroform, which are dechlorinated by *Dehalobacter*, may not be observed. This activity can be introduced at sites through the addition of bioaugmentation cultures containing *Dehalobacter* such as KB-1® Plus.

Key Elements of Gene-Trac® Data

Gene-Trac® test results include two key values (a) Target Gene Enumeration, an enumeration of target gene sequence by quantitative PCR (e.g. “Dhc Enumeration” “Dhb 16S Gene Copies” or “*vcrA* gene copies”) and (b) Target gene percent (e.g. “Percent Dhc”), an estimated percentage of the microbial population comprised by microbes harboring the target gene and other microbes present in sample. Further explanation of these values is provided below.

a) Target Gene Enumeration

This value is the concentration of Dhc or Dhb 16S rRNA or *vcrA* gene copies detected in the sample. Results may be reported as either gene copies per liter (for groundwater) or per gram (for soil). In general, the greater the number of gene copies in a sample the greater the likelihood of related dechlorination activity. Dhc 16S gene copies are typically equivalent to the number of Dhc as they have 1 gene copy per cell this is not necessarily true for Dhb or *vcrA* which have the potential be present in multiple gene copies per cell. Guidelines for relating target gene presence and concentration to observable dechlorination activity for groundwater samples are provided below in previous sections.

b) Target Gene Percent (%Dhc, %Dhb, %*vcrA*)

This value estimates the percentage of the target gene (e.g., %Dhc) relative to other microorganisms in the sample based on the formulas/assumptions presented below. For example, %Dhc is a measure of the predominance of Dhc and, in general, the higher this percentage the better.

$$\%Dhc = \frac{\text{Number Dhc}}{\text{Number Dhc+ Number other Bacteria}}$$

Where:

$$\text{Number other Bacteria} = \frac{\text{Total DNA in sample (ng) – DNA attributed to Dhc (ng)}}{{}^{*}4.0 \times 10^{-6} \text{ ng DNA per bacterial cell}}$$

*Paul and Clark, (1996).

Percent Dhc (and % *vcrA*) values can range from very low fractions of percentages, in samples with low numbers of Dhc and a high number of other bacteria (incompletely colonized by Dhc), to greater than 50% in Dhc enriched locations (highly colonized by Dhc).

In addition to determining the predominance of the target gene target gene percent is also useful for interpretation of Dhc counts from different sampling locations, or the same location over time. For example, the %Dhc value can be used to correct Dhc counts where samples are biased due to non-representative sampling. Example 1 illustrates a hypothetical scenario where the %Dhc value improved data interpretation.

Example 1, use of %Dhc to interpret enumeration data

Table 2 presents results from MW-1 sampled in April, May and June. Based on the Dhc enumeration alone one would conclude that the concentration of Dhc held steady between April and May; however, the %Dhc indicates the proportion of Dhc actually increased from April to May and the unchanged count in May could be a case of low biomass recovery during sampling or other losses such as sample degradation in transit. The higher raw count and the higher percentage of Dhc in June confirm the trend of increasing Dhc concentrations over time.

Table 3: Use of % Dhc* Value to Diagnose Sampling Bias

Sample	Dhc Enumeration	%Dhc	Interpretation Based on %Dhc
MW-1, April	1.0 x 10^5/Liter	0.1%	Dhc is a low proportion of total microbial population
MW-1, May	1.0 x 10^5/Liter	1%	Dhc proportion increased 10-fold from April. Dhc enumeration was unchanged possibly due to low biomass recovery from monitoring well, non-biased sample would be [(1.0/0.1) x 1.0 x10^5] = 1.0 x 10^6/Liter
MW-1, June	1.0 x 10^7/Liter	10%	Dhc has increased 100-fold from April and confirms May sample was likely low biased

**Note: the above approach is also applicable to the "%vcrA" and "%Dhb" values provided on their respective test certificates*

References

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van der Zaan, B. , F. Hannes, N. Hoekstra, H. Rijnaarts, W.M. de Vos, H. Smidt, and J. Gerritse, 2010. Correlation of Dehalococcoides 16S rRNA and Chloroethene-Reductive Dehalogenase Genes with Geochemical Conditions in Chloroethene-Contaminated Groundwater. *Appl. Environ. Microbiol*. 76(3) 843–850.

Appendix A: Data Qualifiers

Data Qualification

Data qualifiers and notes are used to clarify Gene-Trac® test results. Additional explanation beyond that provided on the test certificate is provided below.

"U" Not detected, associated value is the quantitation limit. Indicates that the target gene (microbe) was not detected in the sample above the quantitation limit of the assay. Note the quantitation limit value can change between samples as the volume filtered can vary; thus, a sample in which 100 ml was tested would have a 5–fold higher quantification limit compared with a sample in which 500 ml was tested.

"J" The associated value is an estimated quantity between the method detection limit and quantitation limit. Indicates that the target gene was conclusively detected but the concentration is below the quantitation limit where it cannot be accurately quantified.

"I" Sample inhibited the test reaction. This means universal primers were incapable of amplifying DNA from this sample. The inability to amplify with universal primers suggests that the sample may be imparting matrix interference. Matrix interference is commonly attributed to humic compounds, polyphenols and metals. Non-detects with an "I" qualifier are more likely to be false negative.

"B" Analyte was also detected in the method blank. Indicates that DNA was detected in a method blank or negative control; detectable contamination of the blanks with microbes or DNA containing the gene of interest is not uncommon as the test reaction is extremely sensitive. In most cases, blank contamination is at a very low level relative to test results (often orders of magnitude lower). In these cases, blank contamination is not relevant to interpretation of test results. The potential of test samples being contaminated (i.e. false positives) should be considered in cases where blank results are within 1 order of magnitude of test results.

APPENDIX B

Remedial Alternative Cost Estimates

TABLE B1

CROWN CHEVROLET CADILLAC ISUZU

Crown Chevrolet Cadillac Isuzu
7544 Dublin Boulevard and 6707 Golden Gate Drive
Dublin, California

Remedial Cost Component	Cost
Capital Costs	
1. Excavation (Sump and Pit)	$120,000
2. Groundwater Monitoring	$130,000
3. Vapor Barrier and Sub-Slab Depressurization System	$490,000
4 .Permeable Reactive Barrier with Zero Valent Iron	$820,000
5. In-Situ Bioremediation	$690,000
O&M Costs	
6. Groundwater Monitoring and Reporting (4 years)	$130,000
7. Institutional Controls (30 years)	$120,000
8. Sub-Slab Depressurization System O&M (5 years)	$170,000
9. Indoor Air Monitoring and Reporting (20 years)	$240,000

	Total Costs			**Incremental Costs**		
Alternative	**Capital**	**O&M**	**Total**	**Capital**	**O&M**	**Total**
Alternative 1 (1+2+6+7)	**$250,000**	**$250,000**	**$500,000**	**$250,000**	**$250,000**	**$500,000**
Alternative 2 (1+2+3+6+7+8+9)	**$740,000**	**$660,000**	**$1,400,000**	**$490,000**	**$410,000**	**$900,000**
Alternative 3 (1+2+3+4+6+7+8+9)	**$1,560,000**	**$660,000**	**$2,220,000**	**$820,000**	**$0**	**$820,000**
Alternative 4a (1+2+3+4+5+6+7+8+9)	**$2,250,000**	**$660,000**	**$2,910,000**	**$690,000**	**$0**	**$690,000**

Abbreviation

O&M = operation and maintenance

Note

1. Costs are for the purpose of feasibility study analysis only. Contractor estimates were not obtained for this analysis.
2. All costs are presented in 2012 dollars.

TABLE B2

CORRECTIVE ALTERNATIVE COST ESTIMATE - SUMP AND F.E. PIT EXCAVATION

Crown Chevrolet Cadillac Isuzu
7544 Dublin Boulevard and 6707 Golden Gate Drive
Dublin, California

	Quantity	Unit	Unit Cost	Amount
1 - Contractor and Equipment Costs - Site Preparation and Excavation				
Mobilization/demobilization	1	lump sum	$2,500	$2,500
Buried utility/obstruction survey	1	lump sum	$1,500	$1,500
Soil excavation and loading	100	CY	$95	$9,500
Dewatering costs	1	lump sum	$4,000	$4,000
Testing of dewatered water	1	test	$400	$400
Disposal of dewatered water	1	lump sum	$1,200	$1,200
Testing of excavated soil	2	test	$400	$800
Transport and disposal of non-hazardous soil to Class II landfill	169	ton	$80	$13,520
Testing of confirmation samples	15	test	$150	$2,250
Testing of groundwater	4	test	$150	$600
Controlled-density fill (includes placement)	100	CY	$180	$18,000
Grade area to match existing	1	lump sum	$1,500	$1,500
As-built drawings and closeout documents	1	lump sum	$5,000	$5,000
2 - Health and Safety Costs				
H&S supervisor and PPE	1	lump sum	$5,000	$5,000
A - SUBTOTAL (1 + 2)				$65,770
B. Bid Contingencies (% of A)			10%	$6,577
C. Scope Contingencies (% of A)			15%	$9,866
D. Subtotal Capital Costs With Bid and Scope Contingencies (A + B + C)				$82,213
E. Engineering Design (% of D)			20%	$16,443
F. Permitting & Agency Liaison (% of D)			6%	$4,933
G. Construction Oversight (% of D)			15%	$12,332
H. Project Management (% of D)			10%	$8,221
ESTIMATED TOTAL IMPLEMENTATION COST (D + E + F + G + H)				**$120,000**

Abbreviations

CDF = controlled-density fill
CY = cubic yards
EPA = Environmental Protection Agency
F.E. Pit = front-end alignment pit
H&S = health and safety
O&M = operation and maintenance
PPE = personal protective equipment

Notes

1. Estimated soil overexcavation based remaining soil impacts, as presented in the *Remediation Report* (AMEC, 2011).
2. Excavation assumes 100% of the volume to be disposed of as non-hazardous waste to a Class II facility, because material from the 2011 excavation in the same areas (but with likely higher concentrations in soil) was disposed of as non-hazardous Class II waste.
3. Excavation will be conducted per the non-shoring method and CDF backfill used during the 2011 excavation.
4. Excavation duration based on a percentage of the time of completion for the 2011 excavation (i.e., 13 days to remove approximately 302 CY).
5. Unit rates based on the following sources: vendor costs obtained from other projects; engineering judgment to extrapolate appropriate costs from other projects.
6. Contingencies and professional service costs are from *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study* , EPA 2000.
7. No costs for contractor performance bonds or insurance are included.
8. Monitoring costs are included in the groundwater monitoring O&M task.
9. Costs are for the purpose of feasibility study analysis only. Contractor estimates were not obtained for this analysis.

TABLE B3

CORRECTIVE ALTERNATIVE COST ESTIMATE - GROUNDWATER MONITORING

Crown Chevrolet Cadillac Isuzu
7544 Dublin Boulevard and 6707 Golden Gate Drive
Dublin, California

	Quantity	Unit	Unit Cost	Amount
1 - Contractor and Equipment Costs - Initial Well Destruction and Installations				
Well destruction (seven existing wells)	7	each	$3,000	$21,000
Well installations (five wells coordinated with development)	5	each	$4,000	$20,000
Well destruction/installation reporting	1	lump sum	$5,000	$5,000
Final well destructions (after 4 years of monitoring)	5	each	$3,000	$15,000
Final well destruction report	1	lump sum	$5,000	$5,000
2 - Health and Safety Costs				
H&S supervisor and PPE	1	lump sum	$2,500	$2,500
A - SUBTOTAL (1 + 2)				$68,500
B. Bid Contingencies (% of A)			10%	$6,850
C. Scope Contingencies (% of A)			15%	$10,275
D. Subtotal Capital Costs With Bid and Scope Contingencies (A + B + C)				$85,625
E. Engineering Design (% of D)			20%	$17,125
F. Permitting & Agency Liaison (% of D)			6%	$5,138
G. Construction Oversight (% of D)			15%	$12,844
H. Project Management (% of D)			10%	$8,563
ESTIMATED TOTAL IMPLEMENTATION COST (D + E + F + G + H)				**$130,000**

Abbreviations

EPA = Environmental Protection Agency
H&S = health and safety
O&M = operation and maintenance
PPE = personal protective equipment

Notes

1. Cost assumes destruction of existing wells prior to development.
2. Cost assumes installation of five shallow groundwater monitoring wells for future monitoring. Installation will be coordinated with development.
3. Cost assumes wells to be destroyed after four years of groundwater sampling.
4. Unit rates based on the following sources: vendor costs obtained from other projects; engineering judgment to extrapolate appropriate costs from other projects.
5. Contingencies and professional service costs are from *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study* , EPA 2000.
6. No costs for contractor performance bonds or insurance are included.
7. Monitoring costs are included in the groundwater monitoring O&M task.
8. Costs are for the purpose of feasibility study analysis only. Contractor estimates were not obtained for this analysis.

TABLE B4

CORRECTIVE ALTERNATIVE COST ESTIMATE - VAPOR BARRIER AND SUB-SLAB DEPRESSURIZATION SYSTEM

Crown Chevrolet Cadillac Isuzu
7544 Dublin Boulevard and 6707 Golden Gate Drive
Dublin, California

	Quantity	Unit	Unit Cost	Amount
1 - Contractor and Equipment Costs - SSD and Vapor Intrusion Barrier Installation				
Mobilization/demobilization	3	lump sum	$2,500	$7,500
Install wind-driven turbine fan on roof	17	each	$1,500	$25,500
Install sprayed applied membrane (60 mils, smoke testing) and SSD	55,300	SF	$4	$221,200
System startup and shakedown	1	lump sum	$5,000	$5,000
Site cleanup	1	allow	$1,500	$1,500
2 - Health and Safety Costs				
H&S supervisor and PPE	1	lump sum	$6,000	$6,000
3 - Completion Report				
As-built drawings and closeout documents	3	lump sum	$5,000	$15,000
A - SUBTOTAL (1 + 2 + 3)				$281,700
B. Bid Contingencies (% of A)			10%	$28,170
C. Scope Contingencies (% of A)			15%	$42,255
D. Subtotal Capital Costs With Bid and Scope Contingencies (A + B + C)				$352,125
E. Engineering Design (% of D)			15%	$52,819
F. Permitting & Agency Liaison (% of D)			6%	$21,128
G. Construction Oversight (% of D)			10%	$35,213
H. Project Management (% of D)			8%	$28,170
ESTIMATED TOTAL IMPLEMENTATION COST (D + E + F + G + H)				**$490,000**

Abbreviations

EPA = Environmental Protection Agency
H&S = health and safety
mil = 1/1000 inch
LF = linear feet
PPE = personal protective equipment
SSD = sub-slab depressurization
SF = square feet

Notes

1. Unit rates based on the following sources: vendor costs obtained from other projects; engineering judgment to extrapolate appropriate costs from other projects; recent subcontractor costs for similar projects.
2. Contingencies and professional service costs are from *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study* , EPA 2000.
3. Building square footage estimate based on Achitects Orange development plans ("Option B - Ground Level").
4. Cost assumes no active treatment of sub-slab gas venting is necessary
5. No costs for contractor performance bonds or insurance are included.
6. Costs are for the purpose of feasibility study analysis only. Contractor estimates were not obtained for this analysis.

TABLE B5

CORRECTIVE ALTERNATIVE COST ESTIMATE - ZERO-VALENT IRON PERMEABLE REACTIVE BARRIER

Crown Chevrolet Cadillac Isuzu
7544 Dublin Boulevard and 6707 Golden Gate Drive
Dublin, California

	Quantity	Unit	Unit Cost	Amount
1 - Pre-Design Activities				
Pre-installation investigation and well installations	1	lump sum	$25,000	$25,000
ZVI Column Testing	1	lump sum	$25,000	$25,000
2 - Contractor and Equipment Costs - Site Preparation and PRB Installation				
Mobilization/demobilization	1	lump sum	$50,000	$50,000
Surveying - site preparation - trench alignments - well installations	1	lump sum	$8,000	$8,000
Buried utility/obstruction survey and decommissioning	1	lump sum	$15,000	$15,000
Install ZVI continuous trenching	200	LF	$400	$80,000
Granular ZVI (200 ft x 12 ft x 1.0 ft)	178	ton	$800	$142,400
Sand (200 ft x 12 ft x 0.5 ft)	62	ton	$33	$2,046
Controlled-density fill (includes placement)	119	CY	$180	$21,420
License fee for using ZVI	1	lump sum	$33,000	$33,000
Testing of excavated soil	4	test	$850	$3,400
Transport and disposal of non-RCRA hazardous soil to Class I landfill	375	ton	$80	$30,000
General site restoration/cleanup	1	allow	$2,500	$2,500
As-built drawings and closeout documents	1	lump sum	$10,000	$10,000
3 - Health and Safety Costs				
H&S supervisor and PPE	1	lump sum	$11,000	$11,000
Air monitoring	5	days	$850	$4,250
4 - Completion Report				
As-built drawings and closeout documents	1	lump sum	$10,000	$10,000
A - SUBTOTAL (1 + 2 + 3 + 4)				$473,016
B. Bid Contingencies (% of A)			10%	$47,302
C. Scope Contingencies (% of A)			15%	$70,952
D. Subtotal Capital Costs With Bid and Scope Contingencies (A + B + C)				$591,270
E. Engineering Design (% of D)			15%	$88,691
F. Permitting & Agency Liaison (% of D)			6%	$35,476
G. Construction Oversight (% of D)			10%	$59,127
H. Project Management (% of D)			8%	$47,302
ESTIMATED TOTAL IMPLEMENTATION COST (D + E + F + G + H)				**$820,000**

Abbreviations

CDF = controlled-density fill
CY = cubic yards
EPA = Environmental Protection Agency
ft = feet
H&S = health and safety
LF = linear feet
O&M = operation and maintenance
PPE = personal protective equipment
PRB = permeable reactive barrier
RCRA = Resource Conservation and Recovery Act
VOC = volatile organic compound
ZVI = zero-valent iron

Notes

1. Cost assumes all excavated soil will be disposed of as non-RCRA hazardous waste. Soil is assumed to be non-hazardous based on available VOC data; no data are available for metals or other constituents. Waste characterization will be performed on excavated soil to validate these assumptions. Soil is expected to be classified as a characteristic waste, and not as a listed waste.
2. Cost assumes trenching will be conducted with continuous trenching equipment, and no shoring will be needed.
3. Cost assumes that 66% ZVI will be installed in the bottom 12 feet of the wall with 8 feet of CDF to the top.
4. Cost includes a license fee for the use of ZVI in a PRB.
5. Unit rates based on the following sources: vendor costs obtained from other projects; engineering judgment to extrapolate appropriate costs from other projects.
6. Contingencies and professional service costs are from *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study* , EPA 2000.
7. No costs for contractor performance bonds or insurance are included.
8. Monitoring costs are included in the groundwater monitoring O&M task.
9. Costs are for the purpose of feasibility study analysis only. Contractor estimates were not obtained for this analysis.

TABLE B6

CORRECTIVE ALTERNATIVE COST ESTIMATE - IN-SITU BIOREMEDIATION INJECTION

Crown Chevrolet Cadillac Isuzu
7544 Dublin Boulevard and 6707 Golden Gate Drive
Dublin, California

	Quantity	Unit	Unit Cost	Amount
1 - Contractor and Equipment Costs - Site Preparation and Injection				
Mobilization/demobilization	2	lump sum	$ 5,000	$ 10,000
Surveying - site preparation	2	lump sum	$ 1,000	$ 2,000
Buried utility/obstruction survey	2	lump sum	$ 5,000	$ 10,000
Organic substrate cost (total for two events, delivered)	24,000	lbs	$ 3	$ 72,000
Organic substrate injection costs (single event)	30	days	$ 4,000	$ 120,000
Bioaugmentation substrate cost (total for one event, delivered)	800	liter	$ 120	$ 96,000
Bioaugmentation substrate injection costs (single event)	6	days	$ 4,000	$ 24,000
Water costs for dilution of substrate (1 unit = 748 gallons)	39	unit	$ 1	$ 57
De-oxygenating amendment for dilution water (delivered)	720	lbs	$ 5	$ 3,600
Closed top, vented tank to hold dilution water while de-oxygenating	1	month	$ 3,500	$ 3,500
Labor related to de-oxygenating dilution water	1	lump sum	$ 10,000	$ 10,000
2 - Health and Safety Costs				
H&S supervisor and PPE	2	lump sum	$ 9,000	$ 18,000
3 - Completion Report				
As-built drawings and closeout documents	1	lump sum	$ 30,000	$ 30,000
A - SUBTOTAL (1 + 2 + 3)				$399,157
B. Bid Contingencies (% of A)			10%	$39,916
C. Scope Contingencies (% of A)			15%	$59,873
D. Subtotal Capital Costs With Bid and Scope Contingencies (A + B + C)				$498,946
E. Engineering Design (% of D)			15%	$74,842
F. Permitting & Agency Liaison (% of D)			6%	$29,937
G. Construction Oversight (% of D)			10%	$49,895
H. Project Management (% of D)			8%	$39,916
ESTIMATED TOTAL IMPLEMENTATION COST (D + E + F + G + H)				**$690,000**

Abbreviations

EPA = Environmental Protection Agency
H&S = health and safety
lbs = pounds
PPE = personal protective equipment

Notes

1. Estimate assumes 240 injection points will be installed; injection points will be installed on a 15-foot grid.
2. Unit rates based on the following sources: vendor costs obtained from other projects; engineering judgment to extrapolate appropriate costs from other projects.
3. Contingencies and professional service costs are from *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study* , EPA 2000.
4. No costs for contractor performance bonds or insurance are included.
5. Monitoring costs are included in the groundwater monitoring task.
6. Costs are for the purpose of feasibility study analysis only. Contractor estimates were not obtained for this analysis.

TABLE B7

CORRECTIVE ALTERNATIVE COST ESTIMATE - GROUNDWATER MONITORING O&M

Crown Chevrolet Cadillac Isuzu
7544 Dublin Boulevard and 6707 Golden Gate Drive
Dublin, California

	Quantity	Unit	Unit Cost	Yearly Amount	# of Years	Amount
1 - Maintenance and Repair						
Yearly maintenance	1	each	$ 1,500	$ 1,500	3	$ 4,500
2 - Groundwater Sampling						
First quarterly event (five wells, including analysis)	1	each	$ 4,000	$ 4,000	1	$ 4,000
Quarterly events - first 2 years	3.5	each	$ 4,000	$ 14,000	2	$ 28,000
Annual event - year 3	1	each	$ 4,000	$ 4,000	1	$ 4,000
Annual event - year 4	1	each	$ 4,000	$ 4,000	1	$ 4,000
3 - Groundwater Monitoring Reporting						
First quarterly report	1	each	$ 4,000	$ 4,000	1	$ 4,000
Quarterly reports - first 2 years	3.5	each	$ 2,000	$ 7,000	2	$ 14,000
Annual report - year 3	1	each	$ 2,000	$ 2,000	1	$ 2,000
Closure request report	1	each	$ 21,000	$ 21,000	1	$ 21,000
4 - Agency Oversight						
Review (first quarterly event)	1	each	$ 2,976	$ 2,976	1	$ 2,976
Review (quarterly events - first 2 years)	3.5	each	$ 1,488	$ 5,208	2	$ 10,416
Review (annual event - year 3)	1	each	$ 1,488	$ 1,488	1	$ 1,488
Review (annual event - year 4)	1	each	$ 4,464	$ 4,464	1	$ 4,464
A. SUBTOTAL COSTS (1 + 2 + 3 + 4)						$ 105,000
B. Scope Contingencies (% of A)					10%	$ 11,000
C. Project Management (% of A)					10%	$ 11,000
ESTIMATED TOTAL COST (A + B + C)						**$ 130,000**

Abbreviations

O&M = operation and maintenance
PRB = permeable reactive barrier

Notes

1. Cost assumes four year of groundwater monitoring.
2. Cost assumes quarterly sampling and reporting for years 1 and 2, and annual sampling and reporting for years 3 and 4.
3. Cost assumes the groundwater monitoring program will be used for any groundwater remedy installed (e.g., PRB, etc.).
4. Unit rates based on the following sources: vendor costs obtained from other projects; engineering judgment to extrapolate appropriate costs from other projects.
5. Well destruction costs are included in the capital costs in the groundwater monitoring task.
6. Costs are for the purpose of feasibility study analysis only. Contractor estimates were not obtained for this analysis.

TABLE B8

CORRECTIVE ALTERNATIVE COST ESTIMATE - INSTITUTIONAL CONTROLS

Crown Chevrolet Cadillac Isuzu
7544 Dublin Boulevard and 6707 Golden Gate Drive
Dublin, California

	Quantity	Unit	Unit Cost	Yearly Amount	# of Years	Amount
1 - Plans						
Intitutional Control Plan	1	each	$ 50,000	$ 50,000	1	$ 50,000
Site Management Plan	1	each	$ 20,000	$ 20,000	1	$ 20,000
2 - Annual Site Inspections						
Site inspection (Y1-Y2, semiannual)	2	each	$ 1,200	$ 2,400	2	$ 4,800
Site inspection (Y3-Y4, annual)	1	each	$ 1,200	$ 1,200	2	$ 2,400
Site inspection (Y5-Y20, every five years)	1	each	$ 1,200	$ 1,200	4	$ 4,800
3 - Site Inspection Reporting						
Reporting (Y1-Y2, semiannual)	2	each	$ 2,000	$ 4,000	2	$ 8,000
Reporting (Y3-Y4, annual)	1	each	$ 1,500	$ 1,500	2	$ 3,000
Reporting (Y5-Y20, every five years)	1	each	$ 1,500	$ 1,500	4	$ 6,000
4 - Agency Oversight						
Review (Y1-Y2, semiannual)	2	report	$ 372	$ 744	2	$ 1,488
Review (Y3-Y4, annual)	1	report	$ 372	$ 372	2	$ 744
Review (Y5-Y20, every five years)	1	report	$ 372	$ 372	4	$ 1,488
A. SUBTOTAL COSTS (1 + 2 + 3 + 4)						$ 103,000
B. Scope Contingencies (% of A)					10%	$ 10,000
C. Project Management (% of A)					10%	$ 10,000
ESTIMATED TOTAL COST (A + B + C)						**$ 120,000**

Notes

1. Cost assumes periodical site visits to inspect for compliance with institutional land use controls and integrity of remedy.
2. Cost assumes a period of 20 years; inspection frequencies over this period are outlined in the above table.
3. Cost assumes a letter report for each inspection.
4. Unit rates based on the following sources: vendor costs obtained from other projects; engineering judgment to extrapolate appropriate costs from other projects.
5. Costs are for the purpose of feasibility study analysis only. Contractor estimates were not obtained for this analysis.

TABLE B9

CORRECTIVE ALTERNATIVE COST ESTIMATE - SUB-SLAB DEPRESSURIZATION SYSTEM O&M

Crown Chevrolet Cadillac Isuzu
7544 Dublin Boulevard and 6707 Golden Gate Drive
Dublin, California

	Quantity	Unit	Unit Cost	Yearly Amount	# of Years	Amount
1 - Maintenance and Repair						
Yearly maintenance of conveyance piping and turbines	1	each	$ 2,500	$ 2,500	5	$ 12,500
2 - System Operation & Maintenance						
Passive SSD labor costs, year 1	12	mo	$ 1,500	$ 18,000	1	$ 18,000
Passive SSD analytical costs, year 1	75	each	$ 200	$ 15,000	1	$ 15,000
Passive SSD labor costs, years 2-5	4	mo	$ 1,500	$ 6,000	4	$ 24,000
Passive SSD analytical costs, years 2-5	38	each	$ 200	$ 7,600	4	$ 30,400
3 - System O&M Reporting						
Reporting (quarterly), 5 years	4	report	$ 2,000	$ 8,000	5	$ 40,000
4 - Agency Oversight						
Review (Y1-Y5, annual)	1	report	$ 744	$ 744	5	$ 3,720
A. SUBTOTAL COSTS (1 + 2 + 3 + 4)						$ 144,000
B. Scope Contingencies (% of A)					10%	$ 14,000
C. Project Management (% of A)					10%	$ 14,000
ESTIMATED TOTAL COST (A + B + C)						**$ 170,000**

Abbreviations

BAAQMD = Bay Area Air Quality Management District
mo = months
O&M = operation and maintenance
SSD = sub-slab depressurization

Notes

1. Cost assumes five years of O&M.
2. Cost assumes O&M of SSD system will decrease over time.
3. Cost assumes risers will remain in place until building removal.
4. Cost assumes SSD system is exempt from BAAQMD requirements/fees.
5. Unit rates based on the following sources: vendor costs obtained from other projects; engineering judgment to extrapolate appropriate costs from other projects.
6. Costs are for the purpose of feasibility study analysis only. Contractor estimates were not obtained for this analysis.

TABLE B10

CORRECTIVE ALTERNATIVE COST ESTIMATE - INDOOR AIR MONITORING

Crown Chevrolet Cadillac Isuzu
7544 Dublin Boulevard and 6707 Golden Gate Drive
Dublin, California

	Quantity	Unit	Unit Cost	Yearly Amount	# of Years	Amount
1 - Indoor Air Sampling						
Indoor air labor costs, (Y1-Y3, semiannual)	2	mo	$ 3,000	$ 6,000	3	$ 18,000
Indoor air sampling equipment costs, (Y1-Y3, semiannual)	28	each	$ 75	$ 2,100	3	$ 6,300
Indoor air laboratory costs, (Y1-Y3, semiannual)	28	each	$ 175	$ 4,900	3	$ 14,700
Indoor air labor costs, (Y4-Y6, annual)	1	mo	$ 3,000	$ 3,000	3	$ 9,000
Indoor air sampling equipment costs, (Y4-Y6, annual)	14	each	$ 75	$ 1,050	3	$ 3,150
Indoor air laboratory costs, (Y4-Y6, annual)	14	each	$ 175	$ 2,450	3	$ 7,350
Indoor air labor costs, (Y7-Y20, annual)	1	mo	$ 3,000	$ 3,000	14	$ 42,000
Indoor air sampling equipment costs, (Y7-Y20, annual)	7	each	$ 75	$ 525	14	$ 7,350
Indoor air laboratory costs, (Y7-Y20, annual)	7	each	$ 175	$ 1,225	14	$ 17,150
2 - Indoor Air Monitoring Reporting						
Reporting (Y1-Y3, semiannual)	2	each	$ 3,500	$ 7,000	3	$ 21,000
Reporting (Y4-Y6, annual)	1	each	$ 3,000	$ 3,000	3	$ 9,000
Reporting (Y7-Y20, annual)	1	each	$ 2,500	$ 2,500	14	$ 35,000
3 - Agency Oversight						
Review (Y1-Y3, semiannual)	2	report	$ 372	$ 744	3	$ 2,232
Review (Y4-Y6, annual)	1	report	$ 372	$ 372	3	$ 1,116
Review (Y7-Y20, annual)	1	report	$ 372	$ 372	14	$ 5,208
A. SUBTOTAL COSTS (1 + 2 + 3)						$ 199,000
B. Scope Contingencies (% of A)					10%	$ 20,000
C. Project Management (% of A)					10%	$ 20,000
ESTIMATED TOTAL COST (A + B + C)						**$ 240,000**

Abbreviations

mo = months
QA/QC = quality assurance/quality control
sf = square feet

Notes

1. Cost assumes collection of 1 sample for up to approximately 5,000 sf of floor plan during initial semiannual sampling (12 primary samples), as well as collection of 2 QA/QC samples during each sampling event.
2. Cost assumes a reduction from semiannual to annual sampling after year 3, and a 50% reduction in the number of samples after Year 6.
3. Cost assumes risers will remain in place until building removal.
4. Unit rates based on the following sources: vendor costs obtained from other projects; engineering judgment to extrapolate appropriate costs from other projects.
5. Costs are for the purpose of feasibility study analysis only. Contractor estimates were not obtained for this analysis.