July 31, 2017

Ms. Dilan Roe
Chief – Land Water Division
Alameda County Department of Environmental Health
1131 Harbor Bay Parkway, Suite 250
Alameda, CA 94501-6577

Subject: **Operations, Maintenance, and Monitoring Plan for Permeable Reactive Barrier**
Aster Apartments
6775 Golden Gate Drive
Dublin, California
Assessor's Parcel No. 941-1500-015-09
Post-Closure O&M Document Repository No. RO0003252

Dear Ms. Roe:

Enclosed please find the *Operations, Maintenance, and Monitoring Plan for Permeable Reactive Barrier* associated with the Aster Apartments site at 6755 Golden Gate Drive, in Dublin, California (Post-Closure O&M Document Repository No. RO0003252, GeoTracker Global ID T10000010517). This document was prepared by Amec Foster Wheeler Environment & Infrastructure, Inc., on behalf of Dublin Apartment Properties, LLC. The document was prepared to aid operators in operating, maintaining, and monitoring a permeable reactive barrier adjacent to the property located at 6775 Golden Gate Drive.

I have read and acknowledge the content, recommendations and/or conclusions contained in the attached document or report submitted on my behalf to ACDEH's FTP server and the State Water Resources Control Board's GeoTracker website.

Please contact me at (408) 680-4938 or Avery Whitmarsh of Amec Foster Wheeler at (510) 663-4154 if you have any questions regarding this document.

Sincerely yours,

Pete Beritzhoff
Dublin Apartment Properties, LLC

Attachment: Operations, Maintenance, and Monitoring Plan for Permeable Reactive Barrier

cc: Colleen Winey, Zone 7 Water Agency (electronic copy only)
Gregory Shreeve, City of Dublin (electronic copy only)

OPERATIONS, MAINTENANCE, AND MONITORING PLAN FOR PERMEABLE REACTIVE BARRIER

Aster Apartments
6775 Golden Gate Drive
Dublin, California

Prepared for:

Dublin Apartment Properties, LLC
Dublin, California

Prepared by:

Amec Foster Wheeler Environment & Infrastructure, Inc.
180 Grand Avenue, Suite 1100
Oakland, California 94612

July 2017

Project No. 8617170810.1.1

OPERATIONS, MAINTENANCE, AND MONITORING PLAN FOR PERMEABLE REACTIVE BARRIER
Aster Apartments
6775 Golden Gate Drive
Dublin, California

July 31, 2017
Project 8617170810

This document was prepared by the staff of Amec Foster Wheeler under the supervision of the Geologist whose signature appears hereon.

The findings, recommendations, specifications, or professional opinions are presented within the limits described by the client, in accordance with generally accepted professional engineering and geologic practice. No warranty is expressed or implied.

Douglas C. Bablitch, PE #C64096
Senior Associate Engineer

Avery Whitmarsh, PG #8541
Senior Associate Geologist

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OPERATIONS, MAINTENANCE, AND MONITORING PLAN FOR PERMEABLE REACTIVE BARRIER

Aster Apartments
6775 Golden Gate Drive
Dublin, California

1.0 INTRODUCTION

Amec Foster Wheeler Environment & Infrastructure, Inc. ("Amec Foster Wheeler") has prepared this *Operations, Maintenance, and Monitoring Plan for Permeable Reactive Barrier* ("OMM Plan") on behalf of Dublin Apartment Properties, LLC, to aid operators in operating, maintaining, and monitoring a permeable reactive barrier (PRB) adjacent to the Aster Apartments site at 6775 Golden Gate Drive, Dublin, California (the "site;" Figure 1).[1] The PRB was installed to intercept and treat impacted groundwater that is flowing onto the site from the west.

This OMM Plan was developed to meet the requirements set forth in an August 16, 2013 letter from Alameda County Department of Environmental Health (ACDEH, 2013), the *Final Feasibility Study and Corrective Action Plan* (FS/CAP; AMEC, 2014a), and the *Vapor Mitigation and Permeable Reactive Barrier Basis of Design Report* ("Design Report;" Amec Foster Wheeler, 2015a). The accepted corrective action for the site included installation of a vapor mitigation system (VMS) and a PRB, maintenance and performance monitoring, and long-term site management and institutional controls (IC). The operations, maintenance, and performance monitoring (OMM) of the PRB are discussed in this document. The OMM of the VMS is discussed in the *Operations, Maintenance, and Monitoring Plan for Vapor Mitigation System* ("VMS OMM Plan;" Amec Foster Wheeler, 2017c), long term site management is discussed in the *Site Management Plan* (Amec Foster Wheeler, 2017b), and the *Institutional Controls Plan* summarizes the ICs for the site, which include a deed restriction (Amec Foster Wheeler, 2017a).

1.1 PROJECT BACKGROUND

This section presents a summary of the current site conditions, historical site uses, historical investigations, previous remediation, and redevelopment. More detailed site background information is presented in the Design Report.

[1] The site was formerly known as the Crown Chevrolet North Parcel, with an address at 7544 Dublin Boulevard, Dublin California. The site was previously associated with Site Cleanup Program Case No. RO0003014 and GeoTracker Site ID T10000001616.

1.1.1 Site Current Conditions

The site is bounded by Dublin Boulevard to the north, Golden Gate Drive to the west, St. Patrick Way to the south, and retail businesses to the east. Three residential buildings (Buildings A, C, and D, consisting of four floors of residential apartments) and two mixed-use buildings (Buildings E and F, consisting of ground-floor retail units, with four floors of residential apartments above) are present, in addition to associated hardscape, landscaping, and a pool.

1.1.2 Historical Uses and Layout

The site was developed in 1968 as Crown Chevrolet, a car dealership with auto body and service shops, on land that appears to have been previously used for agricultural purposes. Operations as a car dealership and auto body/repair facility occurred from 1968 until 2013; operations were significantly reduced in the last several years of operation. In December 2014, the four historical site buildings were demolished.

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 environmental case for the south parcel was closed in 2014. In June 2017, the site acreage was further reduced (to 4.73 acres) by a right-of-way dedication that allowed for the City of Dublin to widen Golden Gate Drive.

1.1.3 Historical Investigations and Remediation

Multiple investigations were conducted at the site from 2009 through 2015, as summarized in the FS/CAP; these investigations were performed to address regulatory concerns as well as in support of site property transaction and redevelopment activities.

The investigations identified two main environmental issues at the site. First, VOCs, primarily tetrachloroethene (PCE) and trichloroethene (TCE), have been detected in shallow groundwater and soil vapor throughout the northern portion of the site. Second, chlorobenzenes and related compounds (e.g., 1,2-dichlorobenzene and 1,4-dichlorobenzene) have been detected in soil, shallow groundwater, and soil vapor below former the former auto service building in the central portion of the site. Additionally, a soil investigation was performed during building demolition in 2014 and early 2015 that identified limited areas beneath the former building slabs that were primarily impacted by petroleum hydrocarbons.

Remedial activities were performed to address the chlorobenzenes and petroleum hydrocarbons beneath the historical site buildings. These included excavation of historical sumps and surrounding soil in 2011 (AMEC, 2011) and removal of other subsurface features and impacted soils in 2015 (Amec Foster Wheeler, 2015b). Additionally, a former underground storage tank was removed in 2012 (ENGEO, 2012). The remedial activities successfully addressed the soil impacts to concentrations consistent with protection of human health.

1.1.4 Corrective Actions for Redevelopment

The FS/CAP and Design Report detailed recommendations for a PRB to treat VOC-impacted groundwater as it enters the Site from the west, and a VMS to mitigate potential risks to future building occupants from VOC-impacted soil vapor. The PRB was installed in 2015 (Amec Foster Wheeler, 2016), and the VMS, which includes a vapor barrier and sub-slab depressurization system beneath mixed use commercial and residential buildings at the site, was installed in 2016 during building construction and began operation in May 2017 (Amec Foster Wheeler, 2017d).

The PRB was designed to provide a permeable treatment zone to facilitate dechlorination of PCE-impacted groundwater that flows though the permeable barrier. The specific objectives of the PRB are as follows:

- Provide supplemental protection beyond the VMS.
- Passively treat the core of the groundwater plume to reduce concentrations of PCE and its degradation products entering the site to below levels that may contribute to a vapor intrusion concern.
- Reduce the mass flux of PCE entering the site so that VOC concentrations in groundwater within the site can decline.
- Provide long-term treatment efficacy with a passive system that has minimal operational requirements and little generation of waste during its operational lifetime.

The performance of the PRB is monitored by three upgradient and three in-barrier performance monitoring wells; additionally, five on-site monitoring wells provide information regarding groundwater flow directions and concentration trends (Figure 2). Concentrations of PCE in groundwater at the downgradient side of the PRB should decrease over time, which should also reduce soil vapor concentrations to be addressed by the VMS.

OMM of this PRB, as well as monitoring of the on-site wells, is discussed in the following sections of this document. The OMM of the VMS is discussed in the VMS OMM Plan.

1.2 KEY PERSONNEL

Multiple personnel are involved in the OMM of the PRB; a list of key personnel, their primary responsibilities with respect to the OMM, and specific contact information are provided in Appendix A. Appendix A will be updated as needed when any key personnel (or their contact information) change. Subsequent references to these roles within this OMM Plan will refer to the personnel roles by title only, so that changes to the assigned roles require only that Appendix A be updated. The primary entities referenced in this Plan include the following:

- Owner – Current property owner or their agent responsible for managing the property at any given time. The Site is currently owned and operated by Dublin Apartment Properties, LLC.

- OMM Contractor – Party retained by Owner responsible for managing and performing OMM activities.

1.3 PROCEDURE FOR REVISING OMM PLAN

This OMM Plan will be updated to ensure that all information is accurate and fully describe all OMM procedures. The evaluation checklist will be completed annually and the OMM Plan updated as necessary.

Evaluation Checklist		Yes	No
1.	Have the contacts listed in the original OMM Manual Appendix A changed?		
2.	Has there been a change to the process?		
3.	Have additional tasks been added to the project, which were not originally addressed in the plan?		
4.	Have new contaminants or higher than anticipated levels of original contaminants been encountered?		
5.	Have other safety, equipment, activity or environmental hazards been encountered that are not addressed in the manual?		

The OMM Contractor shall perform OMM Plan updates as follows:

1. Determine need to update OMM Plan based on Evaluation Checklist above.
2. Prepare changes and updates for review.
3. Provide to Owner for review.
4. Sign off, finalize and reissue modified sections.
5. Distribute addenda to all holders for insertion and/or replacement, with instructions to dispose of all outdated sections or copies where appropriate.

1.4 HEALTH AND SAFETY

The OMM Contractor is responsible for maintaining a site-specific Health and Safety Plan (HASP) related to the OMM activities. The HASP will include activity hazard analyses for the tasks required by this OMM Plan. Any additional subcontractors that perform work related to OMM activities are responsible for maintaining a separate HASP related to, at a minimum, general site safety and the work the contractor has been hired to perform. The site HASP shall be the primary source for current health and safety requirements. A copy of the HASP must be kept on site and must be accessible to personnel performing the tasks described herein.

1.5 PERFORMANCE MONITORING WELL AND ON-SITE MONITORING WELL ACCESS

The PRB is located within the public right-of-way beneath an active roadway. Access to the upgradient and in-barrier performance monitoring wells requires partially obstructing a lane of traffic along Golden Gate Drive. The on-site monitoring wells are located in the northern portion of the site, accessible from Golden Gate Drive. Vehicle parking adjacent to the PRB and access to the on-site well locations will be arranged with the Owner.

1.6 PERSONNEL TRAINING AND LICENSE REQUIREMENTS

Field personnel are required to have 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training, as outlined in 29 Code of Federal Regulations (CFR) Part 1910.120. This includes initial training and 8 hours of current annual refresher training and medical surveillance.

If, in the future, it is determined that one or more waste streams associated with PRB OMM are classified as hazardous waste, operators or subcontractors involved in shipping and transporting the waste off-site will consequently be required to have Department of Transportation Hazardous Materials Transportation training meeting the requirements of 49 CFR Part 172.702.

OMM report documents will be prepared under the direction of and reviewed by a California Professional Engineer. There are no license requirements to perform OMM for the PRB.

2.0 PRB DESIGN DESCRIPTION

The PRB is an approximately 146-foot-long permeable trench backfilled with a treatment media consisting of a zero valent iron (ZVI) and sand mixture (Figure 2). The PRB intersects the shallow groundwater zone to intercept and treat impacted off-site groundwater entering the site from the west. The treatment media is significantly more permeable than the native soils which allows groundwater to flow passively through the PRB under natural hydraulic gradients; no pumping is required. The PRB is keyed into the underlying clay in order to prevent underflow of shallow groundwater affected by VOCs beneath the PRB.

The functionality of the PRB is based on ZVI-facilitated reductive dechlorination. A detailed description of the PRB's functionality is described in the Design report, which also includes additional information related to the PRB design. As-build record drawings of the PRB are included in Appendix B.

3.0 PERFORMANCE MONITORING

This section addresses the monitoring program objectives, monitoring well networks, and monitoring methodology and frequency.

3.1 OBJECTIVES

The overall objective of the performance monitoring program is to evaluate whether the PRB functional requirements are being met. Specific objectives of the performance monitoring program are to:

1. Assess the physical integrity of the PRB;
2. Monitor and assess the destruction of VOCs in groundwater moving through the PRB; and
3. Verify the hydraulic performance of the PRB.

3.2 MONITORING WELL NETWORKS

The PRB performance monitoring well network consists of groundwater monitoring wells installed both within and upgradient of the PRB (installed in November 2016). Three in-barrier monitoring wells (PRB-01 through PRB-03) are paired with three upgradient wells (MW-04 through MW-06). The locations of the performance monitoring wells are shown on Figure 2.

Additionally, five groundwater monitoring wells are located on site (downgradient of the PRB). The on-site monitoring wells replaced wells that were destroyed in December 2014 so that groundwater monitoring could resume following completion of site redevelopment (AMEC, 2014b). Although these wells are not considered to be PRB performance monitoring wells, they will be sampled at the same time as the PRB performance monitoring wells (using the same methods) to provide additional information regarding groundwater movement and quality, and are therefore discussed in this document.

The network of six PRB performance monitoring wells and five on-site monitoring wells provides data regarding concentration trends within the plume core and groundwater flow directions. Boring logs and well construction details for the PRB performance monitoring wells and the on-site monitoring wells are included in Appendix C.

3.3 MONITORING AND INSPECTION ACTIVITIES METHODOLOGY

The routine PRB performance monitoring includes the following activities in order to meet the performance monitoring objectives described in Section 3.1:

1. Above-ground visual inspections to monitor the physical integrity of the PRB and its components;
2. Groundwater quality monitoring to assess the treatment performance of the PRB; and
3. Groundwater level monitoring to assess the movement of groundwater in the vicinity of the PRB.

Additionally, groundwater levels and water quality monitoring will be conducted concurrently at the on-site wells.

Appendix D provides a description of the methodology for the PRB performance monitoring and inspection activities and the monitoring of the on-site wells, and includes examples of applicable field forms. Appendix D also includes planned routine laboratory analyses for the PRB performance monitoring groundwater samples, in addition to potential additional analyses that may be performed if PRB performance issues are identified.

3.4 WASTE HANDLING

Groundwater monitoring activities may generate investigation-derived wastes (IDW), including rinse water from equipment decontamination. Additionally, groundwater sampling activities may generate purge water. The IDW will be containerized in Department of Transportation–

approved 55-gallon drums and temporarily stored on site, pending waste profiling prior to disposal. The IDW will be transported, handled, and disposed of at an off-site facility in accordance with state and local requirements.

3.5 MONITORING FREQUENCY

The PRB and on-site groundwater monitoring events will be conducted quarterly for the first two years of PRB operation (i.e., in 2017 and 2018). The monitoring will be conducted annually for years three through five (i.e., 2019 through 2021).

The PRB and on-site groundwater monitoring will be conducted as part of two separate phases, as follows:

1. The performance monitoring phase is anticipated to occur during the first two years of monitoring.
2. Following confirmation of two years of effective treatment, based on the groundwater results during the performance monitoring phase, the monitoring will transition into an operations and maintenance (O&M) phase. The confirmation of effective treatment and the transition to the O&M phase are subject to ACDEH approval.

The OMM Contractor in coordination with the Owner will determine if a transition to O&M phase is appropriate, based on the performance data collected, and seek approval from ACDEH.

3.6 RECORD MANAGEMENT

Monitoring and inspection activities will be documented on the PRB Inspection Form (included in Appendix D). All completed PRB Inspection Forms will be retained by the OMM Contractor. The OMM Contractor will provide copies of maintenance and monitoring records to be maintained on site.

A copy of this OMM Plan, inclusive all updates or addenda, will be maintained on site. The on-site storage area for these documents and other environmental records is located within the leasing office. Additionally, all relevant environmental documents for the site will be retained in ACDEH's Post-Closure O&M Document Repository No. RO0003252.

4.0 DATA EVALUATION

Data evaluation will occur following each monitoring event and annually, as described below.

4.1 QUARTERLY EVALUATION

The quarterly inspection observations will be reviewed following each event to determine if the condition of the PRB or performance monitoring wells has been impacted since the most recent inspection. Following receipt and validation of the laboratory analytical data for groundwater samples, the results will be compared to prior site data to evaluate performance over time.

The PRB's treatment performance will be evaluated on a quarterly basis by comparing the upgradient monitoring well concentrations to the in-barrier monitoring well concentrations. The treatment objectives are considered met if the in-barrier concentrations are significantly reduced compared to upgradient concentrations. The in-barrier monitoring wells are located approximately halfway through the 2-foot width of the PRB; however, treatment will not occur linearly within the PRB because the reductive dechlorination reaction is a first-order (i.e., non-linear) reaction. Expected PCE reductions at the in-barrier well locations are estimated to range from one-half to as low as one-tenth of the influent concentration. The effluent concentration at the full flow-through thickness of can be estimated based on the influent and mid-barrier concentrations. Treatment performance is considered acceptable if PCE concentrations in each in-barrier well are less than one-half of that in the associated upgradient performance monitoring well. If these criteria are not met at any well pair for three consecutive sampling events additional analysis will be required, as discussed in Section 5.0.

Groundwater elevations will be reviewed to compare upgradient and in-barrier elevations. Groundwater elevations within the PRB should be slightly lower or similar to upgradient wells, with no evidence of groundwater mounding behind the PRB.

4.2 ANNUAL EVALUATION

Following collection of at least four quarters of analytical data, concentration trends in on-site monitoring wells will be evaluated using Mann-Kendall methodology, a non-parametric statistical evaluation that uses the relative magnitudes of the data to evaluate the probability that a concentration trend (positive or negative) exists.

5.0 NON-ROUTINE ACTIVITIES

If data from the performance monitoring well pairs indicate that the PRB may not be functioning as expected, additional samples may be collected and analyzed for non-VOC analytes, following discussion with ACDEH. Several non-VOC analytes that may be useful in characterizing PRB performance issues are identified in Appendix D.

If PRB performance issues are identified, corrective actions may be required. Any corrective actions will be determined by a Professional Engineer licensed in the State of California in consultation with, and following approval by, ACDEH.

6.0 PROTECTION PLAN

The following sections summarize physical protection measures and best management practices intended to increase the longevity and effectiveness of the PRB.

6.1 PHYSICAL PROTECTION

Physical protection measures were implemented during PRB construction with the intent of eliminating or making negligible the potential for inadvertent excavation into the PRB at a future date.

The following physical protection measures have been implemented:

- The top of the PRB treatment media (i.e., approximately 9 feet below grade) makes it unlikely that typical trenching for shallow utilities will result in damage to the PRB. The backfill above the PRB consists of controlled density fill (CDF) and pavement materials. If trenching is conducted above the PRB, the CDF will first be encountered by construction crews performing trenching activities in the area, alerting them to the presence of underground construction.
- Detectable metallic tape has been installed along the CDF alignment immediately below the road pavement subbase materials. The tape can be detected from the ground surface using standard utility locating equipment, and can be used to identify the PRB location with a high degree of precision.
- The location of the PRB is registered with Underground Service Alert of Northern California (USA). Parties planning subsurface work are required by law to outline the proposed work in white paint and notify USA. If the work is planned within the vicinity of the PRB, USA will notify the Owner, who will be responsible for marking the location of the PRB on the ground and notifying the party planning subsurface work of its presence. The Owner will also ensure that utility workers or contractors who create a ticket through USA have access to this plan and follow its requirements.

6.2 BEST MANAGEMENT PRACTICES

The following best management practices are intended to prevent reductions in PRB longevity and effectiveness resulting from ordinary site practices:

- As-built record drawings of the PRB system are maintained at the site as part of this OMM Plan. These drawings will be referenced in the event that subsurface excavations are conducted in the vicinity of the PRB at a future date to minimize the potential for inadvertently excavating into the PRB.
- Visual inspections of the PRB will be conducted during performance monitoring site inspections, as described in Section 3.3 and Appendix D.
- The quarterly PRB inspection results will be reported to ACDEH. The need for any repairs or maintenance will first be discussed with ACDEH and any repairs or maintenance performed will be documented, as described below.

7.0 REPORTING

Requirements for both routine and non-routine reporting are discussed in the following sections.

7.1 ROUTINE REPORTING

Following completion of each site inspection and performance monitoring event, the Owner or OMM Contractor will provide ACDEH via email a copy of the site inspection reports, validated and tabulated analytical data, and a statement certifying IC compliance indicating that all IC objectives have been maintained. The email will include confirmation that the PRB is operating as intended or note if any performance issues have been identified.

Comprehensive monitoring reports, including the analytical results from the PRB performance monitoring wells and on-site monitoring wells and an evaluation of performance, will be submitted on an annual basis. Where appropriate, the submittals for the PRB may be coordinated with the submittals for the VMS to simplify reporting.

7.2 NON-ROUTINE REPORTING

Additional reporting requirements beyond routine reporting will apply when any site conditions out of compliance with ICs or the requirements of this OMM plan are identified. Upon determining lack of compliance, the Owner or OMM Contractor will notify ACDEH with a written explanation 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 will also be provided.

If any corrective actions are required to address performance issues with the PRB, a work plan for the corrective action will be provided to ACDEH for review and approval prior to implementation. Additionally a report documenting the corrective action will be provided to ACDEH following implementation.

8.0 REFERENCES

Alameda County Health Care Services Agency, Department of Environmental Health (ACDEH), 2013. Fuel Leak Case No. RO0003014 and GeoTracker Global ID T00000001616, Crown Chevrolet Cadillac Isuzu, 7544 Dublin Boulevard and 6707 Golden Gate Drive, Dublin, California, 94568, August 16.

AMEC Environment & Infrastructure, Inc. (AMEC), 2014a. Final Feasibility Study and Corrective Action Plan, Crown Chevrolet Cadillac Isuzu, 7544 Dublin Boulevard and 6707 Golden Gate Drive, Dublin, California, May 1.

AMEC, 2014b. Revised Additional Investigation and Soil Removal Work Plan, Crown Chevrolet Cadillac Isuzu, 7544 Dublin Boulevard, Dublin, California, August 27.

Amec Foster Wheeler Environment & Infrastructure, Inc. (Amec Foster Wheeler), 2015a. Vapor Mitigation and Permeable Reactive Barrier Basis of Design Report, Crown Chevrolet Cadillac Isuzu, 7544 Dublin Boulevard, Dublin, California, June 11.

Amec Foster Wheeler, 2015b. Post-Demolition Investigation and Soil removal Completion Report, Former Crown Chevrolet North Parcel, 7544 Dublin Boulevard, Dublin, California, June 26.

Amec Foster Wheeler Environment & Infrastructure, Inc., 2016. Dublin Apartments Permeable Reactive Barrier Construction Completion Certification, Former Crown Chevrolet North Parcel, 7544 Dublin Boulevard, Dublin, California, January 28.

Amec Foster Wheeler Environment & Infrastructure, Inc., 2017a. Institutional Controls Plan, Aster Apartments, 6775 Golden Gate Drive, Dublin, California, May 9.

Amec Foster Wheeler Environment & Infrastructure, Inc., 2017b. Site Management Plan, Aster Apartments, 6775 Golden Gate Drive, Dublin, California, July.

Amec Foster Wheeler Environment & Infrastructure, Inc., 2017c. Operations, Maintenance, and Monitoring Plan for Vapor Mitigation System, Aster Apartments, 6775 Golden Gate Drive, Dublin, California, July.

Amec Foster Wheeler Environment & Infrastructure, Inc., 2017d. Vapor Mitigation System Construction Completion Certification, Aster Apartments, 6775 Golden Gate Drive, Dublin, California, July 17.

AMEC Geomatrix, Inc. (AMEC), 2011. Remediation Report, Crown Chevrolet Cadillac Isuzu, 7544 Dublin Boulevard and 6707 Golden Gate Drive, Dublin, California, Fuel Leak Case No. RO003014, December 21.

ENGEO, Inc. (ENGEO), 2012. Underground Storage Tank Removal Report, UST Closure Permit #SR0021261, Crown Chevrolet Cadillac Isuzu, 7544 Dublin Boulevard and 6707 Golden Gate Drive Fuel Leak Case No. RO0003014, Dublin, California, December 20.

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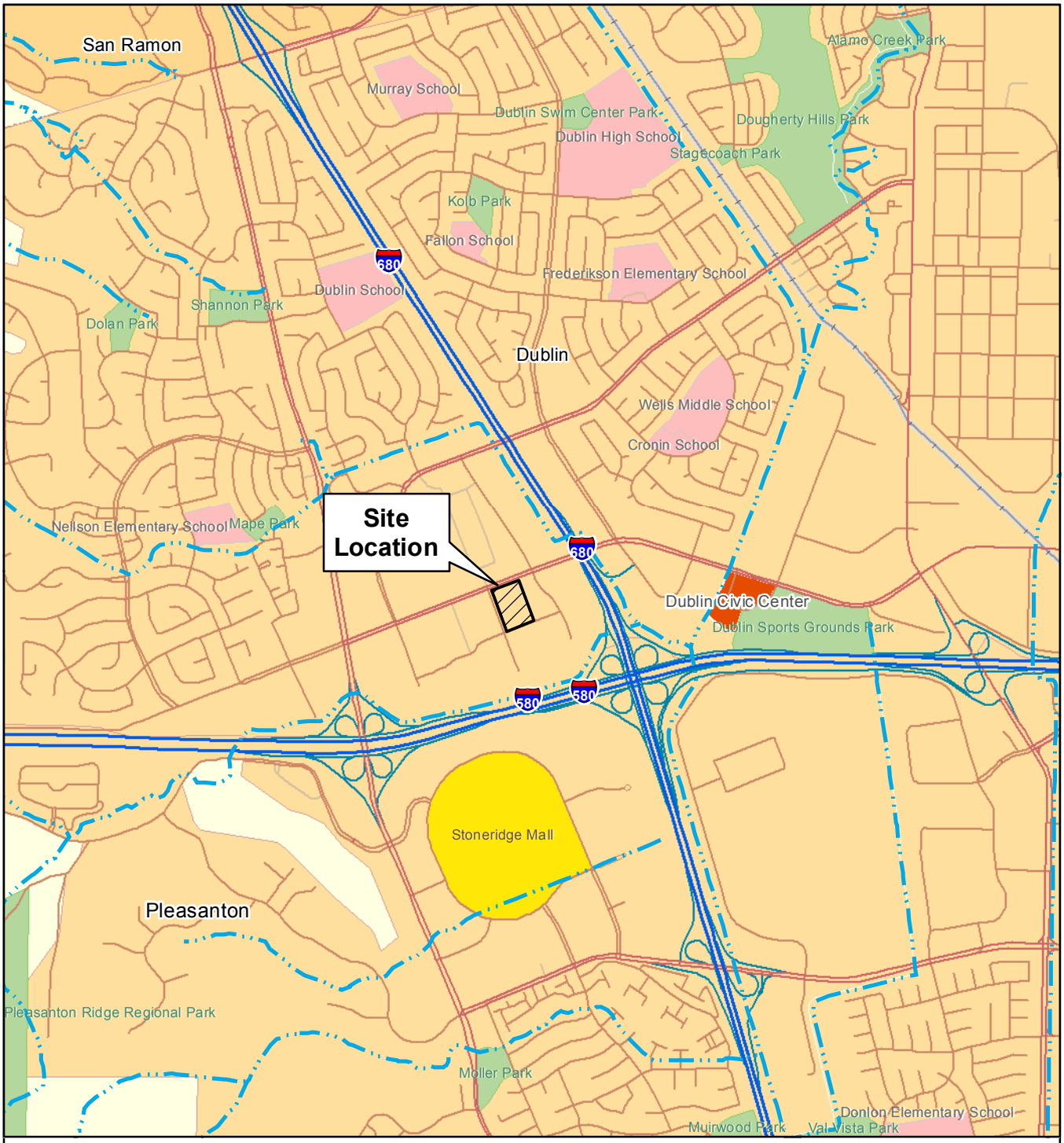
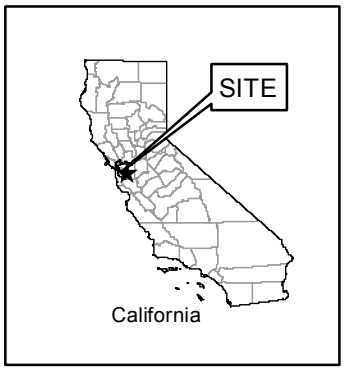
FIGURES



Street map from ESRI, 2007.



0 2,000 4,000 Feet

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SITE LOCATION MAP
Aster Apartments
6775 Golden Gate Drive
Dublin, California

amec foster wheeler

Date: 07/17/2017 | Project No. 8617170810.1.1

Figure 1

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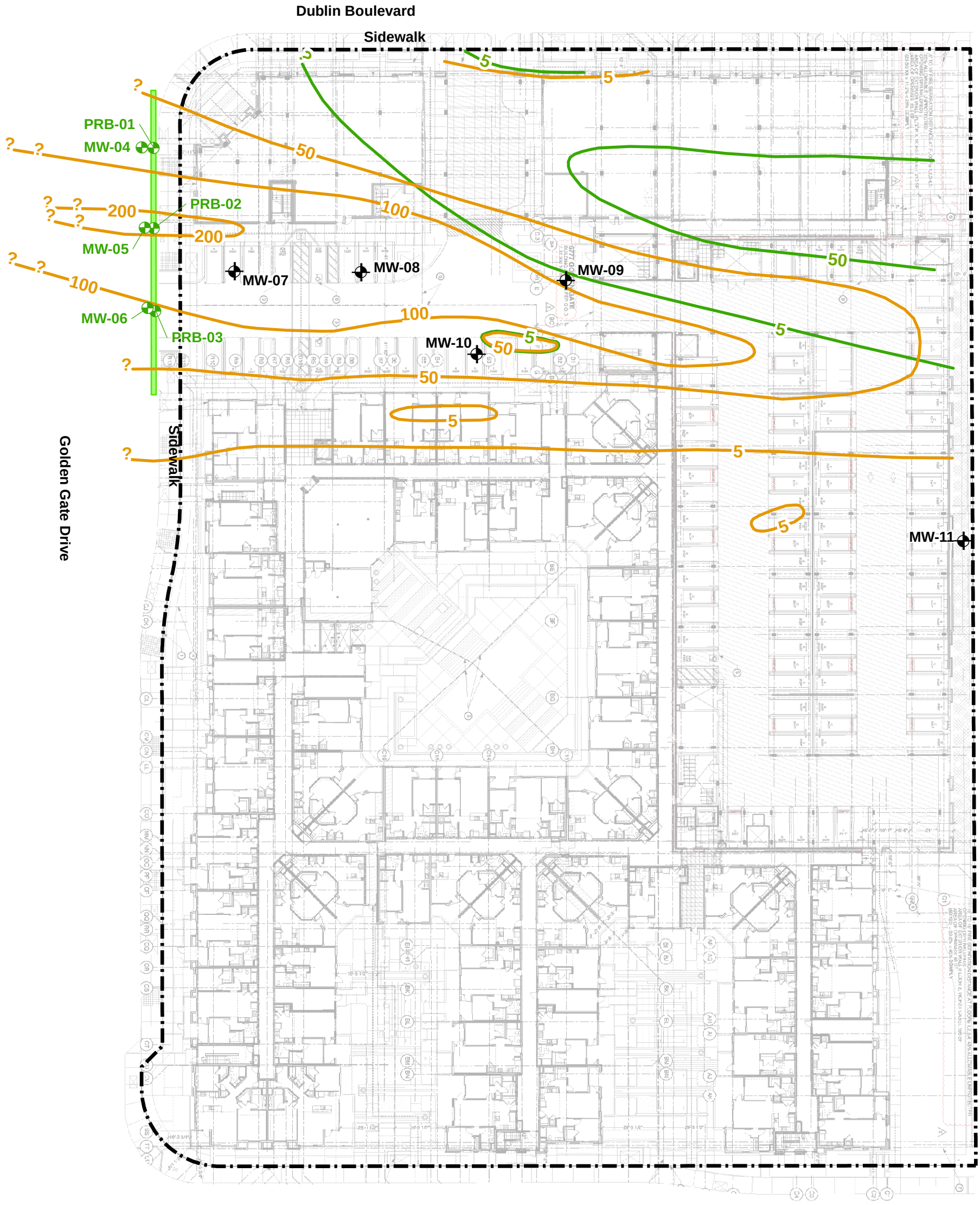

Explanation

- PRB performance monitoring well location
- On-site monitoring well location
- 50 — Approximate line of equal PCE concentration (2012)
- 50 — Approximate line of equal TCE concentration (2012)
- Extent of permeable reactive barrier
- Property line and deed restriction area

Abbreviations:
PCE = tetrachloroethene
TCE = trichloroethene

Notes:
1. Units for lines of equal concentration are micrograms per liter.
2. PRB performance monitoring wells are paired, with one in barrier, and the other upgradient with an approximate 5 foot offset.
3. Locations of structures and foundation layouts provided by Carlon, Barbee, & Gibson, Inc., and BDE Architecture in January 2015. Building site plan and interior details provided by BDE Architecture, dated 02/28/2017.

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0 50

APPROXIMATE SCALE IN FEET

PRB AND MONITORING WELL NETWORK
Aster Apartments
6775 Golden Gate Drive
Dublin, California

amec foster wheeler

Date: 07/21/2017 | Project No. 8617170810.1.1

Figure 2

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APPENDIX A

Key Personnel

APPENDIX A

KEY PERSONNEL

Aster Apartments
6775 Golden Gate Drive
Dublin, California

Project Role	Entity	Title	Contact	Primary Responsibilities
Owner	Dublin Apartment Properties, LLC	Project Manager	Pete Beritzoff (408) 680-4938 (cell)	• Report directly to ACDEH • Ensure that OMM activities are conducted according to the Plan • Coordinate site access between OMM Manager and Site Manager
		Site Manager	Adam Lambert (415) 509-1441 (cell)	• Provide site access for OMM Manager
OMM Contractor	Amec Foster Wheeler Environment & Infrastructure, Inc.	Project Manager	Avery Whitmarsh (510) 663-4154 (office) (415) 378-3912 (cell)	• Report directly to Owner • Ensure that OMM activities are conducted according to the Plan
		OMM Manager	Alex Rosenthal (510) 663-4152 (office) (510) 301-4943 (cell)	• Oversee and/or perform OMM activities according to the Plan
Regulator	Alameda County Department of Environmental Health	Chief – Land Water Division	Dilan Roe (510) 567-6767 (office)	• Provide regulatory oversight for environmental work at the site.

Note
1. This table will be updated as responsible entities and/or contact information changes.

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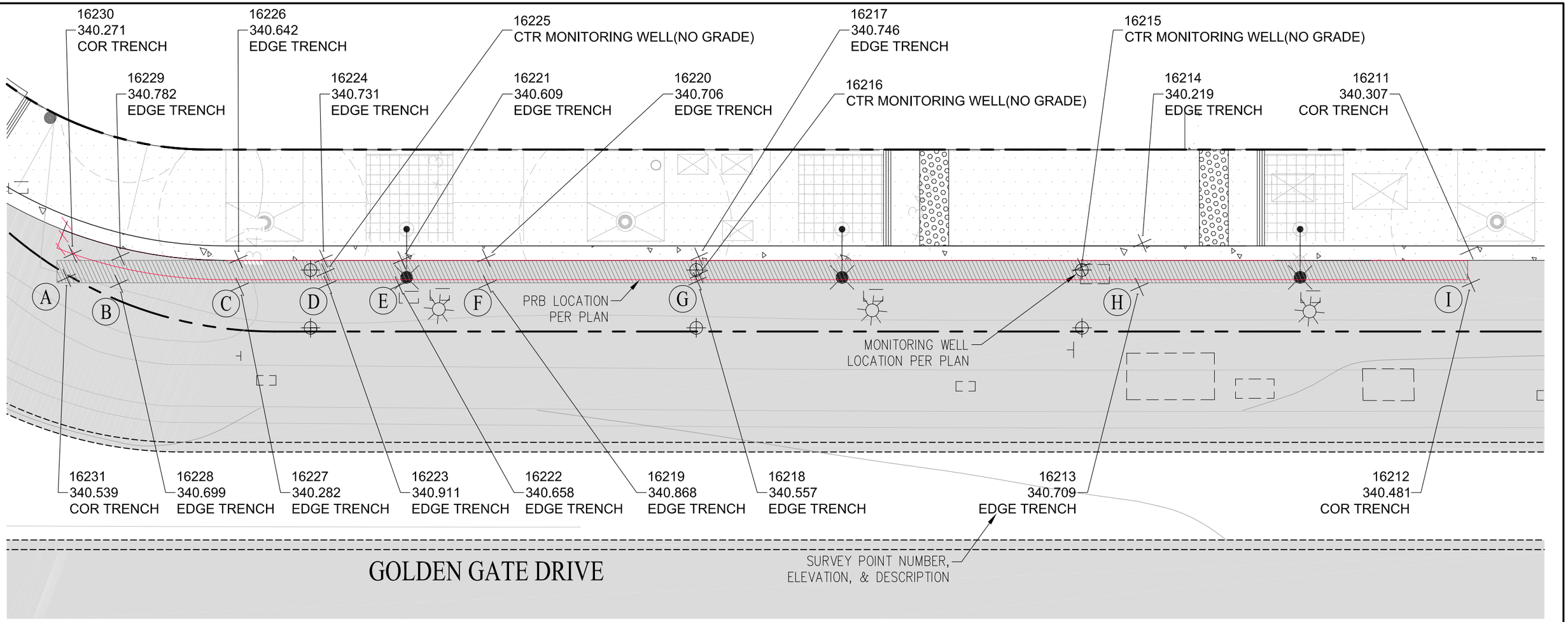
APPENDIX B

As-Built Record Drawings



AS BUILT PRB TRENCH WIDTH	
LOCATION	WIDTH (FT)
A	2.54
B	2.85
C	2.88
D	2.67
E	2.63
F	2.73
G	2.55
H	4.55
I	3.37

LEGEND

PRB LOCATION PER AMEC IMPROVEMENTS PLANS

APPROXIMATE SUBSURFACE PRB LOCATION AS CONSTRUCTED, SEE NOTE 2

NOTES:

1. PRB AS-BUILT LOCATION, WIDTH, & ELEVATIONS ARE BEING SHOWN IN COMPARIOSON TO THE ULTIMATE BUILD OUT CONDITION FOR GOLDEN GATE DRIVE.

2. THE SURVEY REFLECTS THE EXPRESSION OF THE PRB TRENCH BACKFILL AT THE SURFACE, THE SHADED PRB LOCATION INDICATES THE ESTIMATED PRB LOCATION AT DEPTH.

Note: Elevations relative to National Geodetic Vertical Datum of 1929

6775 GOLDEN GATE DRIVE
PRB AS BUILT

CITY OF DUBLIN ALAMEDA COUNTY CALIFORNIA

DATE: NOVEMBER, 2015
SCALE: 1"=10'

cbg
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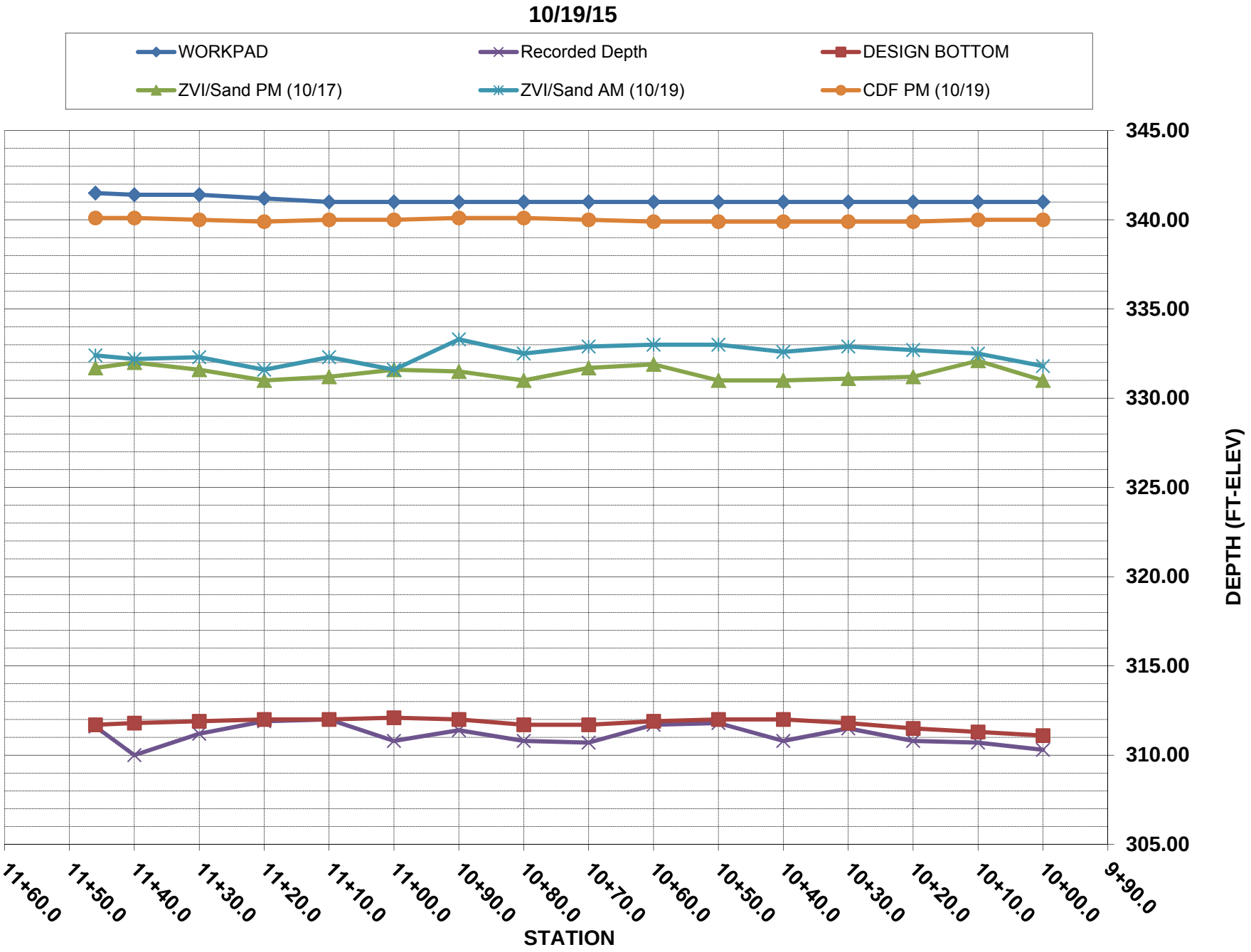
ASTER APARTMENTS
6775 GOLDEN GATE DRIVE
PERMEABLE REACTIVE BARRIER



Note: Elevations relative to National Geodetic Vertical Datum of 1929

amec foster wheeler

APPENDIX C

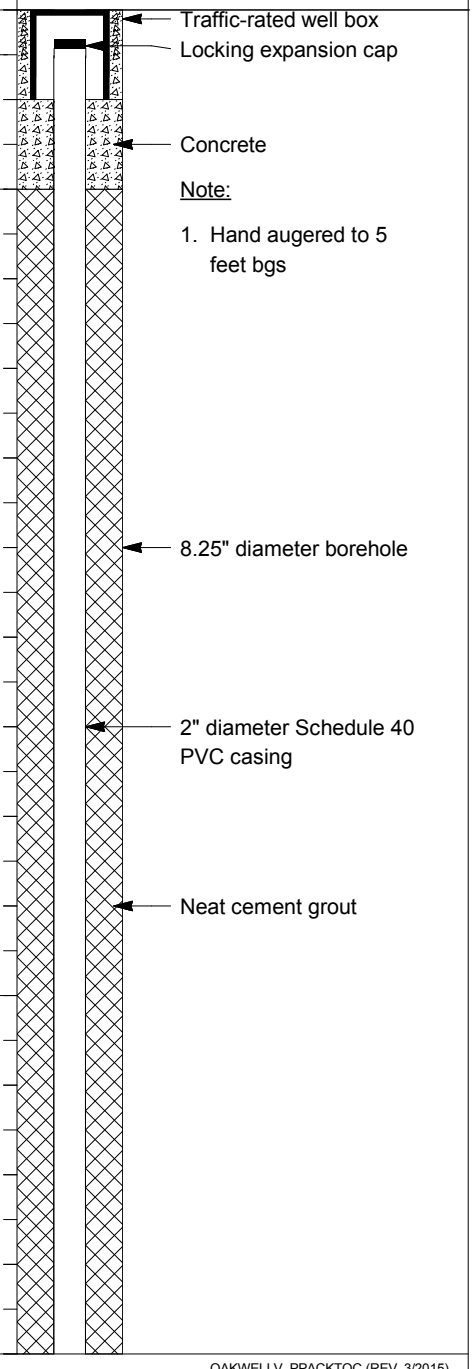
Boring Logs and Well Construction Diagrams

PROJECT: Aster Apartments 6775 Golden Gate Drive, Dublin, California			**Log of Well No. Explanation**
BORING LOCATION:		TOP OF CASING ELEVATION AND DATUM:	
DRILLING CONTRACTOR:		DATE STARTED:	DATE FINISHED:
DRILLING METHOD:		TOTAL DEPTH (ft.): 15.0	SCREEN INTERVAL (ft.):
DRILLING EQUIPMENT:		DEPTH TO WATER (ft.): FIRST / COMPL.	CASING:
SAMPLING METHOD:		LOGGED BY:	
HAMMER WEIGHT:	DROP:	RESPONSIBLE PROFESSIONAL:	REG. NO.

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation:	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
1–15					**Notes:** 1. Soil described using visual-manual procedures of American Society of Testing and Materials (ASTM) Standard D 2488 for guidance; a Standard based on the Unified Soil Classification System. 2. Soil color described according to Munsell Color Chart. 3. Dashed lines separating soil strata represent inferred boundaries between sampled intervals that may be abrupt or gradual transitions. 4. Solid lines represent approximate boundaries observed within sample intervals. 5. OVM = organic vapor meter, reading in volumetric parts per million (ppm). Interval of recovered soil collected with a continuous core sampler. Interval of non-recovery	

PROJECT: Aster Apartments 6775 Golden Gate Drive, Dublin, California	**Log of Well No. MW-04**
BORING LOCATION: Northing: 2081942.9704, Easting: 6148208.8202	TOP OF CASING ELEVATION AND DATUM: 339.90 feet (NGVD 29)
DRILLING CONTRACTOR: Gregg Drilling & Testing, Inc.	DATE STARTED: 11/8/16 / DATE FINISHED: 11/8/16
DRILLING METHOD: Direct push/Hollow-stem auger	TOTAL DEPTH (ft.): 27.0 / SCREEN INTERVAL (ft.): 18.4 - 22.9
DRILLING EQUIPMENT: Marl M5T	DEPTH TO WATER (ft.): FIRST 15.8, COMPL. 10.30 / CASING: 2" Sch. 40 PVC
SAMPLING METHOD: MC5 Sampling System [1.5" x 4.0']	LOGGED BY: A. Rosenthal
HAMMER WEIGHT: NA / DROP: NA	RESPONSIBLE PROFESSIONAL: A. Rosenthal / REG. NO. PG 9387

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 340.54' (NGVD 29)
0					ASPHALTIC CONCRETE (approximately 6 inches)
					AGGREGATE BASE (approximately 18 inches)
1					
2					LEAN CLAY with SAND (SC): dark grayish brown (10YR 4/2), moist, 85% low plasticity fines, 15% fine sand, firm
3					
4					grayish brown (10YR 5/2), 80% low plasticity fines, 20% fine sand
5					
6					
7					
8					
9					
10					
11					LEAN CLAY (CL): grayish brown (10YR 5/2), moist, 95% low plasticity fines, 5% fine sand, hard
12					
13					
14					
15					



WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS

OAKWELLV_PPACKTOC (REV. 3/2015)

PROJECT: Aster Apartments
6775 Golden Gate Drive, Dublin, California

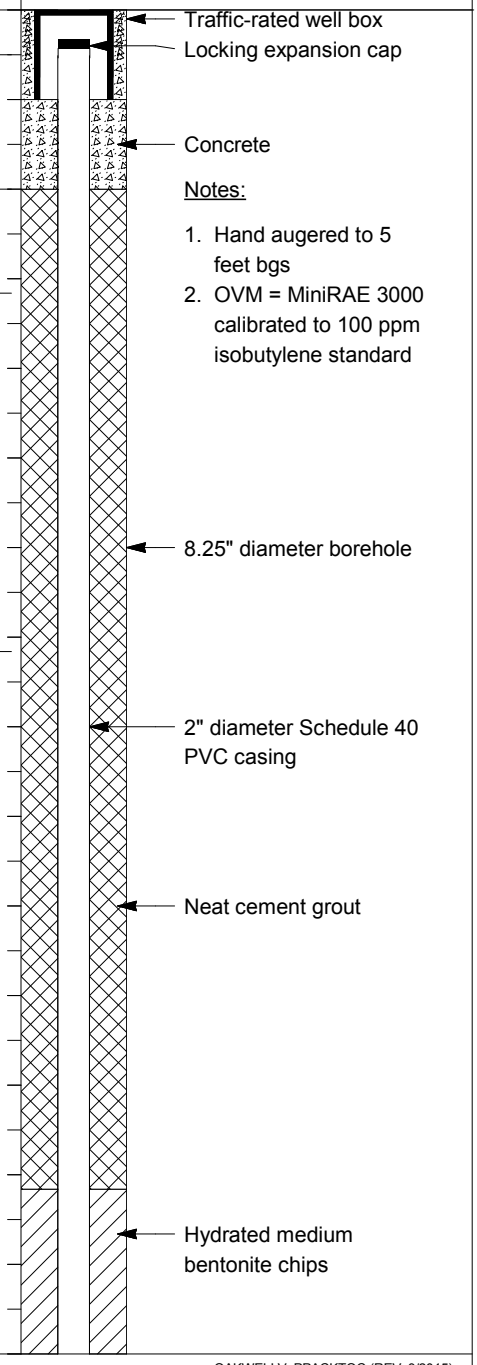
Log of Well No. MW-04 (cont'd)

DEPTH (feet)	SAMPLES Sample No.	SAMPLES Sample	SAMPLES Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
16					LEAN CLAY (CL): continued	
					CLAYEY SAND (SC): grayish brown (10YR 5/2), wet, 60% fine sand, 40% low plasticity fines	Hydrated medium bentonite chips
17					SANDY LEAN CLAY (CL): grayish brown (10YR 5/2), moist, 70% low plasticity fines, 30% fine sand, soft	8.25" diameter borehole
18						2" diameter Schedule 40 PVC casing
19						
20						#2/12 filter pack sand
					Note: free water observed inside acetate liner	
21						2" diameter Schedule 40 PVC, 0.010" slot screen
22						
23					60% low plasticity fines, 40% fine sand	2" diameter Schedule 40 PVC endcap
24						
						Direct push pilot boring
25						
						Hydrated medium bentonite chips
26					LEAN CLAY with SAND (CL): grayish brown (10YR 5/2), moist, 85% low plasticity fines, 15% fine sand, firm	
						Native backfill
27					Bottom of boring at 27.0 feet	
28						
29						
30						
31						
32						
33						

OAKWELLV_PPACKTOC (REV. 3/2015)

PROJECT: Aster Apartments 6775 Golden Gate Drive, Dublin, California	**Log of Well No. MW-05**
BORING LOCATION: Northing: 2081907.5004, Easting: 6148223.7862	TOP OF CASING ELEVATION AND DATUM: 339.64 feet (NGVD 29)
DRILLING CONTRACTOR: Gregg Drilling & Testing, Inc.	DATE STARTED: 11/9/16 / DATE FINISHED: 11/9/16
DRILLING METHOD: Direct push/Hollow-stem auger	TOTAL DEPTH (ft.): 27.2 / SCREEN INTERVAL (ft.): 16.7 - 21.2
DRILLING EQUIPMENT: Marl M5T	DEPTH TO WATER (ft.): FIRST 16.0, COMPL. 9.80 / CASING: 2" Sch. 40 PVC
SAMPLING METHOD: MC5 Sampling System [1.5" x 4.0']	LOGGED BY: A. Rosenthal
HAMMER WEIGHT: NA / DROP: NA	RESPONSIBLE PROFESSIONAL: A. Rosenthal / REG. NO. PG 9387

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.
					Surface Elevation: 340.42' (NGVD 29)
					ASPHALTIC CONCRETE (approximately 6 inches)
					AGGREGATE BASE (approximately 18 inches)
1					
2					CLAYEY GRAVEL with SAND (GC): brown (10YR 4/3), moist, 40% fine to coarse gravel, 30% fine to coarse sand, 30% low plasticity fines [FILL]
3					
4					LEAN CLAY with SAND (CL): grayish brown (10YR 5/2), moist, 80% low plasticity fines, 20% fine sand, firm
5		X			
6				0	
7				0	
8				0	LEAN CLAY (CL): grayish brown (10YR 5/2), moist, 95% low plasticity fines, 5% fine sand, firm
9				0	
10				0	
11				0	
12				0	
13				0	
14				0	
15					



PROJECT: Aster Apartments
6775 Golden Gate Drive, Dublin, California

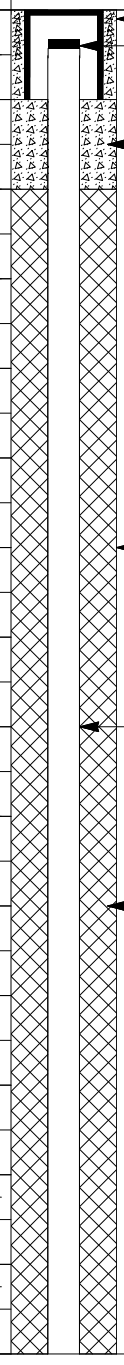
Log of Well No. MW-05 (cont'd)

DEPTH (feet)	SAMPLES Sample No.	SAMPLES Sample	SAMPLES Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
16				0	LEAN CLAY (CL): continued	
					CLAYEY SAND (SC): wet	2" diameter Schedule 40 PVC casing
17				0		8.25" diameter borehole
18				0		
					CLAYEY SAND (SC): wet	
19				0		2" diameter Schedule 40 PVC, 0.010" slot screen
					CLAYEY SAND (SC): grayish brown (10YR 5/2), wet, 70% fine sand, 30% low plasticity fines	
20				0		#2/12 filter pack sand
21				0	SANDY LEAN CLAY (CL): grayish brown (10YR 5/2), moist, 70% low plasticity fines, 30% fine sand, firm	2" diameter Schedule 40 PVC endcap
22				0		
23				0		Direct push pilot boring
24				0		Hydrated medium bentonite chips
25				0		
					LEAN CLAY (CL): grayish brown (10YR 5/2), moist, 95% low plasticity fines, 5% fine sand, hard	
26				0		
27				0		
					Bottom of boring at 27.2 feet	
28						
29						
30						
31						
32						
33						

OAKWELLV_PPACKTOC (REV. 3/2015)

PROJECT: Aster Apartments 6775 Golden Gate Drive, Dublin, California	**Log of Well No. MW-06**
BORING LOCATION: Northing: 2081871.6774, Easting: 6148238.7942	TOP OF CASING ELEVATION AND DATUM: 339.60 feet (NGVD 29)
DRILLING CONTRACTOR: Gregg Drilling & Testing, Inc.	DATE STARTED: 11/10/16 / DATE FINISHED: 11/10/16
DRILLING METHOD: Direct push/Hollow-stem auger	TOTAL DEPTH (ft.): 28.0 / SCREEN INTERVAL (ft.): 19.4 - 23.9
DRILLING EQUIPMENT: Marl M5T	DEPTH TO WATER (ft.): FIRST 19.5, COMPL. 8.82 / CASING: 2" Sch. 40 PVC
SAMPLING METHOD: MC5 Sampling System [1.5" x 4.0']	LOGGED BY: A. Rosenthal
HAMMER WEIGHT: NA / DROP: NA	RESPONSIBLE PROFESSIONAL: A. Rosenthal / REG. NO. PG 9387

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 340.20' (NGVD 29)
0					ASPHALTIC CONCRETE (approximately 6 inches)
0.5					AGGREGATE BASE (approximately 18 inches)
2					CLAYEY GRAVEL with SAND (GC): brown (10YR 4/3), moist, 40% fine to coarse gravel, 30% fine to coarse sand, 30% low plasticity fines [FILL]
3					LEAN CLAY with SAND (CL): dark grayish brown (10YR 4/2), moist, 80% low plasticity fines, 20% fine sand, firm
5				0	
6				0	
7				0	
8				0	
9				0	LEAN CLAY (CL): grayish brown (10YR 5/2), moist, 90% low plasticity fines, 10% fine sand, firm
10				0	
11				0	
12				0	
13				0	CLAYEY SAND (SC): grayish brown (10YR 5/2), moist, 60% fine sand, 40% low plasticity fines
14				0	LEAN CLAY with SAND (CL): grayish brown (10YR 5/2), moist, 80% low plasticity fines, 20% fine sand, soft
15					



WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS

Notes:

1. Hand augered to 5 feet bgs
2. OVM = MiniRAE 3000 calibrated to 100 ppm isobutylene standard

PROJECT: Aster Apartments
6775 Golden Gate Drive, Dublin, California

Log of Well No. MW-06 (cont'd)

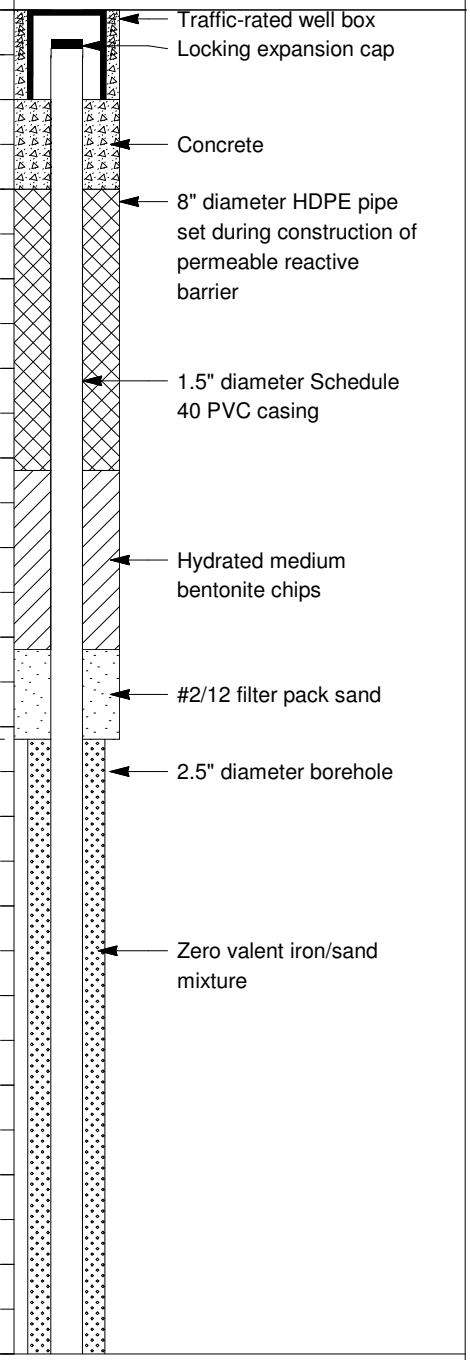
DEPTH (feet)	SAMPLES Sample No.	SAMPLES Sample	SAMPLES Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
16				0	LEAN CLAY with SAND (CL): continued	Neat cement grout
17				0		8.25" diameter borehole
18				0	CLAYEY SAND (SC): grayish brown (10YR 5/2), moist, 60% fine sand, 40% low plasticity fines	Hydrated medium bentonite chips
19				0	LEAN CLAY (CL)	2" diameter Schedule 40 PVC casing
20					wet	
21					Note: free water observed inside acetate liner	#2/12 filter pack sand
22					SANDY LEAN CLAY (CL): grayish brown (10YR 5/2), moist, 60% low plasticity fines, 40% fine sand, soft	
23						2" diameter Schedule 40 PVC, 0.010" slot screen
24				0		2" diameter Schedule 40 PVC endcap
25				0		
26				0		
27				0	LEAN CLAY (CL): grayish brown (10YR 5/2), moist, 95% low plasticity fines, 5% fine sand, hard	Direct push pilot boring Hydrated medium bentonite chips
28					Bottom of boring at 28.0 feet	
29						
30						
31						
32						
33						

OAKWELLV_PPACKTOC (REV. 3/2015)

PROJECT: Aster Apartments 6775 Golden Gate Drive, Dublin, California	**Log of Well No. PRB-01**
BORING LOCATION: Northing: 2081944.6384, Easting: 6148214.1592	TOP OF CASING ELEVATION AND DATUM: 339.80 feet (NGVD 29)
DRILLING CONTRACTOR: Gregg Drilling & Testing, Inc.	DATE STARTED: 11/8/16 / DATE FINISHED: 11/8/16
DRILLING METHOD: Direct push	TOTAL DEPTH (ft.): 23.1 / SCREEN INTERVAL (ft.): 18.2 - 22.7
DRILLING EQUIPMENT: Marl M5T	DEPTH TO WATER (ft.): FIRST NA, COMPL. 10.24 / CASING: 1.5" Sch. 40 PVC
SAMPLING METHOD: MC5 Sampling System [1.5" x 4.0']	LOGGED BY: A. Rosenthal
HAMMER WEIGHT: NA / DROP: NA	RESPONSIBLE PROFESSIONAL: A. Rosenthal / REG. NO. PG 9387

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	OVM Reading	DESCRIPTION: NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.
					Surface Elevation: 340.46' (NGVD 29)
0					ASPHALTIC CONCRETE (approximately 6 inches)
					AGGREGATE BASE (approximately 18 inches)
1					
2					CONTROLLED DENSITY FILL
3					
4					
5					
6					
7					
8					PEARMEABLE REACTIVE BARRIER: zero valent iron/sand mixture consisting of 55% iron and 45% sand
9					
10					
11					
12					
13					
14					
15					

WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS



PROJECT: Aster Apartments
6775 Golden Gate Drive, Dublin, California

Log of Well No. PRB-01 (cont'd)

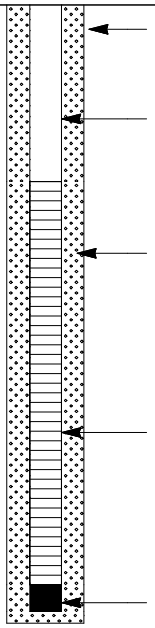
DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
16					PEARMEABLE REACTIVE BARRIER: continued	2.5" diameter borehole Zero valent iron/sand mixture
17						
18						1.5" diameter Schedule 40 PVC casing
19						
20						1.5" diameter Schedule 40 PVC, 0.010" slot screen
21						
22						
23					Bottom of boring at 23.1 feet	1.5" diameter Schedule 40 PVC endcap
24						
25					Note: Monitoring well installed within permeable reactive barrier (PRB). The top 8 feet of the well was installed within an HDPE pipe that was placed during construction of the PRB. Below 8 feet bgs, the well was installed within the PRB material, which was allowed to backfill the boring to provide a filter pack.	
26						
27						
28						
29						
30						
31						
32						
33						

PROJECT: Aster Apartments 6775 Golden Gate Drive, Dublin, California	**Log of Well No. PRB-02**
BORING LOCATION: Northing: 2081908.6194, Easting: 6148227.9172	TOP OF CASING ELEVATION AND DATUM: 339.64 feet (NGVD 29)
DRILLING CONTRACTOR: Gregg Drilling & Testing, Inc.	DATE STARTED: 11/9/16 / DATE FINISHED: 11/9/16
DRILLING METHOD: Direct push	TOTAL DEPTH (ft.): 21.9 / SCREEN INTERVAL (ft.): 17.0 - 21.5
DRILLING EQUIPMENT: Marl M5T	DEPTH TO WATER (ft.): FIRST NA, COMPL. 10.34 / CASING: 1.5" Sch. 40 PVC
SAMPLING METHOD: MC5 Sampling System [1.5" x 4.0']	LOGGED BY: A. Rosenthal
HAMMER WEIGHT: NA / DROP: NA	RESPONSIBLE PROFESSIONAL: A. Rosenthal / REG. NO. PG 9387

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
					Surface Elevation: 340.35' (NGVD 29)	
0					ASPHALTIC CONCRETE (approximately 6 inches)	Traffic-rated well box Locking expansion cap
					AGGREGATE BASE (approximately 18 inches)	
1						Concrete
2					CONTROLLED DENSITY FILL	
3						8" diameter HDPE pipe set during construction of permeable reactive barrier
4						
5						1.5" diameter Schedule 40 PVC casing
6						
7						Hydrated medium bentonite chips
8						#2/12 filter pack sand
9					PEARMEABLE REACTIVE BARRIER: zero valent iron/sand mixture consisting of 55% iron and 45% sand	2.5" diameter borehole
10						
11						Zero valent iron/sand mixture
12						
13						
14						
15						

PROJECT: Aster Apartments
6775 Golden Gate Drive, Dublin, California

Log of Well No. PRB-02 (cont'd)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
16					PEARMEABLE REACTIVE BARRIER: continued	
17						
18						
19						
20						
21						
22					Bottom of boring at 21.9 feet	
23						
24					Note: Monitoring well installed within permeable reactive barrier (PRB). The top 8.75 feet of the well was installed within an HDPE pipe that was placed during construction of the PRB. Below 8.75 feet bgs, the well was installed within the PRB material, which was allowed to backfill the boring to provide a filter pack.	
25						
26						
27						
28						
29						
30						
31						
32						
33						

PROJECT: Aster Apartments 6775 Golden Gate Drive, Dublin, California	**Log of Well No. PRB-03**
BORING LOCATION: Northing: 2081871.5254, Easting: 6148242.7662	TOP OF CASING ELEVATION AND DATUM: 339.32 feet (NGVD 29)
DRILLING CONTRACTOR: Gregg Drilling & Testing, Inc.	DATE STARTED: 11/10/16 / DATE FINISHED: 11/10/16
DRILLING METHOD: Direct push	TOTAL DEPTH (ft.): 25.0 / SCREEN INTERVAL (ft.): 20.1 - 24.6
DRILLING EQUIPMENT: Marl M5T	DEPTH TO WATER (ft.): FIRST NA, COMPL. 9.08 / CASING: 1.5" Sch. 40 PVC
SAMPLING METHOD: MC5 Sampling System [1.5" x 4.0']	LOGGED BY: A. Rosenthal
HAMMER WEIGHT: NA / DROP: NA	RESPONSIBLE PROFESSIONAL: A. Rosenthal / REG. NO. PG 9387

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
					Surface Elevation: 340.11' (NGVD 29)	
0					ASPHALTIC CONCRETE (approximately 6 inches)	Traffic-rated well box Locking expansion cap
1					AGGREGATE BASE (approximately 18 inches)	Concrete
2					CONTROLLED DENSITY FILL	
3						8" diameter HDPE pipe set during construction of permeable reactive barrier
4						
5						1.5" diameter Schedule 40 PVC casing
6						
7						Hydrated medium bentonite chips
8						#2/12 filter pack sand
9					PEARMEABLE REACTIVE BARRIER: zero valent iron/sand mixture consisting of 55% iron and 45% sand	
10						2.5" diameter borehole
11						
12						Zero valent iron/sand mixture
13						
14						
15						

PROJECT: Aster Apartments
6775 Golden Gate Drive, Dublin, California

Log of Well No. PRB-03 (cont'd)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
16					PEARMEABLE REACTIVE BARRIER: continued	2.5" diameter borehole
17						Zero valent iron/sand mixture
18						
19						1.5" diameter Schedule 40 PVC casing
20						
21						
22						1.5" diameter Schedule 40 PVC, 0.010" slot screen
23						
24						
25					Bottom of boring at 25.0 feet	1.5" diameter Schedule 40 PVC endcap
26						
27					Note: Monitoring well installed within permeable reactive barrier (PRB). The top 9 feet of the well was installed within an HDPE pipe that was placed during construction of the PRB. Below 9 feet bgs, the well was installed within the PRB material, which was allowed to backfill the boring to provide a filter pack.	
28						
29						
30						
31						
32						
33						

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APPENDIX D

Routine Performance Monitoring and Inspection Activities Methodology

APPENDIX D

ROUTINE PERFORMANCE MONITORING AND INSPECTION ACTIVITIES METHODOLOGY

Aster Apartments
6775 Golden Gate Drive
Dublin, California

TABLE OF CONTENTS

ATTACHMENTS

APPENDIX D

ROUTINE PERFORMANCE MONITORING AND INSPECTION ACTIVITIES METHODOLOGY

Aster Apartments
6775 Golden Gate Drive
Dublin, California

Amec Foster Wheeler Environment & Infrastructure, Inc. ("Amec Foster Wheeler") has prepared this Appendix to the *Operations, Maintenance, and Monitoring Plan for Permeable Reactive Barrier* ("OMM Plan") to aid in operating, maintaining, and monitoring a permeable reactive barrier (PRB) adjacent to the property located at 6775 Golden Gate Drive, Dublin, California (the "site;" OMM Plan Figure 1). This Appendix describes the methods by which the routine PRB performance monitoring, on-site groundwater monitoring, and PRB inspection activities listed below will be performed.

Performance monitoring for the PRB consists of the following three activities:

1. Above-ground visual inspections to monitor the physical integrity of the PRB and its components.
2. Groundwater quality monitoring to assess the treatment performance of the PRB.
3. Groundwater level monitoring to assess the movement of groundwater in the vicinity of the PRB.

Additionally, monitoring of groundwater levels and water quality will be conducted concurrently at the on-site wells.

The OMM Contractor must conduct all inspections and maintenance activities in accordance with a site-specific health and safety plan (HASP). The OMM Contractor will follow the activity procedures described below to ensure that any PRB performance issues are identified and addressed and to ensure compliance with the conditional approval granted by Alameda County Department of Environmental Health (ACDEH). The activities listed below are subject to revision in consultation with ACDEH as described in Section 1.3 of the OMM Plan.

D1.0 ABOVE-GROUND VISUAL INSPECTIONS

During each monitoring event, a visual inspection of the ground surface along the PRB alignment will be performed. The objective of the visual inspection is to evaluate potential changes in ground surface, land use, construction, or other factors that may indicate a physical change in the PRB. If changes in the ground surface are observed, such as depressions or deterioration of the pavement above the PRB, the location and a description of the change(s) will be documented. Evidence of new landscaping, utilities, or any other physical

or operational changes that could potentially affect the physical integrity of the PRB will also be documented.

Additionally, monitoring well caps, covers, and seals will be inspected during each monitoring event to ensure that the wells are secure against both physical damage and potential storm water or irrigation water runoff entering the wells. If ponded water is observed in or around the well box, this will be documented.

The results of routine visual inspections will be recorded on the Permeable Reactive Barrier Inspection Form (Attachment D-1).

D2.0 GROUNDWATER MONITORING

Groundwater monitoring activities consist of groundwater level measurements and sample collection and analysis for VOCs. Specific groundwater monitoring and sampling methods are described in the following sections. As noted in the OMM Plan, these activities will be performed at both the PRB performance monitoring wells and the on-site monitoring wells.

D2.1 GROUNDWATER LEVEL MONITORING

Depths to groundwater (groundwater level) will be measured within each well during each monitoring event to determine the groundwater elevation relative to the survey datum.

Before depth to groundwater measurements are collected, the expansion cap will be removed from each PRB performance monitoring well and on-site monitoring well, and the wells will be allowed sufficient time to equilibrate with atmospheric conditions. The PDB located within the well will not be removed prior to groundwater level measurement.

Each depth to groundwater will be measured from a surveyed reference point marked on the top of each well casing. The static water level in each well will be measured to the nearest 0.01 foot using an electronic water-level sounder, and the depth to water measurement will be recorded on the Passive Diffusion Bag Sampling Record (Attachment D-2). Electronic water-level measurement equipment will be decontaminated before and after use at each monitoring well location by rinsing with a Liquinox and potable water solution before rinsing with potable water.

D2.2 ROUTINE GROUNDWATER SAMPLING

Groundwater samples will be collected from the PRB performance monitoring wells and on-site monitoring wells using passive diffusion bags (PDBs), allowing for passive, no-purge sampling. Each PDB consists of a low-density polyethylene bag that is provided with deionized water by the manufacturer. Each PDB is laboratory-certified to be free of VOCs. PDBs are available in various sizes; the upgradient performance monitoring wells and on-site monitoring wells (2-inch well casing) accommodate the standard 24-inch by 1.5-inch bag size, while the in-barrier performance monitoring wells (1.5-inch well casing) require a 48-inch by 0.75-inch

bag. The total volume of deionized water in each bag is approximately 220 milliliters (mL). PDBs will be purchased from a vendor that carries a license from both the United States Geological Survey and the General Electric Company (the co-patent holders on the product) to manufacture and distribute PDBs (ALS Environmental of Rochester, New York, or other). Additional information about PDBs is included on the Passive Diffusion Bag Information Sheet (Attachment D-3).

A PDB harness consisting of a weighted cable, anchor points from which to hang the PDB, and a safety disk to prevent the end of the cable from falling into the well, has been custom manufactured for each well. The anchor points on each harness are positioned such that the PDB will hang across the approximate midpoint of the screened interval of each well.

At least 14 days prior to sample collection, a PDB will be deployed in each well by attaching a single PDB to the harness anchor points using new zip ties and lowering the PDB into the well. The well cap will be placed in the top of the well casing and expanded, sealing the well and holding the PDB harness cable in place against the side of the well casing. While submerged across the screened interval of each well, VOCs in the groundwater will diffuse into the water-filled PDB through the polyethylene membrane due to the concentration gradient between the water within the PDB and the groundwater in the well. After 14 days the water within the PDB will be fully equilibrated with the groundwater in the well, and a sample can be collected.

Following the equilibration period and measurement of depth to groundwater (Section D2.1), the PDB and harness will be removed from each monitoring well by coiling the weighted cable in such a way that it does not come into contact with any materials that could introduce contamination to or damage the well. The PDB will then be removed from the harness by cutting the zip ties that hold it to the anchor points. The corner of each PDB will be cut using a pair of decontaminated scissors or similar tool. The contents of the PDB will then be decanted into laboratory-provided volatile organic analysis (VOA) sample containers provided with hydrochloric acid preservative. Immediately following sampling, each VOA will be labeled, placed into a zip-closure bag, and placed into an ice-chilled cooler pending transport to the analytical laboratory under chain-of-custody procedures. The sample collection date, time, and other notes will be recorded on the Passive Diffusion Bag Sampling Record (Attachment D-2).

Before each sampling event, replacement PDBs may be obtained so that they can be deployed immediately following sample collection at each well to allow for sample collection the following quarter. The replacement PDBs will be deployed in each well using the methodology described above.

D2.3 POSSIBLE ADDITIONAL PRB EVALUATION SAMPLING

If potential PRB performance issues are identified, samples for additional analyses may also be collected from the PRB performance monitoring wells. PDBs are not suitable for collection

of non-VOC analytes because the polyethylene membrane does not allow other analytes in groundwater to equilibrate with the deionized water in the PDB. Therefore, if it is determined that additional analyses are required, a method of low-flow sampling will be implemented to collect additional samples.

If low-flow sampling procedures are required, a peristaltic pump (or similar) and new, 0.25" disposable polyethylene tubing lowered to the middle of the well screen interval to purge groundwater at a rate between 100 and 500 milliliters per minute (mL/min) until the water level and the field parameters (pH, specific conductance, temperature, oxidation reduction potential [ORP], and dissolved oxygen [DO]) stabilize. All parameters will be measured using a portable multi-parameter meter and a closed flow-through cell. Stabilization will be confirmed when three consecutive readings are within the following limits: ±3 percent change in specific conductance, ±0.2 pH units, ±10 percent change or 0.2 mg/L for DO, and ±20 millivolts (mV) for ORP. Groundwater field indicator parameters and flow rates will be recorded on the Passive Diffusion Bag Sampling Record (Attachment D-2). After the parameters stabilize, groundwater will be collected into the appropriate laboratory-provided containers, immediately labeled with a unique identifier and sample collection time, and stored in an appropriate manner pending transport to the analytical laboratory.

D2.4 LABORATORY ANALYSIS

All PRB performance monitoring well samples will be analyzed for the following:

- VOCs using U.S. EPA Method 8260B (or the currently approved method at the time of sampling).

If potential PRB performance issues are identified based on groundwater elevation patterns or VOC analytical results, additional analysis, including one or more of the following, may be included in future performance monitoring events:

- Alkalinity using U.S. EPA Method 310.2,
- Cations/anions using U.S. EPA Method 300.0 and/or others, as appropriate, and
- Ethane/ethene using U.S. EPA Method RSK 175.

The Owner will discuss any potential PRB performance issues and proposed additional analyses with ACDEH before implementation.

ATTACHMENT D-1

Permeable Reactive Barrier Inspection Form

PERMEABLE REACTIVE BARRIER INSPECTION FORM

Aster Apartments
6775 Golden Gate Drive
Dublin, California

Date: _____ Weather: _____
Inspection By: _____ Time In: _____
Others On Site: _____ Time Out: _____

Visual Observations – Ground Surface Above Permeable Reactive Barrier (PRB):

	YES	NO	Comments
Photos taken to document site conditions?			
Uneven pavement surface or depressions?			
Cracking that follows the footprint of the PRB?			
Evidence of utility construction (e.g. saw cut trench segments intersecting PRB alignment)?			
Any other signs of work intersecting path of PRB?			
New landscaping observed in vicinity of PRB?			

The PRB is unlikely to be affected by shallow disturbances due to the depth at which it is installed. Note any observations that may indicate that disturbances were deep and potentially impacted the PRB.

_____

_____

_____

Visual Observations – Performance Monitoring Well Network:

	YES	NO	Comments
Are well caps secure and locked?			
Are well seals intact, and lids securely bolted?			
Is the well box concrete apron solid and intact?			

If maintenance is required to resolve any of the above noted items, describe what actions taken, if any. Were all maintenance items resolved during this site visit? If no, what items remain to be resolved?

_____

_____

_____

Note: Groundwater sampling chain-of-custody forms and groundwater level measurement documentation will be recorded separately and attached to this Inspection Form.

ATTACHMENT D-2

Passive Diffusion Bag Sampling Record

PASSIVE DIFFUSION BAG SAMPLING RECORD

Well ID: _____

Project/Task: _____

Project Name: _____

Well Diameter: _____

Field Personnel: _____ Date of Sampling: _____

PDB Diameter: _____ PDB Length: _____

Depth to Water: _____ PDB Installation Date: _____

Depth of PDB: _____

Depth Changed? (if yes, record change): _____

PDB Retrieval Date: _____

Sample ID: _____

Time: _____

Comments (headspace, condition, organic material, etc):

PDB INSTALLATION

Time:

Comments:

Notes:

FIELD PARAMETERS

Instrument:

Date	Time	Purge Rate (mL/min)	Total Volume Purged (mL)	Temp (F/C)	pH	Specific Electrical Conductance (uS/cm)	Dissolved Oxygen (mg/l)	Redox Potential (mV)

ATTACHMENT D-3

Passive Diffusion Bag Sampling Information Sheet

ALS Environmental

PASSIVE DIFFUSION BAGS (PDBs)

Contact your local ALS Technical Sales Representative for more information.

ALS Environmental manufactures high-quality passive diffusion samplers for the collection of groundwater samples for the analysis of volatile organics.

PDBs are polyethylene tubes or bags filled with analyte-free water. Hung in monitoring wells for periods of 14 days, or until equilibrium is complete between the contaminants in the bag and the surrounding groundwater, the PDB operates by diffusion of contaminates across the polyethylene membrane. No purging is necessary.

Developed originally by GE and the USGS, the widely used PDBs have been installed successfully for over ten years at hundreds of monitoring sites. Data from the bag samples is considered as valid as that obtained from other conventional sampling procedures.

The PDB is a rugged device made from medical grade, high strength low density polyethylene. Patented tubes with special heat sealed seams that resist abrasion, unique tabs that allow both quick attachment to hanging assemblies, and ease in pouring upon retrieval have made the PDB the diffusion sampler of choice. Engineers and scientists converting to passive sampling for their groundwater monitoring have installed over 100,000 of our samplers.

Laboratory-like quality control criteria are utilized in the manufacture of the PDB. The analyte-free water is identical to that used in our organics laboratories and certificates of quality (to 0.01 ppb) are provided with each shipment. Medical grade polyethylene is unique to the PDB, providing both additional strength and assurance of contaminant-free material. Strength drop tests are applied to each lot of PDBs.

Simplicity in the design of the PDB extends to its utility and cost effectiveness in the field. No additional parts are required! Storage space is minimal, handling is easy, deployments and retrievals are fast, and sampling into vials is simple.

Stainless steel non-corrosive hanging assemblies are available where long term repetitive monitoring justifies the capital investment. Otherwise, the PDBs can be hung from any sturdy lines of the client's choice. Also, when long storage periods are anticipated, e.g. when large lot sizes are purchased or sampling delays are possible, ALS Environmental makes available pouches made of diffusion resistant mylar.

Continued on reverse side...

Scan the QR code or visit
WWW.ALSGLOBAL.COM

Continued from reverse side...

PDB Options Available

The standard size PDB sampler is 24" long and 1 ¼" in diameter. It is manufactured from 4 Mil-thick, 2" wide, "lay flat", low-density polyethylene. All seams and connections are made by heat-seals only. The pre-filled PDB sampler holds approximately 220 mL of certified, laboratory-grade, analyte-free, deionized water. After retrieval, simply cut the top and pour water into 40 mL vials.

Different sizes are available with advance notice. If there is a chance of abrasion or tearing due to the well's physical condition, we recommend the use of a protective polyethylene mesh cover.

The unfilled PDB sampler must be filled with water prior to deployment. It is fitted at one end with a threaded screw cap for filling and a snap-on spout for pouring water into vials. When ready to sample, just open the snap top and pour.

PDB Manufacturing

ALS Environmental has been granted a license to manufacture, use and provide the bags by the US Geological Survey (USGS) and The General Electric Company (GE), both co-patent holders on the product (US #5,804,743). The downhole passive water sampler and method of sampling was invented by Don Vroblesky (USGS) and Thomas Hyde (GE).

ALS Environmental is a leader in passive diffusion sampler technology and has been since March 2000 when it began manufacturing and distributing samplers for Volatile Organic Compounds (VOCs). Wide acceptance of these samplers has spurred ALS Environmental to partner with USGS to develop passive diffusion samplers for common LTM inorganic parameters. Both laboratory and field demonstration studies are ongoing for the use of rigid porous polyethylene (RPP) samplers for various analytes.

Pricing for PDBs

PDBs, each	Pre-Filled Price	Unfilled Price
1-50 (standard 24" length, 220ML)	$28.50	$20.00
51 or more (standard 24" length, 220ML)	$25.00	$19.00
36" Length - 1-1/4" Diameter, 330MML	$28.50	N/A
36" Length - 3/4" Diameter, 75ML	$28.50	N/A
48" Length - 3/4" Diameter, 120ML	$28.50	N/A
Other non-standard size bags are available	Call for quote	Call for quote

Pricing for PDB Accessories

Storage Pouches, each	Price
zip-lock type (storage < 14 days before deployment)	Free with purchase
foil barrier type (storage > 14 days before deployment)	$15.00
Protective Mesh Cover, each	**Price**
One unit (optional and reusable)	$2.00
Hanging Assemblies and Supplies, each	**Price**
Hanging assembly (custom sized to order) (reusable)	Call for quote
Weights 8 oz. (5/8" diameter x 7" long)	$16.00

All orders are carefully packaged to ensure a safe delivery of your order. Orders are generally shipped 2nd-Day Air and may either be billed normally or to your own shipping account. Expedited shipping options are available.

Scan the QR code or visit
WWW.ALSGLOBAL.COM