PRACTICAL Environmental Services, Inc.

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September 25, 1999

Mr. Steve Pullen
State of New Mexico
NMED/HRMB
P.O. Box 26110
Santa Fe, New Mexico 87502

Re: Giant Ciniza Refinery – LTU Soil Sampling & Analysis for May 1999

Dear Steve:

At the request of Dorinda Mancini, Environmental Affairs Manager for the Giant Ciniza Refinery, enclosed please find a report documenting the results of soil sampling and analysis conducted at the Land Treatment Unit (LTU) during May 1999. This report also addresses the statistical analysis of significant change versus background.

No significant change was detected in subsurface samples. However, a significant increase in several heavy metals may be present in the LTU surface soil layer. A screening level risk assessment is underway and will be completed by the end of October.

If you have any questions, please call me at (303) 629-8703.

Sincerely,

Thomas D. Atwood, P.E.
New Mexico Certificate #14414

TDA/hs

c: Dorinda Mancini, Giant

Enclosure

Overview

On May 18, 1999, thirty soil samples were collected at the Land Treatment Unit (LTU) at the Giant Ciniza Refinery in McKinley County, New Mexico.

- Eighteen of these samples were collected within LTU Cells No. 1 and 2, which is where refinery sludge was treated during the 1980's and early 1990's.

- The remaining twelve samples were collected within LTU Cell No. 3, which was not used for treatment and therefore represents a "background" location.

The samples were analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and heavy metals.

The results for the treatment area (Cells No. 1 and 2) were compared against the results for the background area (Cell No. 3). A statistical analysis was performed to determine if a "significant" change had occurred.

No significant change was detected in subsurface samples. A significant increase in several heavy metals may be present in the treatment area surface soil.

Sampling

Each cell of the LTU was subdivided into 200 numbered sampling points as shown in Figure No. 1. A random number generator was then used to select sampling locations.

- In Cell No. 1, the sampling points were #40, #98, and #143.
- In Cell No. 2, the sampling points were #40, #41, and #107.
- In Cell No. 3, the sampling points were #38, #97, #135, and #152.

At each sampling point, a soil core measuring at least seven feet in length was extracted using split spoon probes. The core was laid out on a flat, clean tarp and three individual samples were collected. See sampling collection photographs.

- The first sample was collected at a depth of 6 inches below ground surface and has been designated as the zone-of-incorporation (ZOI) sample.

- The second sample was collected at depth of 3 feet below ground surface and has been designated as the treatment zone (3FT) sample.

- The third sample was collected at a depth of 6 feet below ground surface and has been designated as the below-treatment-zone (BTZ) sample.

VOC Analytical Results

All thirty soil samples were analyzed for the presence of VOCs. The LTU RCRA permit refers to these VOC analytes as the "Modified Skinner List Volatile Organics."

No VOCs were detected in any sample.

SVOC Analytical Results

All thirty soil samples were analyzed for the presence of SVOCs. The LTU RCRA permit refers to these SVOC analytes as the "Modified Skinner List Semivolatile Organics."

Six samples indicated a trace presence of SVOCs; primarily chrysene. All detections were below 10 mg/kg. All of these samples were from the surface (ZOI) layer. One of these samples was from Cell No. 3.

No SVOCs were detected in the other 24 samples.

Heavy Metals Analytical Results

All thirty soil samples were analyzed for the presence of heavy metals. The LTU RCRA permit refers to these metal analytes as the "Modified Skinner List Metals."

Heavy metals were detected in all thirty samples. Results are presented in Tables #1 and #2. Table #1 presents data for Cells No. 1 and 2. Table #2 presents data for Cell No. 3.

Laboratory analytical documentation is attached as an appendix to this report.

VOC Data Interpretation

By their nature, VOCs evaporate readily. Because the LTU has not received or treated refinery sludges in over five years, and because the local climate is typically arid and hot, it is likely that all VOC constituents evaporated from the LTU many years ago. The data is consistent with this scenario.

SVOC Data Interpretation

The LTU was used to biodegrade organic sludge from the refinery wastewater treatment system. Typically, this sludge included small tar balls and droplets which are resistant to rapid biodegradation. Over time, as this tar slowly biodegrades, it may leach SVOCs into the surrounding soil. Because SVOCs were only detected in surface samples, and at very low concentrations (less than 10 mg/kg), the data is consistent with this scenario.

Heavy Metals Data Interpretation

Heavy metals are typically present in natural soils of the earth. This native concentration is referred to as a "background" value. The data collected from Cell No. 3 are assumed to represent background values.

In reviewing the data for Cell No. 3, Sample ZOI-3-135-051899 appears anomalous. The reported data are an order of magnitude larger than the other 11 samples from Cell No. 3. The data for this sample may represent laboratory error in analysis or reporting.

Refinery sludge was treated in LTU Cells No. 1 and 2. This sludge was spread onto the surface and then tilled into the surface layer. Unlike organics, which biodegrade over time, if heavy metals were present in the sludge, these metals may have accumulated in the soil in Cells No. 1 and 2.

Table #3 presents a comparison of data from Cells No. 1 and 2 (treatment area) and Cell No. 3 (background area). The values shown are the mean (average) concentration of each heavy metal, organized by layer.

Comparison of subsurface samples (3FT and BTZ) indicates very little difference between Cells No. 1 and 2 (treatment) and Cell No. 3 (background).

Comparison of surface samples (ZOI) suggests that a significant increase has occurred in Cells No. 1 and 2 for several heavy metals.

Statistical Analysis

Are the differences in data values due solely to normal and random variations?

Or, are the differences due to a real increase in heavy metal concentration as a result of prior sludge treatment in Cells No. 1 and 2?

A statistical analysis of the data has been performed based the student "t" distribution and a significance level of 1 percent.

For the subsurface samples (3FT and BTZ), this analysis indicates a high probability that the data differences are due to normal and random variations.

For the surface samples (ZOI), this analysis indicates a high probability that the data differences are "significant" for arsenic, chromium, lead, mercury, and nickel.

Conclusions

Subsurface soil in the LTU has not been impacted by prior operations. Data from the 3FT and BTZ layers in Cells No. 1 and 2 are consistent with background values obtained from Cell No. 3. This finding is also consistent with the geotechnical properties of the site, which include a very low hydraulic conductivity (less than 10^{-7} cm/sec) and a generally alkaline soil pH. Both organic and heavy metal constituents have been confined to the LTU surface layer and are substantially inhibited in migration potential.

Surface soil in LTU Cells No 1. and 2 contains trace SVOCs. These constituents are likely to be byproducts of the very slow biodegradation of tar-like residue that was contained in the refinery sludge. Landfarming ceased in the early 1990's and these constituents will naturally attenuate over time.

Surface soil in LTU Cells No. 1 and 2 also contain residual heavy metals which are likely to have accumulated as a result of prior landfarming activity. Arsenic, chromium, lead, mercury, and nickel concentrations are moderately elevated versus ambient background values, but are generally low in comparison to remedial action levels.

Recommendation

A screening-level risk assessment should be performed for the constituents identified in this report.

Table #1
LTU Cells No. 1 and 2 – Treatment Area Data

Sample	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Lead	Mercury	Nickel	Selenium	Vanadium
	21	41-6.5	700	21	-	50	10	20	.05	15	-	70
ZOI-1-40-051899	0.6	0.6	290	0.6	0.6	190.0	7.1	40.0	1.0	28.0	0.6	30.0
3FT-1-40-051899	16.0	0.6	180	1.1	0.6	9.5	4.1	11.0	0.1	9.4	0.6	16.0
BTZ-1-40-051899	0.6	0.6	210	0.6	0.6	12.0	5.2	8.9	0.1	13.0	0.6	20.0
ZOI-1-98-051899	0.6	0.6	1100	0.6	0.6	58.0	6.6	18.0	2.0	13.0	0.6	13.0
3FT-1-98-051899	0.6	0.6	140	0.6	0.6	7.0	0.6	7.9	0.1	7.0	0.6	12.0
BTZ-1-98-051899	0.6	0.6	210	1.1	0.6	15.0	5.7	11.0	0.1	13.0	0.6	19.0
ZOI-1-143-051899	0.6	14.0	350	0.6	0.6	140.0	5.7	53.0	1.4	39.0	0.6	35.0
3FT-1-143-051899	0.6	0.6	240	0.6	0.6	14.0	5.7	10.0	0.1	13.0	0.6	20.0
BTZ-1-143-051899	0.6	0.6	240	1.0	0.6	9.2	0.6	9.1	0.1	10.0	0.6	13.0
ZOI-2-40-051899	0.6	20.0	710	0.6	0.6	200.0	9.7	87.0	13.0	54.0	0.6	40.0
3FT-2-40-051899	0.6	1.2	310	1.3	0.6	7.4	4.9	9.6	0.1	9.4	0.6	14.0
BTZ-2-40-051899	0.6	1.4	260	1.5	0.6	17.0	6.9	12.0	0.2	15.0	0.6	27.0
ZOI-2-41-051899	1.2	10.0	550	0.6	0.6	310.0	8.2	54.0	8.4	32.0	3.3	35.0
3FT-2-41-051899	0.6	1.3	290	1.7	0.6	18.0	7.0	13.0	0.1	15.0	0.6	28.0
BTZ-2-41-051899	0.6	1.8	270	1.4	0.6	18.0	7.1	12.0	0.1	15.0	0.6	30.0
ZOI-2-107-051899	0.6	7.5	350	0.6	0.8	220.0	6.2	40.0	1.6	24.0	0.6	21.0
3FT-2-107-051899	0.6	0.6	290	0.6	0.6	9.4	4.3	11.0	0.1	9.4	0.6	15.0
BTZ-2-107-051899	0.6	0.6	230	1.1	0.6	12.0	5.1	10.0	0.1	12.0	0.6	19.0
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Note: All non detect (ND) values have been given a numerical value equal to one half (1/2) of the analytical method detection limit.

Table #2
LTU Cell No. 3 – Background Area Data

Sample ID	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Lead	Mercury	Nickel	Selenium	Vanadium
ZOI-3-38-051899	0.6	3.9	340	0.6	0.6	190.0	5.1	21.0	0.9	11.0	0.6	16.0
3FT-3-38-051899	0.6	1.5	200	1.4	0.6	8.9	5.0	11.0	0.1	9.8	0.6	18.0
BTZ-3-38-051899	0.6	2.4	300	1.4	0.6	25.0	8.6	12.0	0.1	20.0	0.6	43.0
ZOI-3-97-051899	0.6	1.6	360	1.4	0.6	24.0	7.0	12.0	0.1	14.0	0.6	30.0
3FT-3-97-051899	0.6	1.6	310	1.8	0.6	27.0	8.8	13.0	0.1	19.0	0.6	40.0
BTZ-3-97-051899	0.6	1.6	330	1.2	0.6	10.0	5.3	9.1	0.1	11.0	0.6	22.0
ZOI-3-135-051899*	3.8	17.0	3400	11.0	0.6	130.0	63.0	120.0	0.1	130.0	0.6	220.0
3FT-3-135-051899	0.6	1.7	360	1.5	0.6	24.0	8.4	12.0	0.1	18.0	0.6	36.0
BTZ-3-135-051899	0.6	1.4	330	1.6	0.6	6.2	4.1	10.0	0.1	7.6	0.6	16.0
ZOI-3-152-051899	0.6	1.5	350	1.5	0.6	8.5	5.3	10.0	0.1	11.0	0.6	17.0
3FT-3-152-051899	0.6	1.4	370	1.4	0.6	17.0	7.0	11.0	0.1	15.0	0.6	27.0
BTZ-3-152-051899	0.6	1.1	430	0.6	0.6	7.8	4.7	8.5	0.1	8.8	0.6	18.0

Note: All non detect (ND) values have been given a numerical value equal to one half (1/2) of the analytical method detection limit.
The results for Sample ZOI-3-135-051899 are inconsistent with other samples and therefore may represent laboratory error.

Table #3
Comparison of Mean Data Values

Sample Zone	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Lead	Mercury	Nickel	Selenium	Vanadium
ZOI-Cells No. 1&2	0.7	8.8	558	0.6	0.6	186.3	7.3	48.7	4.6	31.7	1.1	29.0
ZOI-Cell No. 3	0.6	2.3	350	1.2	0.6	74.2	5.8	14.3	0.3	12.0	0.6	21.0
Difference	+0.1	+5.5	+208	-0.6	0.0	+112.1	+1.5	+34.4	+4.3	+19.7	+0.5	+8.0
% Change	+17%	+240%	+59%	-50%	0%	+151%	+25%	+241%	+1433%	+164%	+83%	+38%
3FT-Cells No. 1&2	3.2	0.8	242	1.0	0.6	10.9	4.4	10.4	0.1	10.5	0.6	17.5
3FT-Cell No. 3	0.6	1.6	310	1.5	0.6	19.2	7.3	11.8	0.1	15.5	0.6	30.3
Difference	+2.6	-0.8	-68	-0.5	0.0	-8.3	-2.9	-1.4	0.0	-5.0	0.0	-12.8
% Change	+433%	-50%	-22%	-33%	0%	-43%	-40%	-12%	0%	-32%	0%	-42%
BTZ-Cells No. 1&2	0.6	0.9	237	1.1	0.6	13.9	5.1	10.5	0.1	13.0	0.6	21.3
BTZ-Cell No. 3	0.6	1.6	348	1.2	0.6	12.3	5.7	9.9	0.1	11.9	0.6	24.8
Difference	0.0	-0.7	-111	-0.1	0.0	+1.6	-0.6	+0.6	0.0	+1.1	0.0	-2.5
% Change	0%	-43%	-32%	-8%	0%	+13%	-11%	+6%	0%	+9%	0%	-10%

Note: Mean values for ZOI-Cell No. 3 do not include data from Sample ZOI-3-135-051899.

Figure No. 1
GIANT REFINING COMPANY - CINIZA
Land Treatment Area
Sampling Grid - Random Number System

Sampling Points - Cell #1

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100
101	102	103	104	105	106	107	108	109	110
111	112	113	114	115	116	117	118	119	120
121	122	123	124	125	126	127	128	129	130
131	132	133	134	135	136	137	138	139	140
141	142	143	144	145	146	147	148	149	150
151	152	153	154	155	156	157	158	159	160
161	162	163	164	165	166	167	168	169	170
171	172	173	174	175	176	177	178	179	180
181	182	183	184	185	186	187	188	189	190
191	192	193	194	195	196	197	198	199	200

Sampling Points - Cell #2

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100
101	102	103	104	105	106	107	108	109	110
111	112	113	114	115	116	117	118	119	120
121	122	123	124	125	126	127	128	129	130
131	132	133	134	135	136	137	138	139	140
141	142	143	144	145	146	147	148	149	150
151	152	153	154	155	156	157	158	159	160
161	162	163	164	165	166	167	168	169	170
171	172	173	174	175	176	177	178	179	180
181	182	183	184	185	186	187	188	189	190
191	192	193	194	195	196	197	198	199	200

Sampling Points - Cell #3

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100
101	102	103	104	105	106	107	108	109	110
111	112	113	114	115	116	117	118	119	120
121	122	123	124	125	126	127	128	129	130
131	132	133	134	135	136	137	138	139	140
141	142	143	144	145	146	147	148	149	150
151	152	153	154	155	156	157	158	159	160
161	162	163	164	165	166	167	168	169	170
171	172	173	174	175	176	177	178	179	180
181	182	183	184	185	186	187	188	189	190
191	192	193	194	195	196	197	198	199	200