PASADENA

Pasadena Water and Power

Sunset Reservoir Wells Perchlorate Investigation Carbon Tetrachloride

Presented by
David Kimbrough, Ph.D., Water Quality Manager

Presented to
United States Environmental Protection Agency
at the Jet Propulsion Laboratories, Pasadena
April 30, 2012

Carbon Tetrachloride

Pasadena Water and Power

1. CTC is found on the JPL Facility and numerous monitoring wells
2. CTC is found in the Arroyo & LAWC Wells
3. NASA Argues that CTC is the Definitive Marker
4. The use of CTC as a marker has been challenged in correspondence.

2

PASADENA

NASA's RTCs 12/2008 pg.13

Pasadena Water and Power

"…we see a strong correlation between perchlorate and carbon tetrachloride in LAWC#5 …Therefore, NASA continues to believe that the use of carbon tetrachloride as a tracer is appropriate as one line of evidence to help understand the extent of JPL perchlorate"

3

PASADENA

LAWC Well #5 Results µg/L

Pasadena Water and Power

Date	CTC	PCE	TCE	ClO4
1/6/2009	1.8	0.76	2.9	19
2/3/2009	1.5	0.65	2.5	18
3/3/2009	1.7	0.65	2.4	15
4/7/2009	1.6	0.61	2.5	19
5/4/2009	1.7	0.58	2	19
6/1/2009	1.6	0.58	2.3	19
7/7/2009	1.5	0.05	2.1	21
8/4/2009	0.67	0.56	1.9	24
8/11/2009	1.4	0.51	2	19
9/1/2009	1.5	0.66	2.1	20
10/6/2009	2.3	0.81	2.9	27
11/10/2009	1.4	0.68	2.6	29
1/5/2010	1.4	0.51	1.9	31
2/2/2010	1.5	0.57	2	34
3/2/2010	1.4	0.59	1.9	35
7/8/2010	0.05	0.5	0.66	36
8/3/2010	0.62	0.05	1	30
8/24/2010	0.9	0.05	1.6	35
9/7/2010	1.0	0.52	1.4	34
10/5/2010	1.0	0.54	1.4	34
11/2/2010	1.2	0.54	1.5	41
2/10/2011	0.05	0.05	0.05	34
Mean	1.51	0.47	3.31	17.6
SD	1.04	0.31	3.0	10.6
N	109	109	109	109

Pearson Product Moment Correlation

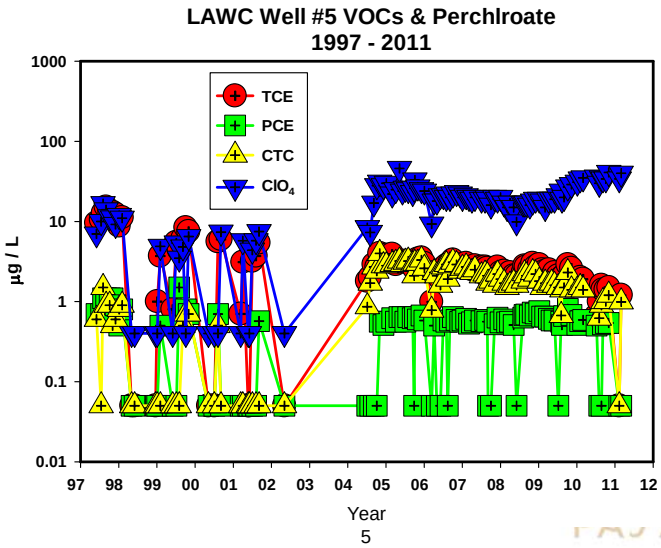
		PCE	TCE	ClO4
CTC	R^2	0.31	-0.08	0.59
	p	0.0013	0.4	<0.001
PCE	R^2		**0.58**	0.19
	p		**<0.001**	0.047
TCE	R^2			-0.17
	p			0.080

4

PASADENA

LAWC Well #5 Results µg/L

Pasadena Water and Power



5

PASADENA

Carbon Tetrachloride

Pasadena Water and Power

1. The Patton Well, which is physically located in Pasadena but belongs to Cal Am Water Co, has elevated levels of perchlorate and, in July of 2011, was found to have CTC (and PCE & TCE as well).
2. The Sunset Reservoir Wells are exactly in the middle.
3. CTC was detected in an number of wells in the mid-1980's and early 1990's, such as Villa and Craig

6

PASADENA

Patton Well Results 2011 µg/L

Pasadena Water and Power

Date	CTC	PCE	TCE	ClO4
3/16/2011	<DLR	<DLR	0.9	<DLR
5/11/2011	<DLR	<DLR	0.8	NA
5/16/2011	<DLR	<DLR	1.1	4.7
5/23/2011	<DLR	0.6	1.1	5.0
6/1/2011	<DLR	0.5	1.3	4.2
6/8/2011	<DLR	0.6	1.2	<DLR
6/13/2011	<DLR	0.6	1.1	4.8
6/20/2011	<DLR	0.6	1.0	<DLR
6/27/2011	<DLR	0.6	1.0	<DLR
7/5/2011	<DLR	0.6	1.1	<DLR
7/11/2011	<DLR	0.7	1.2	5.2
7/18/2011	<DLR	<DLR	1.1	5.3
7/25/2011	<DLR	0.6	1.1	4.8
8/1/2011	0.6	0.7	1.4	5.3
8/8/2011	0.5	0.6	1.5	5.3
8/16/2011	0.5	0.5	1.3	6.2
8/22/2011	0.5	0.7	1.3	5.3
8/29/2011	0.6	0.6	1.5	4.4
9/6/2011	0.6	0.8	1.6	5.1
9/14/2011	0.6	0.7	1.4	5.6
9/19/2011	0.5	0.7	1.5	4.8
9/26/2011	<DLR	<DLR	1.3	5.1
10/3/2011	<DLR	0.6	1.5	4.8
10/10/2011	<DLR	0.7	1.4	5.0
10/17/2011	<DLR	0.6	1.3	4.8
10/24/2011	<DLR	0.6	1.3	4.9
11/2/2011	0.6	0.8	1.6	4.8
11/7/2011	0.5	0.6	1.4	4.7
Mean	0.23	0.53	1.3	4.1
SD	0.25	0.24	0.21	2
N	28	28	28	27

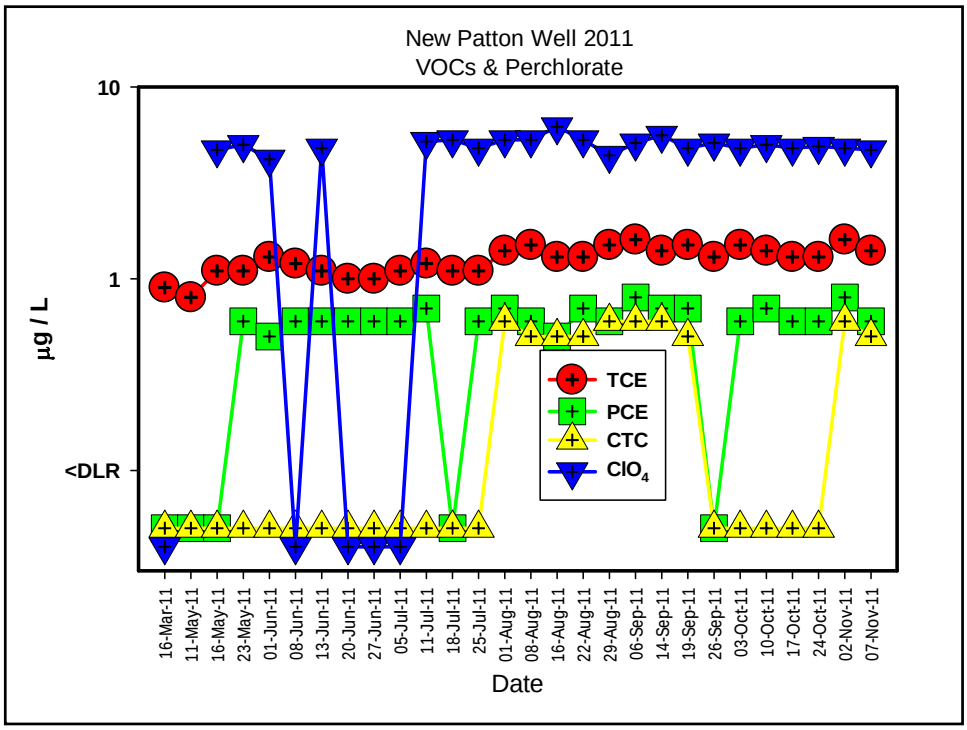
Pearson Product Moment Correlation

		PCE	TCE	ClO4
CTC	R^2	0.46	0.70	0.41
	p	0.015	<0.001	0.034
PCE	R^2		0.59	0.13
	p		<0.001	0.53
TCE	R^2			0.58
	p			0.001

NA = Not Analyzed

7

PASADENA



Patton Well Results

Pasadena Water and Power

Given the fact that all four of these compounds are found on the JPL site, are found in the Monk Hill Wells and the Sunset Reservoir Wells, and show a strong statistically significant correlation, this would strongly suggest that the perchlorate and the VOCs share a common source at JPL.

9

PASADENA

ClO_4 > TCE > PCE & CTC Mean Concentrations (mg/L)

Pasadena Water and Power

Location	CTC	PCE	TCE	ClO_4
MW-4-2	0.62	0.58	1.8	5.9
MW-5	0.20	0.17	2.6	12
MW-10	2.3	8.1	8.2	56
MW-13	4.1	0.66	11	182
MW-23-1	0.10	0.82	1.9	2.2
MW-17-2	0.18	0.27	1.0	5.0
LAWC 5	1.6	0.56	3.3	7.4
Patton	0.22	0.53	1.3	4.1

10

PASADENA

ClO_4 > TCE > PCE & CTC
Pearson Product Moment Correlation

Pasadena Water and Power

Location	CTC/PCE	CTC/TCE	CTC/ClO_4	PCE/TCE	PCE/ClO_4	TCE/ClO_4	
MW-4-2		-0.10	0.92**	0.89**	-0.05	-0.03	0.93**
MW-5	0.79**	0.84**	0.37*	0.91**	0.47*	0.47*	
MW-10	-0.02	0.18	0.96**	-0.49*	0.03	0.17	
MW-13	-0.33*	0.61**	-0.19	-0.47*	-0.28	0.00	
MW-23-1	-0.22	0.88**	0.84**	-0.11	-0.23	0.83**	
MW-17-2	0.26*	0.84**	0.54**	0.47**	0.55**	0.74**	
LAWC 5	0.31*	-0.08	0.59**	0.58**	0.19*	-0.17	
Patton	0.46*	0.70**	0.41*	0.59*	0.13	0.58*	

* P <0.05
** P <0.001

PASADENA

11

CTC Detections

Pasadena Water and Power

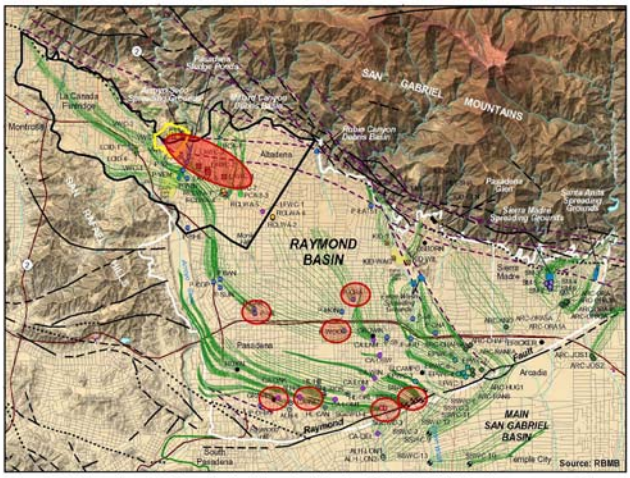


Figure 2. Particle tracking simulations using the independently-developed RBMB Model indicate that capture zones of the Sunset Reservoir Wells are south of the JPL Facility.

PASADENA

12

Conclusions

Pasadena Water and Power

- The Distribution of Carbon Tetrachloride, PCE, TCE, and Perchlorate Indicate that there was No Containment

13

PASADENA