



# Marbledale Road BCP Site: Review of Soil Vapors

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# Methods

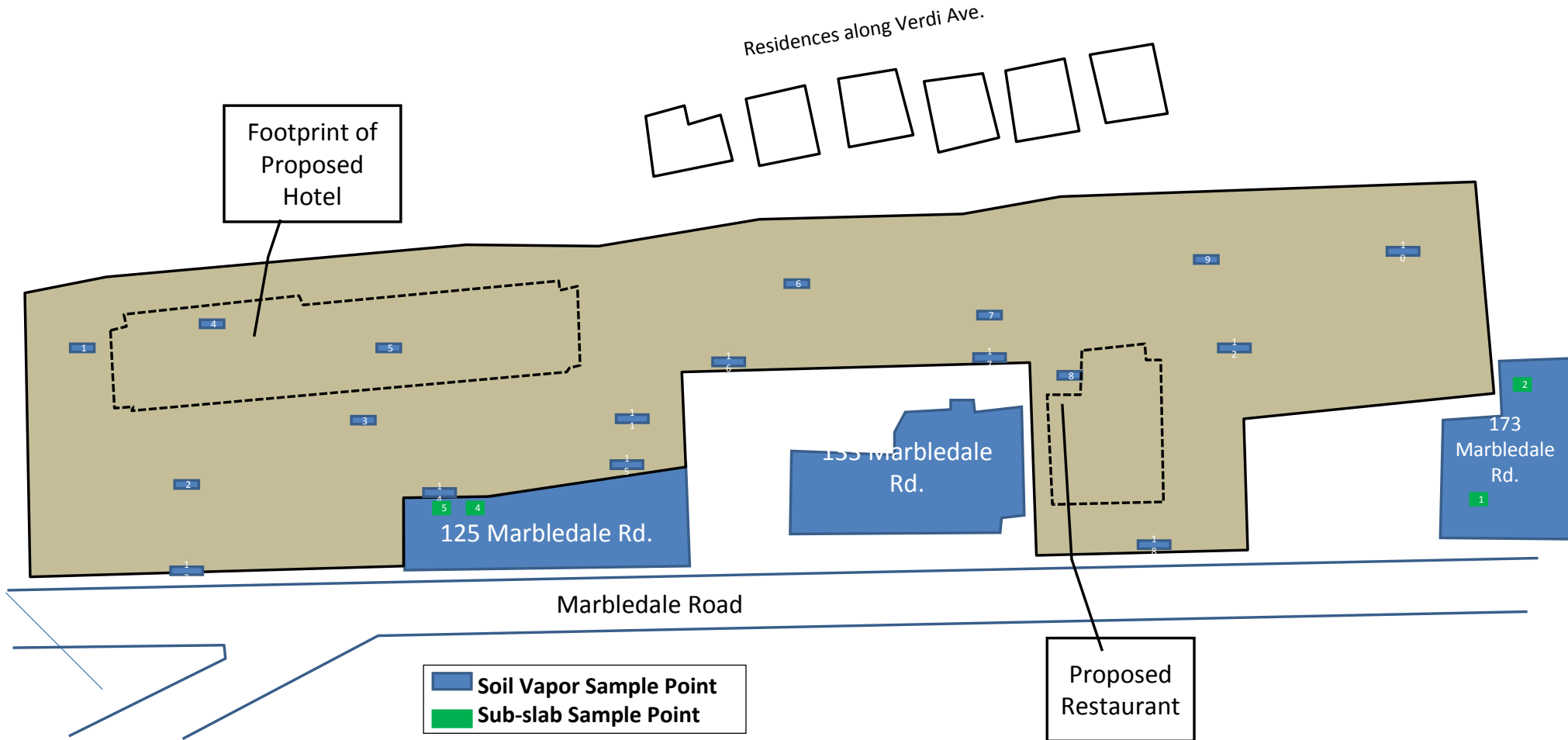
## Remedial investigation (HydroEnvironmental)

- May 18, 2015: 12 soil vapor samples
- August 24, 2015: 6 soil vapor samples

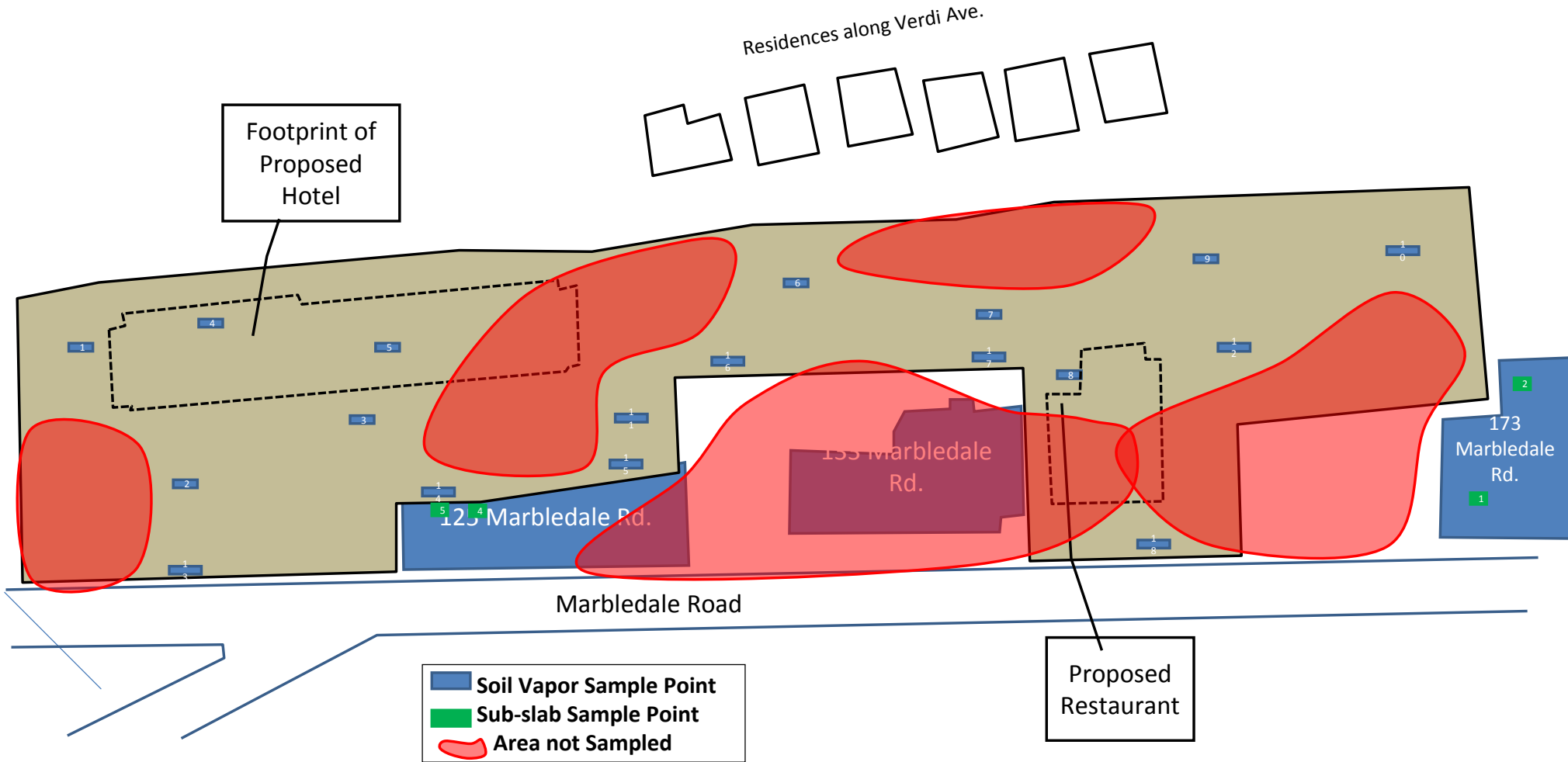
## Building vapor testing (NY Dept. of Health)

- March 28, 2016: 4 sub-slab samples + indoor air + outdoor air

# Soil Vapor Sampling Points at Marbledale BCP Site



# Soil Vapor Sampling Points at Marbledale BCP Site



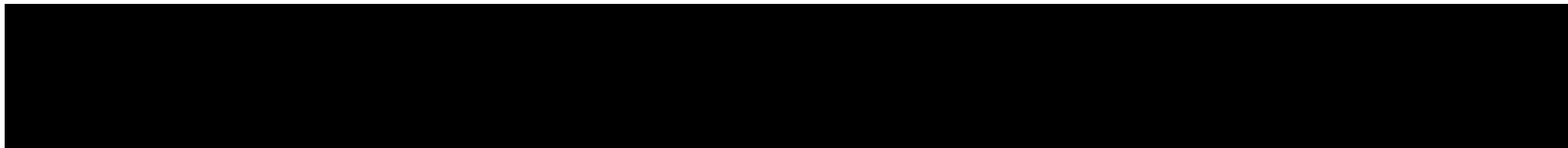
# List of chemicals

- 1,1,1,2-Tetrachloroethane
- 1,1,1-Trichloroethane
- 1,1,2,2-Tetrachloroethane
- 1,1,2-Trichloroethane
- 1,1-Dichloroethane
- 1,1-Dichloroethene
- 1,2,4-Trichlorobenzene
- 1,2,4-Trimethylbenzene
- 1,2-Dibromoethane(EDB)
- 1,2-Dichlorobenzene
- 1,2-Dichloroethane
- 1,2-dichloropropane
- 1,2-Dichlorotetrafluoroethane
- Cis-1,2-Dichloroethene
- cis-1,3-Dichloropropene
- Cyclohexane
- Methyl Ethyl Ketone
- Methyl tert-butyl ether(MTBE)
- Methylene Chloride
- 1,3,5 - Trimethylbenzene
- 1,3 - Butadiene
- 1,3 - Dichlorobenzene
- 1,4 - Dichlorobenzene
- 1,4 - Dioxane 2 - Hexanone(MBK)
- 4 - Ethyltoluene
- 4 - Isopropyltoluene
- 4 - Methyl - 2 - pentanone
- Acetone
- Acrylonitrile
- Benzene
- Benzyl chloride
- Bromodichloromethane
- Bromoform
- n - Butylbenzene
- o - Xylene
- Propylene
- sec - Butylbenzene
- Styrene
- Tetrachloroethene
- Tetrahydrofuran
- Dibromochloromethane
- Dichlorodifluoromethane Ethanol
- Ethyl acetate
- Ethylbenzene
- Heptane Hexachlorobutadiene
- Hexane
- Isopropylalcohol Isopropylbenzene
- m,p - Xylene
- Bromomethane
- Carbon Disulfide
- Carbon Tetrachloride
- Chlorobenzene Chloroethane
- Chloroform
- Chloromethane
- Toluene
- Trans - 1,2 - Dichloroethene
- trans - 1,3 - Dichloropropene
- Trichloroethene
- Trichlorofluoromethane
- Trichlorotrifluoroethane
- Vinyl Chloride

# Health Concerns

List of chemicals for which guidelines have been developed, AND are present at the site

Chemical Compounds	Other names	Max concentration at site ( $\mu\text{g}/\text{m}^3$ )	NY State Guidelines ( $\mu\text{g}/\text{m}^3$ )	New Jersey Guidelines	Max concentration Compared to USEPA Guideline	
					Cancer Risk	Non-Cancer Risk
tetrachloroethene	PCE	550	30	470	above (1.5x)	below
trichloroethene	TCE	459	2	27	above (30x)	above (7x)
vinyl chloride		94		13	above (10x)	below
chloroform		151		24	above (40x)	below
methylene chloride		44.8	60	4800	below	below
benzene		236		16	above (2x)	below
ethylbenzene		76.4		49	below	below
dichlorodifluoromethane	Freon 12	173,000		5,200	unknown	above (50x)
trichlorofluoromethane	Freon 11	198,000		36,000	unknown	above (8x)
Reference		1	2,2a,2b	3	4	4



# Guidelines Have NOT Been Developed For:

ethanol

4-methyl-2-pentanone (MIBK)

trichlorotrifluoromethane

1,2-dichlorotetrafluoroethane

heptane

1,3,5-trimethylbenzene

4-ethyltoluene

4-isopropyltoluene

toluene

trans-1,2-dichloroethene

1,3-dichlorobenzene

cis-1,2 dichloroethene

# Soil Borings Collected in 2013 and 2015

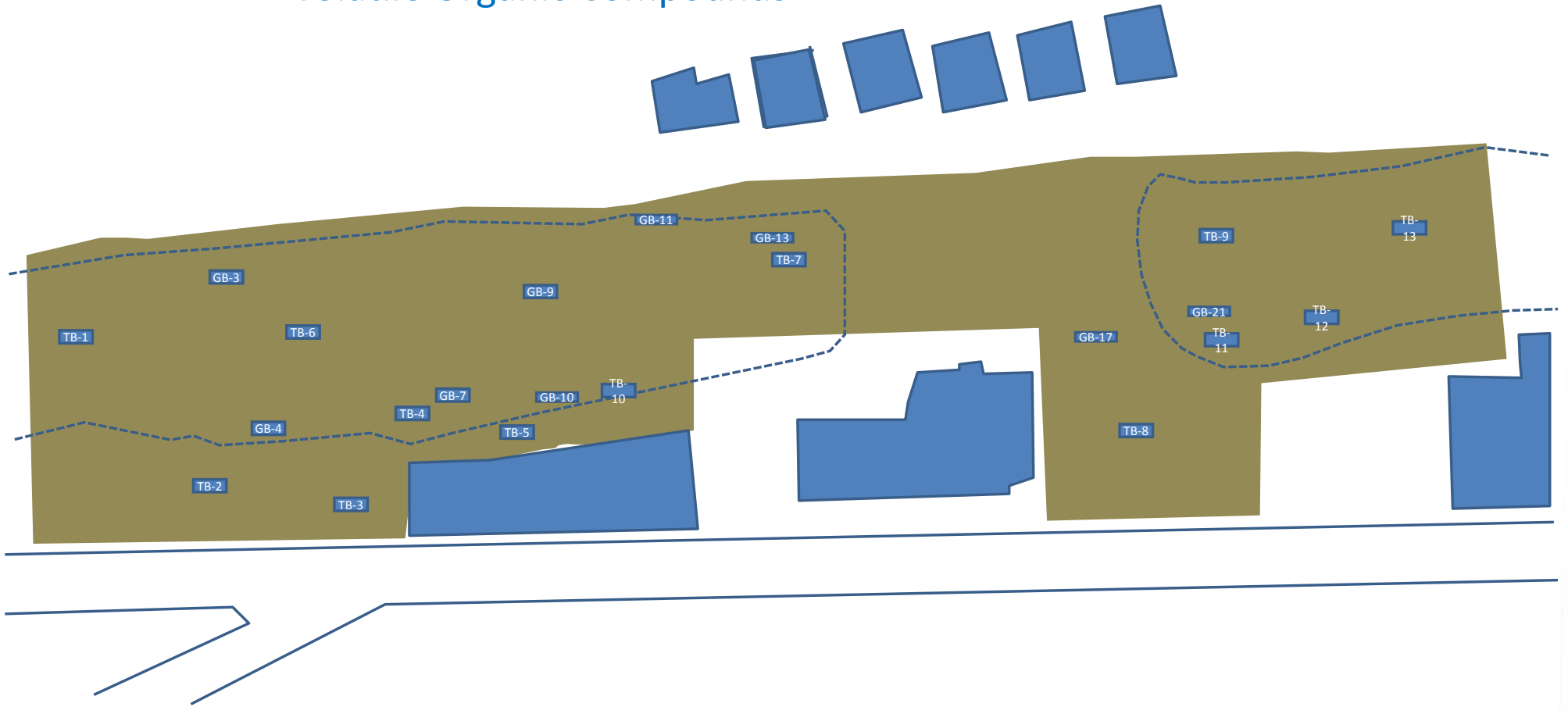


Adapted from HydroEnvironmental Solutions (2016) Remedial Investigation Report, Figure 3.

Note that locations of soil borings installed in 2013 are approximate.



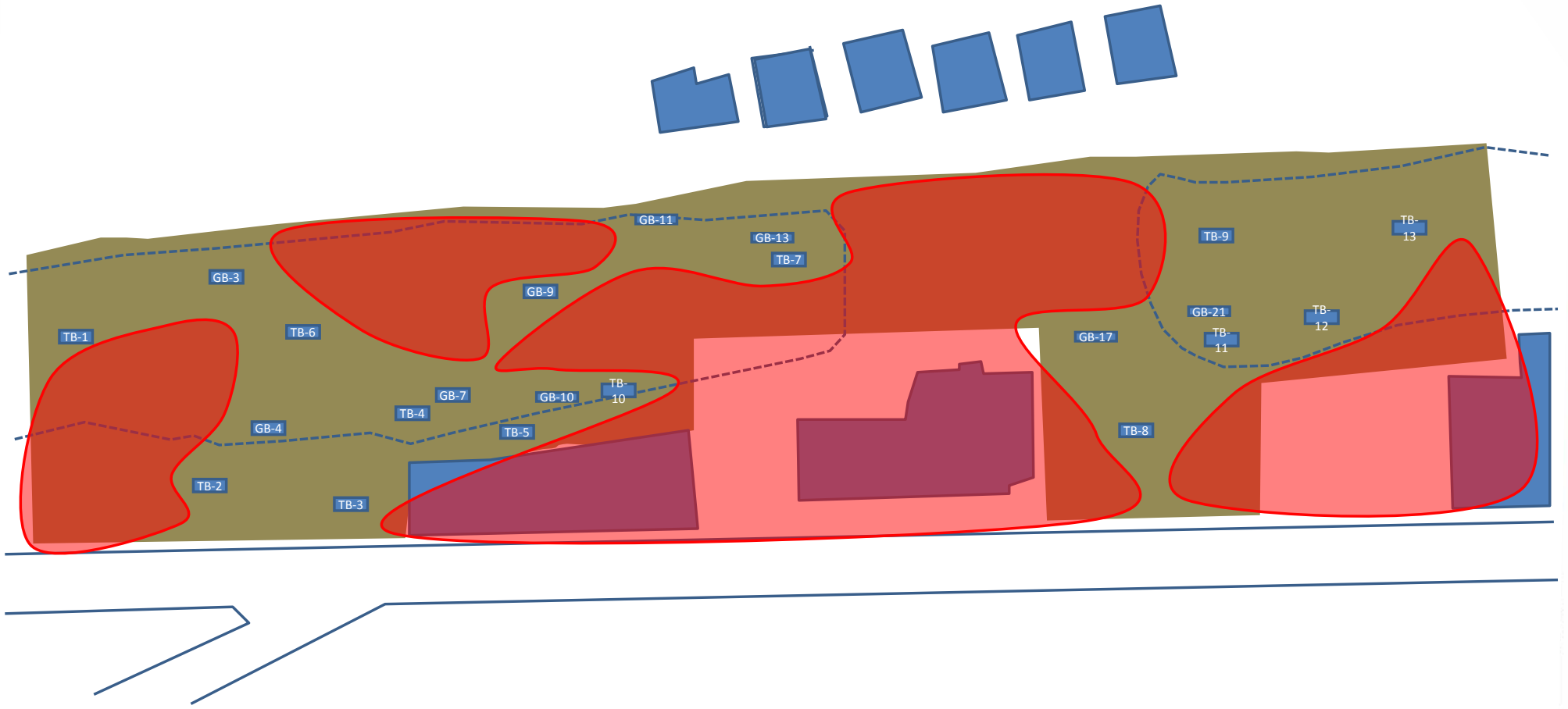
# Soil Borings *Analyzed* for Volatile and Semi-volatile Organic Compounds



Adapted from HydroEnvironmental Solutions (2016) Remedial Investigation Report, Figure 3.

Note that locations of soil borings installed in 2013 are approximate.

Red Highlighting = Areas  
lacking VOC and SVOC Data



Adapted from HydroEnvironmental Solutions (2016) Remedial Investigation Report, Figure 3.

Note that locations of soil borings installed in 2013 are approximate.

## New soil sampling points



Adapted from HydroEnvironmental Solutions (2016) Remedial Investigation Report, Figure 3.

Note that locations of soil borings installed in 2013 are approximate.

# Soil vapors: Chlorinated Organic Compounds, Group 1

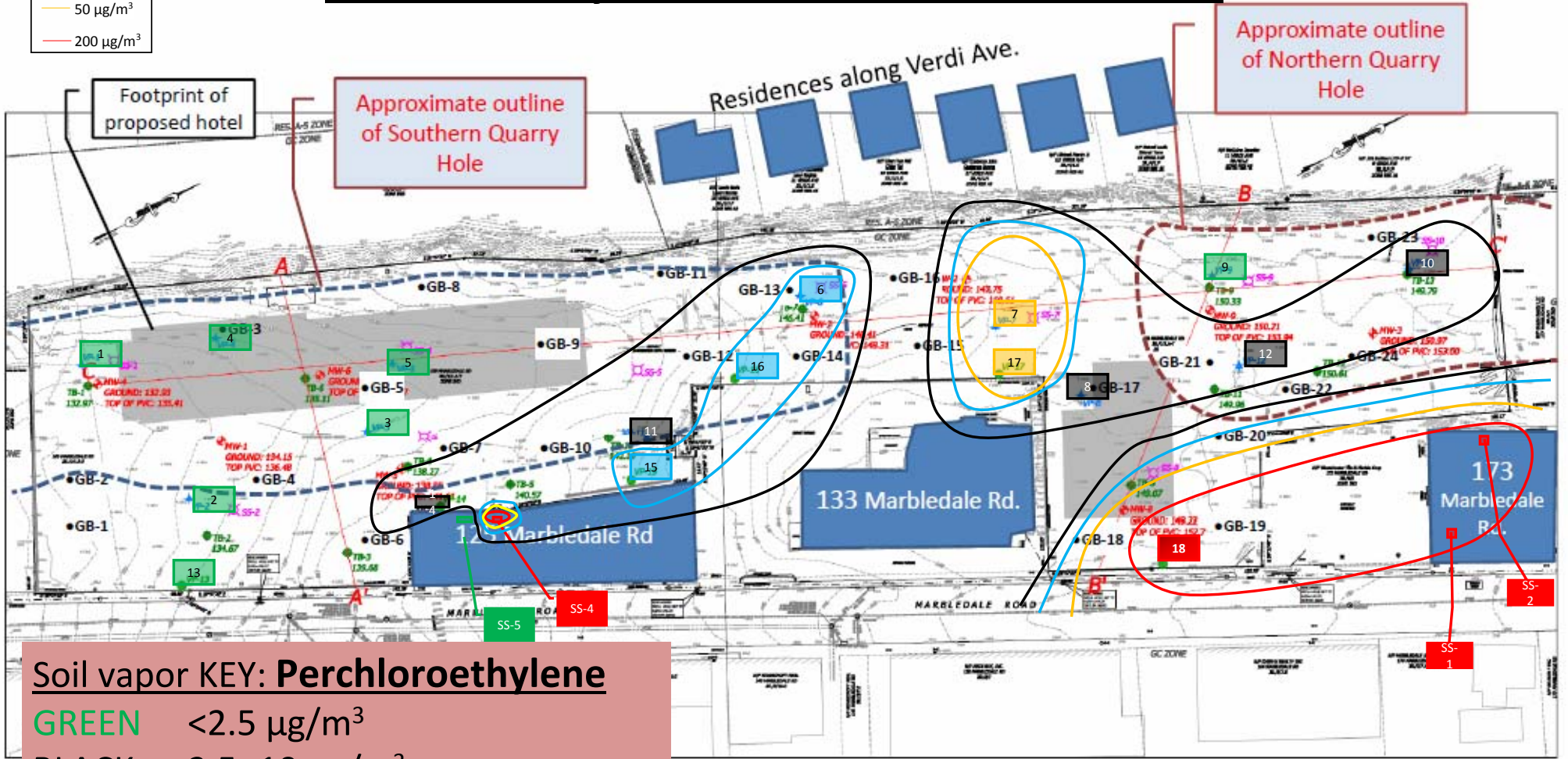
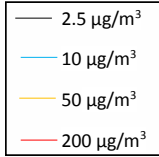
**Perchloroethylene (PCE)**

**Trichloroethene (TCE)**

**Vinyl Chloride (VC)**

**Dichloroethene**

# Perchloroethylene concentration gradients (Case 1)

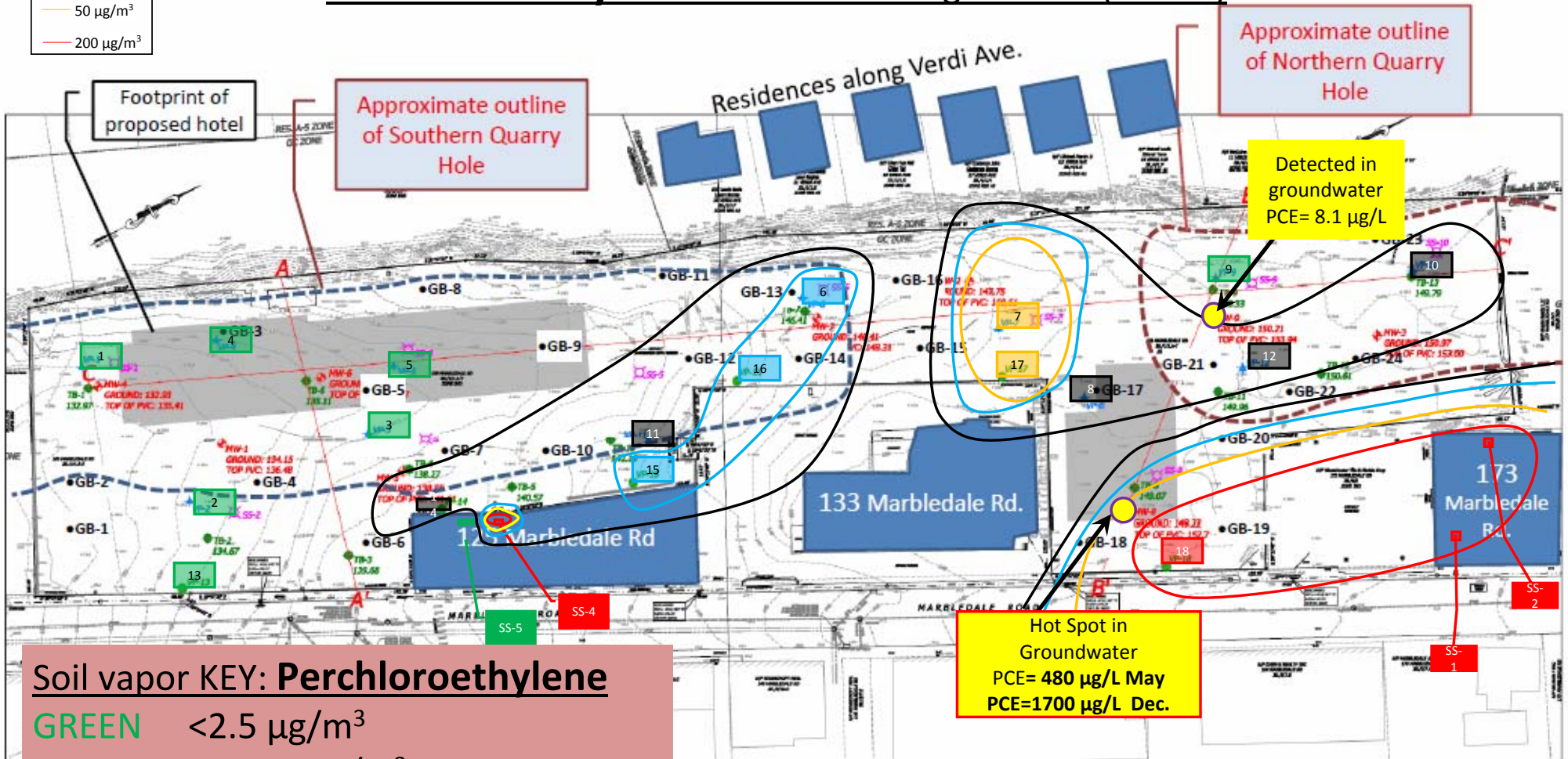
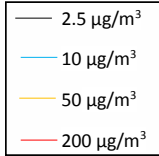


**Soil vapor KEY: Perchloroethylene**

**GREEN** <2.5  $\mu\text{g}/\text{m}^3$   
**BLACK** 2.5 -10  $\mu\text{g}/\text{m}^3$   
**BLUE** 10.1 – 50  $\mu\text{g}/\text{m}^3$   
**YELLOW** 51-200  $\mu\text{g}/\text{m}^3$   
**RED** >200  $\mu\text{g}/\text{m}^3$

Adapted from HydroEnvironmental Solutions (2016) Remedial Investigation Report, Figure 3.  
 Note that locations of soil borings installed in 2013 are approximate.

# Perchloroethylene concentration gradients (Case 1)



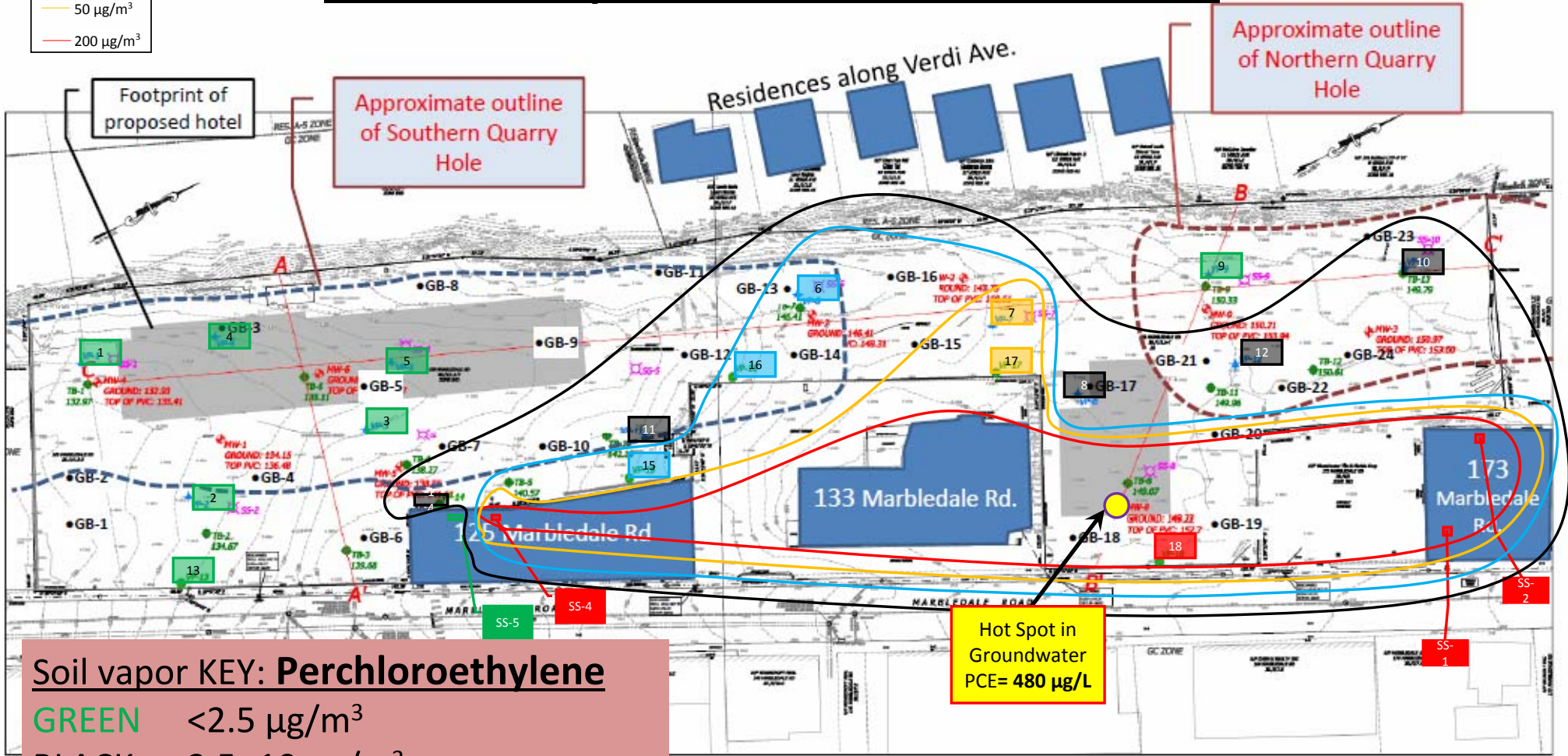
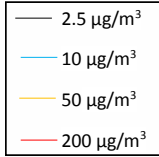
## Soil vapor KEY: Perchloroethylene

- GREEN** < 2.5  $\mu\text{g}/\text{m}^3$
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- BLUE** 10.1 - 50  $\mu\text{g}/\text{m}^3$
- YELLOW** 51 - 200  $\mu\text{g}/\text{m}^3$
- RED** > 200  $\mu\text{g}/\text{m}^3$

Adapted from HydroEnvironmental Solutions (2016) Remedial Investigation Report, Figure 3.

Note that locations of soil borings installed in 2013 are approximate.

# Perchloroethylene concentration gradients (Case 2)



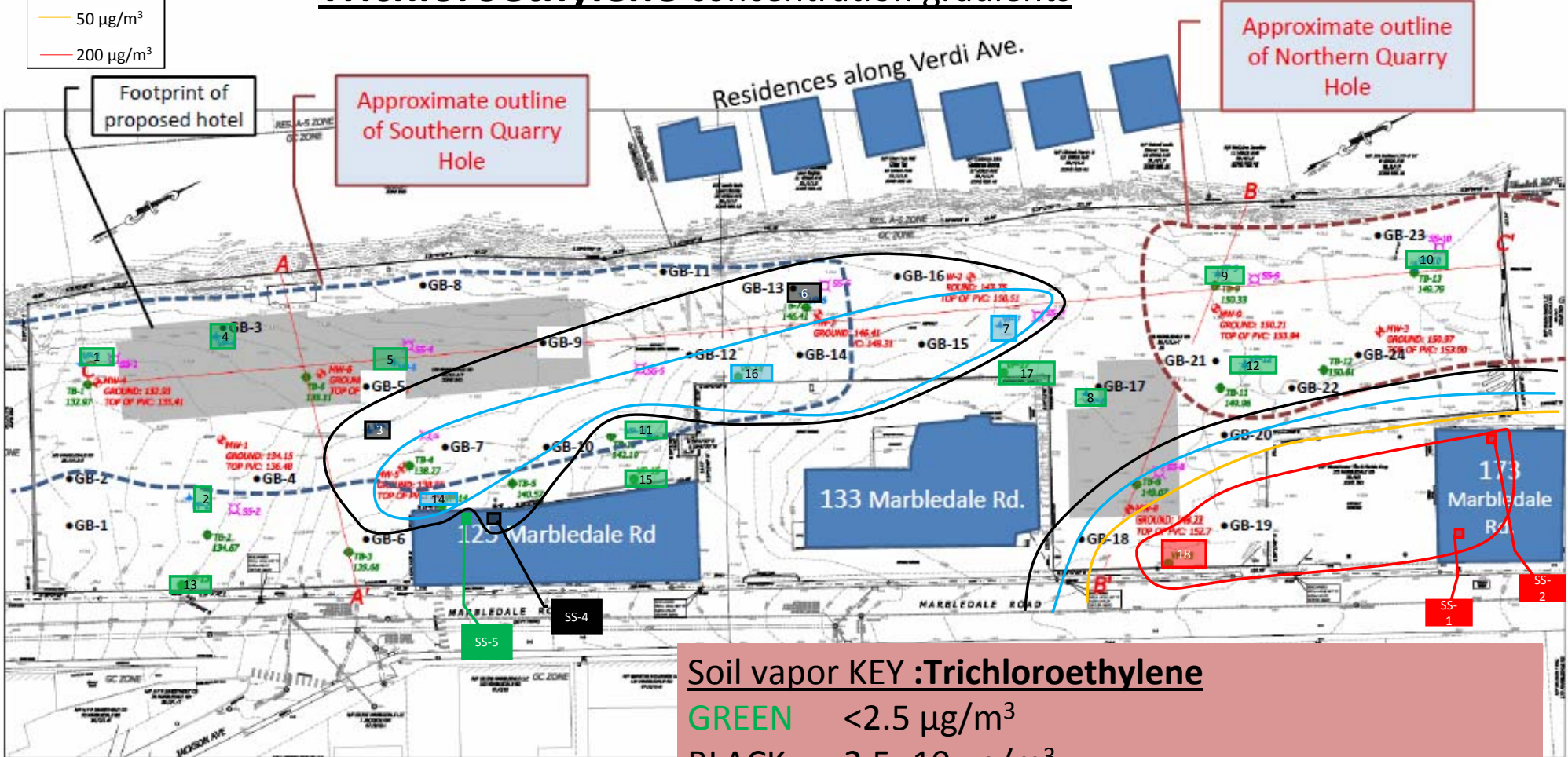
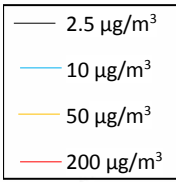
**Soil vapor KEY: Perchloroethylene**

GREEN	<2.5 $\mu\text{g}/\text{m}^3$
BLACK	2.5 - 10 $\mu\text{g}/\text{m}^3$
BLUE	10.1 – 50 $\mu\text{g}/\text{m}^3$
YELLOW	51-200 $\mu\text{g}/\text{m}^3$
RED	>200 $\mu\text{g}/\text{m}^3$

Hot Spot in Groundwater  
PCE= 480  $\mu\text{g}/\text{L}$

Adapted from HydroEnvironmental Solutions (2016) Remedial Investigation Report, Figure 3.  
Note that locations of soil borings installed in 2013 are approximate.

# Trichloroethylene concentration gradients

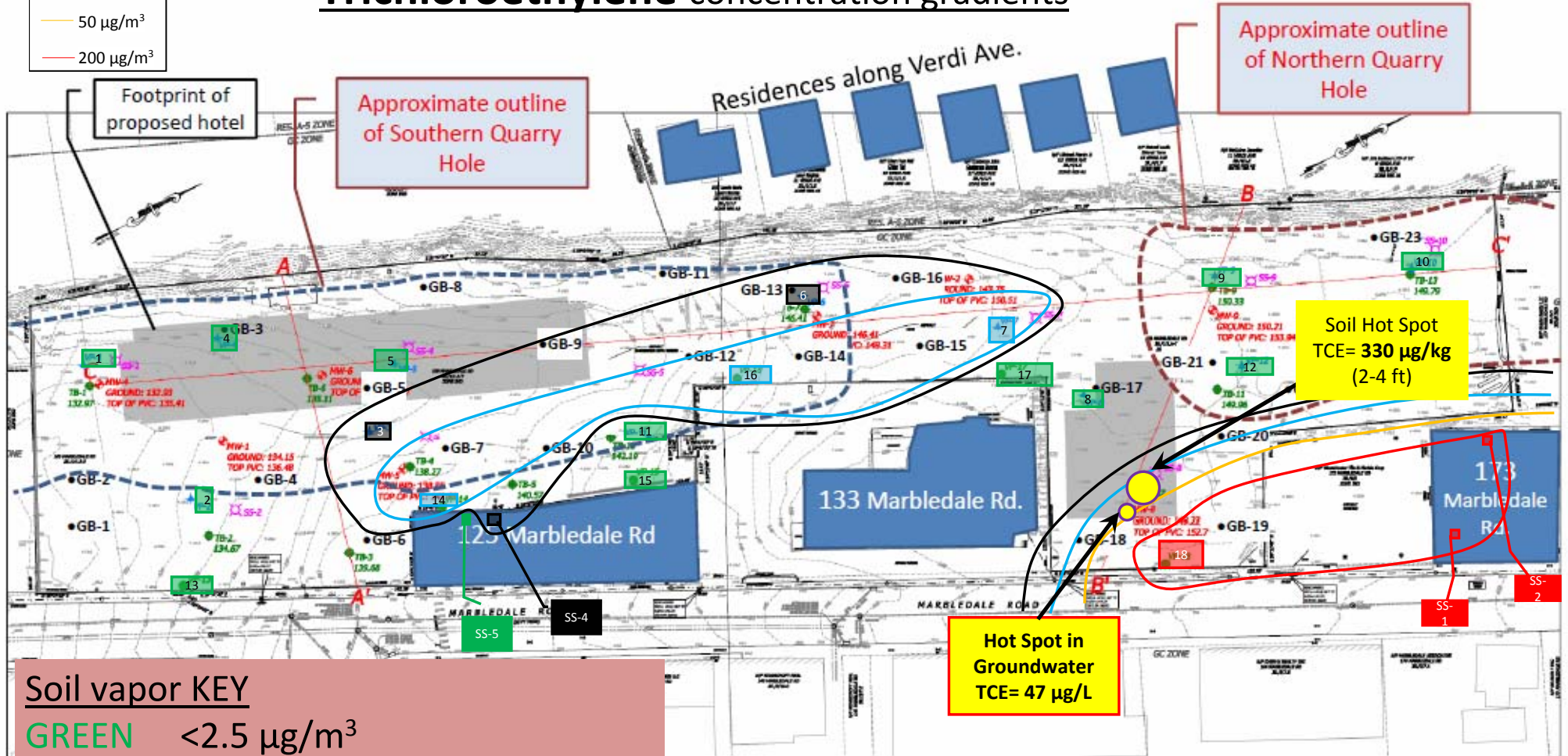
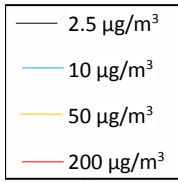


## Soil vapor KEY :Trichloroethylene

- GREEN <2.5 µg/m<sup>3</sup>
- BLACK 2.5 -10 µg/m<sup>3</sup>
- BLUE 10.1 – 50 µg/m<sup>3</sup>
- YELLOW 51-200 µg/m<sup>3</sup>
- RED >200 µg/m<sup>3</sup>



# Trichloroethylene concentration gradients



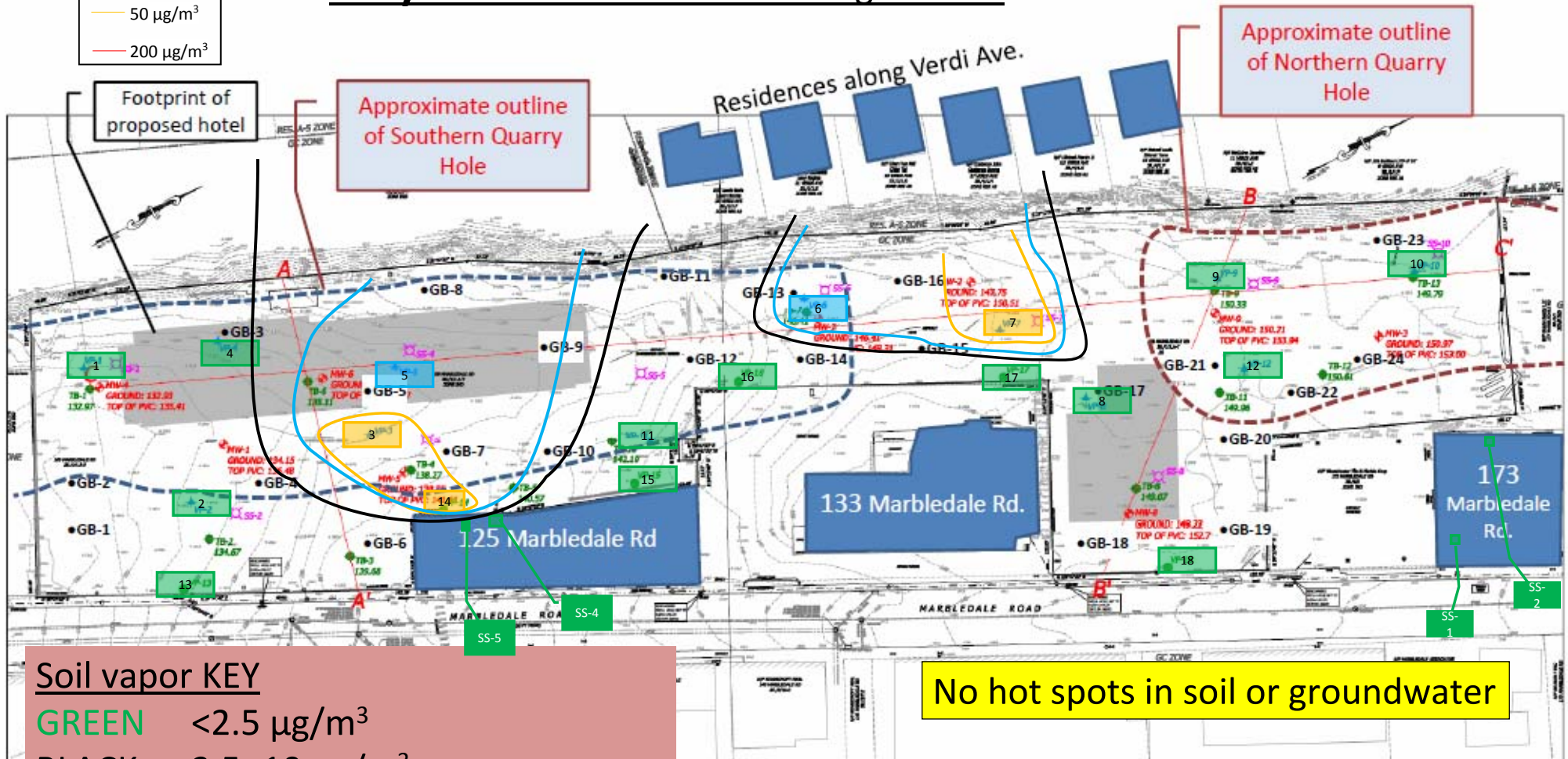
## Soil vapor KEY

GREEN	<2.5 $\mu\text{g}/\text{m}^3$
BLACK	2.5 - 10 $\mu\text{g}/\text{m}^3$
BLUE	10.1 – 50 $\mu\text{g}/\text{m}^3$
YELLOW	51-200 $\mu\text{g}/\text{m}^3$
RED	>200 $\mu\text{g}/\text{m}^3$

Adapted from HydroEnvironmental Solutions (2016) Remedial Investigation Report, Figure 3.

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# Vinyl Chloride concentration gradients

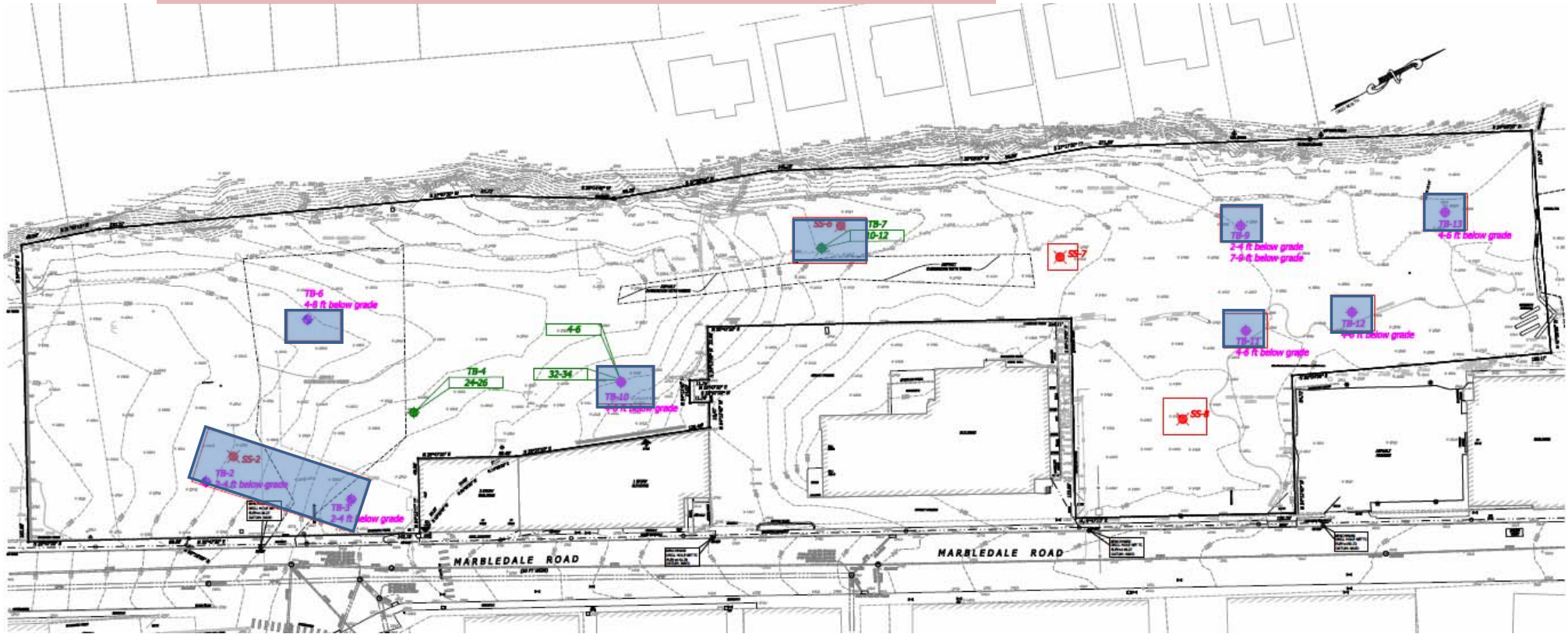




Adapted from HydroEnvironmental Solutions (2016) Remedial Investigation Report, Figure 3.

Note that locations of soil borings installed in 2013 are approximate.

# Hotspot removal areas

(based on August 2016 Remedial Action Work Plan)



-  Area removed to depth of 4-ft or more
-  Surface soil removal

# Conclusions – Group 1 Chlorinated VOCs

- PCE & TCE contamination under & south of Broken Bow brewery
- PCE contamination under 125 Marbledale Rd.  
little TCE
- 173 Marbledale Rd.: no data. Possible source?
- Elevated levels of PCE, TCE & VC in central part of site

# Soil vapors: Chlorinated Organic Compounds, Group 2

**Trichloroethane**

**Dichlorobenzene**

**Carbon tetrachloride**

**Chloroform**

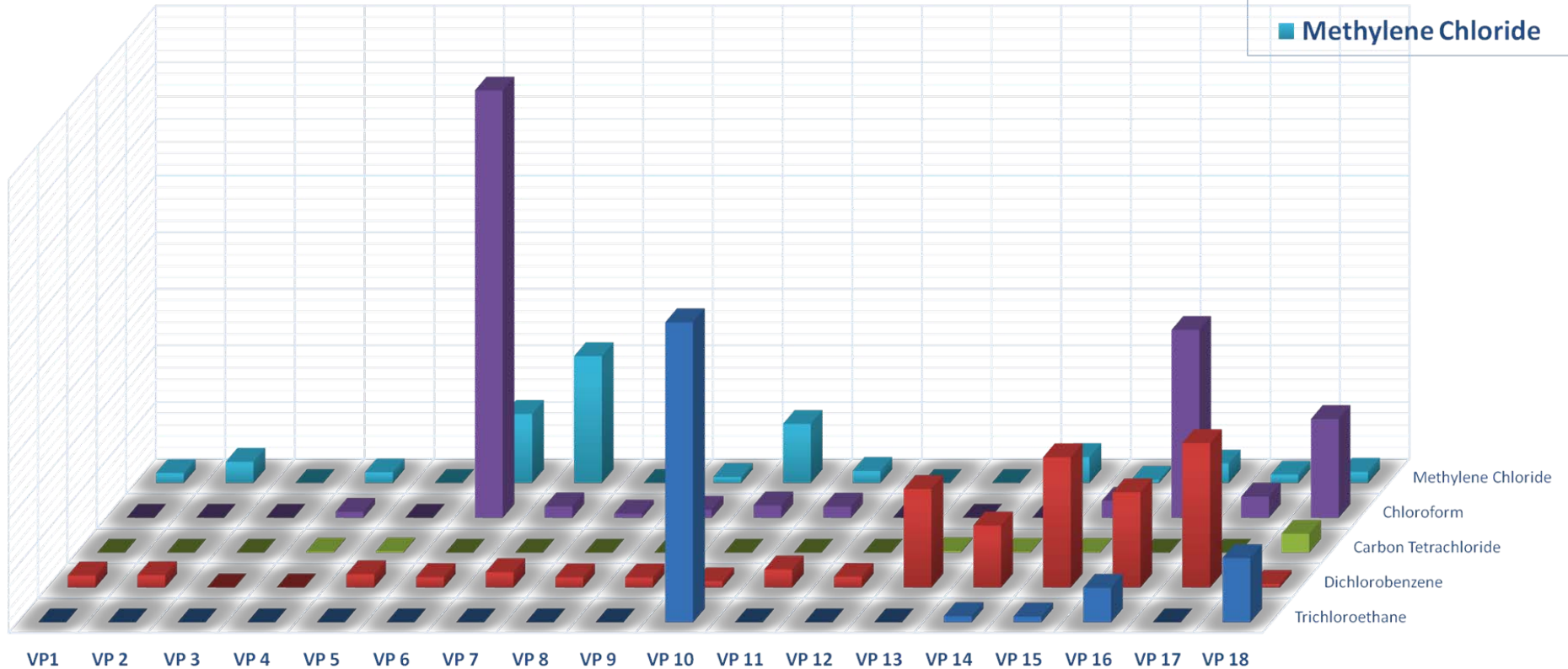
**Methylene chloride**

# Soil Vapors at Marbledale BCP Site: Chlorinated Organic Compounds, Group 2



Concentration ( $\mu\text{g}/\text{m}^3$ )

160  
140  
120  
100  
80  
60  
40  
20  
0



Sampling Points

Methylene Chloride  
Chloroform  
Carbon Tetrachloride  
Dichlorobenzene  
Trichloroethane

# Conclusions – Group 2 Chlorinated VOCs

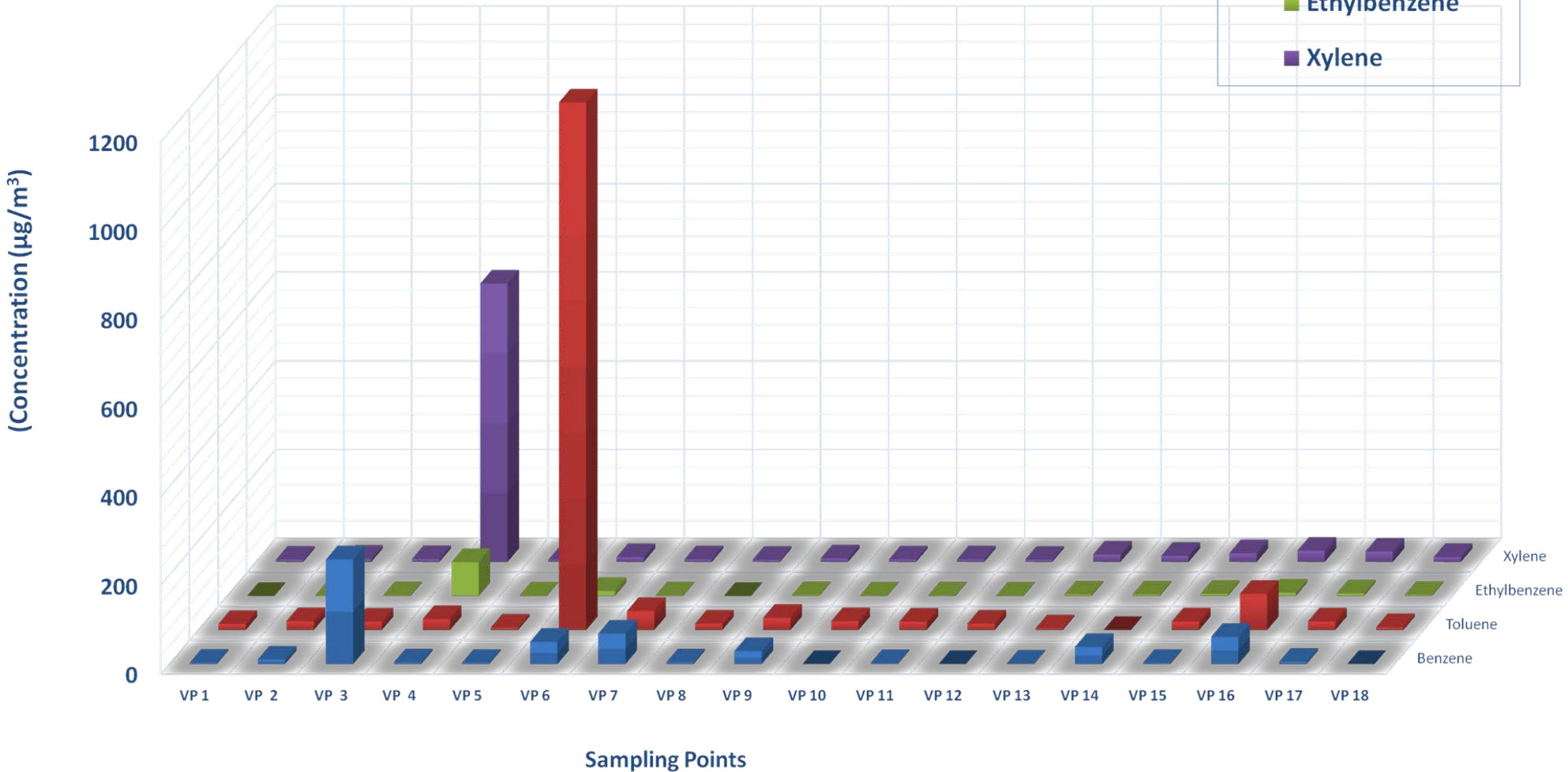
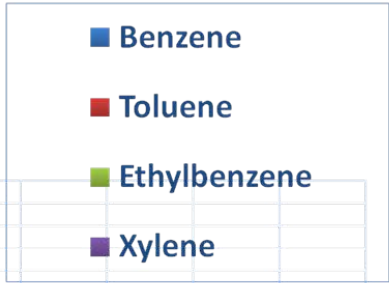
- Chloroform - exceeds USEPA cancer risk ( $37 \times 10^{-6}$ )
- Other compounds (Methylene chloride, trichloroethane, dichlorobenzene) are below all guideline values

# Soil vapors: BTEX

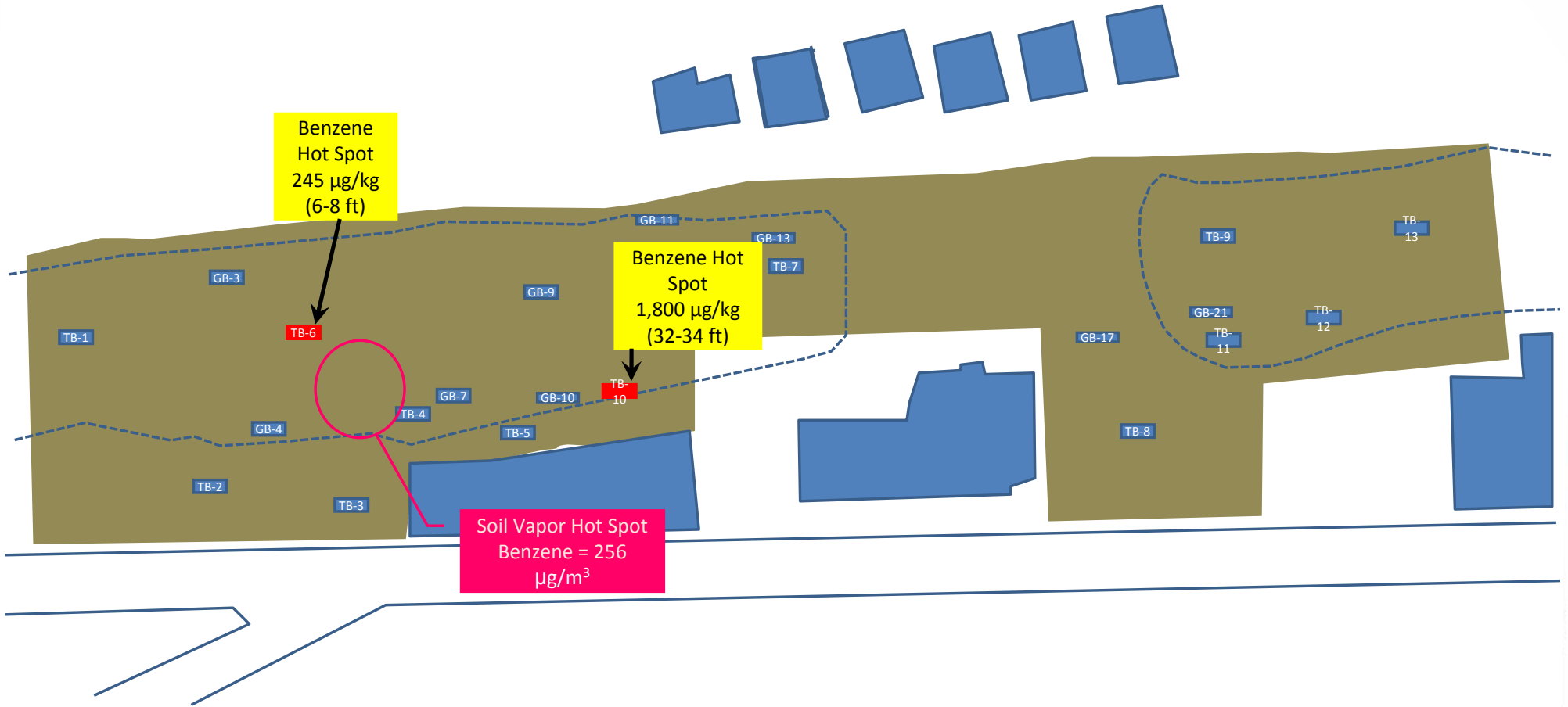
**Benzene, Toluene, Ethyl Benzene,  
Xylene**



# Soil Vapors at Marbledale BCP Site: BTEX (benzene, toluene, xylenes, ethylbenzene)



# Benzene Hot Spots in Soil and Vapor

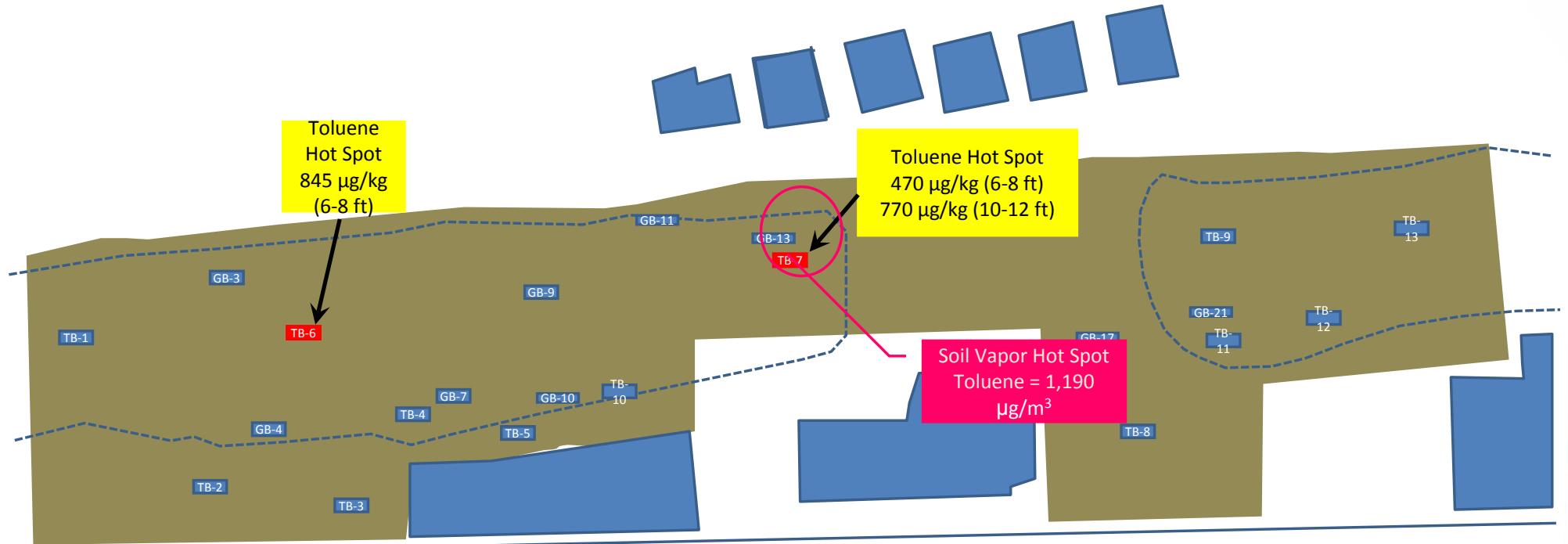








- Key to symbols:
- SS-10 Surface soil sample
  - GB-10 Soil boring (2013)
  - GB-11 Soil boring (2015)
  - MW-9 Monitoring well
  - VP-7 Soil vapor point
  - VP-16 Soil vapor point

Adapted from HydroEnvironmental Solutions (2016) Remedial Investigation Report, Figure 3.

Note that locations of soil borings installed in 2013 are approximate.

# Toluene Hot Spots in Soil



- Key to symbols:
-  Surface soil sample
  -  Soil boring (2013)
  -  Soil boring (2015)
  -  Monitoring well
  -  Soil vapor point
  -  Soil vapor point

Adapted from HydroEnvironmental Solutions (2016) Remedial Investigation Report, Figure 3.  
 Note that locations of soil borings installed in 2013 are approximate.

# Ethylbenzene Hot spots in Soil









- Key to symbols:
- Surface soil sample
  - Soil boring (2013)
  - Soil boring (2015)
  - Monitoring well
  - Soil vapor point
  - Soil vapor point

Adapted from HydroEnvironmental Solutions (2016) Remedial Investigation Report, Figure 3.

Note that locations of soil borings installed in 2013 are approximate.

# Xylene Hot spots in Soil

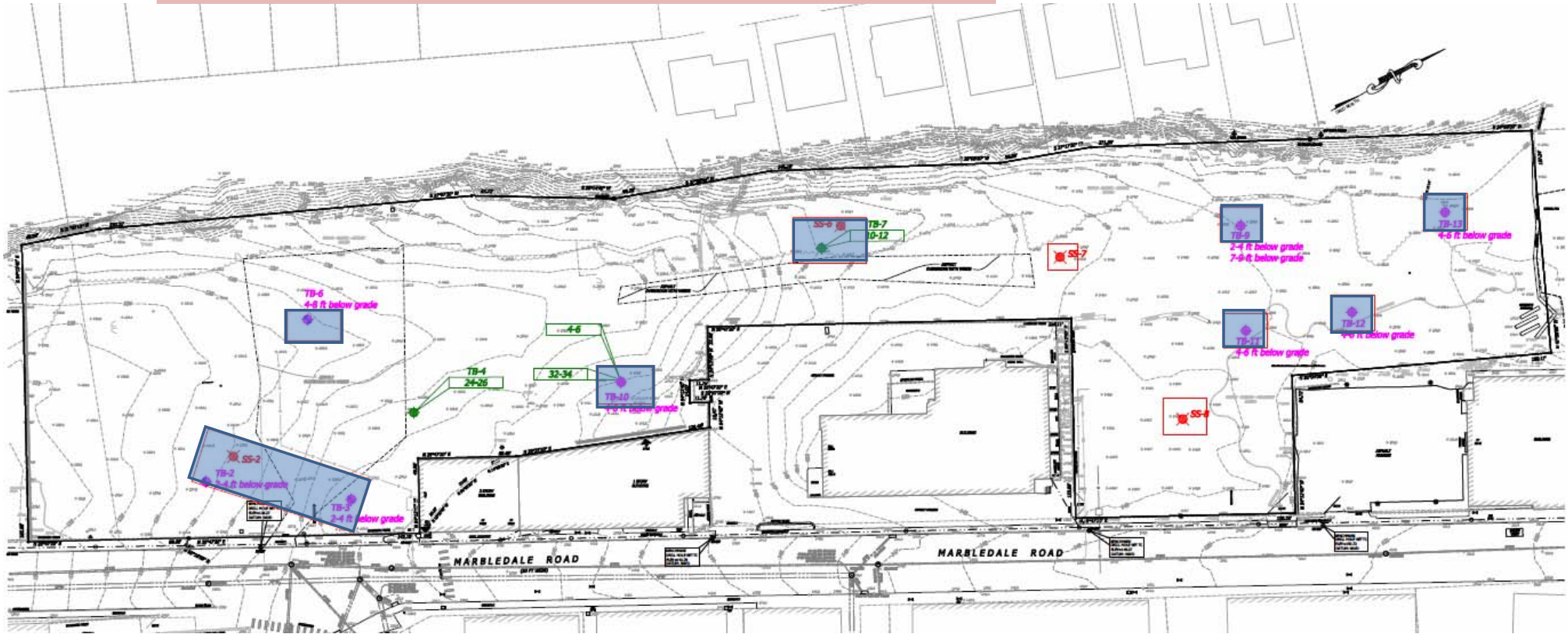




- Key to symbols:
-  Surface soil sample
  -  Soil boring (2013)
  -  Soil boring (2015)
  -  Monitoring well
  -  Soil vapor point
  -  Soil vapor point

Adapted from HydroEnvironmental Solutions (2016) Remedial Investigation Report, Figure 3.  
 Note that locations of soil borings installed in 2013 are approximate.

# Hotspot removal areas

(based on August 2016 Remedial Action Work Plan)



-  Area removed to depth of 4-ft or more
-  Surface soil removal

# Conclusions – BTEX

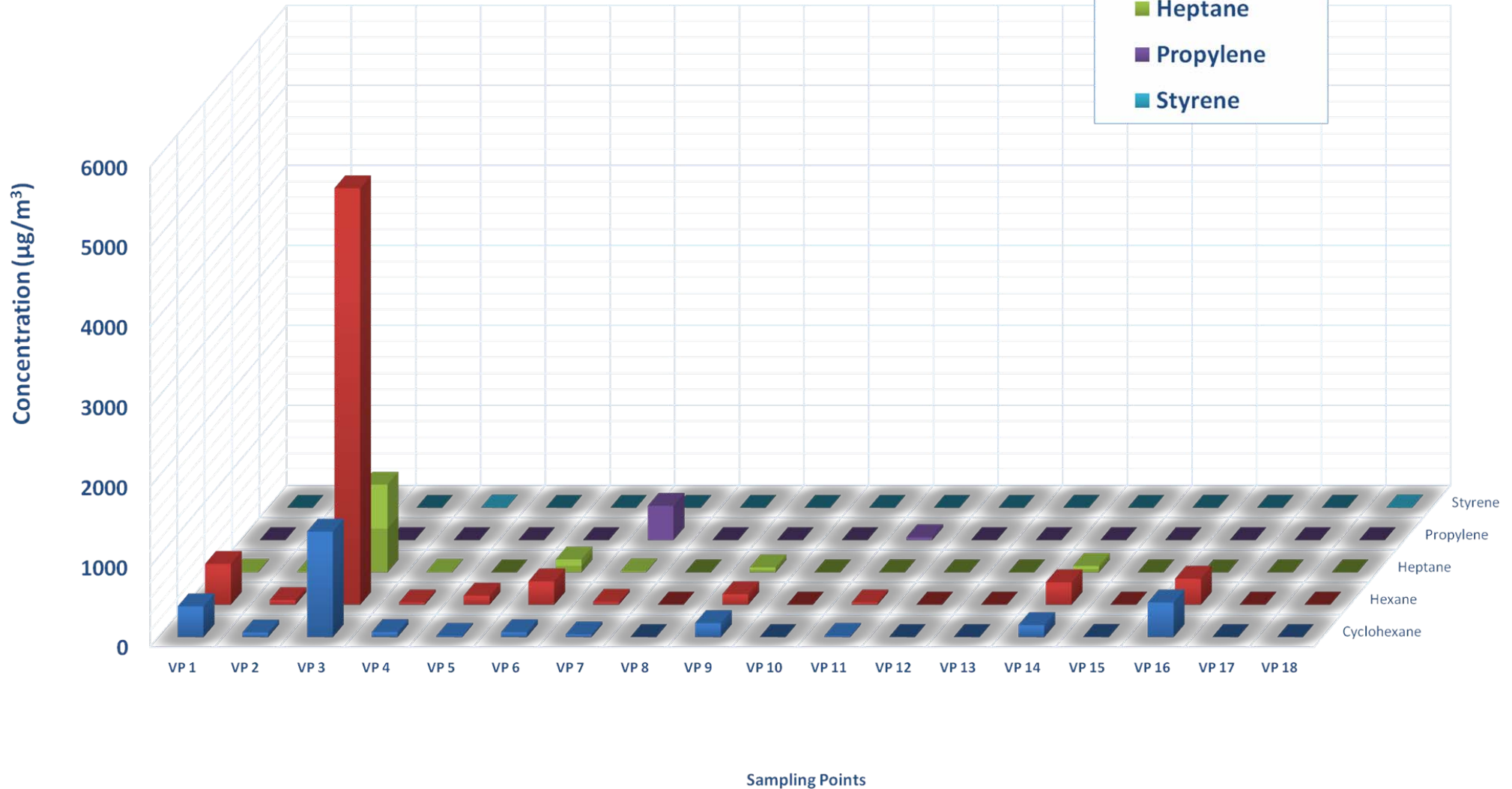
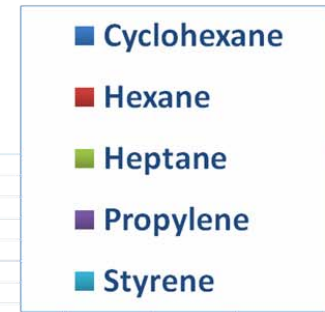
- General gasoline contamination throughout site
- Independent hot spots of
  - benzene
  - toluene
  - Xylene
- Signifies: separate sources of contamination—not petroleum

# Soil vapors: Other Hydrocarbons

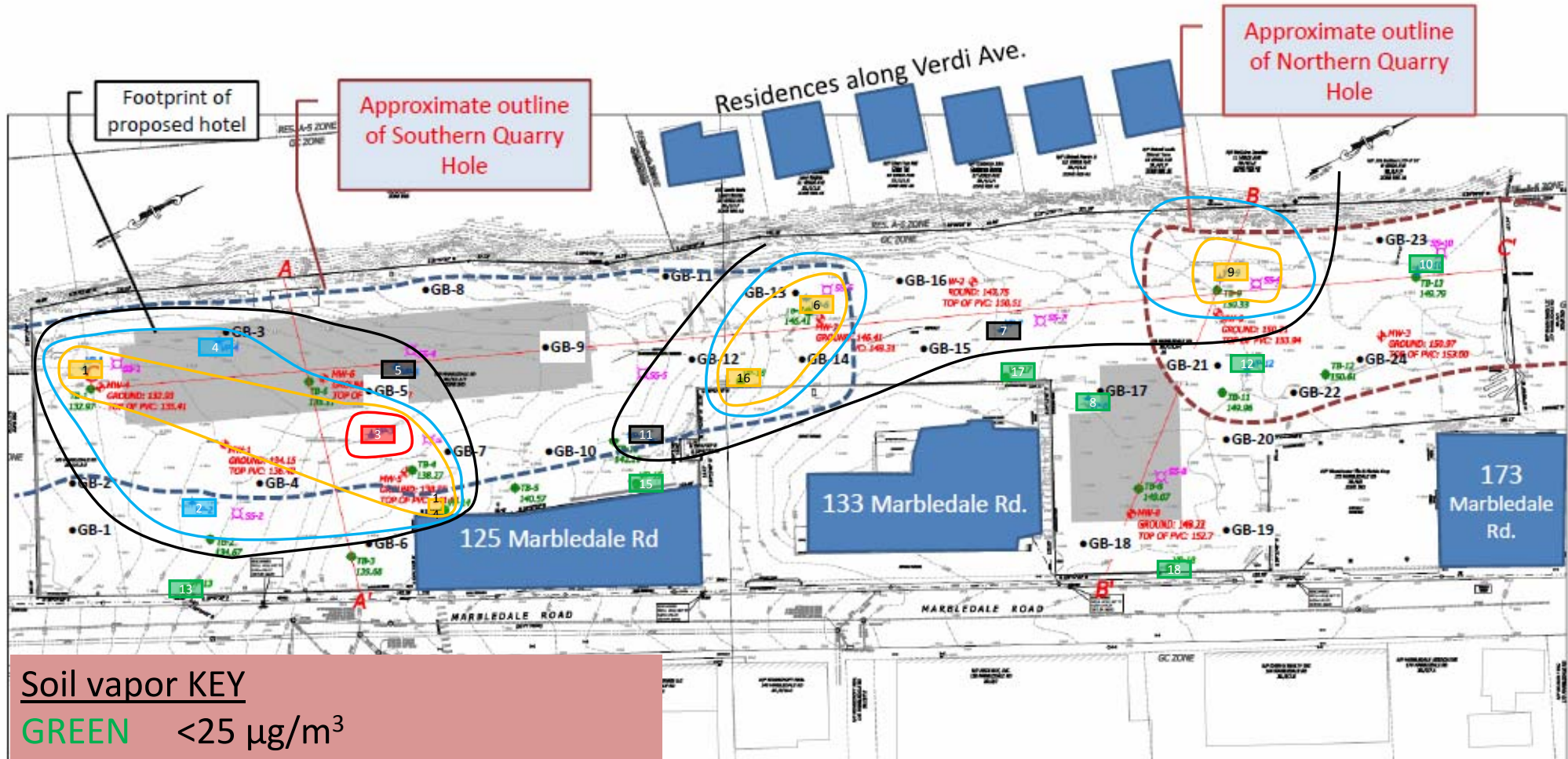
Cyclohexane, Hexane, Heptane,  
Propylene, Styrene



# Soil Vapors at Marbledale BCP Site: Other Hydrocarbons



# Hexane, Cyclohexane and Heptane concentration gradients



## Soil vapor KEY

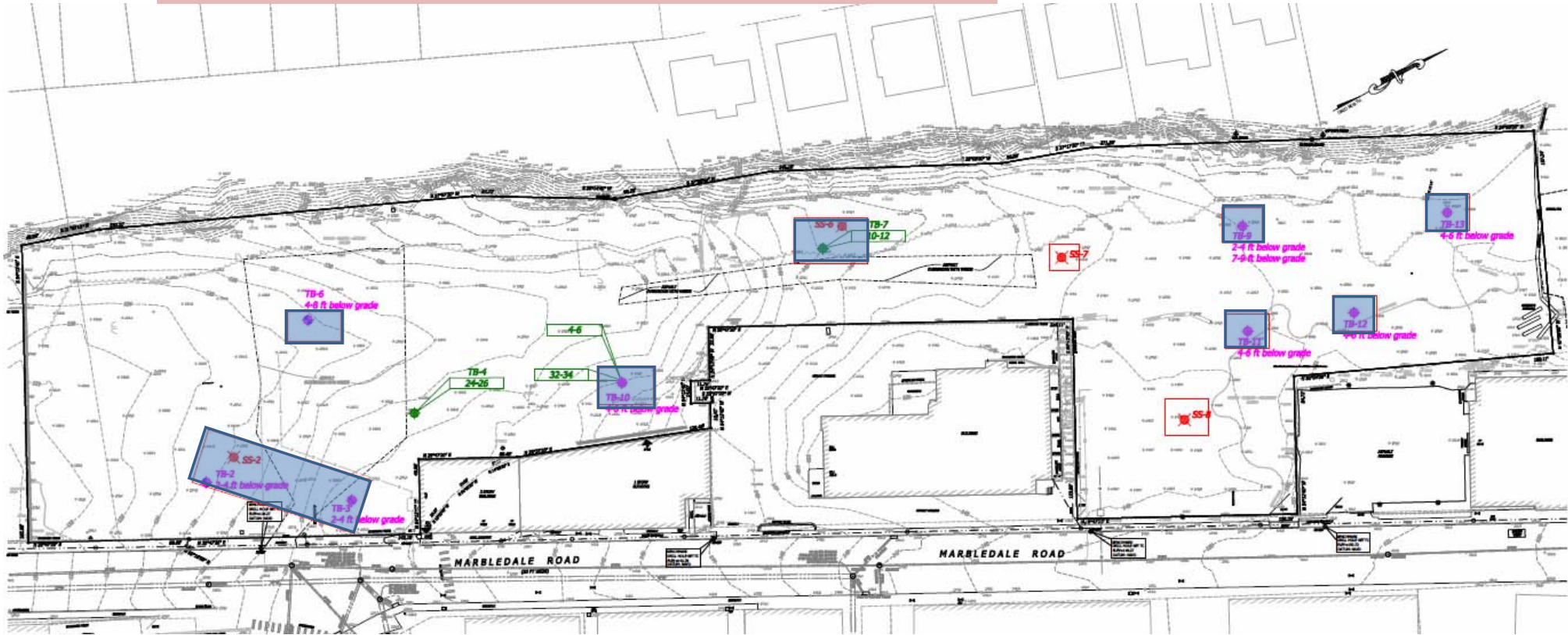
- GREEN** <25  $\mu\text{g}/\text{m}^3$
- BLACK** 25.1 -100  $\mu\text{g}/\text{m}^3$
- BLUE** 101 – 500  $\mu\text{g}/\text{m}^3$
- YELLOW** 501-2,500  $\mu\text{g}/\text{m}^3$
- RED** >2,500  $\mu\text{g}/\text{m}^3$



Adapted from HydroEnvironmental Solutions (2016) Remedial Investigation Report, Figure 3.

Note that locations of soil borings installed in 2013 are approximate.

# Hotspot removal areas

(based on August 2016 Remedial Action Work Plan)



-  Area removed to depth of 4-ft or more
-  Surface soil removal

# Conclusions – other hydrocarbons

- Higher concentrations compared to chlorinated compounds, BTEX, but also less toxic
- One clear hot spot at VP-3

# Soil vapors: Freons

**Freon-11 (CCl<sub>3</sub>F)**

**Freon-12 (CCl<sub>2</sub>F<sub>2</sub>)**

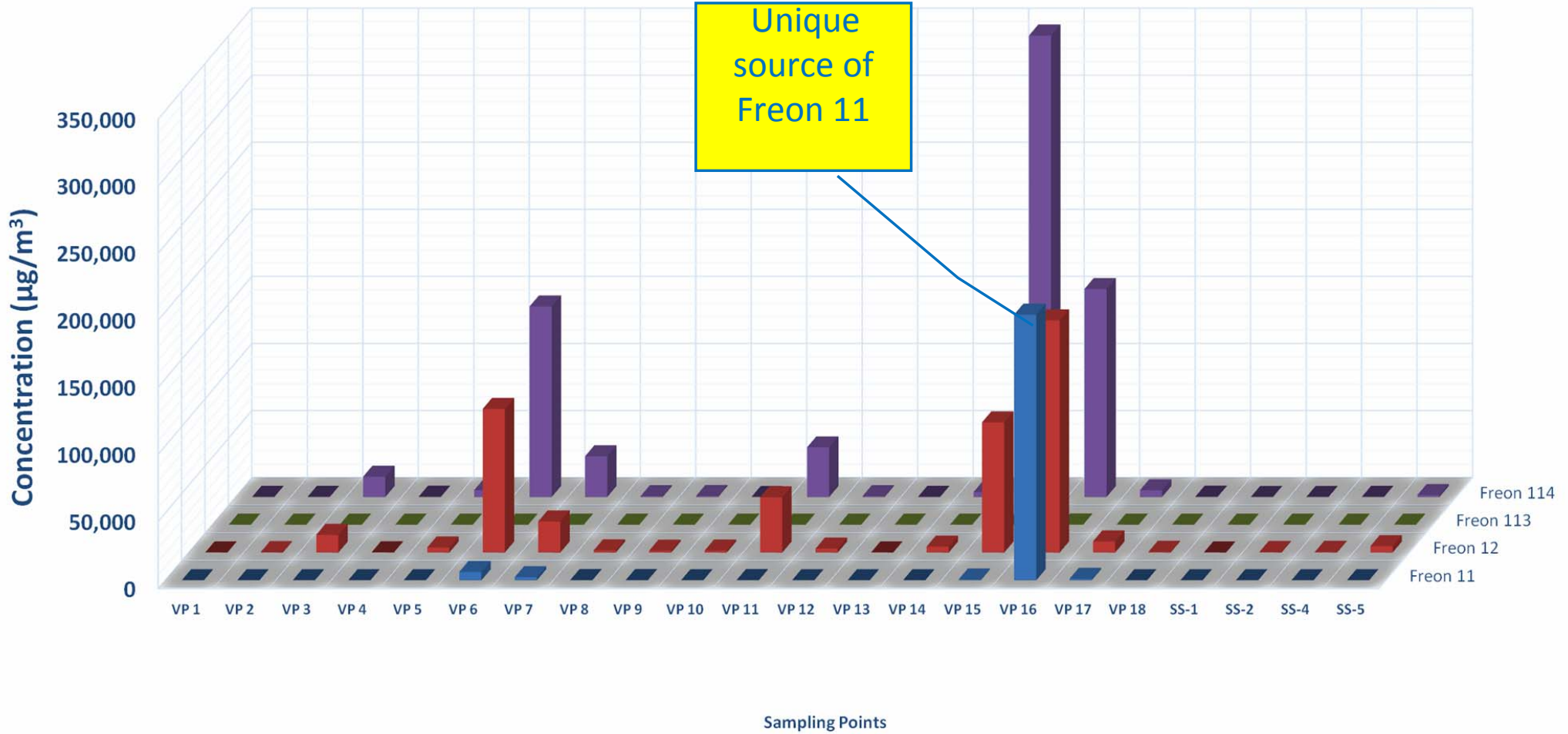
**Freon-113 (CCl<sub>3</sub>F<sub>3</sub>)**

**Freon-114 (CCl<sub>2</sub>F<sub>4</sub>)**

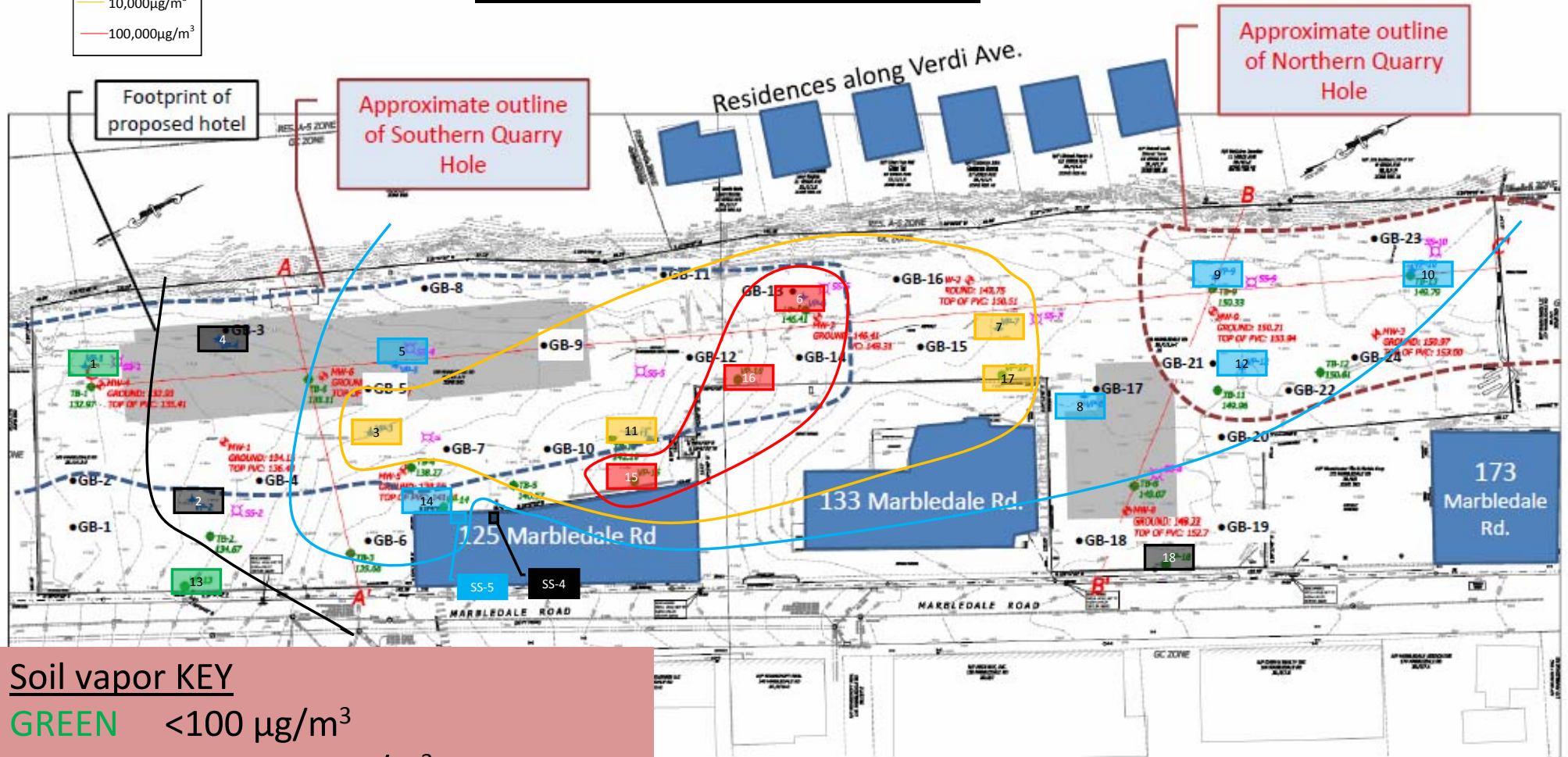
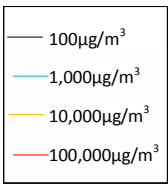
# Soil Vapors at Marbledale Dump Site

## Freons

- Freon 11
- Freon 12
- Freon 113
- Freon 114



# Freons concentration gradients



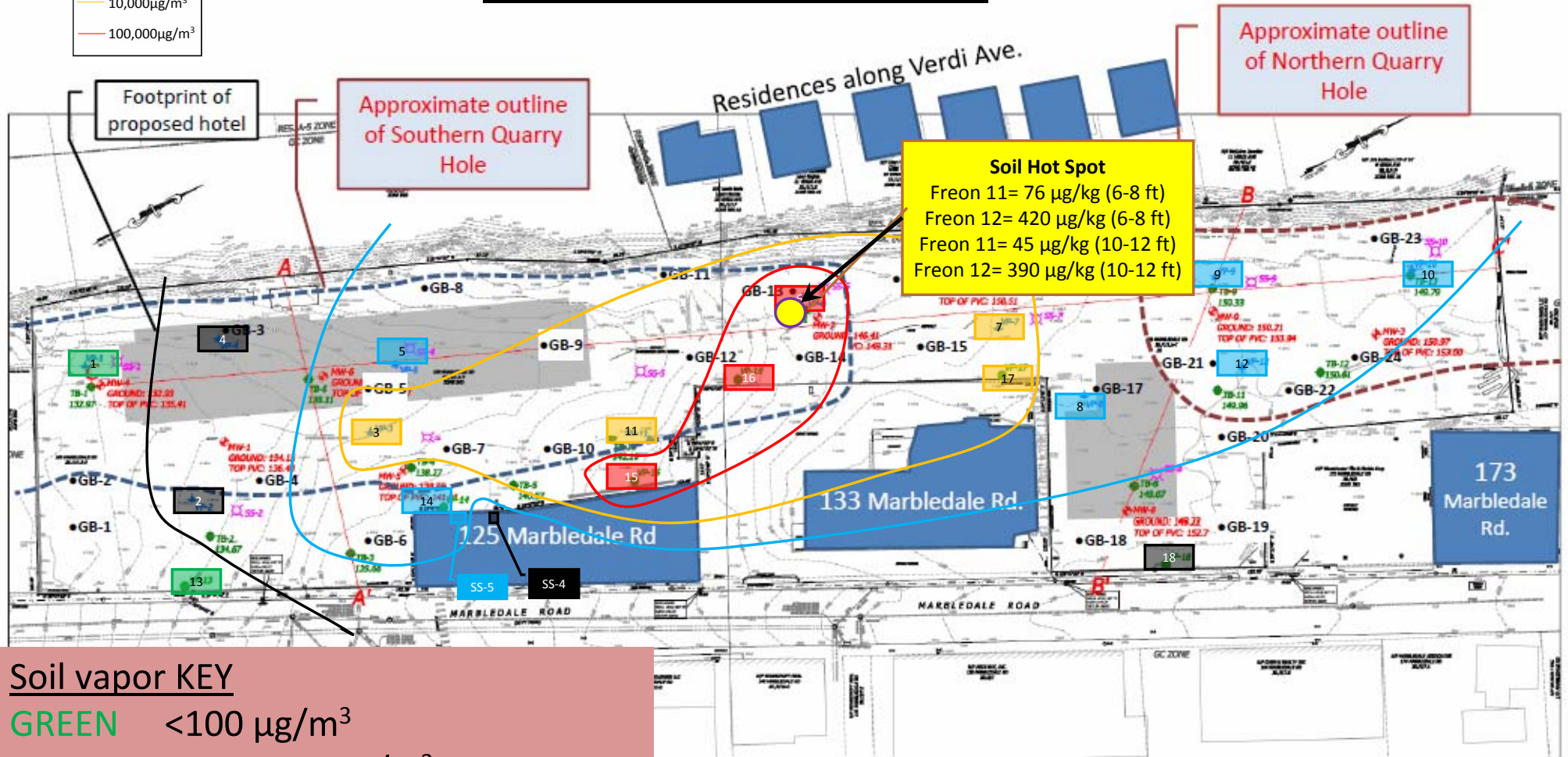
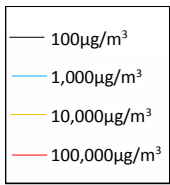
## Soil vapor KEY

- GREEN** <100 µg/m<sup>3</sup>
- BLACK** 100-1,000 µg/m<sup>3</sup>
- BLUE** 1,000 – 10,000 µg/m<sup>3</sup>
- YELLOW** 10,000 – 100,000 µg/m<sup>3</sup>
- RED** >100,000 µg/m<sup>3</sup>

Adapted from HydroEnvironmental Solutions (2016) Remedial Investigation Report, Figure 3.

Note that locations of soil borings installed in 2013 are approximate.

# Freons concentration gradients



## Soil vapor KEY

GREEN	<100 µg/m <sup>3</sup>
BLACK	100-1,000 µg/m <sup>3</sup>
BLUE	1,000 – 10,000 µg/m <sup>3</sup>
YELLOW	10,000 – 100,000 µg/m <sup>3</sup>
RED	>100,000 µg/m <sup>3</sup>

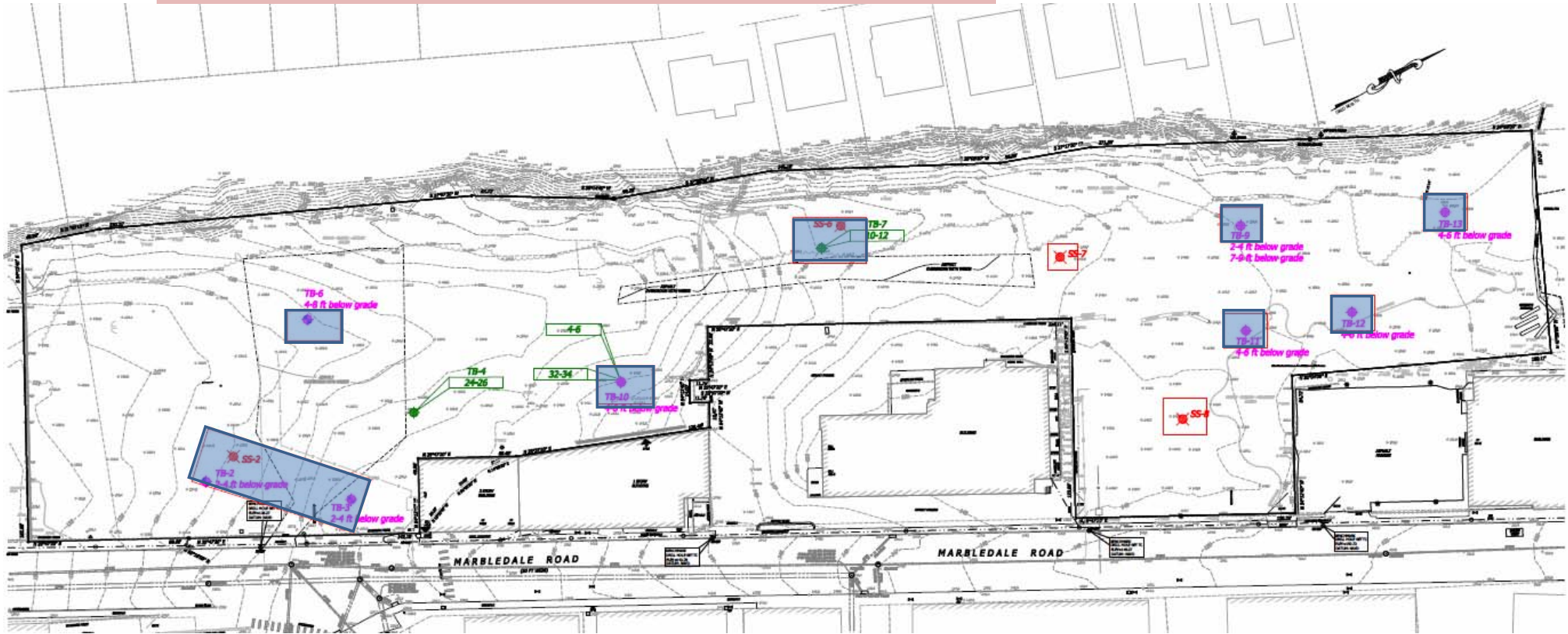
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# Hotspot removal areas

(based on August 2016 Remedial Action Work Plan)



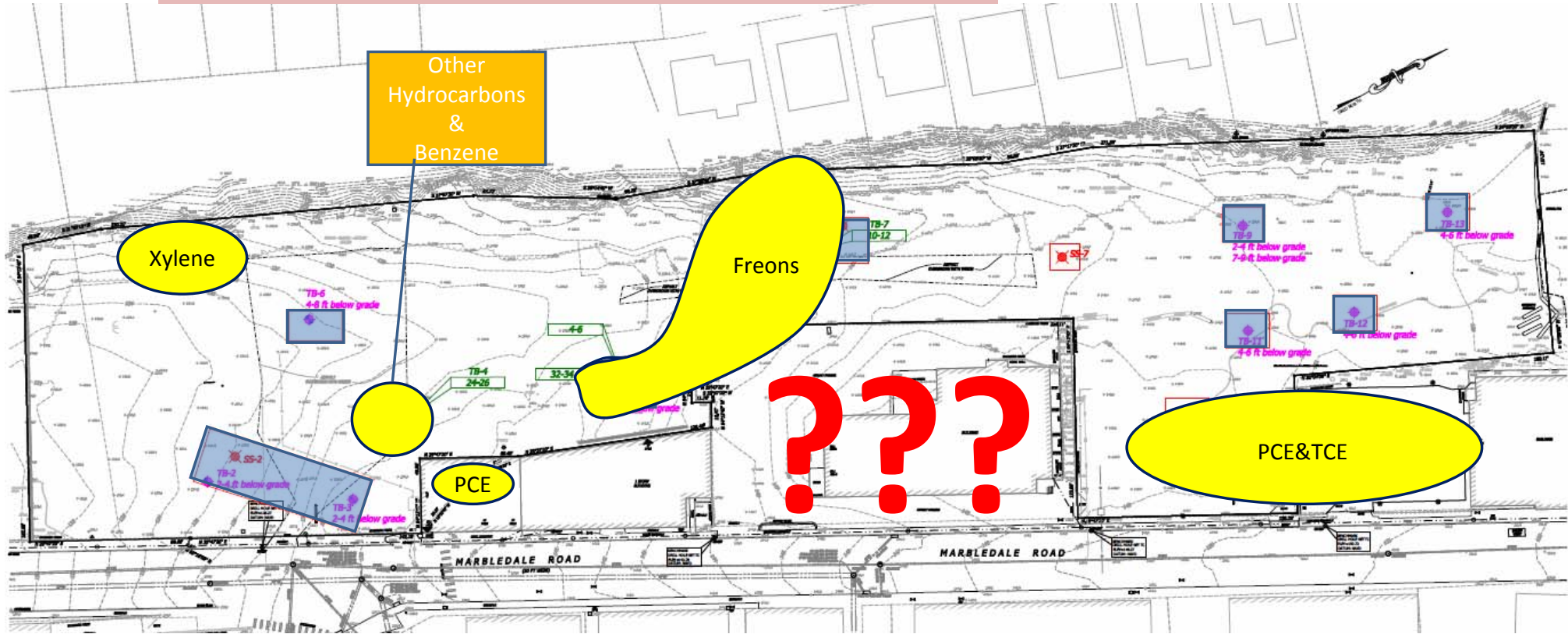
-  Area removed to depth of 4-ft or more
-  Surface soil removal

# Conclusions – Freons

- Highest concentrations! Up to **520,000  $\mu\text{g}/\text{m}^3$**
- Likely leaking from tanks, AC/refrigeration equipment
- Source(s) are in central part of site, W of 125 Marbledale Rd.

# Hotspot removal areas

(based on August 2016 Remedial Action Work Plan)



■ Area removed to depth of 4-ft or more  
■ Surface soil removal

■ Hot Spots not being removed