

# Case Study

## Palermo Well Field

### Use of Stable Isotopes

### Tumwater, Washington

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For

The Ground Water Forum Business Session

U.S. EPA Technical Support Project

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# Overview of the Presentation

- Unanswered questions regarding the Conceptual Site Model (CSM)
- Main question from the CSM – Is PCE degrading to TCE in the Palermo valley?
- Data Results
- CSM / Redevelopment of existing CSM using Compound Specific Isotope Analysis (CSIA)
- Conclusions / Observations / My take home message

# Source area locations and how they may be impacting the Well Field

- Southgate Dry Cleaners (PCE)
- WDOT Testing Lab (TCE)
- Trospen Road & Littlerock Road (TCE)

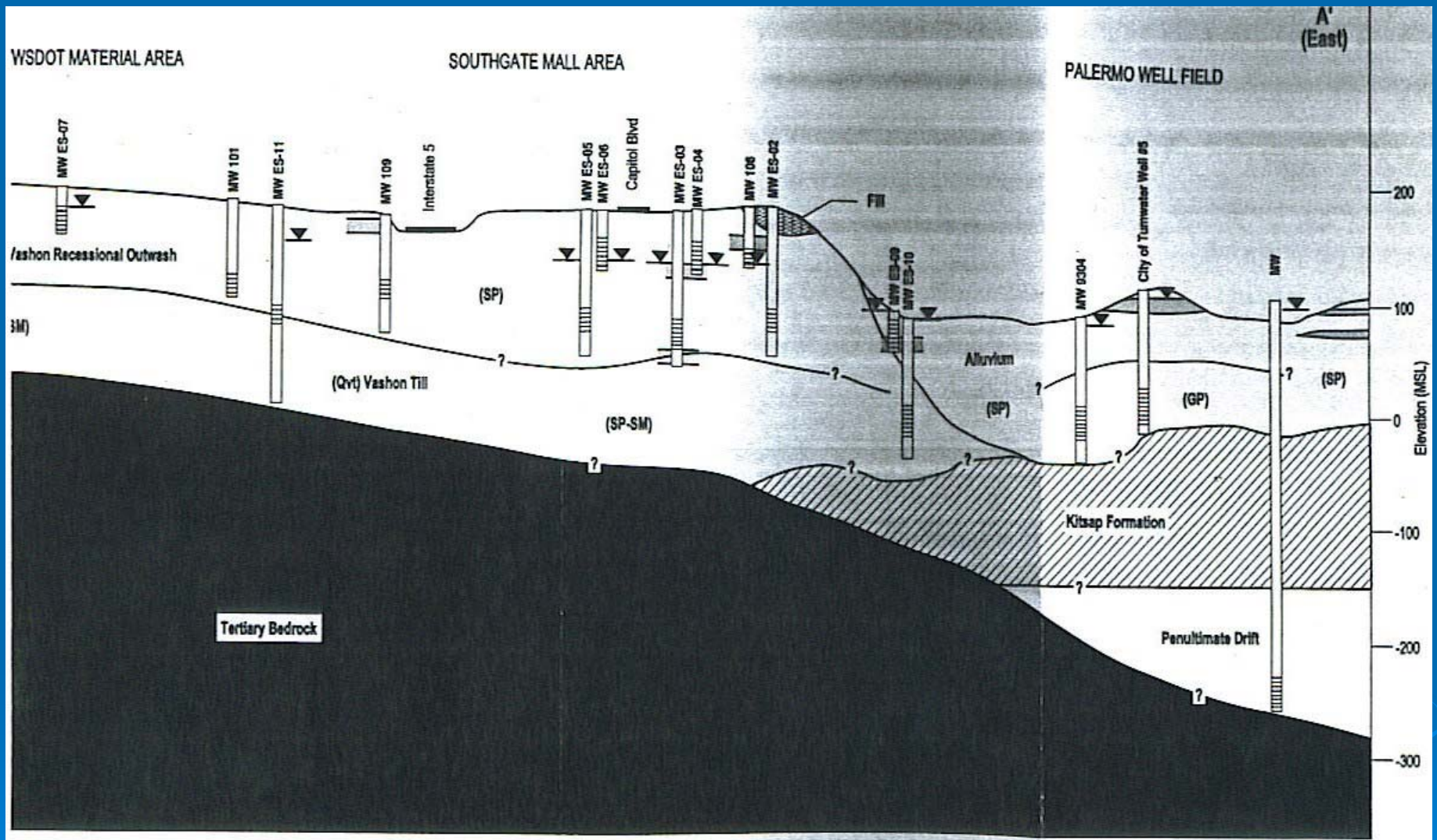
Palermo Wellfield Superfund Site  
Monitoring and Production Wells

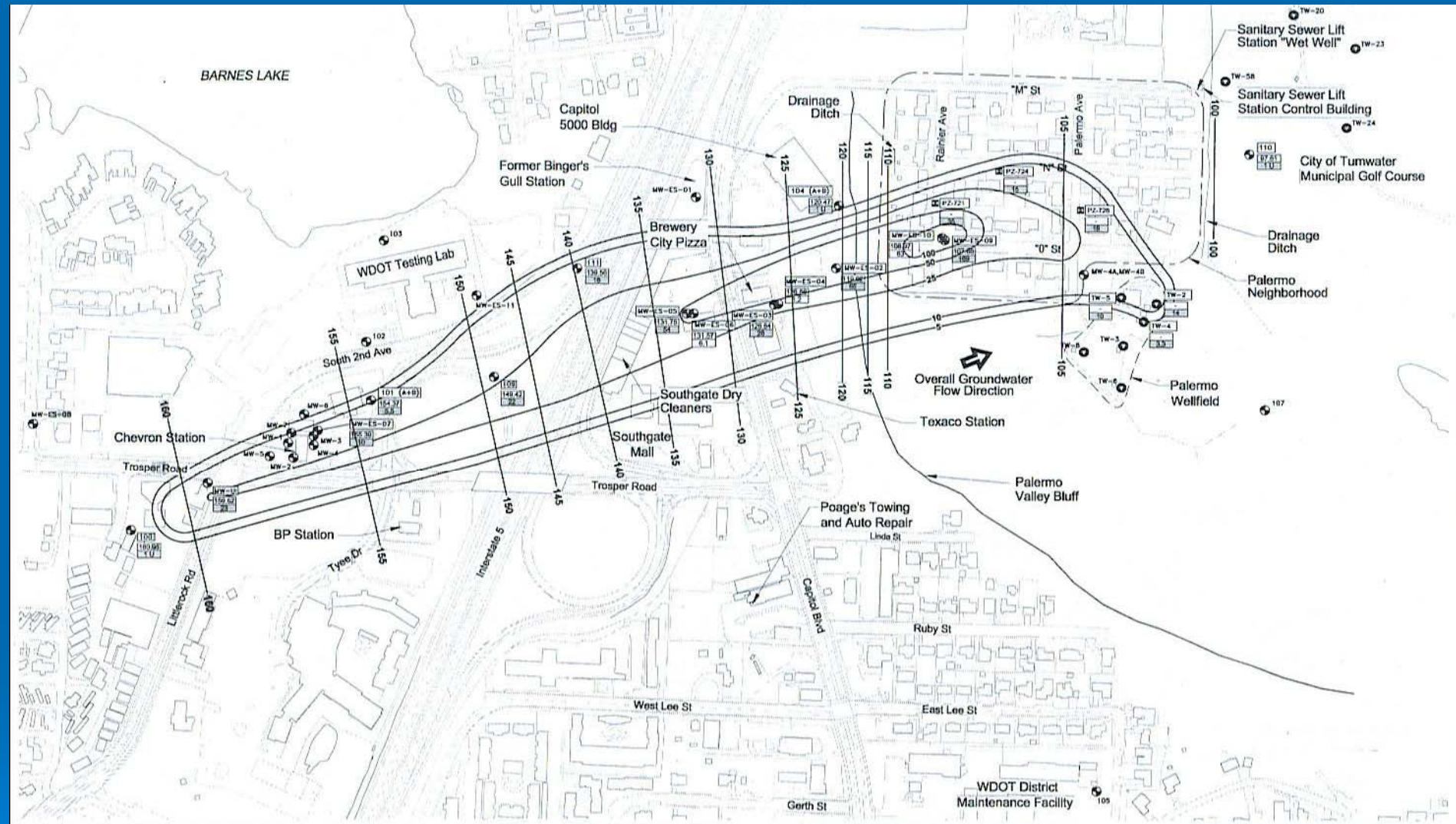


- Legend**
- Monitoring Well
  - Piezometer
  - Production Well

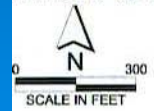


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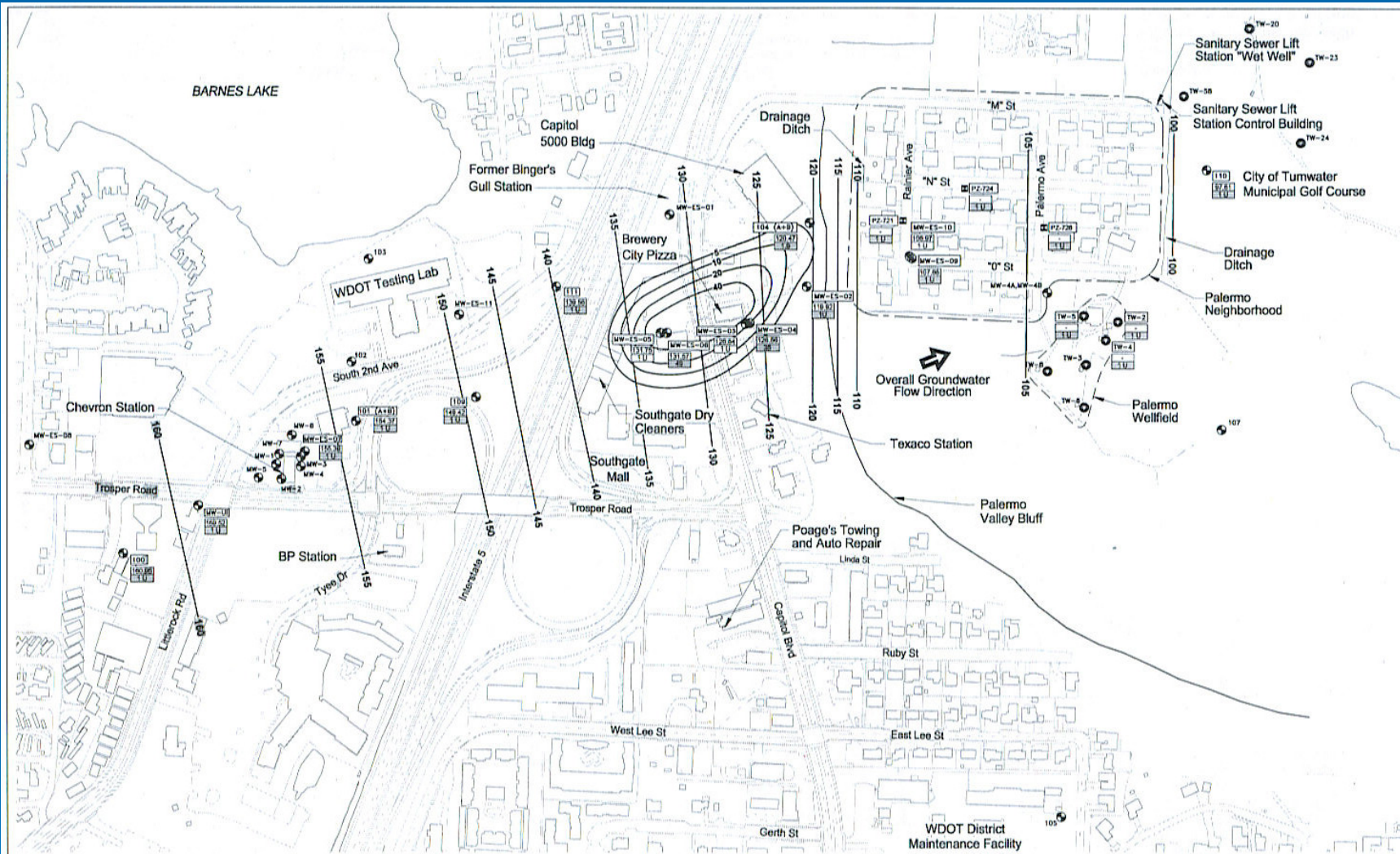
**LEGEND**

- Roads/highway
- Buildings
- Drinking Water Well
- Piezometer
- Monitoring Well Sampled
- Monitoring Well Not Sampled
- Groundwater Elevation (ft)
- TCE Value (ug/l)

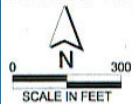
**NOTES**

1. Overall Groundwater Gradient = 0.016 Vertical Feet Per Linear Foot.
2. Highlighted TCE Values Used To Generate Contours.

**Figure 2-2  
Palermo Wellfield LTM  
Piezometric Contour Map with  
TCE Concentrations in Groundwater  
June 2007**



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**LEGEND**

- Roads/highway
- Buildings
- Drinking Water Well
- Piezometer
- MW-ES-05 Monitoring Well Sampled
- 105 Monitoring Well Not Sampled
- 142.90 Groundwater Elevation (ft)  
10.00 PCE Value (ug/l)

**NOTES**

1. Overall Groundwater Gradient =0.016 Vertical Feet Per Linear Foot.
2. Highlighted PCE Values Used To Generate Contours.

**Figure 2-1  
Palermo Wellfield LTM  
Piezometric Contour Map with  
PCE Concentrations in Groundwater  
June 2007**

The ground water at the Tumwater Well field has only detected TCE above the MCL (5 ug/l) with no detections of PCE.



Question: Is PCE degrading to  
TCE in the Palermo valley?



## Monitoring wells which were sampled in June 2007 for the Superfund Site Palermo

Well ID	Elevation TOC (ft-MSL)	Well Depth (bgs/toc-ft)	Screen interval (bgs/toc-ft)	TCE (µg/l)	PCE (µg/l)	D.O. (mg/l)	ORP (mV)
MW-ES-07	177.89	33.94	24-34	10	1 U	5.96	307
MW-ES-02	174.65	104.45	94.5-104.5	66	1 U	2.13	331
MW-101B	176.19	31.10	21-31	5.5	1 U	2.51	328
MW-104B	170.51	60.8	49.75-59.75	1U	1.9	8.71	319
MW-ES-03	175.07	124.94	113.25-123.25	26	1 U	1.85	372
MW-ES-04	175.11	55.25	45-55	1.2	35	7.46	325
MW-ES-05	175.05	95.75	85.5-95.5	54	1 U	3.44	331
MW-ES-06	175.30	54.54	45-55	6.1	49	7.50	360
MW-ES-09	108.33	29.41	19.25-29.25	169	1 U	0.41	378
MW-ES-10	108.25	93.78	83.5-93.5	63	1 U	0.16	345
MW-100	177.70	28.68	18.5-28.5	1 U	1 U	1.89	431
MW-109	168.89	73.07	62.75-72.75	22	1 U	5.39	405
MW-110	101.93		30-40	1 U	1 U	0.56	216
MW-111	165.41	35.22	25.2-35.2	18	1 U	1.27	405
MW-UI	178.82	27.69	17.69-27.69	23	1 U	5.76	419
PZ-721	110	10	7-10	35	1 U	3.09	451
PZ-728	110	10	7-10	18	1 U	1.56	461
PZ-724	110	10	7-10	15	1 U	3.84	441
TW-4		90	80-92	3.3	1 U		
TW-5		115	82-115	10	1 U		
TW-2		92	80-92	14	1 U		

MW-ES-10 depth to water measured June 2007- 0.72 feet above the top of casing

MW-ES-10 depth to water measured November 2007- 0.74 feet above the top of casing

MW-ES-09 depth to water measured June 2007 – 0.65 feet bgs

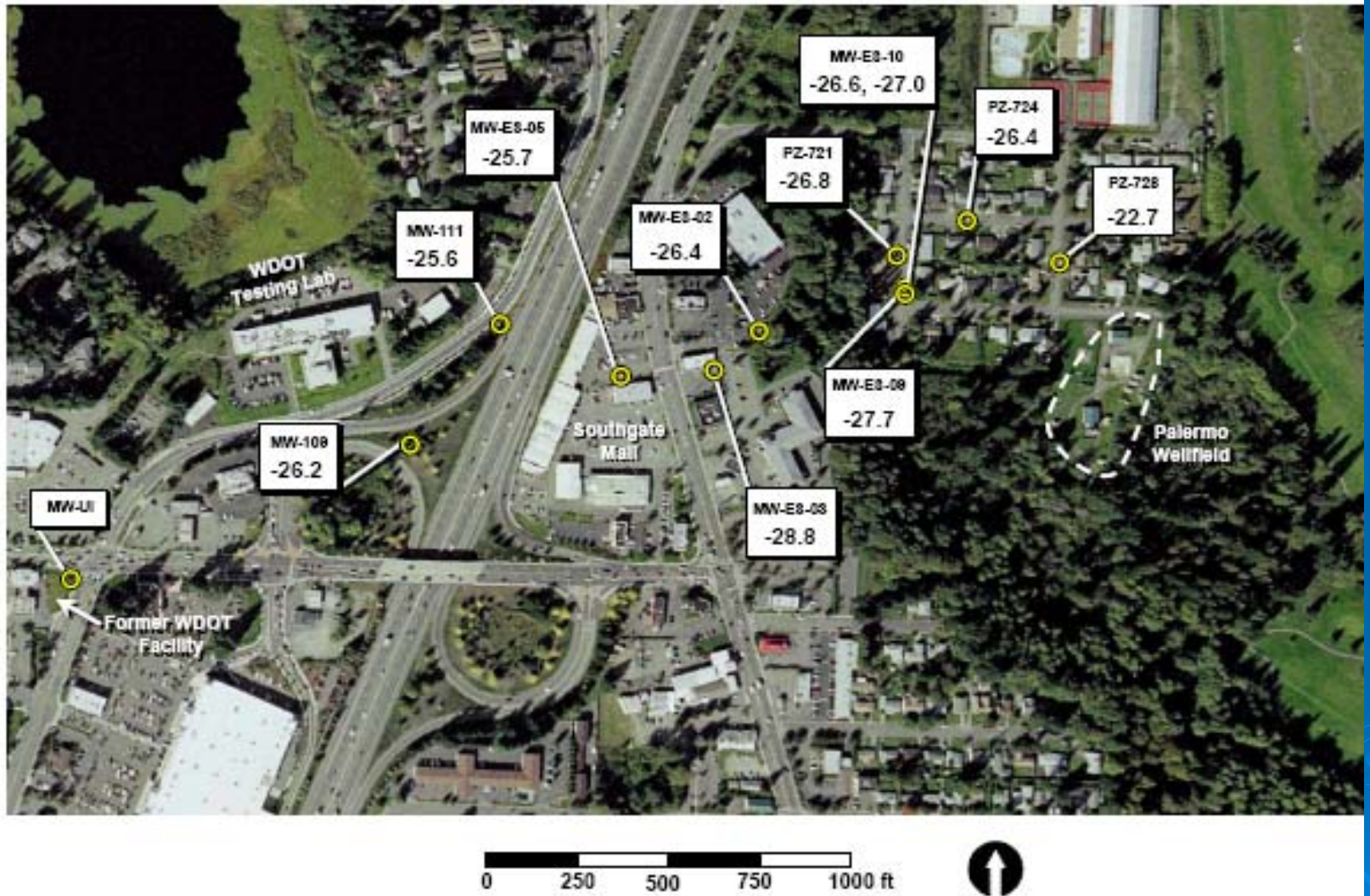
MW-ES-09 depth to water measured November 2007 – 0.21 feet bgs.

Biannual ground water sampling event was conducted during the spring of 2006 and EPA sampled additional monitoring wells and also sampled for stable isotopes or performed a Compound Specific Isotope Analysis (CSIA) of the groundwater.



Using CSIA EPA looked at the carbon isotopic signature or the ratio of  $^{13}\text{C}/^{12}\text{C}$

These isotopes are inherently stable unless a process occurs that will act on one of the isotopes to undergo “enrichment”. This process is called fractionation.



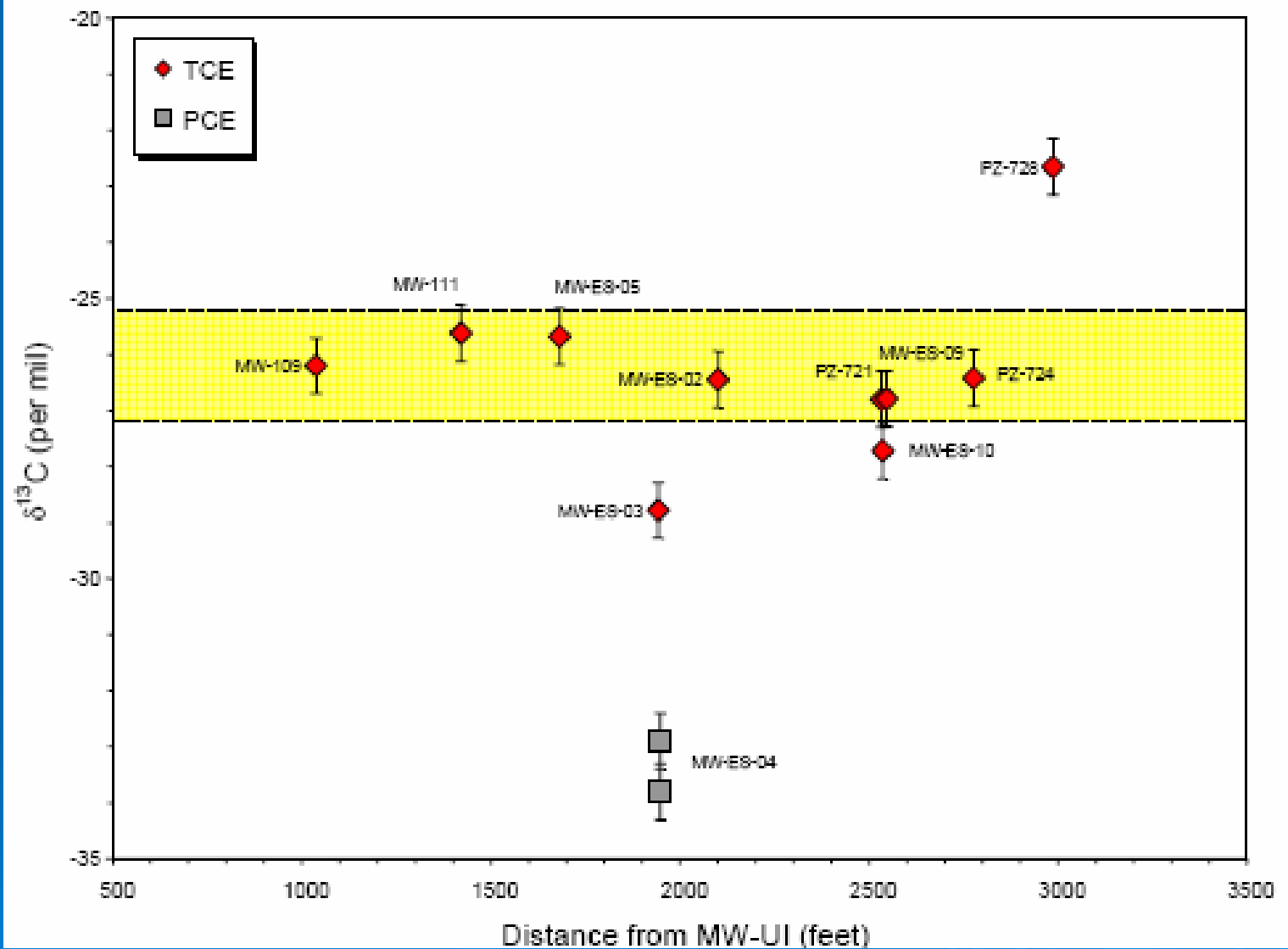
Taken from Vlassopoulos, (May 2006)

Sample ID	Well	cis-1,2-DCE ug/L	TCE ug/L	PCE ug/L	$\delta^{13}\text{C-TCE}$ per mil	$\delta^{13}\text{C-PCE}$ per mil	Location	Sample Type
6114050	PZ-721	0.8 J	47	0.4 J	-26.8		South Rainier Ave	Regular
6114051	PZ-724	2.2	28	0.3 J	-26.4		West N Street	Regular
6114052	PZ-728	2.7	24	1 U	-22.7		South Palermo Ave	Regular
6114053	PW-2	0.3 J	16	1 U			Northeast Wellfield	Regular
6114056	PW-3	1 U	1 U	1 U			South Wellfield	Regular
6114054	PW-4	1 U	3.4	1 U			Between PW-3 and PW-2	Regular
6114055	PW-5	1 U	7.4	1 U			Northwest Wellfield	Regular
6114057	MW-110	1 U	1 U	1 U			Golf Course	Regular
6114058	MW-100	1 U	1 U	1 U			Albertson's Parking Lot	Regular
6114059	MW-104B	1 U	1 U	1.5			North Building 5000	Regular
6114061	MW-104A	1 U	6.6	1 U			South Building 5000	Regular
6114062	MW-101A	1 U	1 U	1 U			Nickelby's Restaurant, North	Regular
6114064	MW-101B	0.5 J	14	0.1 J			Nickelby's Restaurant	Regular
6114065	MW-111	0.6 J	20	1 U	-25.6		West of WSDOT	Regular
6114066	MW-UI	1 U	5.2	1 U			Alberston's Gas Station on Corner	Regular
6124050	MW-ES-03	0.2 J	27	1 U	-28.8		Brewery City Pizza, West	Regular
6124051	MW-ES-04	1 U	0.8 J	48		-32.9	Brewery City Pizza, East	Regular
6124052	MW-ES-04	1 U	0.7 J	49		-33.8	Brewery City Pizza, East	Field Duplicate
6124053	MW-ES-07	1 U	7.8	0.1 J			Chevron Gas Station	Regular
6124054	MW-109	1 U	26	1 U			Traffic Circle	Regular
6124055	MW-109	1 U	27	1 U	-26.2		Traffic Circle	Field Duplicate
6124056	MW-93-03	1 U	1 U	1 U			In Forest Behind Neighborhood	Regular
6124057	MW-4B	1 U	1 U	1 U			Park, West Casing	Regular
6124058	MW-4A	1 U	1 U	1 U			Park, East Casing	Regular
6124060	MW-ES-06	1 U	16	25			Schucks Parking Lot, East	Regular
6124061	MW-ES-05	0.4 J	42	1 U	-25.7		Schucks Parking Lot, West	Regular
6124062	MW-ES-05	0.3 J	46	1 U			Schucks Parking Lot, West	MS/MSD
6124063	MW-ES-02	1 U	56	1 U	-26.5		Behind KFC Parking Lot	Regular
6124064	MW-ES-09	0.5 J	176	1 U	-27.0		Rainier Ave, South	Regular
6124064	MW-ES-09				-26.6			Lab Duplicate
6124065	MW-ES-10	1 U	65	1 U	-27.7		Rainier Ave, North	Regular

Notes: 1. U = not detected at or above the reported result

2. J = The analyte was positively identified. The associated numerical result is an estimate.

3. Limits of quantification for isotope analyses: TCE = 20 ug/L; PCE = 30 ug/L



Taken from Vlassopoulos, (May 2006)

# The ground water sampling results reveals the following:

- The PCE isotope data at the Southgate Dry Cleaners was -33 per mil.
- The TCE isotope data at WDOT Lab was -26 per mil.
- The TCE isotope data near Trosper and Littlerock road was -26 per mil.
- The TCE isotope data within the Palermo valley or near the well field was -26 per mil.

# Conclusions

- Minimal amount of degradation has taken place for PCE
- The carbon isotope ratio were the same near WDOT Lab and the property once owned by WDOT at Trosper and littlerock road (-26 per mil).
- The carbon ratio near the Tumwater wellfield was (-26 per mil).
- EPA believes that WDOT is responsible for the TCE at the Tumwater wellfield.

# Take Home Message

- Use multi-lines of evidence for the development for the CSM.
- Go out to the site, either conduct the sampling or observe key locations.
- CSIA is appropriate for use if specific site conditions are met.

# References

Parametrix, Groundwater Long-Term Monitoring 2007  
Annual Report, January 2008

Vlassopoulos, Dimitri, Expert Report, U.S. VS Washington  
State Department of Transportation, May 2006