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February 17, 2020

Regional Water Quality Control Board, Central Coast Region
Greg Bishop, Site Cleanup Program Greg.Bishop@waterboards.ca.gov
895 Aerovista Place, Ste. 101 (805) 549-3132
San Luis Obispo, CA 93401

Workplan: **Expedited Site Characterization for an Imminent Multi-Use Development**

Location: **County of Santa Cruz Redevelopment Parcels**
1412, 1438, 1500 and 1514 Capitola Road, Santa Cruz (see *Location Map*, Figure 1)

1.0 INTRODUCTION

A recent property screening assessment (RRM, 2020b) was completed in advance of a major redevelopment project[1] being planned for the 3.7-acre subject site (redevelopment plan layout is included in Appendix A). The property screening detected elevated concentrations of the dry cleaning solvent Tetrachloroethylene (PCE) in two (2) shallow soil vapor samples collected along the eastern property line. A follow-up review of historic land use documents indicates the source of the detected PCE contamination is most likely from the adjoining property to the east (i.e., 1600 Capitola Road, see *Site Map*, Figure 2). This conclusion is based on:

- Historic Land Use Documents: The four (4) parcels that make up the subject site have primarily been residential with limited commercial land uses, none of which would be considered a likely source of PCE concentrations detected along the eastern property line. Of note: reverse (historic) telephone directories and advertisements from the 1960s-1970s show the existing commercial building located on the adjoining property to the east operated as a dry cleaner (Fairway Dry Cleaning).
- Laboratory Groundwater Data: A groundwater monitoring well (MW-5) located ~100-ft east of the Fairway Dry Cleaning building contained elevated concentrations of PCE (i.e., between 12-130 ug/L[2]) in groundwater samples collected in 2012 (AES, 2012).
    - Note: Although PCE was detected in MW-5, it was installed as a downgradient well designed to monitor a fuel leak release from a gas station site located across the street (see *Site Map,* Figure 2; additional documentation in Appendix B).

We propose completing an expedited soil vapor and groundwater evaluation in order to: 1) document site conditions prior to construction; and 2) confirm where vapor abatement/barriers might need to be incorporated into the foundation design. It is our intention to initiate this sampling as an extension of property screening for the development's grant funding program. And we are requesting third-party

[1]: Grants have been acquired to redevelop the underutilized vacant site into a mixed-use development consisting of a medical clinic (Santa Cruz Community Health Center} and dental office (Dientes), and 56 affordable apartments (residential). Initial grading earthwork is scheduled for June 2020.

[2]: The maximum cleanup limit (MCL) for Tetrachloroethylene (PCE) in groundwater is 5 ug/L.

oversight from the Regional Water Quality Control Board's Central Coast Region (Water Board) in order to provide independent agency review of our efforts to characterize the extent, and if necessary, abate vapor encroaching contamination from the apparent off-site source.

2.0 BACKGROUND

The relatively flat-lying, subject site is a is vacant 3.7-acre property located in the unincorporated Live Oak area of Santa Cruz (see *Location Map*, Figure 1). Redevelopment construction activities for the site is scheduled to begin in June 2020 (Section 4.0 provides additional details).

2.1 Subsurface Conditions

There have been numerous exploratory borings drilled at a nearby fuel leak site located approximately 200-ft east of the subject parcels (see *Site Map,* Figure 2). Drilling observations show that the unconsolidated soils encountered in the area of the subject site contain shallow, inter-bedded clays and clayey sands, which is underlain by sands and silty sands starting at depths ~6-to-9 feet below ground surface (bgs). First encountered groundwater has been measured to generally fluctuate at depths between 20 to 25 feet bgs and the flow direction has been calculated to be primarily to the south–southwest. A cross-section of nearby subsurface conditions is included in Appendix A.

2.2 Assessments and Investigations

Property assessment information used as part of this *Workplan* includes: a) data collected to evaluate a nearby fuel leak site; and b) subject site data collected during two (2), recent assessments (i.e., a *Phase I Environmental Site Assessment (ESA),* and a *Phase II Vapor Sampling Assessment*).

2.2.1 Nearby Fuel Leak Site Closure (AES, 2012)

A fuel leak was discovered during tank removals and the closure of a gasoline station located ~200-ft east and across Capitola Road from the subject site (i.e., 1671 Capitola Road). The fuel release was fully characterized by soil, soil vapor and groundwater sampling (34 events) and cleaned up with several remedial actions. Trace levels of PCE were detected back at the gas station site but downgradient monitoring well MW-5 contained higher levels that suggested a second source. The consultant concluded that the PCE plume detected at MW-5 was distinctly separate in size and shape from the fuel leak plume and appeared to originate from a source close to MW-5 (i.e., from a source on the south side of Capitola Avenue).

2.2.2 Phase I Environmental Site Assessment (ESA) (RRM, 2020a)

A recently completed *Phase I ESA* was done as part of redevelopment due diligence. The ESA documented the following:

- The subject site is comprised of four (4) parcels totaling approximately 3.7 acres, and is located at 1412, 1438, 1500, and 1514 Capitola Road, in the unincorporated Live Oak area of Santa Cruz County (see Figure 2).
- A historic review of aerial photographs, maps and street directories determined that the subject site, was initially developed in or around 1916 as four (4) small residential farm parcels and continued through about 1985 (likely consisting of chicken or flower farming).
- Records show a road construction company occupied one of the parcels (#1438) from ~1985-94 for the storage, servicing, and repair of their heavy equipment. When the road company vacated the 1438 parcel in 1994, minor hydrocarbon impacts to surface soils were discovered and remediated to the satisfaction of Santa Cruz County (RRM, 1994).
- The *Phase I ESA* documented a long-term fuel leak case located ~200-ft to the east of the subject site and across Capitola Road (i.e., the Live Oak Texaco at 1671 Capitola Road, see aerial clip, below). This gas station fuel leak has been fully delineated by monitoring wells (see Appendix B for delineation maps). The State GeoTracker archive for this fuel leak case (GeoTracker, 2020) documents this case was closed as of June 2013. The *Phase I ESA* noted that the fuel leak concentrations near the subject site would likely be at very low and would not be likely to pose a threat to subject site's redevelopment or future occupants.
- The site-specific, *Phase I ESA* concluded:
    - There were no *recognized environmental conditions* associated with current or historic on-site land uses. And,

- Based on proximity to the 20-year old fuel leak originating at the Live Oak Texaco (1671 Capitola Road), there is some potential risk associated with hydrocarbons in soil vapor and/or groundwater that may have migrated into the subject site.

2.2.3 Limited Soil Vapor Investigation (Phase II, RRM, 2020b)

Based on the conclusions of the *Phase I ESA* (Section 2.2, above) and as a due diligence condition for obtaining project funding for property redevelopment, two (2) soil vapor samples were collected along the eastern property boundary to evaluate whether there were contaminant impacts from an offsite source. Two soil vapor borings, designated VP-1-5 and VP-2-5, were advanced to depths of 5-ft at locations along the easternmost boundary (i.e., east side of 1514 Capitola Road) on December 13, 2019 (see aerial clip above, or the *Site Map,* Figure 2).

Laboratory results of the tested soil gas samples indicated only one contaminant compound, the dry cleaning solvent compound of PCE, exceeded its risk-based threshold limit established in the *Environmental Screening Levels* (CRWQCB-SFB, 2019). Specifically, PCE was detected in samples VP-1 and VP-2 at concentrations of **8,200 micrograms per cubic meter** (ug/m3) and **40,000 ug/m3,** respectively, both of which exceed the *Environmental Screening Level* for PCE of **15 ug/m3,** established for a residential land use (-- the most conservative threshold). Additional details, including tabulated results and a writeup of the Phase II investigation is included in Appendix B.

3.0 PROPOSED REDEVELOPMENT

The four-parcel, subject property (1412, 1438, 1500 and 1514 Capitola Road) is being redeveloped into mixed-use development consisting of:

- A two-story, dental office (Dientes) and a two story medical clinic (Santa Cruz Community Health Center}, and
- Four (4), three-story residential buildings containing 56 affordable residential apartments.

Maps and renderings of the development are included in Appendix A. Groundbreaking for grading work is planned for June 2020.

4.0 OFF-SITE ASSESSMENT OF ENCROACHING VAPOR/GROUNDWATER PLUMES

Collected land use and laboratory sampling data suggests that a release of PCE is encroaching onto the subject site from an off-site source. In order to prevent losing grant monies for a valuable community project, the development is required to keep initiate demolition and grading earthworks which are scheduled for June 2020. We are proposing to complete an expedited soil vapor and groundwater evaluation in order to:

1. Document the lateral and vertical limits of encroaching PCE in soil gas and groundwater; and
2. Confirm where vapor abatement/barriers might need to be incorporated into the foundation design.

4.1 Sample Collection & Reporting

We intend to initially collect 50 passive vapor samples (including QA/QC duplicates and field blanks) in a grid pattern across the site to order to accurately pin down where PCE soil gas is encroaching across the property line and to map where vapors could underly building footprints (see *Proposed Passive Vapor Sampling Locations,* Figure 3). Once the passive vapor sample results are received and PCE equal-concentration isocontours are mapped, the preliminary encroachment footprint will be established. We will then collect additional samples to delineate the extent of potential groundwater, soil vapor, and soil impacts at the subject site. Specifically:

- Groundwater Sampling: We will use the passive soil gas sample results to map the extent of the dissolved PCE plume in first groundwater which is encountered at approximately 20-ft bgs (includes collection of groundwater grab samples from 6 on-site locations). The groundwater results will be used to evaluate dissolved plume off-gassing vs nearby source (soil) off-gassing.
- Soil Sampling: We will use the passive soil gas sample results to map any potential on-site locations where elevated soil concentrations may be present (includes eight (8) locations x 2 depths). The goal of soil sampling is to confirm there is no on-site source of PCE in shallow soils.
- Active Soil Gas Sampling: We will use the passive soil gas sample results as the basis for collecting follow-up, active soil vapor samples to calibrate results (passive v. active) and to evaluate potential attenuation of plume off-gassing (includes three (3), dual-depth vapor samples at 5 and 15-ft and four (4) additional 5-ft samples).

To confirm Water Board staff agree with follow-up sample locations, we will provide:

1) A PCE, equal-concentration isocontour map once the passive sample results are in; and
2) A map showing the proposed follow-up sample locations for groundwater, soil and active soil-gas samples.

All media testing will be completed by a California State-certified laboratory (ELAP accredited). Field methodology and protocols for the sampling of all media (passive/active soil vapor, soil and groundwater) are included in Appendix C. A summary report will be provided within 2 weeks of the receipt of final laboratory results that will include:

- Tabulated results of the lab results.
- Plan view figures showing sample location and results.
- A written description of field observations and protocols, a summary of the findings, conclusions and recommendations. And
- Support documents including field notes/photographs, protocols, and the State-certified laboratory reports.

4.2 Vapor Abatement/Barrier Design for Development Foundations

On a parallel track, the development's architects are evaluating several off-the-shelf, vapor abatement/barrier designs, should such a system be required for foundations that overlie elevated

concentrations of PCE in soil gas or groundwater. Construction specifications for any proposed vapor abatement system (i.e., a passive or active vapor barrier) will be forwarded to staff from both the County of Santa Cruz Building Department and the Water Board to confirm it addresses standard building and abatement design requirements. Should a vapor abatement system be installed, a follow-up *Vapor Abatement System Monitoring Plan* will be separately submitted.

Please contact me at our office if you have any questions regarding this proposal (831-722-3580).

Sincerely,

WEBER, HAYES AND ASSOCIATES

By _____

Pat Hoban, PG
Principal Geologist

cc: Rebecca Supplee, R.E.H.S.
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Figures: 1) Location Map
2) Site Map with Land Use Information
3) Proposed Passive Sample Locations

Appendix A: Site Redevelopment Plans
Appendix B: Supplemental Documentation (previous on & off-site investigation results)
Appendix C: Field Methodologies (GeoProbe coring, and soil, groundwater & soil vapor sampling

REFERENCES

California Regional Water Quality Control Board, San Francisco Bay Region (RWQCB-SFB):

- (CRWQCB-SFB, 2019) guideline document: "Screening for Environmental Concerns at Sites with Contaminated Soil And *Groundwater*", Final January.
  - https://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/esl.html

Earth Systems report regarding (1412, 1438, 1500, and 1514 Capitola Road:

- (Earth Systems, 2018), *Revised Geotechnical Engineering Report*, October 24.

Remediation Risk Management, Inc. (RRM) reports regarding 1412, 1438, 1500, and 1514 Capitola Road:

- (RRM, 1994): *Remedial Action Summary Report for 1438 Capitola Road,* October 3.
- (RRM, 2020a): *Phase I Environmental Site Assessment (ESA),* January 6.
- (RRM, 2020b): *Limited Soil Vapor Investigation (Phase II),* January 20.

Reports summarizing the Live Oak Texaco fuel leak case (1990-2012) at 1671 Capitola Road:

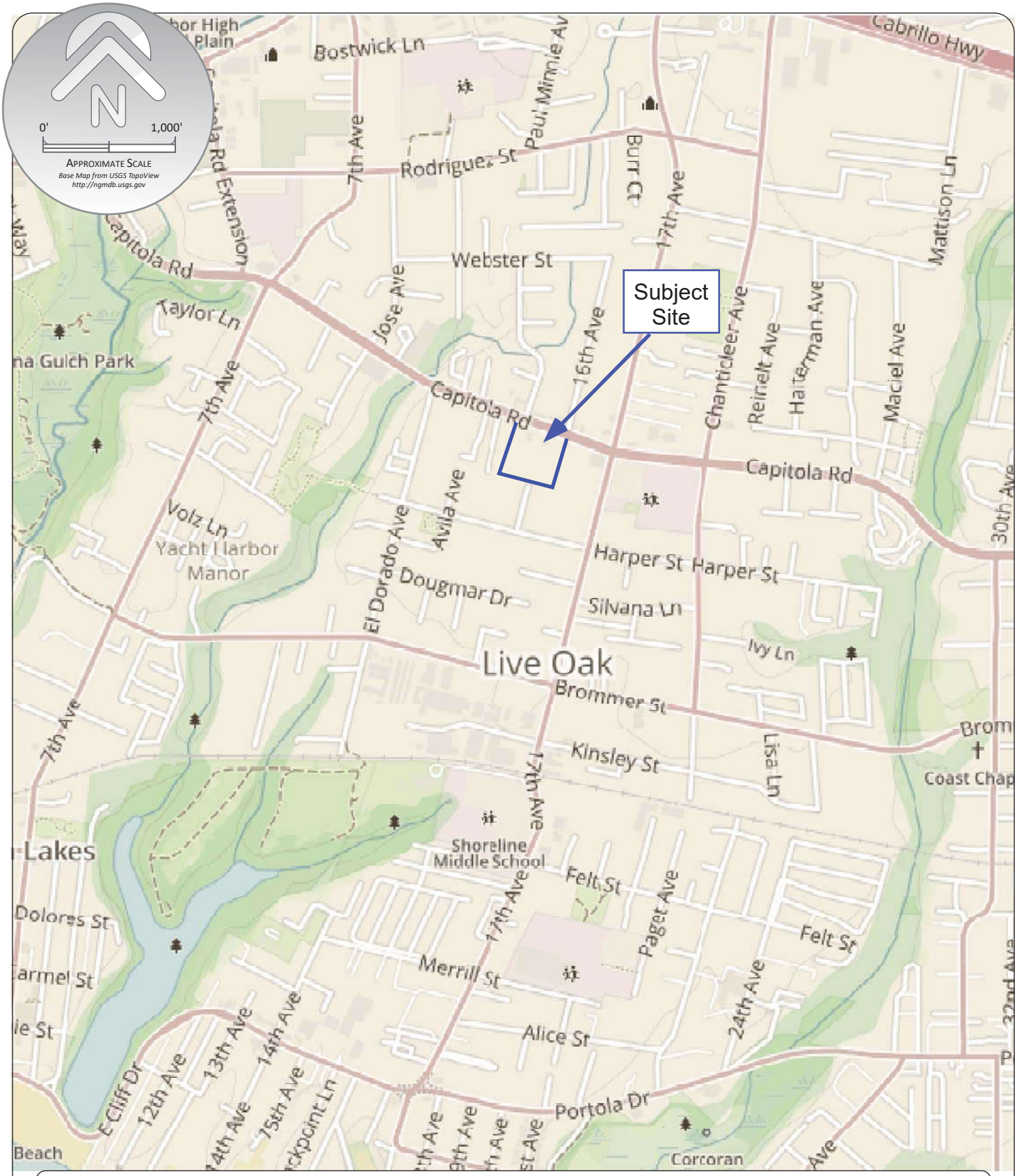
- (Clearwater Group, 2011): *Site Conceptual Model (SCM) Report,* June
- (AES, 2012): A+ Environmental Solutions report: *Groundwater Monitoring Report & Request for Case Closure, May 18.*
- (GeoTracker, 2020): *Geotracker Archive of site-specific, fuel leak reports are at: https://geotracker.waterboards.ca.gov/profile_report.asp?global_id=T0608700286*

Figures

Figure 1: Location Map

Figure 2: Site Map with Previous Sample Results

Figure 3: Proposed Passive Sample Locations



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Location Map

Site: County of Santa Cruz Redevelopment Parcels
Address: 1412, 1438, 1500 and 1514 Capitola Road, Santa Cruz

Date: February 2019

Revisions/Notes:

Figure 1
Project 2t009

Site Map and Previous Sample Results

Supplemental Property Screening Assessment

Site: County of Santa Cruz Redevelopment Parcels
Address: 1412, 1438, 1500 and 1514 Capitola Road, Santa Cruz

Date: February 2020

Revisions/Notes:

FIGURE 2
Project 2t009

Weber, Hayes & Associates
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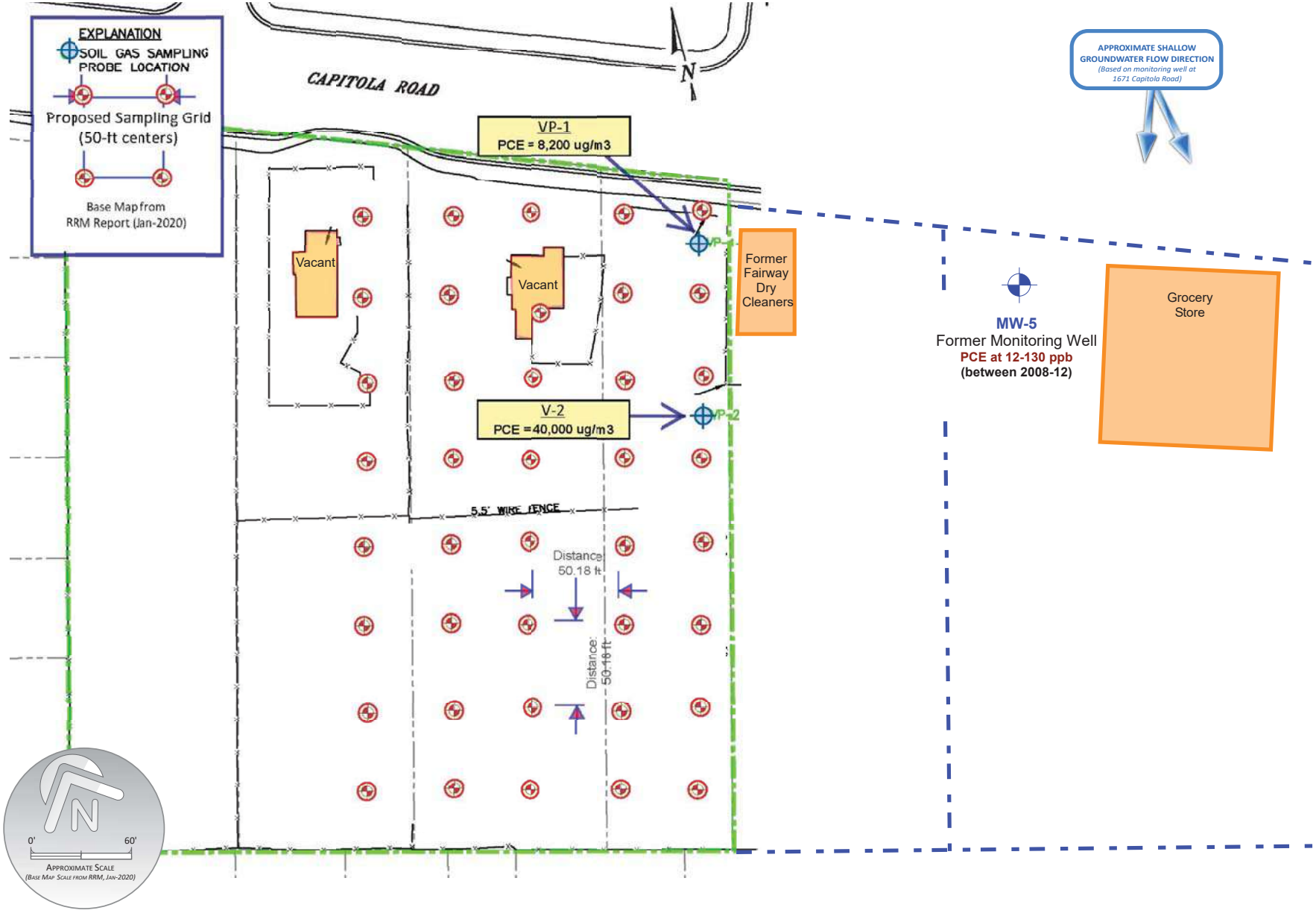

Proposed Passive Soil Vapor Survey
- Supplemental Property Screening Assessment

Site: County of Santa Cruz Redevelopment Parcels
Address: 1412, 1438, 1500 and 1514 Capitola Road, Santa Cruz

Date: February 2020

REVISIONS/NOTES:

FIGURE 3
Project 2t009

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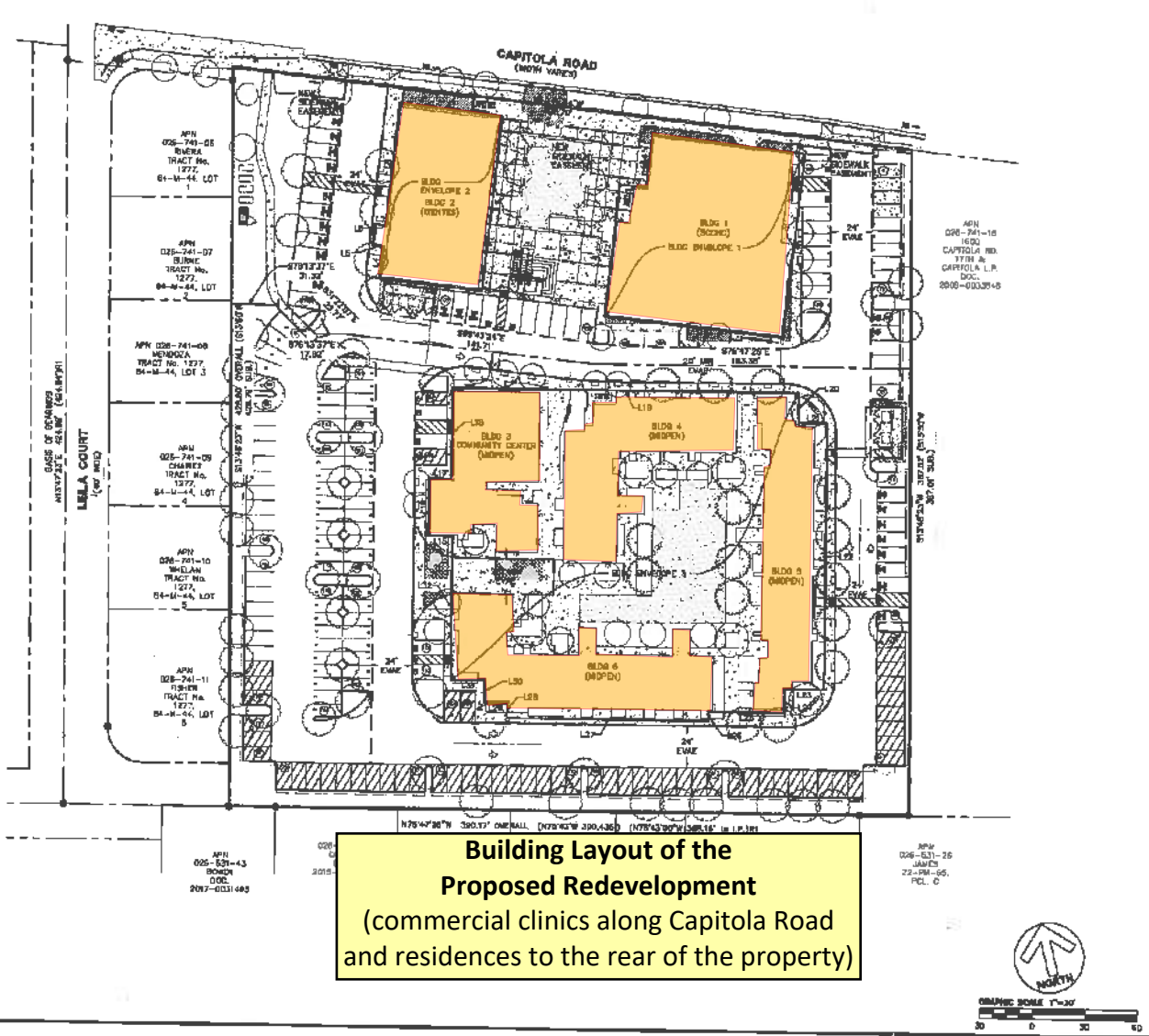
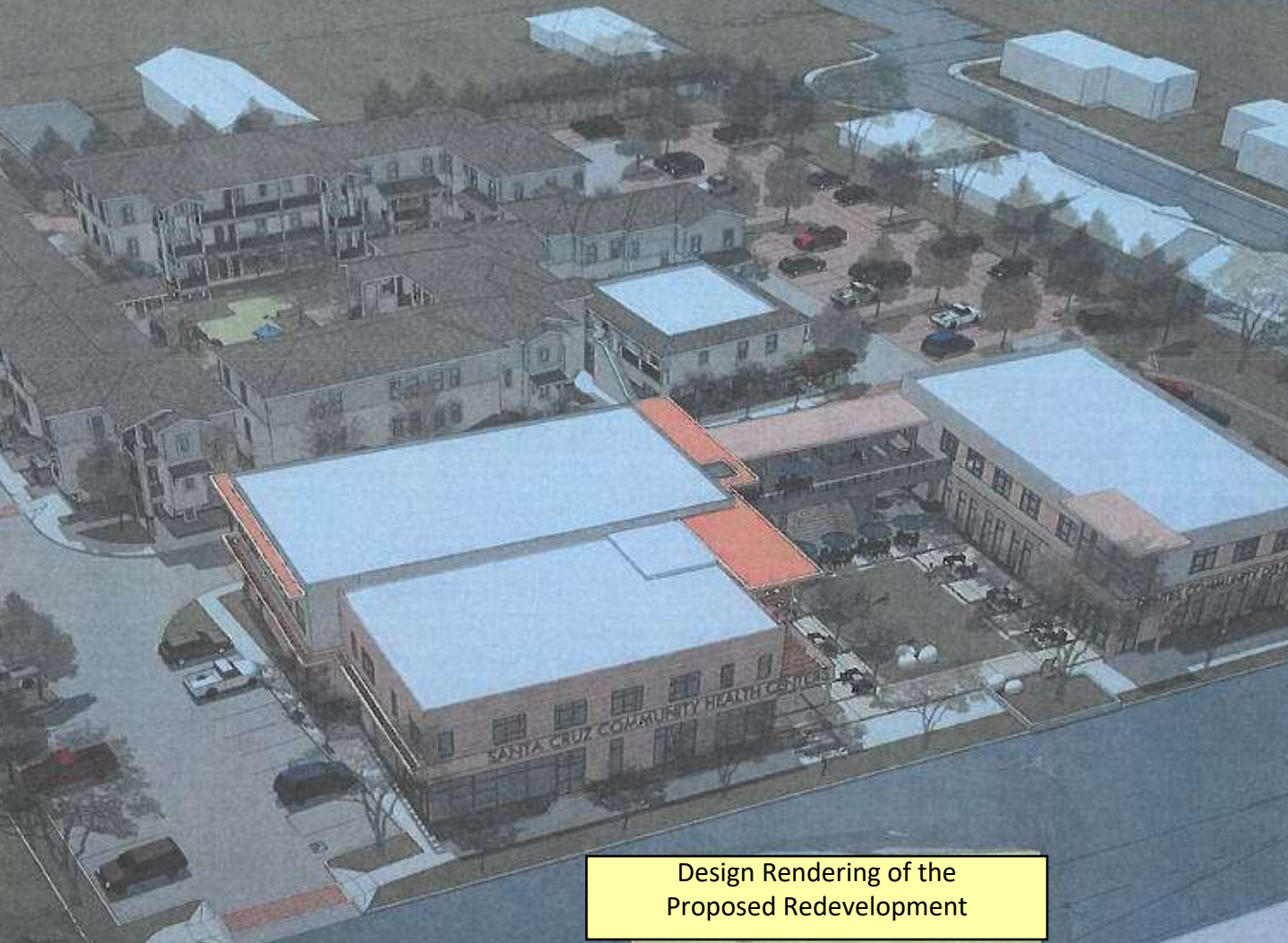
Appendix A

Redevelopment Plans
(groundbreaking planned for June-2020)

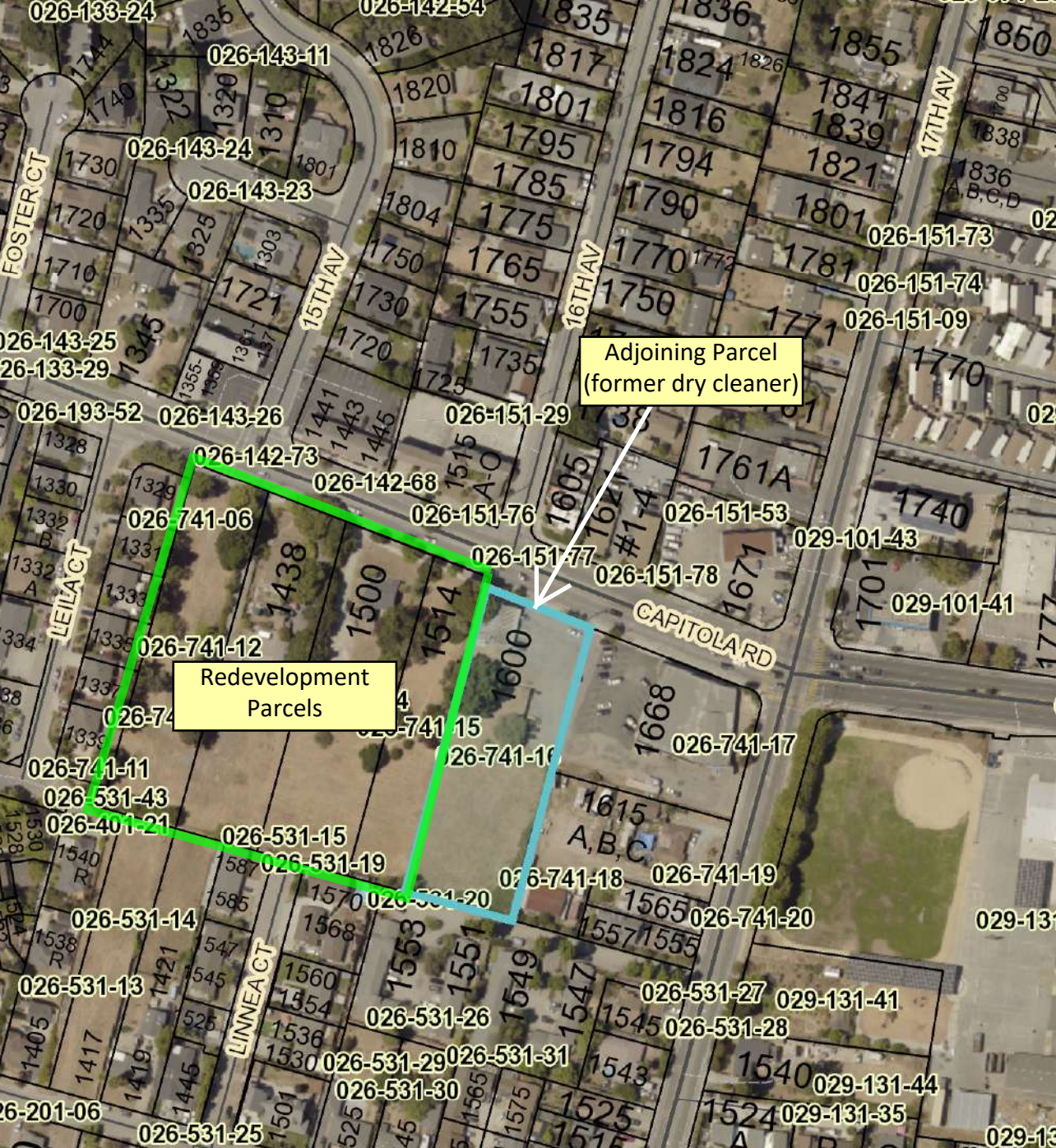


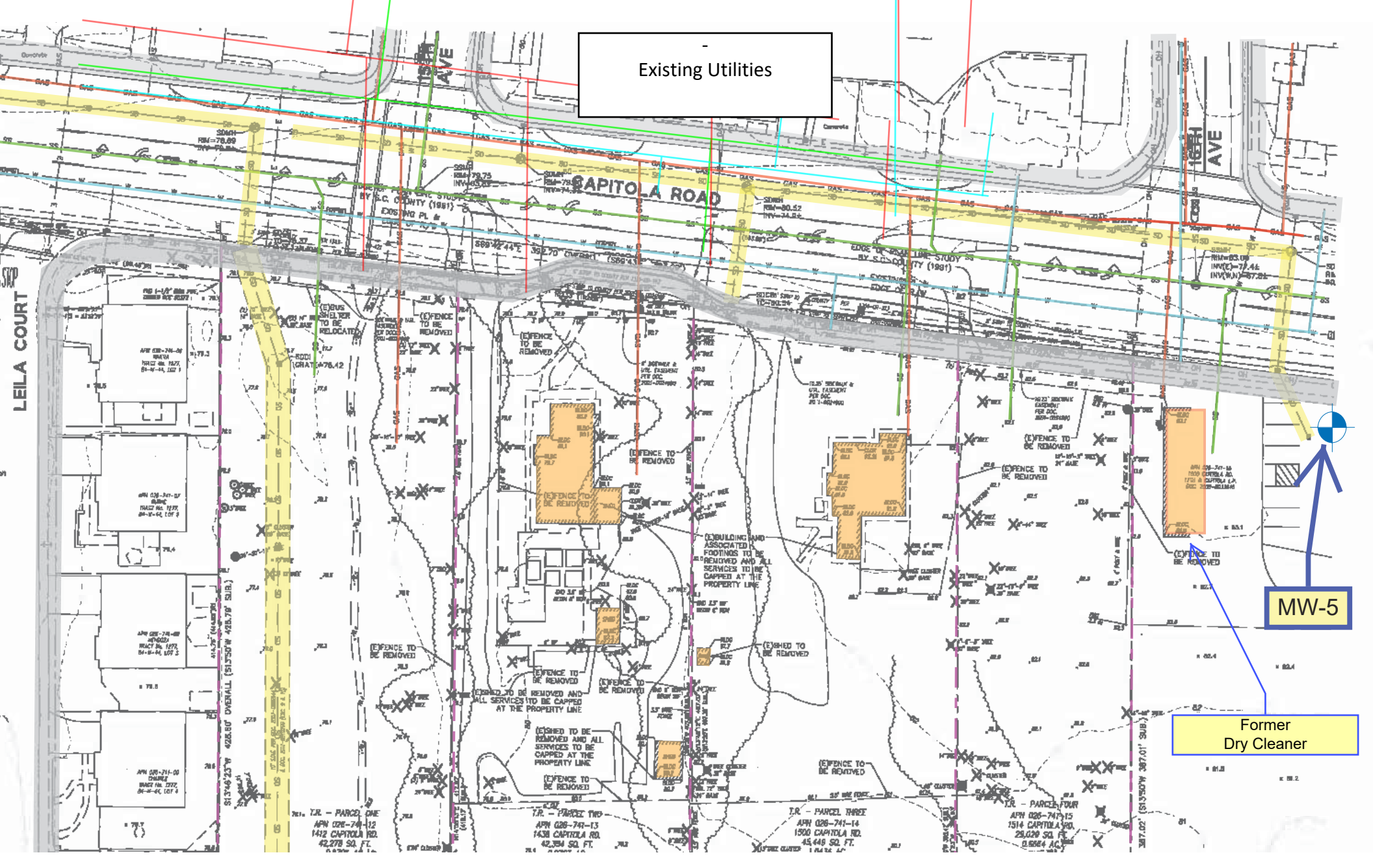
Building Layout of the Proposed Redevelopment

(commercial clinics along Capitola Road and residences to the rear of the property)



Design Rendering of the
Proposed Redevelopment


Adjoining Parcel
(former dry cleaner)
Redevelopment
Parcels
026-133-24
026-143-11
026-143-24
026-143-23
026-143-25
026-133-29
026-193-52
026-143-26
026-151-29
026-142-73
026-142-68
026-741-06
026-151-76
026-151-77
026-151-78
026-151-53
029-101-43
029-101-41
026-741-12
026-741-11
026-531-43
026-401-21
026-531-15
026-531-19
026-531-14
026-531-13
026-741-17
026-741-18
026-741-19
026-741-20
026-531-27
026-531-28
026-531-26
026-531-29
026-531-30
026-531-31
026-531-25
026-151-73
026-151-74
026-151-09
029-131-41
029-131-44
029-131-35
FOSTER CT
15TH AV
16TH AV
17TH AV
LEILA CT
LINNEA CT
CAPITOLA RD


-
Existing Utilities
CAPITOLA ROAD
LEILA COURT
MW-5
Former
Dry Cleaner

Appendix B

Supplemental Documentation

Monitoring Documentation of Nearby Well with PCE Concentrations
(fuel leak site well had PCE detected at 12-130 ppb (2008-12) prior to its destruction)

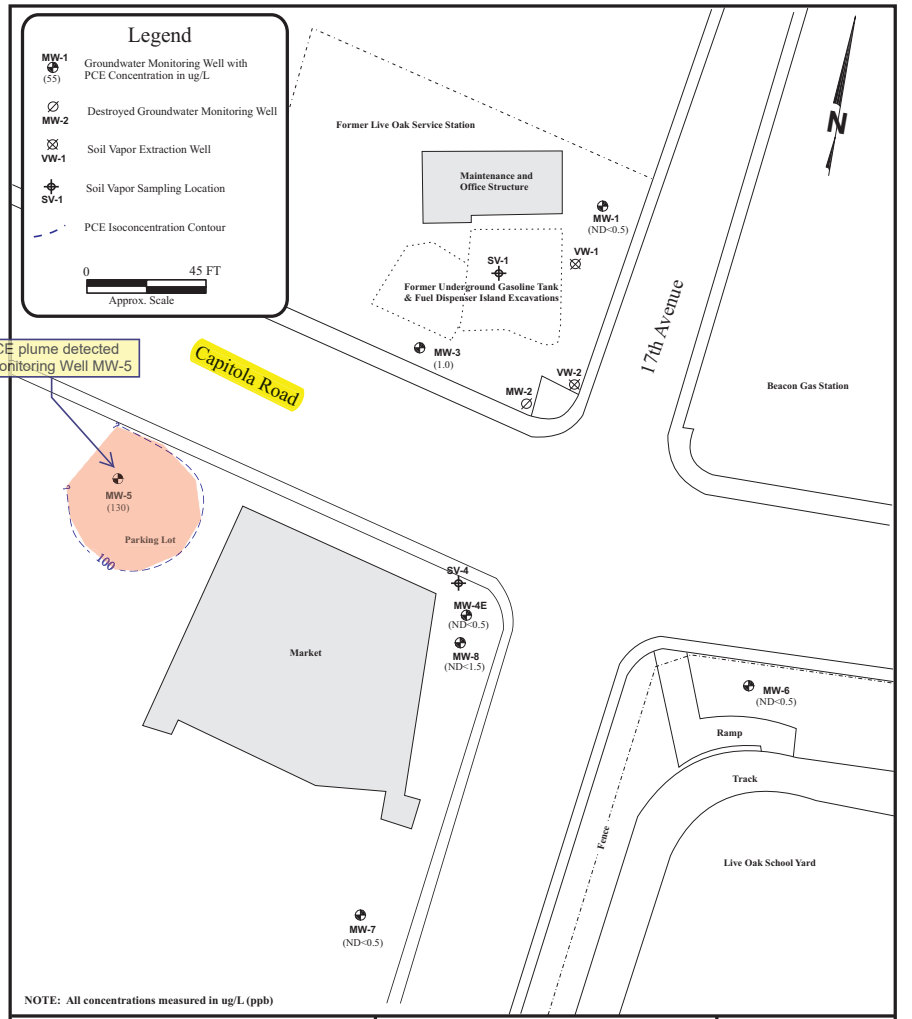
Historical Telephone Directory Research
(adjoining, 1600 Capitola Road property documented to have a dry cleaner)

Recent Phase II Property Screening Report Data
(elevated PCE concentrations in soil vapor samples collected along eastern property boundary)
RRM, January 2020 (draft)

-

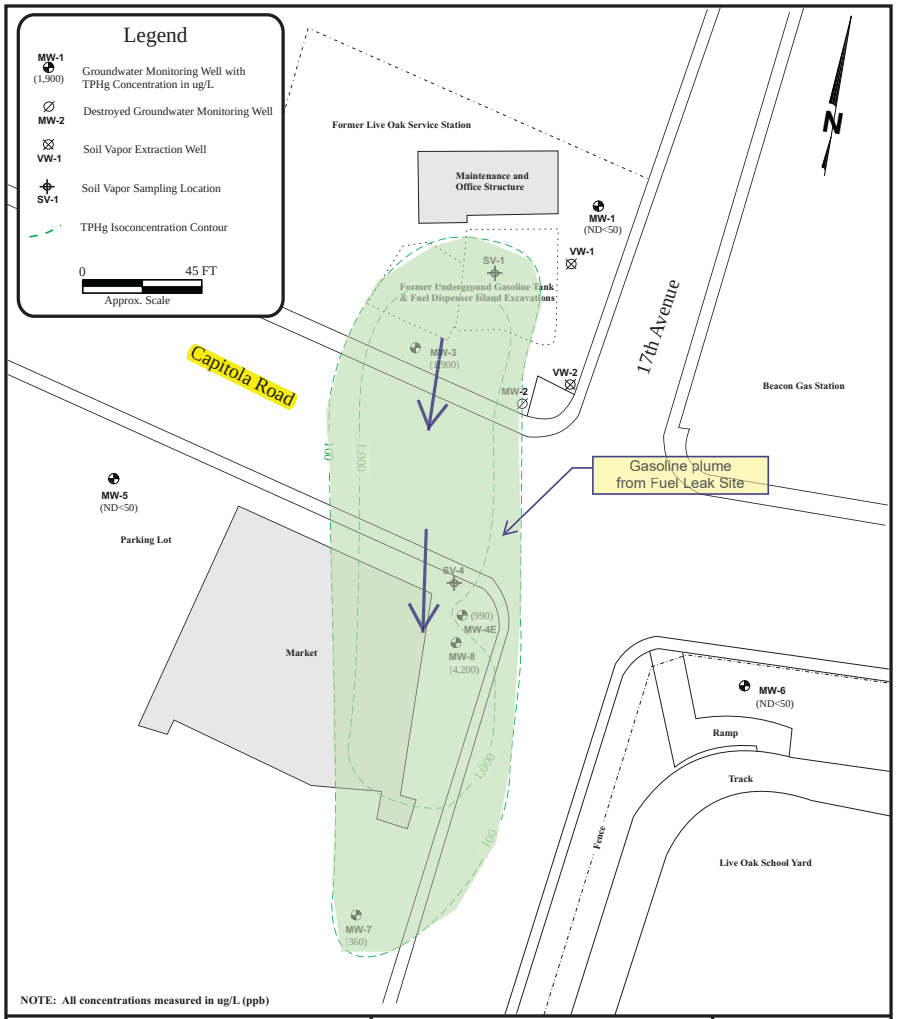
Monitoring Documentation of Nearby Well with PCE concentrations
(fuel leak site well had PCE detected at 12-130 ppb (2008-12) prior to its destruction)

https://documents.geotracker.waterboards.ca.gov/esi/uploads/geo_report/3420745134/T0608700286.PDF

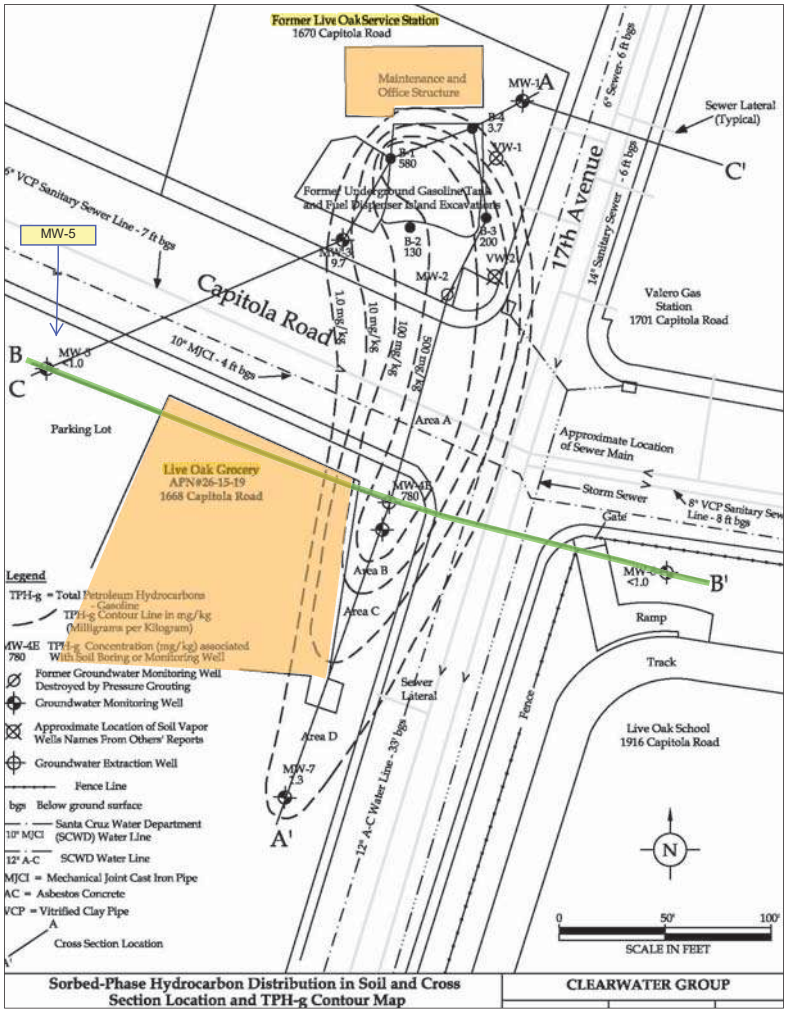


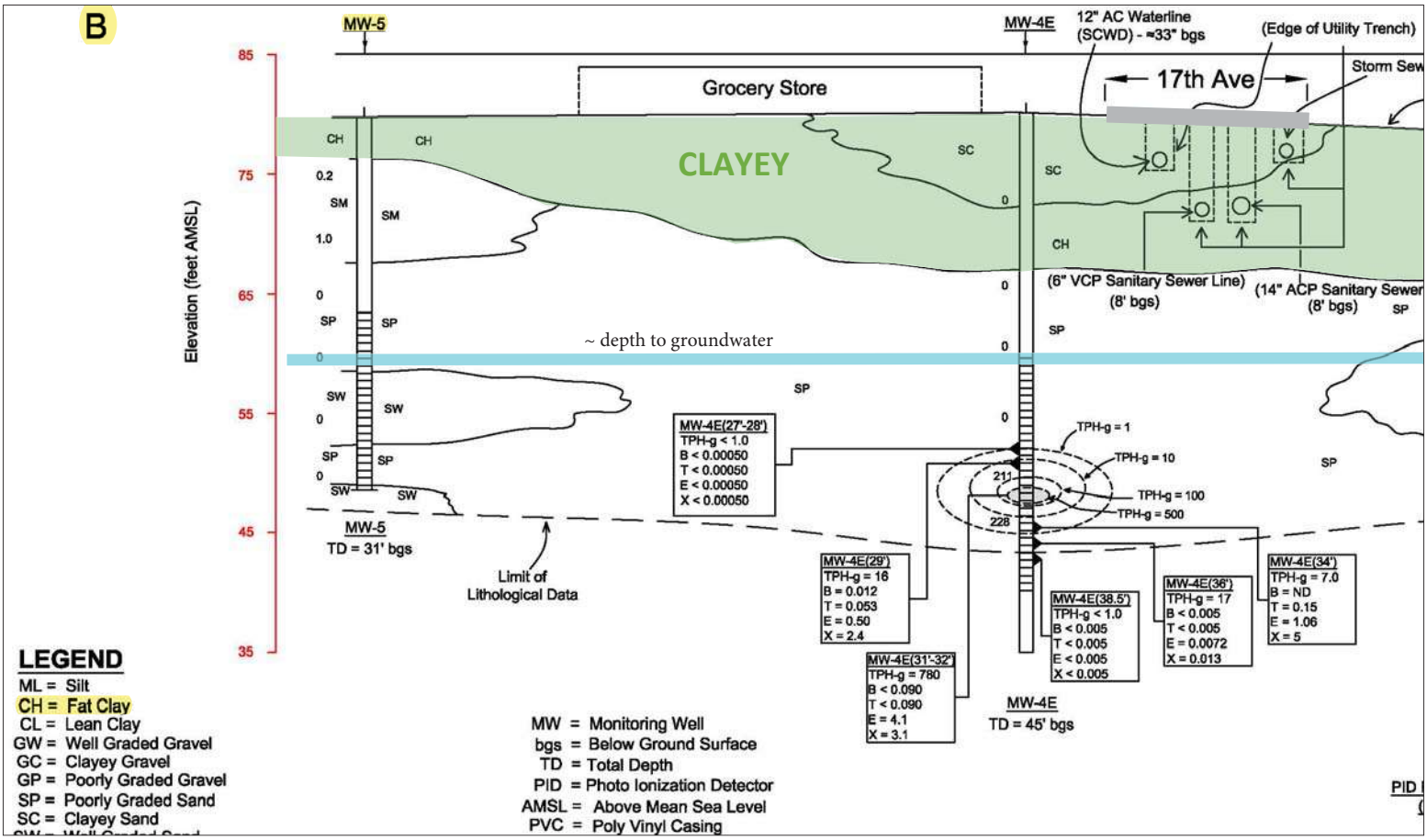
A+ Environmental Solutions, LLC	Former Live Oak Service Station 1671 Capitola Rd. Santa Cruz, California	Figure 5C
	March 18, 2009 PCE Isoconcentration Map	

https://documents.geotracker.waterboards.ca.gov/esi/uploads/geo_report/3420745134/T0608700286.PDF



A+ Environmental Solutions, LLC	Former Live Oak Service Station 1671 Capitola Rd. Santa Cruz, California	Figure 4
	March 27, 2012 TPHg Isoconcentration Map	





Source: SITE CONCEPTUAL MODEL, the Clearwater Group, 2011.

MW-5

BORING LOG

No. MW-5

PROJECT FORMER LIVE OAK SERVICE | DATE 12/17/97 | LOGGED BY ACK

DRILL RIG MOBILE B-53 | HOLE DIA. 8" | SAMPLER MODCAL

GROUND WATER DEPTH INITIAL ~24' | FINAL 23.41 | HOLE ELEVATION 79.19

DESCRIPTION	SOIL TYPE	DEPTH	SAMPLE	BLOWS PER FOOT	POCKET PEN (tsf)	WATER CONTENT	PID READING (ppmv)	WATER LEVEL	CASING	ANNULAR MATERIAL
ASPHALT AND BASEROCK										
FAT CLAY; medium brown, moist; SOIL	CH	1								
		2								
		3								
SILTY SAND; mottled tan brown and orange brown, moist, very dense; ~20-40% fines, fine-grained; TERRACE DEPOSITS	SM	4	\							
		5	\	>79			0.2			
		6								
		7								
		8								
		9	\							
dense		10	\	41			1.0			
		11								
		12								
POORLY GRADED SAND; medium brown, moist, dense; <5% fines, medium-grained; minor gravel ~0.25"; gravel is well rounded; TERRACE DEPOSITS	SP	13								
		14	\							
		15	\	47			0			
		16								
5-10% fines		17								
		18								
		19	\							
<5% fines; fine- to medium-grained; no gravel		20	\	53			0			

BLANK 2" SCH. 40 PVC

CEMENT GROUT

BENTONITE

BORING LOG

No. MW-5

PROJECT FORMER LIVE OAK SERVICE | DATE 12/17/97 | LOGGED BY ACK

DRILL RIG MOBILE B-53 | HOLE DIA. 8" | SAMPLER MODCAL

GROUND WATER DEPTH INITIAL ~24' | FINAL 23.41 | HOLE ELEVATION 79.19

DESCRIPTION	SOIL TYPE	DEPTH	SAMPLE	BLOWS PER FOOT	POCKET PEN (tsf)	WATER CONTENT	PID READING (ppmv)	WATER LEVEL	CASING	ANNULAR MATERIAL
		21								
WELL GRADED SAND; medium brown, moist, very dense; <5% fines, fine to coarse, trace gravel to ~2"; TERRACE DEPOSITS	SW	22								
		23								
saturated ~24'		24	\							
		25	\	>50			0			
		26								
		27								
POORLY GRADED SAND; medium brown, wet, very dense; <5% fines; TERRACE DEPOSITS	SP	28								
		29	\							
		30	\	>90			0			
WELL GRADED SAND WITH GRAVEL	SW	31								
Bottom of boring @ 31' Monitoring well constructed		32								
		33								
		34								
		35								
		36								
		37								
		38								
		39								
		40								

0.010" SLOTTED 2" SCH 40 PVC

2/12 SAND

https://documents.geotracker.waterboards.ca.gov/esi/uploads/geo_report/3420745134/T0608700286.PDF

TABLE 3
SUMMARY OF HISTORICAL GROUNDWATER ANALYTICAL DATA
FORMER LIVE OAK SERVICE STATION
1671 Capitola Road
Santa Cruz, California

Well ID	Sample Date	TPHg µg/L	B µg/L	T µg/L	E µg/L	X µg/L	MtBE µg/L	1,2-EDB µg/L	1,2-DCA µg/L	PCE µg/L	DO mg/L	ORP mV
MW-5	12/22/97	<50	<0.5	<0.5	<0.5	<0.5	170.0	<0.5	<0.5	---	---	---
	03/25/98	190	<0.5	<0.5	<0.5	<0.5	3300.0	<85	<85	---	---	---
	06/29/98	92	<0.5	<0.5	<0.5	<0.5	760.0	---	---	---	---	---
	09/15/98	<50	<0.5	<0.5	<0.5	<0.5	6.2	---	---	---	---	---
	12/29/98	<50	<0.5	<0.5	<0.5	<0.5	<5.0	---	---	---	---	---
	03/05/99	66	<0.5	<0.5	<0.5	<0.5	9.8	---	<0.5	---	---	---
	06/24/99	<50	<0.5	<0.5	<0.5	<0.5	<5.0	---	---	---	---	---
	08/25/99	<50	<0.5	<0.5	<0.5	<0.5	<5.0	---	---	---	---	---
	12/13/99	<50	<0.5	<0.5	<0.5	<0.5	<5.0	---	---	---	---	---
	03/16/00	<50	<0.5	<0.5	<0.5	<0.5	<5.0	---	---	---	---	---
	11/07/00	<50	<0.5	<0.5	<0.5	<0.5	1.4	---	---	---	---	---
	04/24/01	55	<0.5	<0.5	<0.5	<0.5	<1.0	---	---	---	---	---
	09/24/01	---	---	---	---	---	---	---	---	---	---	---
	04/09/02	---	---	---	---	---	---	---	---	---	---	---
	10/30/02	---	---	---	---	---	---	---	---	---	---	---
	04/22/03	---	---	---	---	---	---	---	---	---	---	---
	10/14/03	---	---	---	---	---	---	---	---	---	---	---
	04/28/04	---	---	---	---	---	---	---	---	---	---	---
	10/28/04	---	---	---	---	---	---	---	---	---	---	---
	04/22/05	---	---	---	---	---	---	---	---	---	---	---
	10/19/05	---	---	---	---	---	---	---	---	---	---	---
	04/25/06	---	---	---	---	---	---	---	---	---	---	---
	10/22/08	62	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	37	1.1	63.3
	03/18/09	200	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	130	0.9	-14.1
	12/14/09	<50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	12	1.7	286.4
	12/06/10	<50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	12	0.2	160.0
	03/27/12	<50	<0.50	<0.50	<0.50	<1.0	<0.50	<0.5	<0.5	55	2.5	181.0

-

Historical Documentation of
Dry Cleaner Land Use on Adjoining Property
(1500 Capitola Road)

Target,Street	Cross,Street	Source
✓	-	POLK DIRECTORY CO

CAPITOLA,RD 1971

1310 Boughan Fredk R © 475-1953
1330 Avery John W 475-4680
1345 Amaya Reyes A © 475-1564
1350 Souza John P © 475-8245
1352 Waters Lois A Mrs 475-1308
1354 Vacant
1355 Live Oak Liquor Store 475-7789
1357 Richardson Margt
1359 Becker Mary G 476-2031
1361 Frank Hazel L 476-4894
1363 Vacant
1365 Vacant
1367 Fairbanks Les Real Estate 475-2483
Pacific Investments & Construction Co 475-2483
1412 Jones Darrel
1438 No Return
1441 Decor Co draperies 475-9110
1447 Betty's Hair Styles 475-6622
1451 Vacant
1461 State Farm Insurance 475-1991
1465 Kanney E Renee Hearing Aids sls & serv 475-8296
1467 Dodson Realty 475-1957
1500 Ziegelmeier Lee 476-0665
1514 Thompson Mary E 476-1744
1515 Wadak Kevin B © 475-3611
16TH AV INTERSECTS
1600 Fairway Dry Cleaning & Laundry 476-4174
1605 Earls Melvin F 475-3063
1621 Apartments
1 Peoples Lucille C Mrs 475-2829
2 No Return
3 Jackson Agnes
4 Vacant
1665 Fairway Market 475-3600
1671 Anderson's Texaco Service 475-1611

60

17TH AV INTERSECTS
1916 Live Oak Elementary School 475-2000
Live Oak School District 475-2000
1935 Gzsanka Les picture framing 476-1740
CHANTICLEER AV INTERSECTS

Target,Street	Cross,Street	Source
✓	-	POLK DIRECTORY CO

CAPITOLA,RD 1964

CAPITOLA RD--CONTD
1600 FAIRWAY DRY CLEANING & LAUNDRY SELF SERV LNDRY & DRY CLNG 475-9801
1605 MC ALEER ROBT
1621 APARTMENTS
1 PEOPLES OTIS O 475-2829
2 DOGGER AGNES MRS 475-4223
3 HAGAN EDW
4 DAVIS FRANKLIN 475-2101
STREET CONTINUED
1670 BARTELL'S TEXACO SERVICE 475-1611
---17TH AV INTERSECTS
1835 UNIVERSITY HOMES REAL EST 475-5300
1916 LIVE OAK ELEMENTARY SCHOOL 475-2000
1935 VACANT
---CHANTICLEER AV INTERSECTS

Recent Phase II Property Screening Report Data

(elevated PCE concentrations in soil vapor samples collected along eastern property boundary)

RRM, January 2020 (draft)

DRAFT

January 24, 2019
RRM Project# IA771

Ms. Ashley Schweickart
MidPen Housing Corp.
Watsonville Development Office
275 Main Street, Suite 204
Watsonville, California 95076

Re: ***Limited Soil Vapor Investigation (Phase II)***
1412, 1438, 1500 and 1514 Capitola Road
APNs 026-741-12, 026-741-13, 026-741-14 and 026-741-15
Unincorporated Census-Designated Place of Live Oak
Santa Cruz County, California

Dear Ms. Schweickart:

This letter report, prepared by Remediation Risk Management, Inc. (RRM), presents the results of a limited soil vapor investigation (Phase II) performed at the referenced property (Figure 1). This Phase II was conducted subsequent to completion of a Phase I environmental site assessment (ESA) of the property where petroleum hydrocarbons were confirmed to exist on a nearby parcel (Former Live Oak Texaco, 1671 Capitola Road Avenue, Figure 2). Based on the documented cleanup history at the Former Live Oak Texaco, it is possible that contamination from this site may have impacted soil, soil gas, and/or groundwater beneath the property. As a due diligence condition for obtaining project funding for redevelopment of the property, MidPen requested a subsurface investigation to determine if the property has been impacted by migrating contaminants from an offsite source. Summarized below are a description of the property and its background, the scope of work performed, the field and laboratory results, and our conclusions and recommendations. Supporting documentation is attached.

PROPERTY DESCRIPTION AND BACKGROUND

The Property is comprised of four parcels totaling approximately 3.7 acres, situated along Capitola Road, in the unincorporated, census-designated place of Live Oak, Santa Cruz County, California. The Property parcels are assigned assessor's parcel numbers (APNs) 026-741-12 (1412 Capitola Road), 026-741-13 (1438 Capitola Road), 026-741-14 (1500 Capitola Road), and 026-741-15 (1514 Capitola Road). The Property is set in a mixed commercial and residential neighborhood. Two small houses occupy the north half of the parcels at 1438 and 1500 Capitola Road; the south half of these parcels and the parcels at 1412 and 1514 Capitola Road are currently vacant and undeveloped. The west and south Property boundaries are fenced with wood, chain-link, or wire fencing. Chain link or wire fencing oriented north to south has been constructed along the north half of the three common parcel boundaries separating the four parcels from each other. Wire and chain-link fencing-oriented east to west near the middle of the

parcels at 1438 and 1500 Capitola Road, separates the north half of the parcels from the south half. Bollard and chain barriers have been installed by the current owner along the north parcel boundaries at 1412 and 1514 Capitola Road, to prevent vehicle entry onto the vacant parcels. A site location map is presented as Figure 1, and a site map is presented as Figure 2.

The property was initially developed in or about 1916 as four "ranchettes", or small residential farm parcels. Available evidence suggests farming activities, likely consisting of chicken or flower farming, continued on the Property from at least the early 1930's through about 1985. In or about that same year, a road construction company leased or rented the parcel at 1438 Capitola Road for the storage, servicing, and repair of their heavy equipment. The Road contractor vacated the Property in or about 1994, but their tenancy resulted in minor hydrocarbon impacts to surface soils. These were properly addressed to the satisfaction of Santa Cruz County Environmental Health Services staff that same year.

SCOPE OF WORK

Soil Vapor Sampling

Two soil vapor borings, designated VP-1-5 and VP-2-5, were advanced along the east boundary of parcel 026-741-15 (1514 Capitola Road) on December 13, 2019 (Figure 2). A 5/8" diameter rod with expendable tip was used to drive a new sample point to 5 feet below ground surface (bgs); the sample point was connected to 0.17" inner diameter Teflon® tubing for sample collection. A hydrated bentonite seal was placed from 3 feet bgs to grade. The well point was tested by applying a vacuum and observing formation pressure to ensure a viable sample could be collected. After waiting two hours for the bentonite grout to properly seal, and for subsurface conditions to equilibrate, RRM staff proceeded to obtain soil vapor samples from the vapor points.

The sampling procedure entailed connecting sampling manifold to the probe tubing, and stainless-steel Summa™ canisters (6-liter purge canister and 1-liter sample canister) to the manifold. Samples were collected by drawing soil vapor through the probe, tubing, and into the sample manifold attached to the probe tubing using the vacuum provided in the purge canister. The sample manifold was outfitted with push-to-connect type fittings, valves, and vacuum gauges to monitor and control the flow of soil vapor. The laboratory pre-cleaned Summa™ canisters were provided at an initial vacuum of approximately 28 inches of mercury.

Helium tracer leak testing was conducted during purging at each location to check for leaks in the above-ground sampling system. Approximately three calculated volumes of gas were purged from the manifold and probe prior to sample collection. Purge volumes were calculated by summing the internal probe and tube volume, annular space around the probe, and manifold tube volume. Purging and sampling were conducted at rates between 100 and 200 milliliters/minute. Helium tracer leak testing was accomplished by placing a plastic shroud over the sample probe location and sampling manifold, and filling the enclosed space with a mixture of helium and air; the mixture was measured in the shroud using a field meter. A diagram of a typical shroud set-up is included in Attachment A.

RESULTS

Subsurface Conditions

Groundwater was encountered when advancing boring VP-3-5 (Figure 2) at approximately 23 inches bgs, thus rendering it an unviable sample collection location.

Laboratory Analysis

Soil Vapor Laboratory Analyses: BC Laboratories, a California State-certified laboratory, provided the pre-cleaned Summa™ canisters, and performed all analyses. The soil vapor samples were analyzed for volatile organic compounds (VOCs) using U.S. EPA Modified Method TO-15 and for helium using Modified EPA Method 3C. Analytical results from soil vapor samples are summarized on Table 2, and the laboratory analytical report is included in Attachment A.

Tetrachloroethene (PCE) was detected in samples VP-1-5 and VP-2-5 at concentrations of 8,200 micrograms per cubic meter ($\mu g/m^3$) and 40,000 $\mu g/m^3$, respectively. Styrene was detected in SV-1-5 and SV-2-5 at an estimated concentration of 180 $\mu g/m^3$ and 190 $\mu g/m^3$. Toluene and xylenes were detected in SV-2-5 at 210 $\mu g/m^3$ and 240 $\mu g/m^3$, respectively. Toluene was detected in SV-1-5 at an estimated concentration of 240 $\mu g/M^3$, but Xylenes were not detected above laboratory limits.

Other analytes detected in VP-1-5 and VP-2-5 included methyl ethyl ketone (estimated concentration of 120 $\mu g/m^3$) and styrene (estimated 180 $\mu g/m^3$ and 190 $\mu g/m^3$).

Helium was detected in VP-2-5 at 620 parts per million by volume (0.062%), indicating the presence of a negligible leak; the results for sample VP-2-5 are considered valid. Helium was not detected in the sample taken from VP-1-5.

Environmental Screening Levels

The laboratory results were compared to risk characterization environmental screening levels (ESLs) published by the San Francisco Bay Regional Water Quality Control Board[1]. The ESLs selected were for residential land use, where ground water is considered a drinking resource (most conservative scenario), and soil impacts were shallow. The presence of a chemical at concentrations in excess of an ESL does not necessarily indicate adverse effects on human health or the environment, and the presence of a chemical at concentrations below the corresponding ESL can be assumed to not pose a significant threat to human health, water resources, or the environment. The only detected compound exceeding their respective ESL concentration was PCE. The most conservative (residential land use) ESL for PCE is 15 $\mu g/m^3$. Detected compounds and their respective ESLs are shown on Table 1.

ESLs or environmental screening levels, refer to contaminate levels for specific compounds published in: "*Screening For Environmental Concerns At Sites With Contaminated Soil And Groundwater* ", by the Regional Water Quality Control Board, San Francisco Bay region, February 2005, updated November 2007, revised May 2008, and most recently, January 2019.

CONCLUSIONS AND RECOMMENDATIONS

From the findings of this investigation, RRM concludes the following:

- PCE was detected in soil gas samples collected from borings VP-1-5 and VP-2-5 at concentrations of 8,200 $\mu g/m^3$ and 40,000 $\mu g/ m^3$, respectively.
- Methyl ethyl ketone, styrene, toluene, and xylenes were also detected in soil gas samples collected from both borings; concentrations of these compounds did not exceed their respective ESLs for the most conservative land use scenario.
- PCE has previously been detected in a sample of groundwater collected from a monitoring well formerly located on the adjacent parcel to the east of the property, approximately 200 feet from the east border of the 1514 Capitola Road parcel. The monitoring well was installed during the environmental investigation phase of the former Live Oak Service (Texaco) at 1671 Capitola Road. PCE was detected in groundwater from the most recent sample at 55 parts per billion (or micrograms per liter), in 2012.

Based on the foregoing conclusions, RRM recommends confirmation soil gas samples be collected in the same locations or near to VP-1-5 and VP-2-5. RRM also recommends collecting grab-groundwater samples in order to evaluate the condition of groundwater beneath the property, and to determine whether the PCE plume emanating from the former Texaco site has migrated onto the property.

Should you have any questions regarding the contents of this document, please do not hesitate to call RRM at (831) 475-8141.

Sincerely,
RRM, Inc.

DRAFT

Steven Clark
Senior Geologist
CHG 167

Cate Townsend
Project Geologist

Attachments:
Table 1 – Soil Gas Analytical Data
Figure 1 – Site Location Map
Figure 2 – Soil Vapor Sampling Locations
Attachment A – Shroud Diagram, Field Notes, Laboratory Analytical Report

Table 1
Soil Vapor Analytical Data

1514 Capitola Road
Santa Cruz, California

Sample Designation	Sample Date	Methyl Ethyl Ketone ($\mu g/m^3$)	Styrene ($\mu g/m^3$)	PCE ($\mu g/m^3$)	Toluene ($\mu g/m^3$)	Total Xylenes ($\mu g/m^3$)
VP-1-5	12/13/19	120J	180J	**8,200**	240J	<260
VP-2-5	12/13/19	120J	190J	**40,000**	210	240
ESL		170,000	31,000	15	14,000	3,500

Notes:

Only detected analytes were tabulated. See laboratory report for full analyte list.

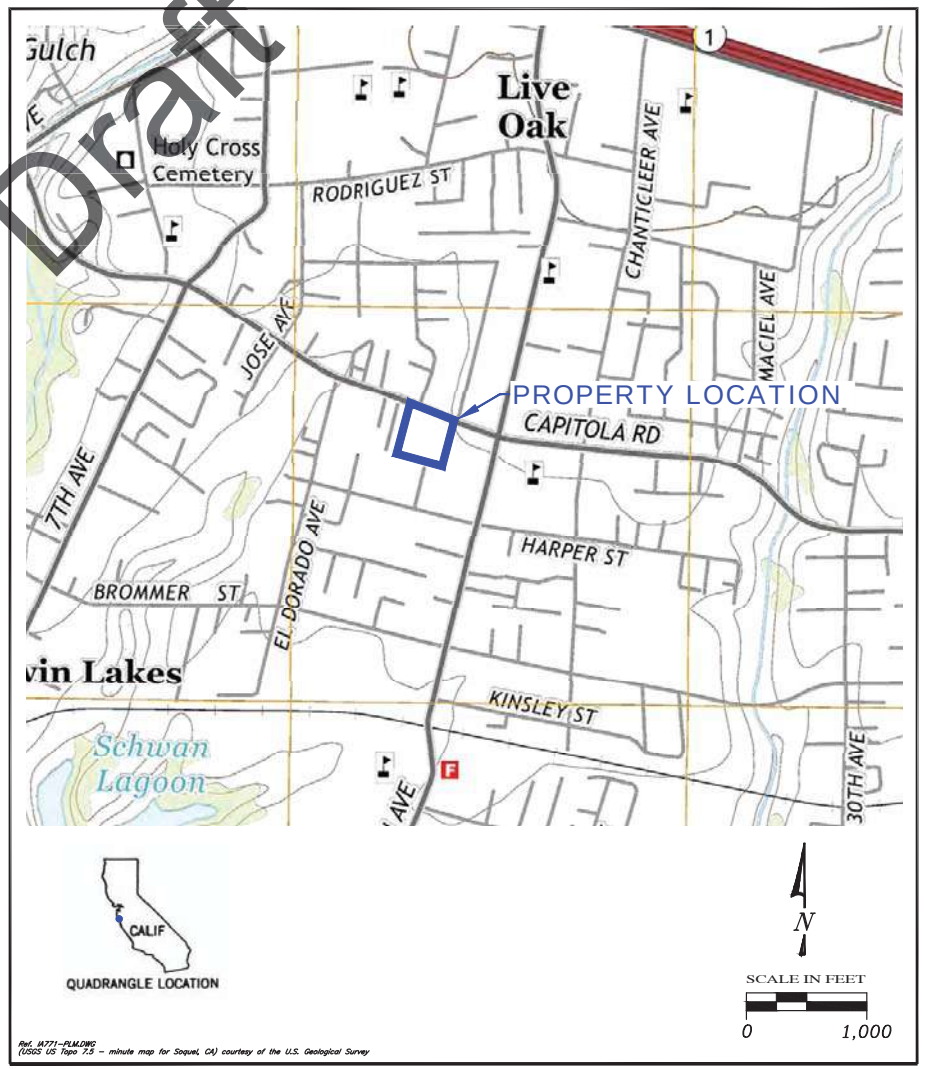
PCE = tetrachloroethene

($\mu g/m^3$) = micrograms per meter cubed

< = Less than the indicated laboratory detection limit

J = Estimated value; detected above the method detection limit, but below the reporting limit.

ESL = Environmental Screening Levels, from *Screening for Environmental Concerns at Sites with Contaminated Soil and Water*, RWQCB, Interim Final-February 2005, Rev. 01/19

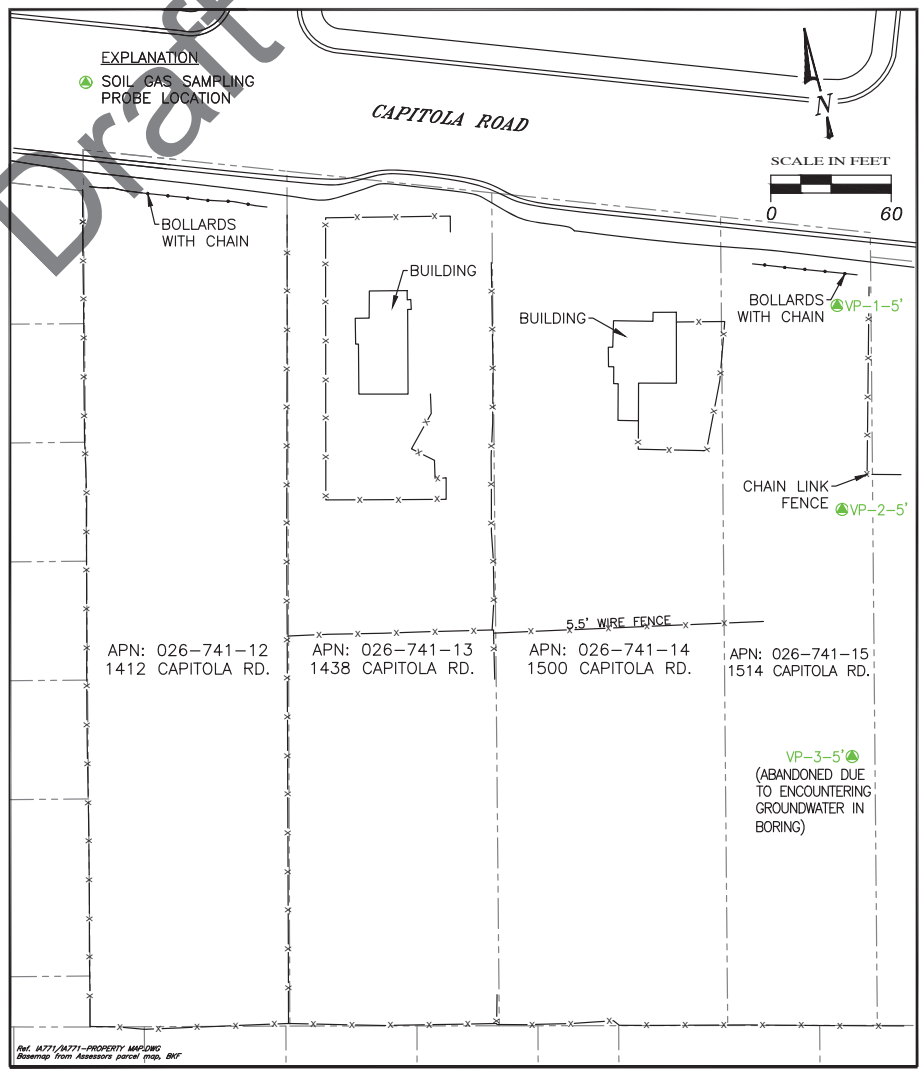


PREPARED BY RRM

PROPERTY LOCATION MAP

PROPERTY OF SANTA CRUZ COUNTY
REDEVELOPMENT SUCCESSOR AGENCY
1412, 1438, 1500 and 1514 Capitola Road
Santa Cruz, California

FIGURE: 1
PROJECT: IA771



PREPARED BY	SOIL VAPOR SAMPLING LOCATIONS	FIGURE: 2
RRM	PROPERTY OF SANTA CRUZ COUNTY REDEVELOPMENT SUCCESSOR AGENCY 1412, 1438, 1500 and 1514 Capitola Road Santa Cruz, California	PROJECT: IA771

Draft

A

SHROUD DIAGRAM, FIELD NOTES, LABORATORY ANALYTICAL REPORT

2560 Soquel Avenue, Suite 202
Santa Cruz, California 95062
Tel: 831.475.8141
Fax: 831.475.8249

Field Data Sheet

Client: Capitola Rd Parcels	Project #: 1A771
Job Address: 1514 Capitola Rd, Live Oak	Date: 12/13/19
Weather Conditions: Cloudy, overcast	Field Tech: MT
Equipment on site: SG Sampling	Page: 1 of 1
Arrival Time: 1310	
Departure Time: 1500	

Field Notes:

- Arrived on site, Rich working on SV-3-5
  *see Rich's notes for encountering water
- Purge Calcs: VP-2-5' & VP-1-5

$V_{tubing} = \pi(0.095")^2(60") = 1.36 in^3$

$V_{hole} = \pi(0.3125")^2(18")(0.3) = 1.65 in^3$

$V_{dry\,b} = \pi(0.3125")^2(12")(0.3) = 1.10 in^3$

$4.11 in^3 \sim 67mL$

$67mL \times \frac{1min}{150mL} = 27sec\ purge$

- Removed tubing from ground, SC checked in
- Cleaned & Packed
- Departed

Signature: MT

Soil Gas Work Order

Project #: 1A771
Site Address: 1514 Capitola Road
APN 026-741-15

Requested by: Cate Townsend
Date of Request:
Ideal Completion Date: ASAP

Please check or fill appropriate boxes, and indicate you have included the requested attachments.

[X] **Sample SG Wells or Vapor Points**

3 Total # of samples to be collected

Requested Attachments

Yes* A site map with sample locations (preferrably with [ ] contours, to determine order)

Yes COC sample analysis & methodology

List here: TO-15

* No data previously collected from this site. Included a contour map of adjacent site to show gw flow and direction.

___ Other COC/special instructions: Rich is going to install the soil sampling probes. These are temporary sampling points. Not to be left in ground longer than 24 hours.

[ ] **Sample Indoor/Outdoor Air**

[ ] 24 hour [ ] 8 hour

___ Total # of INDOOR air samples

___ Total # of OUTDOOR air samples

Requested Attachments

___ A site map with sample locations, and alternative locations if wind direction changes

___ COC analysis & methodology

List here:

___ Other COC/special instructions:

[ ] **Vapor Pin Installation**

___ Total number of Vapor Pins to be installed

Requested Attachments

___ A site map with proposed installation locations

Soil Gas Sampling Field Data Sheet

Project Name	Project Location	Project Number	Personnel	Date
Capitola Rd Parcels	1514 Capitola, Santa Cruz, CA	IA771	MT	12/13/19

Sample Name	Sample Canister ID	Sample Can Volume	Manifold/Train ID	Manifold Flow Rate (mL/min)	Purge Canister ID
VP-1-5	2644	1.4L	21	150	27743

Was there a minimum 48-hour wait period observed between sample point installation or sub-surface disturbance and sampling event?	Cross-Slab Differential Pressure ("H_2O)	Cross-Building Differential Pressure ("H_2O)	
YES / (NO)	N/A	N/A	

Shut-In Test (3min minimum)

Time (24:00) ~ 1min intervals	Flow Rate (mL/min)		Pressure @ Purge Canister ("Hg)	Pressure @ Well Head ("Hg)	No observable loss of vacuum for at least 1 min?
1403	150		22.5	24.0	(YES (PASS)) NO (FAIL)
1404	150		22.5	24.0	
1405	150		22.5	24.0	

Leak Test (Purge)

Time (24:00) ~ 2min intervals	Flow Rate (mL/min)	Pressure @ Purge Canister ("Hg)	Pressure @ Well Head ("Hg)		Notes
					27S
1406	150	21.5	0		~~28.2sec~~ purge @ 150mL/min
1406	150	21.0	0		70.5mL purge total
	150				
	150				
	150				
	150				
	150				
	150				
	150				
	150				

Sample Collection

Time (24:00) ~2 min intervals	Flow Rate (mL/min)	He in Shroud (%)	Pressure @ Sample Canister ("Hg)	Pressure @ Well Head ("Hg) *keep <7.5"Hg
1410	150	23.3	24.5	0
1412	150	29.8	18.5	0
1414	150	33.8	13.5	0
1415	150	23.6	9.5	0
1416	150	24.0	6.5	0
	150			
	150			
	150			
	150			
	150			
	150			

Sample Name	Sample End Time (24:00)	Sample Start Pressure ("Hg)	Sample Final Pressure ("Hg)
SV-1-5	1417	25.0	5.0

Notes:
*final sample pressure ideally ~ 4"Hg
*request lab include final can vac upon lab receival
*request lab report in ug/m^3
*include can#, mani#, start/end pressures
*shroud [ ] ideally 20-40ppm with IPA
*shroud [ ] ideally 25-30% He

2ND SHUT IN:

Time	PC can	PC well
1407	26.0	28.0
1408	26.0	28.0
1409	28.0 ← →	26.0

Soil Gas Sampling Field Data Sheet

Project Name	Project Location	Project Number	Personnel	Date
Capitola Rd Parcels	1514 Capitola, Santa Cruz, CA	IA771	MT	12/13/19

Sample Name	Sample Canister ID	Sample Can Volume	Manifold/Train ID	Manifold Flow Rate (mL/min)	Purge Canister ID
VP-2-5	2855	1.4L	22	150	27743

Was there a minimum 48-hour wait period observed between sample point installation or sub-surface disturbance and sampling event?	Cross-Slab Differential Pressure ("H_2O)	Cross-Building Differential Pressure ("H_2O)	
YES / (NO)	N/A	N/A	

Shut-In Test (3min minimum)

Time (24:00) ~ 1min intervals	Flow Rate (mL/min)		Pressure @ Purge Canister ("Hg)	Pressure @ Well Head ("Hg)	No observable loss of vacuum for at least 1 min?
1332	150		26	25	(YES (PASS)) NO (FAIL)
1333	150		26	25	
1334	150		26	25	

Leak Test (Purge)

Time (24:00) ~ 2min intervals	Flow Rate (mL/min)	Pressure @ Purge Canister ("Hg)	Pressure @ Well Head ("Hg)		Notes
					27S
1335	150	25.5	0		~~28.2sec~~ purge @ 150mL/min
1336	150	25.5	0		70.5mL purge total
	150				
	150				
	150				
	150				
	150				
	150				
	150				
	150				

Sample Collection

Time (24:00) ~2 min intervals	Flow Rate (mL/min)	He in Shroud (%)	Pressure @ Sample Canister ("Hg)	Pressure @ Well Head ("Hg) *keep <7.5"Hg
1345	150	28.5	28.0	0
1347	150	33.2	18.0	0
1348	150	33.8	14.5	0
1349	150	22.5	11.0	0
1350	150	23.4	9.0	0
1351	150	28.9	5.5	0
	150			
	150			
	150			
	150			
	150			

Sample Name	Sample End Time (24:00)	Sample Start Pressure ("Hg)	Sample Final Pressure ("Hg)
SV-2-5	1351	28.0	4.5

Notes:
*final sample pressure ideally ~ 4"Hg
*request lab include final can vac upon lab receival
*request lab report in ug/m^3
*include can#, mani#, start/end pressures
*shroud [ ] ideally 20-40ppm with IPA
*shroud [ ] ideally 25-30% He

2ND SHUT IN:

Time	PC can	PC well
1342	28.0	27.5
1343	"	"
1344	"	"

Draft

2560 Soquel Avenue, Suite 202
Santa Cruz, California 95062
Tel: 831.475.8141
Fax: 831.475.8249

Field Data Sheet

Client:	Project #: IA771
Job Address:	Date: 12/13/19
Weather Conditions:	Field Tech: Rich
Equipment on site:	Page: 1 of 3
Arrival Time:	
Departure Time:	

Field Notes:

Install Soil Gas
Vapor Points

- Find the 3 locations
- Start w/ ~~SV~~ vp-2-5'
- drive vapor point/screen/teflon tubing to 5'. 0-4' easy, last 1' foot slow - much harder
- hole stayed open to 5'
- build up → 1'6" sand / 1' dry granular bentonite / 2.5' hydrated bentonite to surface.
- test briefly train # 22 for vp-2-5' shut-in good, will vac 0, can 25-24"Hg
- done 0930

vp-1-5' - drive to 5' easy the whole way down
- hole stayed open to 5'
- build up with 1'6" sand / 1' dry gran. bentonite / 2.5' hydrated bentonite to surface
- test - train # 21 for vp-1-5' shut-in good, will vac 4"Hg can vac 24-23"Hg (well gauge climed slowly to 4"Hg while topping on gauge - stopped @ 4"Hg)
- done 1025

Signature: Rich

2560 Soquel Avenue, Suite 202
Santa Cruz, California 95062
Tel: 831.475.8141
Fax: 831.475.8249

Field Data Sheet

Client:	Project #: IA771
Job Address:	Date: 12/13/19
Weather Conditions:	Field Tech: Rich
Equipment on site:	Page: 2 of 3
Arrival Time:	
Departure Time:	

Field Notes:

Install Soil Gas
Vapor Points

Vp-3-5'

- implant "drive end" broke on last vapor point (vp-1-5') - cannot insert screen vapor points into drive rod - needs the "drive end". Return to shop for pipe to make "drive end" Return to site.
- Attempt to install vapor point → drive w/ use roto hammer to 1" Medium wall electrical conduit - worked to 3'8" below ground surface - then drive rod broke/ Sheered off @ "Extention Drive adapter"
- Remove pipe - soil in pipe - pipe wet, dripping w/ H_2O
- Measure DTwater - 1'11" below ground surface
- unable to install vapor point - equipment failure and wet conditions.

- pack up / trvl back to Shop.
- cln up wash mud off equipment.
- write up ppwrk

Signature: Rich

Draft

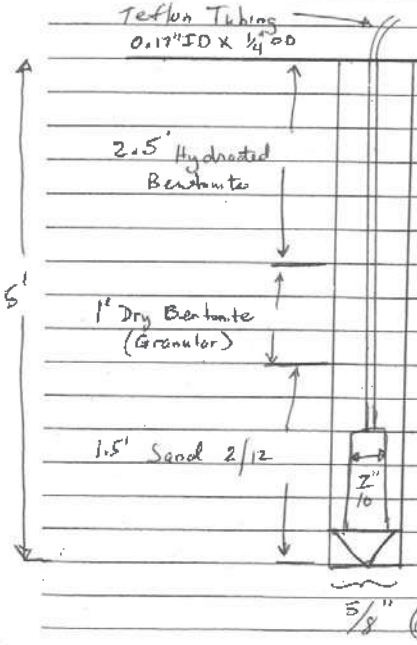
2560 Soquel Avenue, Suite 202
Santa Cruz, California 95062
Tel: 831.475.8141
Fax: 831.475.8249

Field Data Sheet

Client:	Project #: IA771
Job Address:	Date: 12/13/19
Weather Conditions:	Field Tech: Rick
Equipment on site:	Page: 3 of 3
Arrival Time:	
Departure Time:	

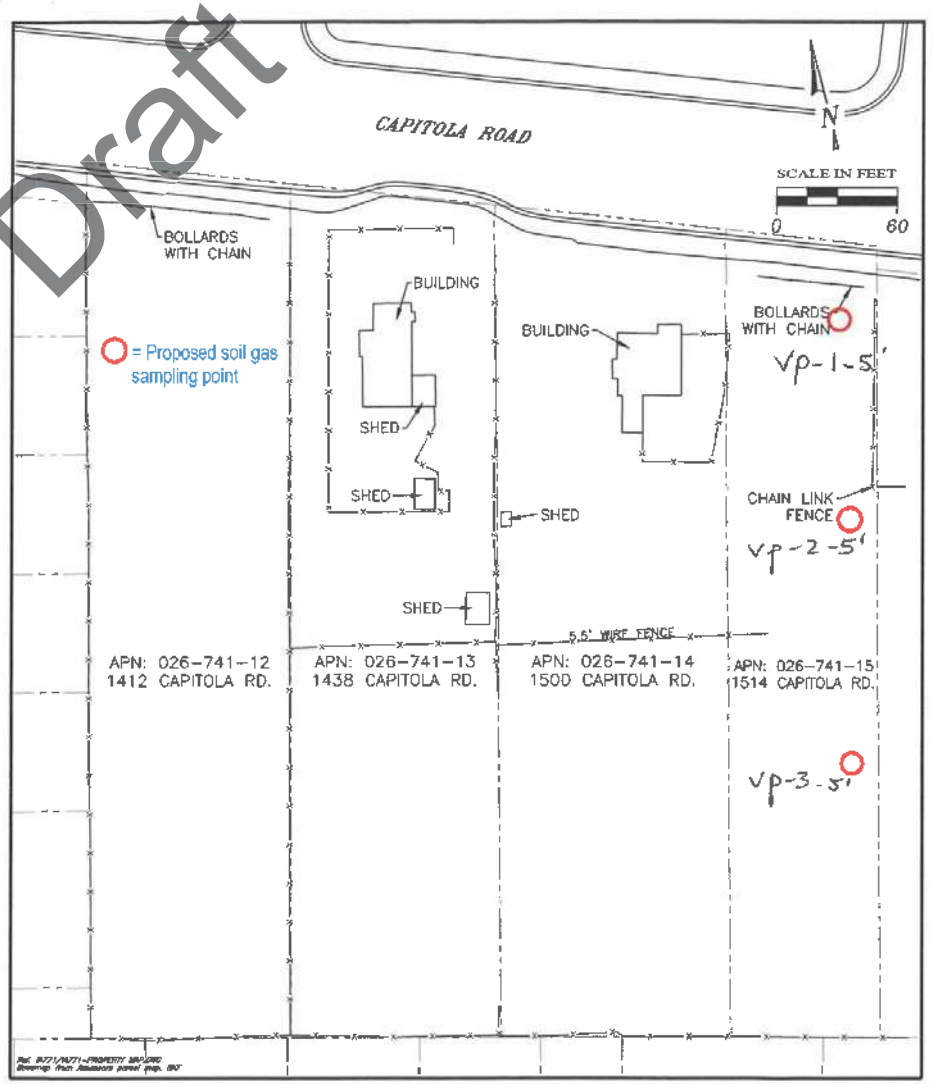
Field Notes:

Vp-1-5' and Vp-2-5' Build Specs



- Vapor Implants (points) Driven to 5' w/ Rototherm. After drive rod removal, hole remained open. Built up well as shown. After 2+ hrs wait time vapor points sampled. After sampling implants/tubing pulled out and any remaining open hole filled w/ hydrated bentonite.

Signature: Rick



PREPARED BY RRM

PROPERTY MAP

PROPERTY OF SANTA CRUZ COUNTY REDEVELOPMENT SUCCESSOR AGENCY
1412, 1438, 1500 and 1514 Capitola Road
Santa Cruz, California

FIGURE: 2
PROJECT: IA771

Laboratories, Inc.
Environmental Testing Laboratory Since 1949

Date of Report: 01/08/2020

Cate Townsend

RRM, Inc.
2560 Soquel Avenue, Suite 202
Santa Cruz, CA 95062

Client Project: [none]
BCL Project: IA771
BCL Work Order: 1942419
Invoice ID: B367908

Enclosed are the results of analyses for samples received by the laboratory on 12/16/2019. If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Contact Person: Christina Herndon
Client Service Rep

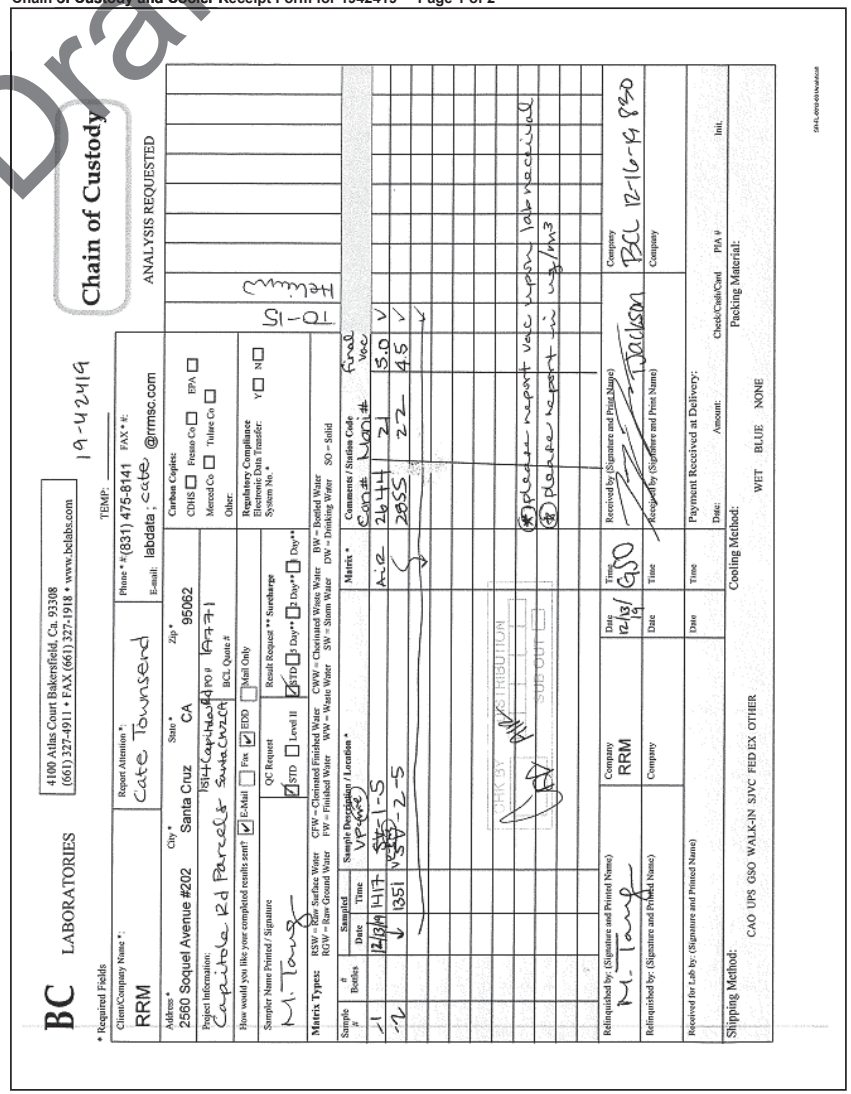
Stuart Buttram
Technical Director

Certifications: CA ELAP #1186; NV #CA00014; OR ELAP #4032-001; AK UST101

Draft

Laboratories, Inc.
Environmental Testing Laboratory Since 1949

Chain of Custody and Cooler Receipt Form for 1942419 Page 1 of 2



The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.
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Appendix C

Field Methodology & Sampling Protocols

Driven Probe Soil Coring & Groundwater Sampling

Passive Soil-Gas Sampling (and reporting limits)

Active Soil Gas Sampling

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Driven Probe Soil Coring & Groundwater Sampling

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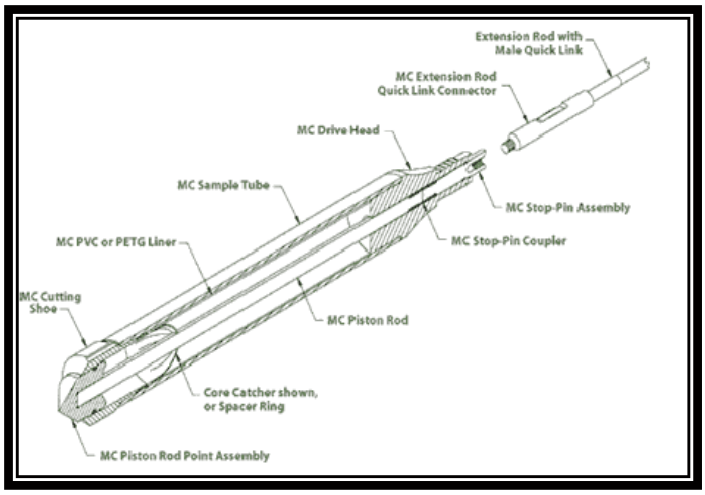
FIELD METHODOLOGY FOR:
HYDRAULIC DRIVEN PROBES

Using Macro-Core®, Large Bore® or Dual Tube® Hydraulic Driven Probes

Direct push exploratory borings are "drilled" with a Hydraulic Driven Probe drill rig, which hydraulically vibrates and drives steel probes into the soil. This sampling technology has the ability for either continuous or discrete sampling using a 4-foot long nickel-plated sampling probes fitted with clear acetate liners. During coring operations, the sampler remains open as it is driven into undisturbed soil over its entire 4-foot sampling interval.



The soil cores are logged by an experienced geologist using the Unified Soil Classification System (USCS), noting in particular, the lithology of the soils, moisture content, and any unusual odor or discoloration. Relatively undisturbed soil samples are obtained for both lithologic logging and laboratory analysis. A portion of individual soil cores are stored in a sealed plastic bags for field screening of hydrocarbons and/or volatile organic compounds by an Photoionization Detector (PID). Vapor readings in parts per million (ppm) are recorded on the boring logs. The PID is also used during drilling for monitoring the work area for site safety.

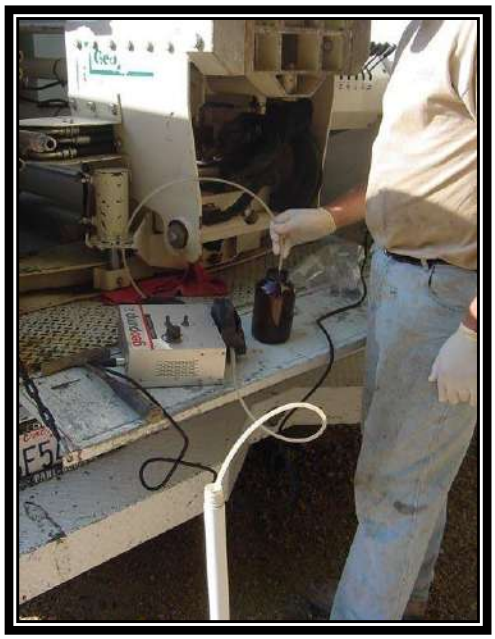
All drilling equipment is decontaminated prior to arriving on-site to prevent possible transfer of contamination from another site. The sampling probe and all other soil sampling equipment are thoroughly cleaned between each borehole by washing in a Liqui-Nox or Alconox solution followed by a double rinsing with distilled water to prevent the transfer of contamination.

After drilling, all exploratory boreholes are grouted with continuous pour neat cement grout from the bottom of the borehole to the ground surface. Soil cuttings and purge water generated during sampling are stored on site in DOT-approved, drums for disposal by a state-licensed contractor pending laboratory analysis results.

Samples Targeted for Laboratory Analysis:

Soil Samples: Soil samples targeted for laboratory analysis are immediately cut from the acetate sample liner and protected at both ends with Teflon tape, sealed with non-reactive caps, taped, labeled, placed in a plastic ZipLock baggie, and immediately stored in an insulated container chilled to a temperature of 4 degree Celsius. Soil samples selected for Volatile Organic Compound (VOC) analysis will follow field preservation protocols according to EPA Method 5035, as described in DTSC's *Guidance Document for the Implementation of United States Environmental Protection Agency Method 5035: Methodologies for Collection, Preservation, Storage, and Preparation of Soils to be Analyzed for Volatile Organic Compounds*, dated November 2004.

Groundwater Samples: Once encountered, depth to groundwater is measured to the nearest hundredth (0.01) of a foot with an pre-cleaned, electric sounder (subsequent measurements may be made to evaluate first encountered vs. stabilized levels). Groundwater samples are collected after temporary PVC casing is placed in the hole and at least one borehole volume is purged and groundwater is visually observed to be free of sediment.



Relatively representative groundwater samples are collected either: 1) using a peristaltic pump and dedicated polyethylene tubing and dispensed directly into containers specifically prepared for the analyses (typically for groundwater encountered at depths of less than 27 feet below ground surface (bgs)); or 2) by mechanically lifting groundwater through a clean stainless steel foot valve and dedicated polyethylene and dispensed directly into containers specifically prepared for the analyses.

During purging, the purge water is monitored. A calibrated, YSI Professional Plus Multi-Parameter flow-through meter is used to measure the physical parameters of temperature, conductivity, pH, dissolved oxygen (D.O.) concentration, and Oxidation-Reduction Potential (ORP) to evaluate stabilized parameters (i.e., measured parameters are within ~ 10 percent of the previous measurement). Purging is determined to be complete (stabilized aquifer conditions reached) when the physical parameters have stabilized and/or the removal of approximately two well casings for driven probes and three-to-five well volumes of water for permanent wells.

Samples being analyzed for dissolved metals will be preserved and acidified by the testing laboratory following their receipt of samples. Once collected, groundwater sample containers are placed in ZipLock bags and are stored in an insulated container chilled to a temperature of 4 degree Celsius.

All field data (depth-to-groundwater, well purge volume, physical parameters, and sampling method) is recorded on field data sheets

Sample Transport: All samples are transported in chilled coolers to a State-certified laboratory under appropriate chain-of-custody documents. Soil samples that may be put on “hold” for potential future analysis will be stored in a dedicated sample freezer, be frozen, and stored under chain-of-custody documentation. Hold times will be confirmed with the testing laboratory to ensure that potential analysis of any “hold” samples will be analyzed within the laboratory hold times.

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Passive Soil-Gas Sampling (and reporting limits)

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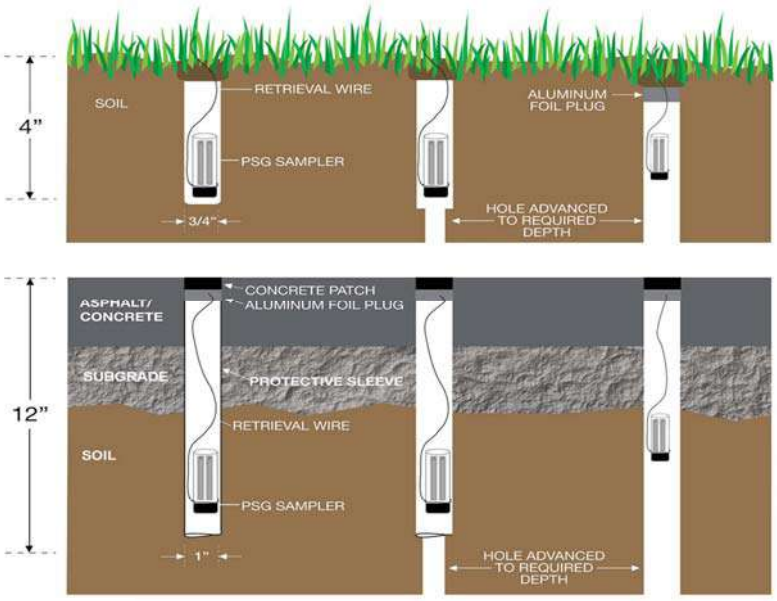
Attachment 1

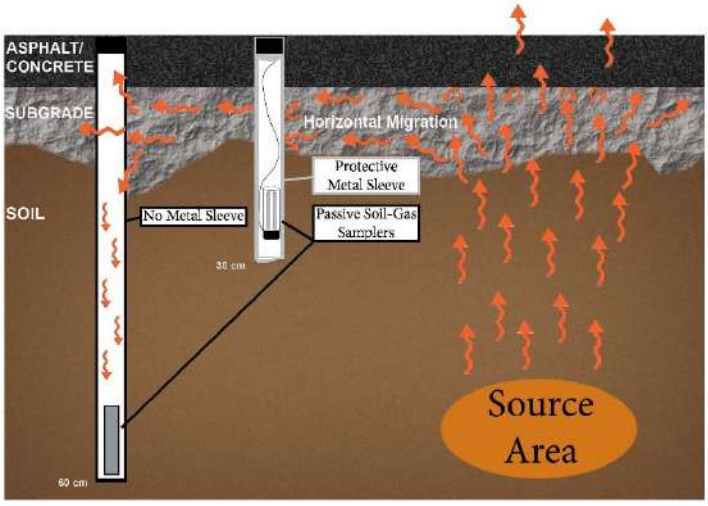
EFFECTIVE PASSIVE SOIL-GAS SAMPLING PROCEDURES

PSG Samplers need only be installed to a shallow depth in some applications because of the sensitivity of the method. However, the method is extremely versatile and installation procedures can be adapted to meet project objectives or client requirements.

When a PSG Sampler is installed in the ground, the top of the hole is completely sealed by collapsing the soils above the Sampler or patching the drilled hole through the surfacing. Other vendors use a permeable cork to plug their installation hole, which allows subsurface gases to escape before the adsorbent captures the organic compounds (reducing sensitivity) *and* permits vapors from above the surface, as well as surface water, to enter the hole (false positives). BEACON's PSG Samplers are not susceptible to these influences because they are effectively sealed in the subsurface.

As mentioned above, BEACON's Samplers are versatile and for some projects a higher sensitivity is required because contaminants are present at low concentrations or soils are fairly impermeable. In these situations, the sampling hole is advanced to a greater depth using a hammer drill, slide hammer, or direct push equipment. *Because the soil vapors that enter the hole will migrate upwards in this newly created preferential pathway, it is not necessary to push the Sampler to the bottom of the hole.* Therefore, the Sampler can still be installed in the upper portion of the hole





Samplers installed through an impermeable surface are sleeved in pre-cleaned protective metal sleeves (provided by BEACON). These sleeves prevent any horizontal migration of vapors in the more porous subgrade from influencing the soil-gas Samplers. As the accompanying diagram shows, the metal sleeves are advanced below the subgrade and tapped into the underlying soils so that the Samplers will only be adsorbing compounds in soil gas that are moving vertically through the soils beneath, and not in the vapors that may be migrating laterally through the more porous subgrade. Other soil-gas vendors simply create a hole 2 to 3 feet deep, and leave their samplers unprotected to the horizontal migration of vapors in the subgrade. This easy-to-perform but important procedure is yet another reason why BEACON's method has achieved the reputation as being the most accurate and reliable soil gas technology available.

Soil-Gas Sampling Procedures

To perform the soil-gas investigation, Beacon Environmental provides a BESURE Sample Collection Kit™ with all the materials necessary to collect the requested number of soil-gas samples. To collect soil-gas samples, an approximately one-inch diameter hole is advanced to the appropriate depth to meet the objectives of the survey (e.g., one to three feet). The PSG Sampler (which contains two sets of ***hydrophobic adsorbent*** cartridges) is installed in the hole and covered with an aluminum foil plug and soil to seal the sampler in the ground. The adsorbent cartridges used by Beacon Environmental are hydrophobic, which allows the samplers to be effective even in water-saturated conditions. Extensive empirical evidence, which is supported by a government study, has proven that hydrophobic adsorbents work perfectly well in high moisture conditions and should not be encased by a hydrophobic membrane.

For locations covered by asphalt or concrete surfacing, an approximately 1 ½-inch diameter hole is drilled through the surfacing to the underlying soils. A ½" to 1" diameter drill bit can then be used to advance the hole to a three foot depth to increase the sensitivity of the method. The upper 12 inches of the hole is sleeved with a sanitized metal pipe provided in the Kit. After the Sampler is installed inside the metal pipe, the hole is patched with an aluminum foil plug and a thin concrete patch to effectively protect the sampler.

The samplers are exposed to subsurface gas for approximately three to 14 days, with the exact length of time appropriate to meet the objectives of the survey. The sampler is shipped to the site with a length of wire wrapped around the vial and twisted around the shoulder of the vial to expedite retrieval from the ground. Following the exposure period, the Samplers are retrieved and shipped to Beacon Environmental's laboratory for analysis. It is not necessary to use ice or preservatives during shipment; however, the samplers are sealed and shipped under established chain-of-custody procedures. Trip blanks, which remain with the other samples during preparation, shipment, and storage, are included at a typical rate of five percent of the total number of field samples. **Figure 2** shows a PSG Sampler as it looks when received in the BESURE Kit™.

Figure 2 – Beacon PSG Sampler

A two-person team can install approximately 50 to 100 samplers per day depending on the number of sample locations that are covered with asphalt, concrete, or gravel surfacing. For retrieval of the Samplers, one person can retrieve approximately 50 samplers per day and patch the holes through the surfacing. **Figure 3** shows installation through asphalt and grass surfaces, respectively.

Figure 3 — Installation of Samplers with Beacon Environmental's BESURE Kit™

The amount of days required to complete the installation and retrieval procedures is dependent upon the number of personnel deployed for the execution of the fieldwork, weather conditions, and health and safety considerations.

3.0 Analytical Procedures

A chain-of-custody accompanies the field samples at all times from the time the samples are collected until final analysis. BESURE Kits™ are shipped with tug-tight custody seals to ensure that samplers are not tampered with during transport (see **Figure 4**). Once samples are received at the laboratory, the sample custodian receives the samples and logs the samples into the laboratory's Sample Receipt Log.

Figure 4 – BESURE Sample Collection Kit™

Beacon Environmental's laboratory is maintained in a safe and secure manner at all times. The facility is locked when not occupied and is monitored for fire and unauthorized access. Beacon Environmental personnel escort all visitors at all times while inside the facility. Neither soil nor water analyses are performed at Beacon Environmental, so no solvents are stored or used that

can create background contamination problems as experienced by wet labs. This ensures that a clean laboratory environment is maintained for trace analyses.

Soil gas samples are analyzed by Beacon Environmental using thermal desorption-gas chromatography/mass spectrometry (TD-GC/MS) instrumentation, following EPA Method 8260C procedures. Samples are routinely analyzed for a list of approximately 40 compounds, which can additionally include total petroleum hydrocarbons (TPH). Results are based on an ***initial five-point calibration***. In addition, a BFB tune is performed daily and a method blank is run following the daily calibration verifications. ***Internal standards and surrogates*** are included with each sample analysis. The laboratory's reported quantitation level (RQL) for each of the targeted compounds is 10 or 25 nanograms (ng); however, the limit of quantitation (LOQ) is 10 ng and the limit of detection (LOD) is 5 ng. MDL studies are performed, as well. As an option, tentatively identified compounds (TICs) can be reported for each sample, with the results based on the closest internal standard to the TIC.

Beacon Environmental is known for providing the highest level of accuracy and quality assurance and quality control (QA/QC) procedures for the analysis of soil gas samples in the industry. The table below summarizes these analytical procedures.

Description	**Included**
Analysis by thermal desorption-gas chromatography/mass spectrometry (TD-GC/MS) following EPA Method 8260C - Accredited	√
Analytical results based on 5-point initial calibration	√
MDLs are based on a seven replicate study with contiguous analyses	√
Limit of Detection (LOD) and Limit of Quantitation (LOQ) studies performed quarterly	√
Internal standards and surrogates included with each run	√
BFB tunes (5 to 50 nanograms through GC, per method)	√
Continuing calibration checks and method blanks	√

Analyses of the samples are performed at Beacon Environmental's laboratory using state-of-the-art instruments that are listed below. The Markes thermal desorption instruments outperform other older thermal desorption equipment, which cannot target as broad a range of compounds with as much sensitivity or accuracy.

- Agilent 7890 Gas Chromatograph / 5975 Mass Spectrometer,
- Markes UltrA autosampler and Unity thermal desorber,
- Markes TD100 and TD100xr, and
- Markes Mass Flow Controller Module.

4.0 Reporting

Following analysis and a thorough data review, a comprehensive survey report is provided that contains:

project objectives,
the investigation plan,
the QA/QC program and findings,
laboratory data,
color isopleth maps showing the distribution of detected compounds,
field procedures,
laboratory procedures,
Field Deployment Reports, and
Chain-of-Custody documentation.

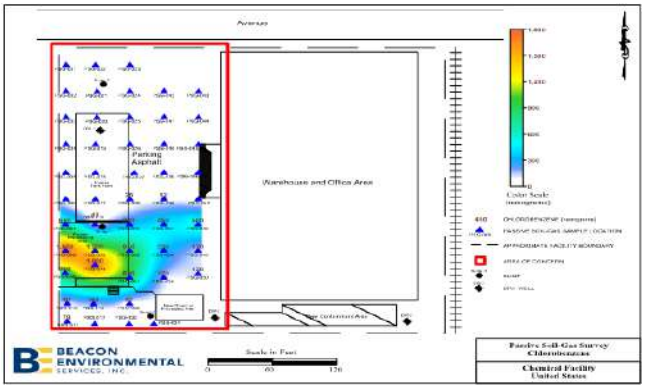


Figure 5 – Example Color Isopleth Map

Beacon Environmental requests a CAD drawing of the site is provided with coordinate data for each location to facilitate creation of color isopleth maps. BEACON can provide the color isopleth maps as layers for use with CAD software or provide data files of the contours for use with GIS software. Beacon Environmental provides post survey support to assist in interpreting the data, when requested.

Biography of Author

Harry O'Neill is the President of Beacon Environmental Services and has managed soil gas and vapor intrusion investigations for more than 25 years, working on federal, state, and commercial projects throughout the United States, as well as internationally across six continents. Under his direction since 1999, Beacon Environmental has achieved DoD ELAP, NELAP, and ISO/IEC 17025 accreditation for the analysis of soil gas and air samples to target trace concentrations of organics using sorbent samplers. In addition, Mr. O'Neill oversaw the implementation of the quality program that enabled Beacon to become the first National Environmental Field Activities Program (NEFAP) accredited field sampling and measurement organization (FSMO) in the United States, and the company's accreditation is for the collection of soil gas and air samples. Mr. O'Neill has been on the forefront of the acceptance of passive sampling technologies at the national and international level and has managed the implementation of thousands of soil gas and air sampling surveys. He is a member of AWMA, ITRC, and ASTM, and is the lead author of ASTM Standard D7758: *Standard Practice for Passive Soil Gas Sampling in the Vadose Zone* and has published and presented findings throughout the United States, as well as internationally across four continents as an invited speaker. Mr. O'Neill can be contacted at Harry.ONeill@Beacon-usa.com or by phone at 1-410-838-8780.

Part 2: PSG Sampler Step-by-Step Installation and Retrieval Procedures

PSG Sampler Installation

1. At each survey point, clear vegetation as necessary and, using a hammer drill and drill bit (or comparable equipment), create a 1"- to 1½"-diameter hole approximately 12 inches deep, but can be as shallow as 6 inches. When appropriate, use a ½" to 1" diameter drill bit to extend the hole to a three foot depth. Note: In areas of very organic topsoil or landscaped areas (*i.e.*, mulched areas, gardens, etc.) it is important to get beneath the organic soil layer to the underlying soil below. For locations covered with asphalt or concrete, an approximately 1½"-diameter hole is drilled through the surfacing to the underlying soils and the hole is sleeved with a 12" long pre-cleaned, aluminum pipe provided in the BeSure Sample Collection Kit. The pipe is then pushed or tapped ½" to 1" into the base of the hole using a hammer and tapping dowel also provided in the Kit.

2. After the hole is created, remove a Beacon PSG Sampler (a rugged, borosilicate glass vial containing two sets of ***hydrophobic adsorbent cartridges***) and unwind the retrieval wire wrapped around it. Holding the capped end of the vial in one hand, pull the wire tight (to straighten it) with the other hand. Remove the solid cap on the Sampler Vial and replace it with a Sampling Cap (a one-hole cap with a screen meshing insert). Store the solid cap in the Cap Storage Container.

3. Lower the Sampler with the screened-capped-end pointing down into the hole. If the hole was created to a greater depth it is only necessary to suspend the sampler in the upper portion of the hole because compounds in soil gas that enter the hole will migrate up to the sampler. With the retrieval wire extending from the hole, plug the top of the hole with aluminum foil and use a hammer to collapse the soils above the foil plug. Coil the wire and lay it flat on the ground surface. For those locations through concrete or asphalt, lower the Sampler into the aluminum pipe and bend the end of the wire over the top of the pipe so that the coil of wire hangs over the top and outside the pipe. Next, plug the top of the hole with a wad of aluminum foil and a thin concrete patch (approximately ¼" thick) to effectively seal the Sampler in the ground. **Figure 6** depicts sampler installation options.

4. Close the Kit, and on the Chain of Custody record: (a) sample-point number; (b) date and time of emplacement; and (c) other relevant information (*e.g.*, soil type, vegetation, proximity to potential source areas). Be sure to mark the sample location and take detailed notes (*i.e.*, compass bearings and distances from fixed reference points or GPS coordinates).

5. Move to next location.

PSG Sampler Retrieval

1. At each sample location open the BeSure Sample Collection Kit and place it and the wire cutters within easy reach. Remove a square of gauze cloth and place it and a clean towel on the open Kit. Remove a solid cap from the Cap Storage Container and place it on the Kit, also.

2. Expose the Sampler by pulling on the wire when in soils or using a small chisel and hammer to chip the thin concrete patch away when in asphalt/concrete. Retrieve the Sampler from its hole by pulling on the retrieval wire. Holding the Sampler upright, clean the sides of the vial with the clean towel (especially close to the Sampling Cap). Remove the Sampling Cap, cut the wire from the vial with the wire cutters, and clean the vial threads completely with the gauze cloth.

3. Firmly screw the solid cap on the Sampler Vial and with a ballpoint pen record the sample number, corresponding to the sample location, on the cap's label.

4. On the Field Deployment Report, record: (a) date and time of retrieval (to nearest minute); and (b) any other relevant information.

5. Return the sampling cap to the Sampling Cap container. Place the sealed and labeled Sampler Vial in a 3" x 4" re-sealable Sampler Bag. Then place the individually bagged and labeled sampler into the larger bag labeled "Return Shipment Bag." Each sampler is to be individually bagged and placed in a Return Shipment Bag, with at least one trip blank per Return Shipment Bag included with the PSG Samplers.

6. On the Chain of Custody, record: (a) date and time of retrieval; and (b) any other relevant information. After all samples have been retrieved, verify that the caps on each Sampler are sealed tightly and that the seals on the Sampler Bags are closed. Verify that all Samplers are stored in the Return Shipment Bag, which contains an adsorbent pack. Seal the Return Shipment Bag and place it in the upper tray of the Kit, and place the provided tools and materials in the lower compartment of the Kit.

7. Complete the chain-of-custody for shipment of Samplers. Seal the BESURE Sample Collection Kit with the provided tug tight custody seal, provided in the Kit, which has a unique identification number that is documented on the chain-of-custody. Place the Kit and paperwork in a cardboard box and ship via overnight delivery to Beacon Environmental Services for analysis of the samples.

PASSIVE SOIL GAS SAMPLER REPORTING LIMITS

Limits of Quantitation (LOQs) based on Exposure Periods.
When required, lower detection limits can be reported.

COMPOUND	CAS	Uptake Rate (ml/min)	1 Day LOQs (ug/m3)	3 Days LOQs (ug/m3)	7 Days LOQs (ug/m3)	14 Days LOQs (ug/m3)
Vinyl Chloride	75-01-4	0.77	9.02	3.01	1.29	0.64
1,1-Dichloroethene	75-35-4	0.33	21.04	7.01	3.01	1.50
1,1,2-Trichlorotrifluoroethane (Fr.113)	76-13-1	0.86	8.07	2.69	1.15	0.58
trans-1,2-Dichloroethene	156-60-5	0.44	15.78	5.26	2.25	1.13
Methyl-t-butyl ether	1634-04-4	0.51	13.66	4.55	1.95	0.98
1,1-Dichloroethane	75-34-3	0.84	8.27	2.76	1.18	0.59
cis-1,2-Dichloroethene	156-59-2	0.54	12.86	4.29	1.84	0.92
Chloroform	67-66-3	0.36	19.44	6.48	2.78	1.39
1,2-Dichloroethane	107-06-2	0.56	12.40	4.13	1.77	0.89
1,1,1-Trichloroethane	71-55-6	1.02	6.81	2.27	0.97	0.49
Carbon Tetrachloride	56-23-5	0.43	16.32	5.44	2.33	1.17
Benzene	71-43-2	0.54	32.15	10.72	4.59	2.30
Trichloroethene	79-01-6	0.34	20.42	6.81	2.92	1.46
1,4-Dioxane	123-91-1	0.42	41.44	13.81	5.92	2.96
1,1,2-Trichloroethane	79-00-5	0.34	20.58	6.86	2.94	1.47
Toluene	108-88-3	0.41	42.34	14.11	6.05	3.02
1,2-Dibromoethane (EDB)	106-93-4	0.39	18.03	6.01	2.58	1.29
Tetrachloroethene	127-18-4	0.41	16.94	5.65	2.42	1.21
1,1,1,2-Tetrachloroethane	630-20-6	0.41	17.04	5.68	2.43	1.22
Chlorobenzene	108-90-7	0.84	8.31	2.77	1.19	0.59
Ethylbenzene	100-41-4	0.83	20.92	6.97	2.99	1.49
p & m-Xylene	108-38-3	0.86	20.19	6.73	2.88	1.44
1,1,2,2-Tetrachloroethane	79-34-5	0.41	17.04	5.68	2.43	1.22
o-Xylene	95-47-6	0.86	20.19	6.73	2.88	1.44
1,2,3-Trichloropropane	96-18-4	0.73	9.51	3.17	1.36	0.68
Isopropylbenzene	98-82-8	0.81	21.48	7.16	3.07	1.53
1,3,5-Trimethylbenzene	108-67-8	0.81	21.48	7.16	3.07	1.53
1,2,4-Trimethylbenzene	95-63-6	0.81	21.48	7.16	3.07	1.53
1,3-Dichlorobenzene	541-73-1	0.73	9.50	3.17	1.36	0.68
1,4-Dichlorobenzene	106-46-7	0.73	9.50	3.17	1.36	0.68
1,2-Dichlorobenzene	95-50-1	0.73	9.50	3.17	1.36	0.68
1,2,4-Trichlorobenzene	120-82-1	0.39	17.72	5.91	2.53	1.27
Naphthalene	91-20-3	0.78	22.18	7.39	3.17	1.58
1,2,3-Trichlorobenzene	87-61-6	0.39	17.72	5.91	2.53	1.27
2-Methylnaphthalene	91-57-6	0.74	23.36	7.79	3.34	1.67
TPH C4-C9		0.59	5,870	1,960	839	420
TPH C10-C15		0.67	5,180	1,730	740	370

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Active Soil Vapor Sampling

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Field Methodology for Active Soil Gas Sampling

The active soil gas / soil vapor (we use the terms interchangeably) sampling field methodology is conducted in general accordance with the procedures outlined in the CalEPA's/DTSC/LARWQCB/SFRWQCB *Advisory – Active Soil Gas Investigations* (July 2015)[1], and the DTSC/CalEPA's final *Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air (Vapor Intrusion Guidance)* (October 2011). We use the terms soil gas and soil vapor interchangeably. The field methodology for soil vapor sampling entails:

- Constructing Soil Vapor Sample Points and Purge Test Points (if necessary);
- Purge volume testing at the Purge Test Point(s);
- Setting up the sampling and leak testing equipment; and
- Soil Vapor Sampling

Constructing & Decommissioning Soil Vapor Sample and Purge Test Probes

Soil vapor sample probes can be either semi-permanent or temporary. A semi-permanent sample probe is constructed with a secure surface completion consisting of bolt-down flush-mounted well vault so it can be reused. A field geologist or engineer logs the soils encountered using the Unified Soil Classification System (USCS), unless the site is already well characterized geologically.

Shallow soil vapor probe installation via GeoProbe drill rig

Shallow Soil Vapor Probe: The soil vapor/gas probe is installed to the target sampling depth via a Geo-Probe drill rig, which hydraulically drives and vibrates steel probes into the soil. The soil is cored out using a 4-foot long nickel-plated sampling barrel fitted with a clear acetate liner. During coring operations, the sample barrel remains open as it is driven into undisturbed soil over its entire 4-foot sampling interval. Alternatively, the soil gas probe borehole can be created via a hollow stem auger or hand auger. Shallow soil gas / soil vapor sample depths will be no less than 5 feet deep (if possible) in order to avoid breakthrough of ambient air from the surface. Shallow and deeper soil gas probes are constructed in a similar manner. Once the probe hole is cored to the desired sample depth, a length of 3/16–inch inner diameter Teflon or Nylaflo tubing having a porous media tip (i.e., ceramic filter stone) attached at the down-hole

[1]: https://www.dtsc.ca.gov/SiteCleanup/upload/VI_ActiveSoilGasAdvisory_FINAL.pdf

end of the tubing is inserted through a 1-inch diameter tremie-pipe that runs the entire length of the borehole. This sample tubing is placed approximately 6-inches above the base of the borehole. A minimum of a one-foot sand pack is emplaced at the base of the borehole (the grain size of the sand pack is larger than the grain size of the adjacent formation), followed by at least one foot of dry granular bentonite. The probe tip is emplaced midway within the sand pack. The tremie-pipe is used to insert the sand pack and granular bentonite to ensure that no bridging occurs. The remainder of the borehole is sealed to the ground surface with hydrated bentonite gel for temporary probes or neat cement mixed with 1% – 5% bentonite, which are both pre-mixed at the ground surface; this ensures a sound surface seal and/or seal between multi-depth nested probe sample intervals.

Decommissioning Shallow Soil Vapor Probes: Following sample collection the vapor probe is properly decommissioned by one of the following regulatory approved techniques:

- The sample tubing is completely removed from the ground surface (if possible) allowing the bentonite gel slurry to flow into the small vertical void thereby sealing the borehole. Subsequently, approximately 6-inches of bentonite slurry is removed below the ground surface and the surface is patched to match the existing grade.
- The sample tubing is properly destroyed by injecting neat cement grout into the tubing via a syringe. The volume of grout injected into the tubing is monitored to ensure that the entire tubing is completely sealed. Subsequently, the tubing is cut off approximately 6-inches below the ground surface and the surface is patched to match the existing grade.
- The vapor probe is properly destroyed by over-drilling the sample tubing and annular seal material. Once the material has been removed, the subsequent borehole is filled with neat cement grout to within about 6-inches of the ground surface and the surface is patched to match the existing grade.

Sub-Slab Soil Vapor Probe: The emplacement of the sub-slab soil vapor sampling probe is conducted by coring a 1 to 1-1/4-inch diameter hole via an electric hand rotary hammer drill through the slab foundation. The sub-slab borehole is advanced approximately 3 to 4-inches below the base of the slab and into the sub-slab material. Once the probe hole is cored to the desired sample depth a length of 3/16–inch inner diameter Teflon or Nylaflo or inert, cleaned metal tubing with a porous media tip (i.e., ceramic filter stone) attached at the down-hole end of the tubing is inserted into the borehole. The probe tip is emplaced 1 to 2-inches above the base of the bore hole. A minimum of 2 to 4-inches of sand pack is emplaced at the base of the borehole followed by at least 1 to 2-inches of dry granular bentonite to above the base of the slab. The probe tip is emplaced midway within the sand pack. The remainder of the borehole is sealed to the ground surface with hydrated bentonite for temporary probes or hydrated

bentonite followed by neat cement for permanent probes to ensure a sound surface seal. Permanent probes have a flush-mount inert metal fitting for providing a good seal when connecting the above-ground sample tubing and for plugging between sampling events. Following sample collection from a temporary probe the sample tubing is removed and the subsequent void is sealed with hydrated bentonite and the surface is patched with concrete.

Purging

Prior to soil gas sample collection, a purge volume or "dead space volume" will be calculated in order to purge ambient or stagnant air from the sampling system to ensure that collected samples are representative.

Per the procedures outlined in the CalEPA's Advisory, a default of three purge volumes will be extracted prior to sampling. The purge volume consists of approximately three system volumes (i.e. tubing and annular space) of soil gas, while capturing the purge effluent. One system volume is calculated by summing the inner diameter (id) tubing volume (i.e., id area times the length of tubing) and the annular pore space volume (i.e., area of the borehole times the length of sand pack and granular bentonite surrounding the ceramic filter stone tip times an estimated sand-pack pore space volume of 33.8%). The purge rate will be conducted at the same rate soil gas is sampled (approximately 200-mL/min flow). We note that Cal-EPA guidance recommends purging or sampling at rates between 100 to 200-mL/min for soil vapor probes at all depths, including sub-slab vapor probes, to limit air stripping and to prevent ambient air form diluting the sample. After the specific pre-determined purge volume is removed, a soil vapor/gas sample is collected for laboratory analyses for the site-specific target compounds as discussed below.

Sample Collection

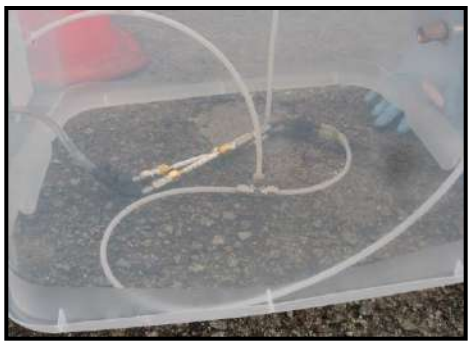
Before purging the appropriate "dead space volume" from the soil vapor/gas probe, the probe seal is allowed to cure and the subsurface is allowed to equilibrate for the appropriate amount of time per the procedures outlined in the CalEPA's Advisory. We note that an equilibration time of 2-hours is required for soil vapor/gas probes installed via a direct push drill rig and 48-hours for soil vapor/gas probes installed via a hollow stem auger drill rig, hand-auger, or an electric hand rotary hammer drill. Once the appropriate "dead space volume" has been purged, the sample tubing will be attached to a laboratory prepared soil vapor manifold and 1 or 6-liter Summa canister or sorbent sampling media depending on required laboratory analysis. We note that the choice between using a 1-L or 6-L canister is typically dependent on the purpose of the site investigation. However, for soil vapor/gas samples collected at a depth less than 5-feet, including sub-slab vapor probes, a 1-L canister should be used to avoid excessive air removal and to prevent ambient air from entering the sub-surface and sample.

When sampling for ambient indoor air, a 6-L canister is nearly always required because of the extremely low detection limits required to meet Indoor Air ESLs. For soil vapor collection, a 1-L canister may be all that is necessary if the site is known to contain high concentrations of contaminants of interest that make achieving low detection limits a secondary concern. In those cases, only a small volume of the 1-L collected is necessary for analysis of both the TO-15 and the TO-3 compounds. However, if a site does not have historical data indicating that it is significantly contaminated, or if multiple analytical runs become necessary to achieve reporting limit/CHHSL/ESL goals, it becomes critical to have a larger initial volume of collected sample. A 6-L volume allows the laboratory to provide the lowest possible detection for the compounds of interest for full list TO-15 while providing enough volume for the additional analysis of individual compounds that may require dilution to bring them within the instrument calibration range. The 6-L volume will provide enough residual sample to analyze for additional contaminants (e.g., EPA Method TO-3) and/or fixed Gases (ASTM D1946) including Helium, which may be used as a tracer or leak check compound in the investigation. A consultation with the selected testing laboratory will be conducted for each investigation to ensure that appropriate sample volumes are obtained.

Sample collection with Summa canisters

The following sample collection procedures are followed for each sample collection media:

- The Summa canisters will be supplied by the analytical laboratory with a vacuum of approximately 30-inches of mercury and outfitted with a 200-mL/min flow control valve. The tubing will be connected to the soil vapor manifold and Summa canister using airtight stainless-steel or brass fittings. The flow control valve will then be opened slowly to draw the vapor sample from the target depth.



Sample collection with sorbent tube

- Laboratory sorbent media and canister with a vacuum of approximately 30-inches of mercury and outfitted with a 200- mL/min flow control valve or sampling pump (10 to 200 mL/min) will be supplied by the analytical laboratory. The tubing will be connected to the sorbent media sample tube, upstream of the vacuum canister/sample pump/syringe using airtight stainless-steel or brass fittings. The sample vacuum canister/ pump/syringe will then be activated to draw approximately 1 to 3-L of

sample volume for TO-17 analysis from the target depth at a flow rate of 200- mL/min or less per sorbent media sample tube manufacturer and/or laboratory guidelines.

Schematic diagrams of sample configurations for the different sampling media (i.e., Summa canister and sorbent media) and probe construction (i.e., shallow soil and sub-slab) are included as attachments 1, 2, and 3 of this field methodology.

Leak Detection Monitoring

Monitoring leak check compound within shroud during sample collection

Leak detection monitoring will be conducted during soil gas sampling by applying a tracer compound (i.e., isopropyl alcohol [isopropanol, IPA] or helium) to the sample system connections and bentonite seal. Specifically, a shroud will be used to encapsulate the entire system (i.e., the sample canister and surface bentonite seal) so as to trap the applied tracer compound. The leak detection monitoring configuration is graphically depicted on Attachments 1, 2, and 3 of this field methodology. The concentration of the leak check compound within the shroud will be monitored periodically throughout the sample collection period with a PID calibrated to the specific tracer gas compound and these values will be recorded into the field notes. The tracer compound (i.e., IPA or helium) is maintained within the shroud at a concentration of approximately two (2) orders of magnitude higher than the detection limit of the field meter used throughout the duration of sample collection. The testing laboratory will screen for this compound in all analyzed air samples when IPA is used. If helium is used the laboratory can screen for this compound if collected in Summa canisters, or the sample effluent after passing through the sorbent media will be field screened for the presence of the helium.

Prior to purging and sample collection, a “shut-in test” is performed to check the above-ground sample system connections downstream from the top of the soil vapor/gas probe, including the laboratory provided sample manifold (“sample train”). The “shut-in test” is completed in the field by closing off all valves to the laboratory provided soil vapor manifold and the soil vapor/gas probe tubing, and subsequently opening the valve to the connected “purge” Summa canister to increase the vacuum in the sample train to a minimum of 100-inches of water, at which point the purge canister is closed. Then the vacuum gauge on the sample train is observed for at least 1-minute to confirm it remains stable.

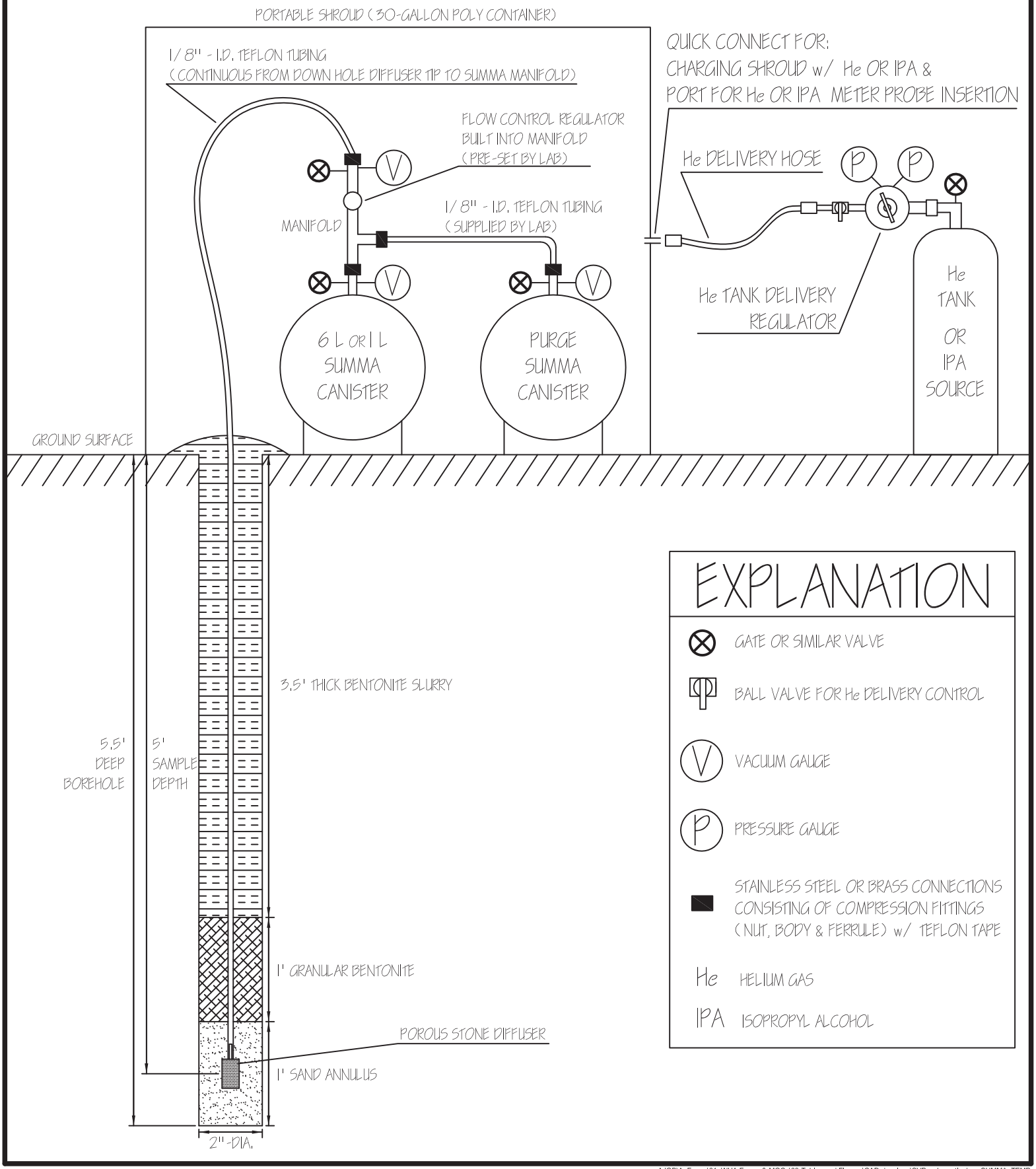
Low Flow Sampling Conditions

A low flow sampling condition is characterized as a condition where the sample probe cannot sustain a flow rate of 100-mL/min for more than three minutes while maintaining an applied vacuum of less than 100-inches of water (or 7.4-inches of mercury). The vacuum applied to the sample probe will be measured and monitored via a vacuum gauge installed between the sample probe and the sample collection flow regulator. If the vacuum measured within the sample probe exceeds 100-inches of water during dead space volume purging, then one of the following sample collection procedures will be employed:

- If the lithology observed during sample probe installation indicates potential for low permeability / low flow conditions a representative soil sample at the soil vapor sample depth will be collected and put on ice for possible laboratory analysis.
- If extreme low flow conditions are observed during purging, specifically excessive time will be required to purge and collect a sample, we will contact the regulating agency to confirm collecting a purge volume approximating one dead space volume (i.e., volume of the sample tube plus the volume of the sand pack pore space and granular bentonite pore space surrounding the probe tip) will be evacuated prior to sample collection. Sample collection will proceed until the sample probe vacuum equals 100-inches of water. The sample system will then be closed off to allow the probe to relax and equilibrate. Over time the vacuum will eventually dissipate, the rate of which can be monitored via an in-line vacuum gauge installed as described above. Once the vacuum in the sample probe has dissipated, sampling will resume as described above. This process will be repeated until an adequate sample volume has been obtained for the required laboratory analysis.
- If during low flow sampling as stated above, the sample system when closed off to allow the probe to relax and equilibrate the probe vacuum does not reduce by 13.5 inches of water (1 inch of mercury) in 3-minutes, soil vapor sampling will cease and the previously collected soil sample will be submitted to the laboratory for potential analysis for site specific constituents.

Sample Storage and Transport

Once collected, the soil gas samples are transported to a State-certified laboratory under appropriate chain-of-custody documentation. Sorbent media are wrapped in foil and placed in individual zip-lock type bags and immediately placed in a chilled cooler (chilled to 4 degrees Celsius) for storage and transport to the testing laboratory. Summa canisters are placed in laboratory provided cardboard boxes and stored at ambient temperature for transport to the testing laboratory.



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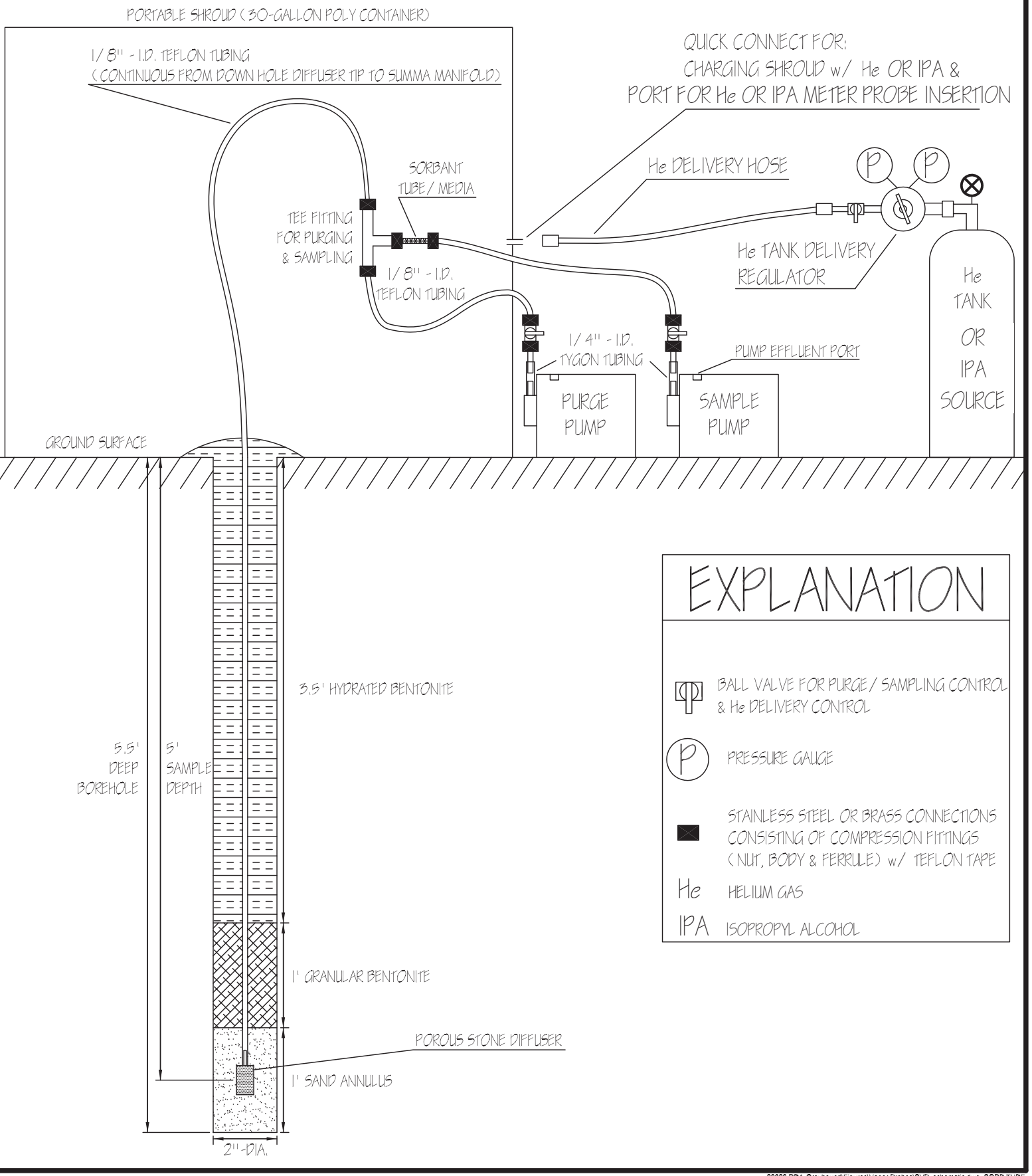
Temporary Soil Vapor Probe Construction Details

Attachment 1



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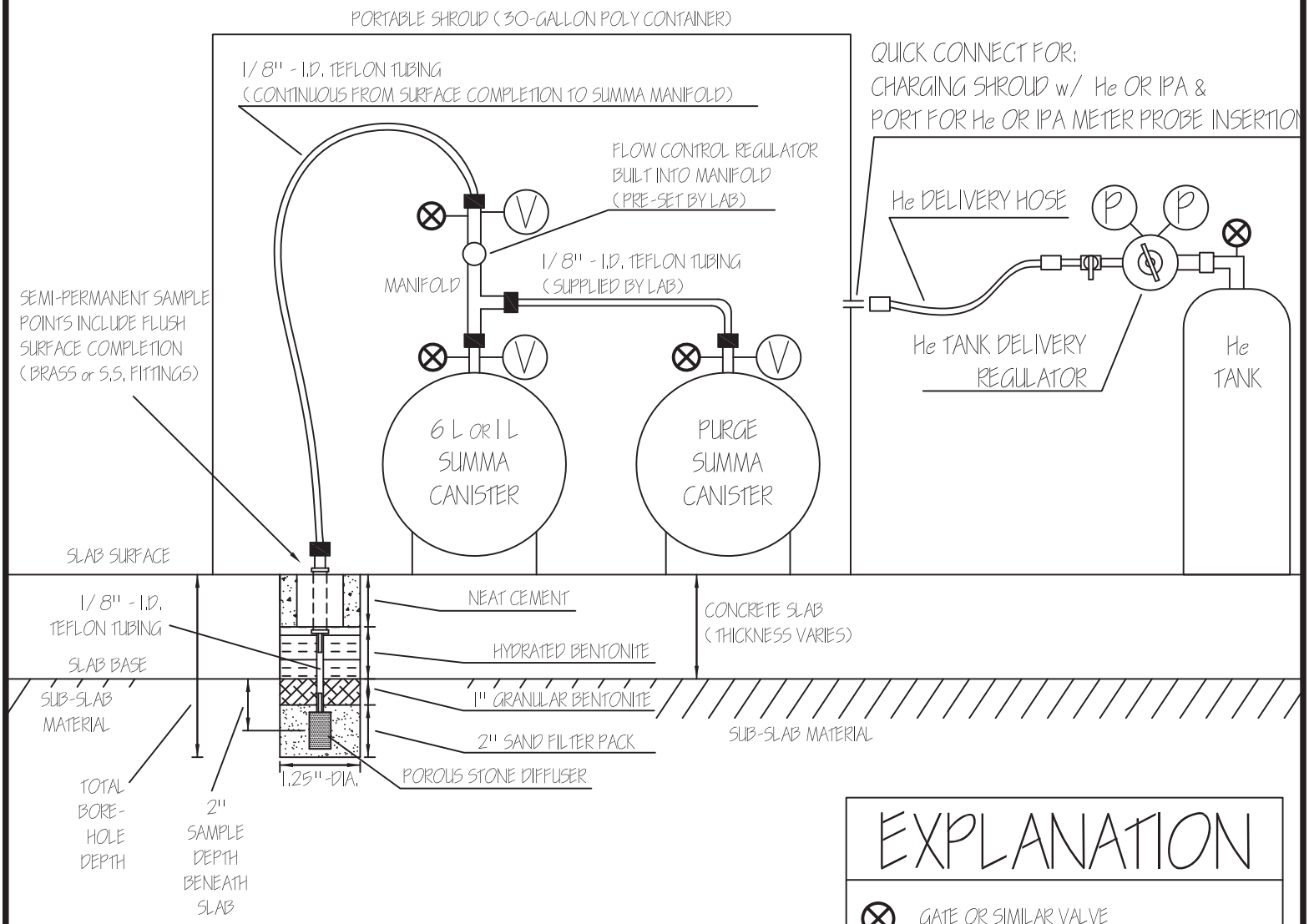
Semi-Permanent Soil Vapor Probe Construction Details
Sorbent Tube

Attachment 2



EXPLANATION

- GATE OR SIMILAR VALVE
- BALL VALVE FOR PURGE / SAMPLING CONTROL & He DELIVERY CONTROL
- PRESSURE GAUGE
- STAINLESS STEEL OR BRASS CONNECTIONS CONSISTING OF COMPRESSION FITTINGS (NUT, BODY & FERRULE) w/ TEFLON TAPE
- He — HELIUM GAS
- IPA — ISOPROPYL ALCOHOL

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Semi-Permanent, Sub-Slab Soil Vapor Probe Construction Details

Attachment 3

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