GW – 028

ANNUAL GW MONITORING REPORT

2012

HOLLYFRONTIER®

August 21, 2015

Mr. John Kieling
Chief, Hazardous Waste Bureau
New Mexico Environmental Department
2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505

Mr. Carl Chavez
New Mexico Energy, Minerals and Natural Resources Department
Oil Conservation Division
1220 South St. Francis Drive
Santa Fe, New Mexico 87505

RE: Submittal of *Response to Approval with Modifications, 2012 Annual Groundwater Report, Navajo Refining Company, Artesia Refinery*
EPA ID No. NMD048918817
HWB-NRC-13-002

Dear Mr. Kieling and Mr. Chavez:

Enclosed is the *Response to Approval with Modifications, 2012 Annual Groundwater Report*. Attached to the response to comments letter are two copies of the replacement for Table 1 and the recovery well logs, as requested in the approval letter dated April 13, 2015.

If you have any questions or comments regarding this request, please feel free to contact me at 575-746-5487 or Robert Combs at 575-746-5382.

Sincerely,

Scott M. Denton
Environmental Manager
Navajo Refining Company, L.L.C.

c: Robert Combs, NRC
Pam Krueger, ARCADIS

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ENVIRONMENT

Subject:
Response to Approval with Modifications,
2012 Annual Groundwater Report
Navajo Refining Company, Artesia Refinery
EPA ID No. NMD048918817
HWB-NRC-13-002

Date:
August 20, 2015

Contact:
Pamela Krueger

Phone:
713.953.4816

Email:
pam.krueger@arcadis-us.com

Our ref:
TX000836.0007.15002

Dear Mr. Kieling:

This letter provides detailed responses to the New Mexico Environment Department (NMED) letter dated April 13, 2015 regarding the document titled *Annual Groundwater Report* (Report) dated March 2013. The replacement pages requested in the approval with modifications letter are provided in an attachment to this response letter. Two hard copies and one electronic copy have been provided for your files.

The comments made in the approval with modifications letter are provided below in italics font and a response is provided following each comment.

Comment 1

In Section 2.1 (Monitoring Well Installation, Damage, and Repairs), page 3, paragraph 1, the Permittee states that the survey elevation data for the recovery wells installed in late 2011 is inconsistent with previously collected elevation data. The Permittee planned to submit the well completion logs for these recovery wells "under a separate cover when the well elevations have been surveyed." NMED does not have this submittal in our record. Revise Table 1 (Well Information and Gauging Data) with the correct survey information, submit a replacement Table 1 and also provide the well completion logs for the recovery wells installed in late 2011 with the Response Letter. In addition, all future tables must include the most recent, correct survey elevation data for all wells.

Response to Comment 1

The recovery wells were surveyed by a different licensed surveyor along with nearby monitoring wells for comparison. The data was much more comparable and has been incorporated into the subsequent reports, including the 2013 and 2014 annual groundwater monitoring reports as well as annual updates to the Facility-Wide Groundwater Monitoring Work Plans.

An updated version of Table 1 and the requested well logs are included in the attachment to this response letter.

Comment 2

In Section 2.4 (Equipment Decontamination Procedures), page 5, paragraph 1, the Permittee describes the decontamination procedure for the probes and states that "[t]he equipment was then rinsed with clean water. The clean water used for washing and rinsing was obtained from the refinery's reverse osmosis (RO) water system." There appears to be a discrepancy with the information provided in Section 2.4, the 2011 and 2012 Facility Wide Groundwater Monitoring Workplans (FWGMWPs). The 2011 and 2012 FWGMWPs state that "[t]he equipment will be washed with a brush in a bath of soap and water then rinsed twice with distilled water." In the Response Letter, provide an explanation for using the water from the RO water system instead of the distilled water for rinsing the equipment. In all future work plans and reports, ensure that the proposed activities in the work plans are followed through during field work activities and that deviations from the work plans are explained in the reports.

Response to Comment 2

The discrepancy in sampling procedures, use of RO permeate stream water instead of distilled water for decontamination, was not discovered until after the sampling had been completed. Subsequent changes to the sample collection procedures have been made, including a change in sample collection contractors. Every effort will be made to clearly identify deviations from work plans in future reports.

Comment 3

In Section 4.2.4 (Former Tetra Ethyl Lead Impoundment Area), page 13, paragraph 1, the Permittee states "PSH was detected in MW-39 just northeast of well TEL-1. Due to a probe malfunction during the 2012 first semiannual event, the PSH/water *interface could not be determined." Discuss if PSH groundwater elevation measurements at other wells were affected and how the situation was remedied in the Response Letter.*

Response to Comment 3

There were no other issues identified in the sampling crew field notes other than the inability to determine the depth of the PSH/water interface. The sampling crew did not document the remedies attempted or implemented with the probe. Every effort will be made to more thoroughly document equipment issues encountered in the field during future sampling efforts.

Comment 4

In Section 5.3.3.2 (Total Petroleum Hydrocarbons -Diesel Range Organics) on page 25, paragraph 1, the Permittee states that "the DRO concentration in MW-77 increased to 40 mg/L in the sample collected in September 2012; this concentration is one order of magnitude greater than the previously detected concentrations of DRO in this well." In addition to MW-77, monitoring wells MW-74, MW-75, MW-83, and MW-84 also experienced significant increases in DRO concentration in September 2012. Provide an explanation for the increase in DRO concentrations during the September 2012 sampling event, if known, in the Response Letter.

Response to Comment 4

Slightly increasing trends in DRO concentrations in select wells in the Evaporation Ponds are have been identified between September 2012 and 2014. The potentiometric water levels have also shown an overall increase in the same area for the same time period. Although the factors affecting concentration are many and complex, it is most likely that the increased water level has increased contact between impacted soil and groundwater, resulting in increased groundwater concentrations. There have been no new releases or discharges to the Evaporation Ponds; thus, there are no new sources of DRO.

Monitoring of the groundwater in this area continues on a semiannual basis. A closure plan and corrective measures are being developed for the Evaporation Ponds, which will include measures designed to reduce groundwater impacts over time.

Comment 5

In Figure 2 (Well Locations), the figure depicts all the abandoned, irrigation, monitoring, and recovery well locations from the Refinery to the Evaporation Ponds. However, it is difficult to determine all of the well locations because labels block the well locations and IDs (i.e., Evaporation Ponds). In future work plans and reports, ensure all well locations and IDs are visible on all figures. No response required.

Response to Comment 5

Although no response to this comment is required, it should be noted that improvements continue to be made to all figures, and every effort is made to prevent overlapping labels for features indicated on figures.

Comment 6

In Appendix A (Field Sampling Notes), Field Notes 2012 Mar-Apr, pages 116-118, the Permittee provides three pages of field notes for MW-104-0412 that present the same information. In future reports, ensure that the field notes submitted are not duplicate copies of the same page and that all field notes are submitted for review. No response required.

Response to Comment 6

Although no response is required, it should be noted that a change in sample collection contractor and the method for recording field data has been made. Every effort will be made to prevent submittal of duplicate records.

Comment 7

In Tables B.1 through B.6 of Appendix B (Laboratory Reports and Tabulated Data 2010-2012), the Permittee summarizes analytical data results and groundwater screening levels. There are several instances where groundwater screening levels are not available for the constituents. For example, in Table B.4 (Groundwater Analytical Data 2010-2012: Volatile Organic Compounds), page 29 of 56, there is no groundwater screening level for methyl n-butyl ketone. However, methyl n-butyl ketone is also identified as 2-hexanone which does have an EPA tapwater groundwater screening level. In addition, there are other constituents that have EPA tapwater groundwater screening levels that are not reported in the tables. For example, in Table B.5 (Groundwater Analytical Data 2010-2012: Semivolatile Organic Compounds), page 2 of 3, a groundwater screening level is not reported for *analine; however, there is an EPA tapwater groundwater screening level for this constituent. In future reports, the Permittee must ensure screening levels for all constituents are reported, including those constituents with alternate names. Determination of the appropriate screening levels must be in accordance with Section 4.1.1 (Groundwater, Soil and Surface Water Cleanup Levels) of the December 2010 Post- Closure Care Permit. No response required.*

Response to Comment 7

Although no response is required, the request to include EPA Tap Water screening values is noted and has been incorporated into recent reports where groundwater screening is performed. A review of chemical synonyms has also been undertaken and incorporated into the development of screening values to ensure that the most complete evaluation of data possible is performed.

If you have any questions or comments regarding this response letter or the associated revised Work Plan, please feel free to contact me at 713.953.4816.

Sincerely,

ARCADIS U.S., Inc.

Pamela R Krueger
Senior Project Manager

Copies:
Robert Combs, Navajo

Table 1 - Well Information and Gauging Data

2012 Annual Groundwater Report

Navajo Refinery, Artesia, New Mexico

Water-Bearing Zone (a)	Well ID	Northing	Easting	TOC Elevation (ft amsl)	Screen Interval (ft bgs)	Date Measured	Depth to PSH (ft btoc)	Depth to Water (ft btoc)	Water Elevation (b) (ft amsl)	PSH Thickness (ft)
Shallow	KWB-1A	672969.12	526181.36	3353.46	18 to 32	3/22/2012	--	12.87	3340.59	--
Shallow	KWB-1A	672969.12	526181.36	3353.46	18 to 32	9/14/2012	--	14.33	3339.13	--
Shallow	KWB-1B	672968.90	526191.02	3352.83	18 to 32	3/22/2012	--	14.58	3338.25	--
Shallow	KWB-1B	672968.90	526191.02	3352.83	18 to 32	9/14/2012	--	16.03	3336.80	--
Valley Fill	KWB-1C	672968.22	526202.95	3351.38	30.5 to 49.5	3/22/2012	--	15.17	3336.21	--
Valley Fill	KWB-1C	672968.22	526202.95	3351.38	30.5 to 49.5	9/14/2012	--	16.62	3334.76	--
Shallow	KWB-2R	670207.24	524897.59	3364.32	unknown	3/21/2012	24.22	25.47	3339.85	1.25
Shallow	KWB-2R	670207.24	524897.59	3364.32	unknown	9/13/2012	21.89	21.94	3342.42	0.05
Shallow	KWB-3AR	669972.87	528901.80	3347.08	18 to 33	3/21/2012	Access to well denied by landowner			
Shallow	KWB-3AR	669972.87	528901.80	3347.08	18 to 33	9/13/2012	Access to well denied by landowner			
Shallow	KWB-4	670616.38	524572.44	3370.25	20 to 39	3/21/2012	26.00	29.67	3343.52	3.67
Shallow	KWB-4	670616.38	524572.44	3370.25	20 to 39	9/13/2012	24.65	27.02	3345.13	2.37
Shallow	KWB-5	670729.55	525244.51	3364.72	24.7 to 38.7	3/21/2012	24.81	27.42	3339.39	2.61
Shallow	KWB-5	670729.55	525244.51	3364.72	24.7 to 38.7	9/13/2012	23.60	23.65	3341.11	0.05
Shallow	KWB-6	670449.36	526158.70	3360.30	17.5 to 36.5	3/21/2012	23.52	26.78	3336.13	3.26
Shallow	KWB-6	670449.36	526158.70	3360.30	17.5 to 36.5	9/13/2012	21.00	22.32	3339.04	1.32
Shallow	KWB-7	671266.72	529055.47	3346.16	18 to 32	3/21/2012	--	23.13	3323.03	--
Shallow	KWB-7	671266.72	529055.47	3346.16	18 to 32	9/14/2012	--	19.02	3327.14	--
Shallow	KWB-8	671000.57	527874.87	3350.41	15 to 34	3/21/2012	24.32	28.40	3325.27	4.08
Shallow	KWB-8	671000.57	527874.87	3350.41	15 to 34	9/14/2012	19.65	20.18	3330.65	0.53
Shallow	KWB-9	669628.19	527592.61	3354.53	20 to 34	3/21/2012	Access to well denied by landowner			
Shallow	KWB-9	669628.19	527592.61	3354.53	20 to 34	9/14/2012	Access to well denied by landowner			
Shallow	KWB-10R	671756.34	526206.06	3350.97	9 to 29	3/22/2012	17.25	17.60	3333.65	0.35
Shallow	KWB-10R	671756.34	526206.06	3350.97	9 to 29	9/14/2012	18.42	18.68	3332.50	0.26
Shallow	KWB-11A	670643.67	529043.46	3348.72	20 to 39.5	3/21/2012	--	25.15	3323.57	--
Shallow	KWB-11A	670643.67	529043.46	3348.72	20 to 39.5	9/14/2012	--	18.95	3329.77	--
Valley Fill	KWB-11B	670653.84	529044.06	3348.03	50 to 69.5	3/21/2012	--	25.88	3322.15	--
Valley Fill	KWB-11B	670653.84	529044.06	3348.03	50 to 69.5	9/14/2012	--	19.72	3328.31	--
Shallow	KWB-12A	669074.44	527590.88	3351.81	15.5 to 24.5	3/21/2012	--	Dry	--	--
Shallow	KWB-12A	669074.44	527590.88	3351.81	15.5 to 24.5	9/11/2012	--	20.31	3331.50	--
Valley Fill	KWB-12B	669064.18	527590.12	3351.63	25.5 to 39.5	3/21/2012	--	28.12	3323.51	--
Valley Fill	KWB-12B	669064.18	527590.12	3351.63	25.5 to 39.5	9/11/2012	--	20.13	3331.50	--
Shallow	KWB-13	669077.00	524892.42	3365.67	unknown	3/22/2012	--	19.90	3345.77	--
Shallow	KWB-13	669077.00	524892.42	3365.67	unknown	9/13/2012	--	24.38	3341.29	--
Shallow	KWB-P2	671184.46	530219.31	3338.97	unknown	3/21/2012	--	30.68	3308.29	--
Shallow	KWB-P2	671184.46	530219.31	3338.97	unknown	9/11/2012	--	30.18	3308.79	--
Shallow	KWB-P3	669704.98	538134.01	3308.50	unknown	9/11/2012	--	7.57	3300.93	--
Shallow	KWB-P4	670970.10	537416.92	3305.39	unknown	3/21/2012	--	6.47	3298.92	--
Shallow	KWB-P4	670970.10	537416.92	3305.39	unknown	9/11/2012	--	10.21	3295.18	--
Shallow	MW-1R	675135.17	538636.78	3313.28	8 to 23	3/20/2012	--	11.08	3302.20	--
Shallow	MW-1R	675135.17	538636.78	3313.28	8 to 23	9/10/2012	--	13.38	3299.90	--
Shallow	MW-2A	675979.09	540803.91	3312.97	unknown	3/20/2012	--	10.58	3302.39	--
Shallow	MW-2A	675979.09	540803.91	3312.97	unknown	9/10/2012	--	12.36	3300.61	--
Valley Fill	MW-2B	675969.73	540801.44	3312.49	38.5 to 47.5	3/20/2012	--	11.23	3301.26	--
Valley Fill	MW-2B	675969.73	540801.44	3312.49	38.5 to 47.5	9/10/2012	--	13.07	3299.42	--
Shallow	MW-3	674443.34	540503.24	3310.32	unknown	3/20/2012	--	9.63	3300.69	--
Shallow	MW-3	674443.34	540503.24	3310.32	unknown	9/10/2012	--	11.44	3298.88	--
Shallow	MW-4A	674083.00	540529.44	3312.71	unknown	3/20/2012	--	12.18	3300.53	--
Shallow	MW-4A	674083.00	540529.44	3312.71	unknown	9/10/2012	--	20.08	3292.63	--
Valley Fill	MW-4B	674089.71	540541.34	3312.01	unknown	3/20/2012	--	11.44	3300.57	--
Valley Fill	MW-4B	674089.71	540541.34	3312.01	unknown	9/10/2012	--	14.00	3298.01	--
Shallow	MW-5A	674272.84	541759.78	3308.62	unknown	3/20/2012	--	8.70	3299.92	--
Shallow	MW-5A	674272.84	541759.78	3308.62	unknown	9/11/2012	--	10.03	3298.59	--
Valley Fill	MW-5B	674272.33	541739.12	3308.95	41.5 to 50.5	3/20/2012	--	8.91	3300.04	--
Valley Fill	MW-5B	674272.33	541739.12	3308.95	41.5 to 50.5	9/11/2012	--	10.58	3298.37	--
Valley Fill	MW-5C	674279.57	541728.80	3309.28	59.25 to 68.75	3/20/2012	--	9.06	3300.22	--
Valley Fill	MW-5C	674279.57	541728.80	3309.28	59.25 to 68.75	9/11/2012	--	10.76	3298.52	--
Shallow	MW-6A	674427.07	539833.47	3313.46	unknown	3/20/2012	--	12.82	3300.64	--
Shallow	MW-6A	674427.07	539833.47	3313.46	unknown	9/10/2012	--	14.73	3298.73	--
Valley Fill	MW-6B	674418.57	539834.04	3313.35	39.5 to 48.5	3/20/2012	--	12.71	3300.64	--
Valley Fill	MW-6B	674418.57	539834.04	3313.35	39.5 to 48.5	9/10/2012	--	14.63	3298.72	--
Shallow	MW-7A	674447.64	542716.01	3309.24	unknown	3/20/2012	--	7.93	3301.31	--
Shallow	MW-7A	674447.64	542716.01	3309.24	unknown	9/11/2012	--	9.46	3299.78	--
Valley Fill	MW-7B	674455.63	542715.61	3307.87	39.5 to 48.5	3/20/2012	--	9.23	3298.64	--
Valley Fill	MW-7B	674455.63	542715.61	3307.87	39.5 to 48.5	9/11/2012	--	10.83	3297.04	--
Shallow	MW-8	673215.93	529055.18	3336.42	unknown	3/21/2012	--	12.06	3324.36	--
Shallow	MW-8	673215.93	529055.18	3336.42	unknown	9/11/2012	--	12.86	3323.56	--
Shallow	MW-9	673169.56	529232.03	3336.20	unknown	3/21/2012	--	12.72	3323.48	--
Shallow	MW-9	673169.56	529232.03	3336.20	unknown	9/11/2012	--	13.47	3322.73	--
Shallow	MW-10	672121.15	541540.05	3304.76	unknown	3/21/2012	--	5.71	3299.05	--
Shallow	MW-10	672121.15	541540.05	3304.76	unknown	9/10/2012	--	12.62	3292.14	--
Shallow	MW-11A	677317.73	543675.36	3310.76	5.5 to 19.5	3/20/2012	--	9.71	3301.05	--
Shallow	MW-11A	677317.73	543675.36	3310.76	5.5 to 19.5	9/10/2012	--	11.24	3299.52	--
Valley Fill	MW-11B	677305.72	543685.50	3310.76	35.5 to 44.5	3/20/2012	--	9.68	3301.08	--
Valley Fill	MW-11B	677305.72	543685.50	3310.76	35.5 to 44.5	9/10/2012	--	11.24	3299.52	--
Shallow	MW-12	676952.63	541505.50	3312.73	6.5 to 15.5	3/20/2012	--	10.42	3302.31	--
Shallow	MW-12	676952.63	541505.50	3312.73	6.5 to 15.5	9/10/2012	--	12.60	3300.13	--
Shallow	MW-13	674951.80	539762.62	3314.24	9.5 to 18.5	3/20/2012	--	12.59	3301.65	--
Shallow	MW-13	674951.80	539762.62	3314.24	9.5 to 18.5	9/10/2012	--	15.06	3299.18	--
Shallow	MW-14	676122.48	543280.49	3311.84	5.5 to 19.5	3/20/2012	--	Dry	--	--
Shallow	MW-14	676122.48	543280.49	3311.84	5.5 to 19.5	9/10/2012	--	14.66	3297.18	--
Shallow	MW-15	674731.39	539003.75	3313.72	9 to 18.5	3/20/2012	--	12.19	3301.53	--
Shallow	MW-15	674731.39	539003.75	3313.72	9 to 18.5	9/10/2012	--	11.58	3302.14	--
Shallow	MW-16	675613.35	534389.17	3316.12	8.5 to 18	3/21/2012	--	8.61	3307.51	--
Shallow	MW-16	675613.35	534389.17	3316.12	8.5 to 18	9/11/2012	--	9.49	3306.63	--
Shallow	MW-17	678064.09	535480.70	3322.01	17 to 31.3	9/14/2012	--	21.25	3300.76	--

Table 1 - Well Information and Gauging Data

2012 Annual Groundwater Report

Navajo Refinery, Artesia, New Mexico

Water-Bearing Zone (a)	Well ID	Northing	Easting	TOC Elevation (ft amsl)	Screen Interval (ft bgs)	Date Measured	Depth to PSH (ft btoc)	Depth to Water (ft btoc)	Water Elevation (b) (ft amsl)	PSH Thickness (ft)
Shallow	MW-18	674172.45	522318.86	3365.42	15 to 19	3/22/2012	--	14.18	3351.24	--
Shallow	MW-18	674172.45	522318.86	3365.42	15 to 19	9/13/2012	--	11.16	3354.26	--
Shallow	MW-18A	672548.16	543447.78	3308.58	10 to 19.5	3/20/2012	--	10.31	3298.27	--
Shallow	MW-18A	672548.16	543447.78	3308.58	10 to 19.5	9/11/2012	--	11.80	3296.78	--
Valley Fill	MW-18B	672557.96	543458.22	3308.74	37 to 46.5	3/20/2012	--	10.28	3298.46	--
Valley Fill	MW-18B	672557.96	543458.22	3308.74	37 to 46.5	9/11/2012	--	11.78	3296.96	--
Valley Fill	MW-18T	672559.79	543449.75	3308.55	37 to 46.5	3/20/2012	--	10.58	3297.97	--
Valley Fill	MW-18T	672559.79	543449.75	3308.55	37 to 46.5	9/11/2012	--	12.08	3296.47	--
Shallow	MW-19	673597.29	521670.75	3368.00	unknown	3/22/2012	--	14.90	3353.10	--
Shallow	MW-19	673597.29	521670.75	3368.00	unknown	9/13/2012	--	12.07	3355.93	--
Shallow	MW-20	673800.56	527834.67	3340.91	9.5 to 23.5	3/21/2012	--	10.43	3330.48	--
Shallow	MW-20	673800.56	527834.67	3340.91	9.5 to 23.5	9/11/2012	--	13.81	3327.10	--
Shallow	MW-21	673180.38	529150.62	3337.31	7.5 to 22	3/21/2012	--	13.52	3323.79	--
Shallow	MW-21	673180.38	529150.62	3337.31	7.5 to 22	9/11/2012	--	14.31	3323.00	--
Shallow	MW-22A	672866.82	541801.63	3307.62	5.5 to 20	3/21/2012	--	8.24	3299.38	--
Shallow	MW-22A	672866.82	541801.63	3307.62	5.5 to 20	9/11/2012	--	9.89	3297.73	--
Valley Fill	MW-22B	672866.58	541786.97	3307.63	42.3 to 51.8	3/21/2012	--	8.11	3299.52	--
Valley Fill	MW-22B	672866.58	541786.97	3307.63	42.3 to 51.8	9/11/2012	--	9.77	3297.86	--
Shallow	MW-23	672851.25	522821.05	3368.38	unknown	3/23/2012	--	15.65	3352.73	--
Shallow	MW-23	672851.25	522821.05	3368.38	unknown	9/14/2012	--	14.71	3353.67	--
Shallow	MW-24	676498.23	544101.56	3312.85	6.5 to 21	3/20/2012	--	12.22	3300.63	--
Shallow	MW-24	676498.23	544101.56	3312.85	6.5 to 21	9/10/2012	--	13.52	3299.33	--
Shallow	MW-25	675386.30	537955.86	3312.29	15.75 to 25.25	3/20/2012	--	13.70	3298.59	--
Shallow	MW-25	675386.30	537955.86	3312.29	15.75 to 25.25	9/10/2012	--	15.18	3297.11	--
Shallow	MW-26	676229.18	535348.61	3314.87	15.25 to 24.25	3/21/2012	--	11.05	3303.82	--
Shallow	MW-26	676229.18	535348.61	3314.87	15.25 to 24.25	9/11/2012	--	9.52	3305.35	--
Shallow	MW-27	674495.64	532942.65	3320.85	18.25 to 27.75	3/21/2012	--	12.98	3307.87	--
Shallow	MW-27	674495.64	532942.65	3320.85	18.25 to 27.75	9/11/2012	--	14.01	3306.84	--
Shallow	MW-28	671508.38	524521.56	3370.27	25 to 30	3/23/2012	--	24.70	3345.57	--
Shallow	MW-28	671508.38	524521.56	3370.27	25 to 30	9/13/2012	--	13.90	3356.37	--
Shallow	MW-29	673481.15	523544.65	3360.64	19 to 22	3/23/2012	--	11.61	3349.03	--
Shallow	MW-29	673481.15	523544.65	3360.64	19 to 22	9/13/2012	--	13.49	3347.15	--
Shallow	MW-30	674125.92	523548.75	3354.33	unknown	3/23/2012	--	8.89	3345.44	--
Shallow	MW-30	674125.92	523548.75	3354.33	unknown	9/13/2012	Well damaged - could not be gauged			
Shallow	MW-39	673039.50	523422.93	3358.79	14 to 24	3/23/2012 (c)	Not measured			
Shallow	MW-39	673039.50	523422.93	3358.79	14 to 24	9/13/2012	10.00	10.04	3348.78	0.04
Shallow	MW-40	673161.12	523489.02	3356.93	unknown	3/23/2012	--	8.03	3348.90	--
Shallow	MW-40	673161.12	523489.02	3356.93	unknown	9/14/2012	--	9.29	3347.64	--
Shallow	MW-41	673379.87	523374.64	3356.58	14 to 19	3/23/2012	--	9.10	3347.48	--
Shallow	MW-41	673379.87	523374.64	3356.58	14 to 19	9/13/2012	--	9.58	3347.00	--
Shallow	MW-42	673480.27	523263.53	3358.59	unknown	3/23/2012	Well damaged - could not be gauged			
Shallow	MW-42R	673480.27	523263.53	3358.44	unknown	9/13/2012	--	10.86	3347.58	--
Shallow	MW-43	673115.86	522950.40	3365.49	15.5 to 20.5	3/23/2012	--	12.87	3352.62	--
Shallow	MW-43	673115.86	522950.40	3365.49	15.5 to 20.5	9/14/2012	--	11.92	3353.57	--
Shallow	MW-45	674247.07	523663.75	3351.51	10.5 to 15.5	3/23/2012	--	6.03	3345.48	--
Shallow	MW-45	674247.07	523663.75	3351.51	10.5 to 15.5	9/14/2012	--	5.07	3346.44	--
Shallow	MW-46R	674223.03	524920.28	3350.11	3.5 to 18.5	3/23/2012	--	5.61	3344.50	--
Shallow	MW-46R	674223.03	524920.28	3350.11	3.5 to 18.5	9/14/2012	--	7.77	3342.34	--
Shallow	MW-48	670689.39	524080.35	3362.97	unknown	3/21/2012	21.40	21.68	3341.51	0.28
Shallow	MW-48	670689.39	524080.35	3362.97	unknown	9/13/2012	19.87	20.34	3343.01	0.47
Shallow	MW-49	672051.80	523610.79	3359.77	unknown	3/23/2012	--	13.68	3346.09	--
Shallow	MW-49	672051.80	523610.79	3359.77	unknown	9/14/2012	--	12.47	3347.30	--
Shallow	MW-50	671502.45	521857.84	3371.05	unknown	3/22/2012	--	19.51	3351.54	--
Shallow	MW-50	671502.45	521857.84	3371.05	unknown	9/13/2012	--	18.08	3352.97	--
Shallow	MW-52	670165.24	523370.99	3368.30	unknown	3/21/2012	--	22.68	3345.62	--
Shallow	MW-52	670165.24	523370.99	3368.30	unknown	9/13/2012	--	19.95	3348.35	--
Shallow	MW-53	673626.07	521459.12	3368.73	13.8 to 23.8	3/22/2012	--	14.97	3353.76	--
Shallow	MW-53	673626.07	521459.12	3368.73	13.8 to 23.8	9/13/2012	--	12.02	3356.71	--
Shallow	MW-54A	674138.65	522110.51	3366.49	12.7 to 27.7	3/22/2012	--	15.48	3351.01	--
Shallow	MW-54A	674138.65	522110.51	3366.49	12.7 to 27.7	9/13/2012	--	12.27	3354.22	--
Valley Fill	MW-54B	674148.44	522118.80	3366.47	33.8 to 43.8	3/22/2012	--	15.23	3351.24	--
Valley Fill	MW-54B	674148.44	522118.80	3366.47	33.8 to 43.8	9/13/2012	--	12.03	3354.44	--
Shallow	MW-55	674091.95	522766.46	3364.77	13.7 to 23.7	3/22/2012	--	12.85	3351.92	--
Shallow	MW-55	674091.95	522766.46	3364.77	13.7 to 23.7	9/13/2012	--	9.73	3355.04	--
Shallow	MW-56	674160.38	523450.14	3357.44	13.4 to 23.4	3/23/2012	--	11.89	3345.55	--
Shallow	MW-56	674160.38	523450.14	3357.44	13.4 to 23.4	9/13/2012	--	10.52	3346.92	--
Shallow	MW-57	669935.59	527579.02	3350.91	10 to 30	3/21/2012	--	25.22	3325.69	--
Shallow	MW-57	669935.59	527579.02	3350.91	10 to 30	9/11/2012	--	17.96	3332.95	--
Shallow	MW-58	670207.27	525197.99	3362.22	13 to 28	3/21/2012	23.22	24.12	3338.82	0.90
Shallow	MW-58	670207.27	525197.99	3362.22	13 to 28	9/13/2012 (c)	Not measured			
Shallow	MW-59	672815.74	523854.62	3354.78	15 to 30	3/23/2012	--	7.21	3347.57	--
Shallow	MW-59	672815.74	523854.62	3354.78	15 to 30	9/13/2012	--	7.80	3346.98	--
Shallow	MW-60	672850.69	524144.40	3354.33	15 to 30	3/23/2012	--	8.23	3346.10	--
Shallow	MW-60	672850.69	524144.40	3354.33	15 to 30	9/13/2012	--	9.33	3345.00	--
Shallow	MW-61	672453.76	522578.38	3369.47	14 to 29	3/23/2012	--	15.14	3354.33	--
Shallow	MW-61	672453.76	522578.38	3369.47	14 to 29	9/14/2012	--	14.36	3355.11	--
Shallow	MW-62	672648.15	522702.48	3371.29	14 to 29	3/23/2012	--	18.54	3352.75	--
Shallow	MW-62	672648.15	522702.48	3371.29	14 to 29	9/14/2012	--	17.67	3353.62	--
Shallow	MW-64	670716.03	523338.61	3369.52	15 to 30	3/23/2012	22.26	25.78	3346.56	3.52
Shallow	MW-64	670716.03	523338.61	3369.52	15 to 30	9/14/2012	21.62	22.15	3347.79	0.53
Shallow	MW-65	670949.22	523711.75	3363.60	14.5 to 29.5	3/23/2012	18.70	22.39	3344.16	3.69
Shallow	MW-65	670949.22	523711.75	3363.60	14.5 to 29.5	9/14/2012	17.68	19.70	3345.52	2.02
Shallow	MW-66	671247.57	524560.06	3363.46	14.6 to 29.6	3/23/2012	--	18.98	3344.48	--
Shallow	MW-66	671247.57	524560.06	3363.46	14.6 to 29.6	9/13/2012	--	17.09	3346.37	--
Shallow	MW-67	673224.88	522342.43	3365.45	12 to 27	3/22/2012	12.50	14.56	3352.54	2.06
Shallow	MW-67	673224.88	522342.43	3365.45	12 to 27	9/14/2012	10.08	11.86	3355.01	1.78

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Navajo Refinery, Artesia, New Mexico

Water-Bearing Zone (a)	Well ID	Northing	Easting	TOC Elevation (ft amsl)	Screen Interval (ft bgs)	Date Measured	Depth to PSH (ft btoc)	Depth to Water (ft btoc)	Water Elevation (b) (ft amsl)	PSH Thickness (ft)
Shallow	MW-68	674301.02	531466.90	3328.21	14.75 to 24.25	3/21/2012	--	20.84	3307.37	--
Shallow	MW-68	674301.02	531466.90	3328.21	14.75 to 24.25	9/11/2012	--	21.18	3307.03	--
Shallow	MW-69	675962.29	540401.29	3313.86	5 to 19.5	3/20/2012	--	Dry	--	--
Shallow	MW-69	675962.29	540401.29	3313.86	5 to 19.5	9/10/2012	--	10.52	3303.34	--
Shallow	MW-70	670892.66	542787.60	3306.30	5 to 19.5	3/20/2012	--	8.79	3297.51	--
Shallow	MW-70	670892.66	542787.60	3306.30	5 to 19.5	9/11/2012	--	10.00	3296.30	--
Shallow	MW-71	673016.80	529560.41	3335.29	9.75 to 19.25	3/21/2012	--	15.12	3320.17	--
Shallow	MW-71	673016.80	529560.41	3335.29	9.75 to 19.25	9/11/2012	--	10.81	3324.48	--
Shallow	MW-72	676691.27	542662.31	3308.45	2 to 12	3/20/2012	--	7.53	3300.92	--
Shallow	MW-72	676691.27	542662.31	3308.45	2 to 12	9/10/2012	--	9.09	3299.36	--
Shallow	MW-73	675910.20	542130.56	3310.18	2 to 17	3/20/2012	--	9.41	3300.77	--
Shallow	MW-73	675910.20	542130.56	3310.18	2 to 17	9/10/2012	--	10.48	3299.70	--
Shallow	MW-74	675059.14	541546.30	3310.03	2 to 17	3/20/2012	--	9.41	3300.62	--
Shallow	MW-74	675059.14	541546.30	3310.03	2 to 17	9/10/2012	--	10.95	3299.08	--
Shallow	MW-75	674622.31	541132.78	3310.21	3 to 18	3/20/2012	--	9.67	3300.54	--
Shallow	MW-75	674622.31	541132.78	3310.21	3 to 18	9/10/2012	--	11.38	3298.83	--
Shallow	MW-76	674482.47	541053.83	3311.84	3 to 18	3/20/2012	--	11.23	3300.61	--
Shallow	MW-76	674482.47	541053.83	3311.84	3 to 18	9/10/2012	--	12.98	3298.86	--
Shallow	MW-77	674529.89	541104.86	3310.07	3 to 18	3/20/2012	--	9.50	3300.57	--
Shallow	MW-77	674529.89	541104.86	3310.07	3 to 18	9/10/2012	--	11.22	3298.85	--
Shallow	MW-78	674529.23	541073.45	3310.14	2 to 17	3/20/2012	--	9.55	3300.59	--
Shallow	MW-78	674529.23	541073.45	3310.14	2 to 17	9/10/2012	--	11.27	3298.87	--
Shallow	MW-79	675349.67	540906.08	3311.43	2 to 17	3/20/2012	--	10.27	3301.16	--
Shallow	MW-79	675349.67	540906.08	3311.43	2 to 17	9/10/2012	--	12.12	3299.31	--
Shallow	MW-80	675371.74	540646.46	3310.79	2 to 17	3/20/2012	--	9.40	3301.39	--
Shallow	MW-80	675371.74	540646.46	3310.79	2 to 17	9/10/2012	--	11.46	3299.33	--
Shallow	MW-81	675252.80	540544.47	3312.34	2 to 17	3/20/2012	--	11.08	3301.26	--
Shallow	MW-81	675252.80	540544.47	3312.34	2 to 17	9/10/2012	--	13.12	3299.22	--
Shallow	MW-82	675035.42	540806.88	3310.75	2 to 17	3/20/2012	--	9.86	3300.89	--
Shallow	MW-82	675035.42	540806.88	3310.75	2 to 17	9/10/2012	--	11.68	3299.07	--
Shallow	MW-83	674524.97	540832.80	3310.19	2 to 17	3/20/2012	--	9.51	3300.68	--
Shallow	MW-83	674524.97	540832.80	3310.19	2 to 17	9/10/2012	--	11.80	3298.39	--
Shallow	MW-84	674798.43	540109.13	3311.59	2 to 17	3/20/2012	--	10.33	3301.26	--
Shallow	MW-84	674798.43	540109.13	3311.59	2 to 17	9/10/2012	--	10.42	3301.17	--
Shallow	MW-85	674566.12	539805.49	3311.09	3 to 18	3/20/2012	10.25	11.98	3300.49	1.73
Shallow	MW-85	674566.12	539805.49	3311.09	3 to 18	9/10/2012	12.21	14.45	3298.43	2.24
Shallow	MW-86	674645.96	539671.17	3311.06	2 to 17	3/20/2012	10.02	11.14	3300.82	1.12
Shallow	MW-86	674645.96	539671.17	3311.06	2 to 17	9/10/2012	12.12	13.93	3298.58	1.81
Shallow	MW-87	673379.98	543280.45	3307.64	2 to 17	3/20/2012	--	8.70	3298.94	--
Shallow	MW-87	673379.98	543280.45	3307.64	2 to 17	9/11/2012	--	10.25	3297.39	--
Shallow	MW-88	672899.14	540832.09	3308.68	3 to 18	3/21/2012	--	9.04	3299.64	--
Shallow	MW-88	672899.14	540832.09	3308.68	3 to 18	9/11/2012	--	10.71	3297.97	--
Shallow	MW-89	675221.56	533835.00	3318.32	2 to 17	3/21/2012	--	9.12	3309.20	--
Shallow	MW-89	675221.56	533835.00	3318.32	2 to 17	9/11/2012	--	11.17	3307.15	--
Shallow	MW-90	672909.28	521960.18	3369.42	5 to 20	3/22/2012	--	15.85	3353.57	--
Shallow	MW-90	672909.28	521960.18	3369.42	5 to 20	9/13/2012	--	13.91	3355.51	--
Shallow	MW-91	672945.86	522167.26	3367.73	7 to 22	3/22/2012	14.57	14.81	3353.11	0.24
Shallow	MW-91	672945.86	522167.26	3367.73	7 to 22	9/14/2012	12.06	12.56	3355.57	0.50
Shallow	MW-92	672766.10	522167.26	3368.72	5 to 20	3/22/2012	15.28	17.47	3353.00	2.19
Shallow	MW-92	672766.10	522167.26	3368.72	5 to 20	9/14/2012	13.62	13.89	3355.05	0.27
Shallow	MW-93	672897.25	522446.83	3363.79	5 to 20	3/23/2012	--	10.77	3353.02	--
Shallow	MW-93	672897.25	522446.83	3363.79	5 to 20	9/14/2012	--	9.47	3354.32	--
Shallow	MW-94	673510.54	522336.27	3367.97	5 to 20	3/22/2012	14.91	19.12	3352.22	4.21
Shallow	MW-94	673510.54	522336.27	3367.97	5 to 20	9/13/2012	13.42	14.31	3354.37	0.89
Shallow	MW-95	673084.72	522308.89	3368.70	7 to 22	3/22/2012	--	15.88	3352.82	--
Shallow	MW-95	673084.72	522308.89	3368.70	7 to 22	9/14/2012	--	14.05	3354.65	--
Shallow	MW-96	673143.60	521917.50	3368.92	7 to 22	3/22/2012	--	15.58	3353.34	--
Shallow	MW-96	673143.60	521917.50	3368.92	7 to 22	9/14/2012	--	13.67	3355.25	--
Shallow	MW-97	672660.45	522295.96	3365.92	8 to 23	3/22/2012	12.55	17.42	3352.40	4.87
Shallow	MW-97	672660.45	522295.96	3365.92	8 to 23	9/14/2012	11.78	13.82	3353.73	2.04
Shallow	MW-98	672517.05	523220.39	3361.36	13 to 23	3/23/2012	--	11.46	3349.90	--
Shallow	MW-98	672517.05	523220.39	3361.36	13 to 23	9/13/2012	--	14.46	3346.90	--
Shallow	MW-99	670943.33	524523.63	3364.51	12 to 27	3/23/2012	20.02	20.18	3344.46	0.16
Shallow	MW-99	670943.33	524523.63	3364.51	12 to 27	9/13/2012	18.55	18.58	3345.95	0.03
Shallow	MW-101	671628.25	523506.58	3364.23	8 to 23	3/23/2012	--	18.08	3346.15	--
Shallow	MW-101	671628.25	523506.58	3364.23	8 to 23	9/13/2012	--	15.95	3348.28	--
Shallow	MW-102	671176.70	522937.01	3367.64	12 to 27	3/23/2012	18.66	21.72	3348.37	3.06
Shallow	MW-102	671176.70	522937.01	3367.64	12 to 27	9/14/2012	17.78	20.02	3349.41	2.24
Shallow	MW-103	670472.55	522607.80	3372.47	7 to 22	3/23/2012	--	20.76	3351.71	--
Shallow	MW-103	670472.55	522607.80	3372.47	7 to 22	9/14/2012	--	12.89	3359.58	--
Shallow	MW-104	670450.35	522729.44	3371.43	3 to 18	3/23/2012	--	14.83	3356.60	--
Shallow	MW-104	670450.35	522729.44	3371.43	3 to 18	9/14/2012	--	19.58	3351.85	--
Shallow	MW-105	671924.44	522454.93	3364.99	8 to 18	3/22/2012	14.17	14.77	3350.70	0.60
Shallow	MW-105	671924.44	522454.93	3364.99	8 to 18	9/14/2012	13.07	13.38	3351.86	0.31
Shallow	MW-106	672207.14	523454.55	3358.98	11 to 26	3/23/2012	--	11.18	3347.80	--
Shallow	MW-106	672207.14	523454.55	3358.98	11 to 26	9/13/2012	--	9.54	3349.44	--
Shallow	MW-107	671961.38	524600.45	3359.44	12 to 22	3/23/2012	--	14.32	3345.12	--
Shallow	MW-107	671961.38	524600.45	3359.44	12 to 22	9/13/2012	--	14.11	3345.33	--
Shallow	MW-108	673659.33	521910.16	3369.11	9 to 24	3/22/2012	--	16.83	3352.28	--
Shallow	MW-108	673659.33	521910.16	3369.11	9 to 24	9/13/2012	--	13.12	3355.99	--
Shallow	MW-109	670174.25	523065.52	3368.09	15 to 29.5	3/21/2012	--	20.97	3347.12	--
Shallow	MW-109	670174.25	523065.52	3368.09	15 to 29.5	9/13/2012	--	16.83	3351.26	--
Shallow	MW-110	670174.33	522796.69	3368.03	15 to 29.5	3/21/2012	--	18.25	3349.78	--
Shallow	MW-110	670174.33	522796.69	3368.03	15 to 29.5	9/13/2012	--	19.25	3348.78	--
Shallow	NCL-31	673629.51	521669.01	3367.54	13 to 18	3/22/2012	--	14.49	3353.05	--
Shallow	NCL-31	673629.51	521669.01	3367.54	13 to 18	9/13/2012	--	10.31	3357.23	--

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Navajo Refinery, Artesia, New Mexico

Water-Bearing Zone (a)	Well ID	Northing	Easting	TOC Elevation (ft amsl)	Screen Interval (ft bgs)	Date Measured	Depth to PSH (ft btoc)	Depth to Water (ft btoc)	Water Elevation (b) (ft amsl)	PSH Thickness (ft)
Shallow	NCL-32	673984.83	521808.14	3364.91	17 to 22	3/22/2012	--	14.03	3350.88	--
Shallow	NCL-32	673984.83	521808.14	3364.91	17 to 22	9/13/2012	--	9.87	3355.04	--
Shallow	NCL-33	673967.20	522245.18	3363.97	13 to 18	3/22/2012	--	13.42	3350.55	--
Shallow	NCL-33	673967.20	522245.18	3363.97	13 to 18	9/13/2012	--	10.57	3353.40	--
Shallow	NCL-34A	673885.52	522235.08	3365.49	16 to 21	3/22/2012	13.63	17.60	3351.07	3.97
Shallow	NCL-34A	673885.52	522235.08	3365.49	16 to 21	9/13/2012	11.31	11.47	3354.15	0.16
Shallow	NCL-44	673986.41	522062.11	3364.45	unknown	3/22/2012	--	12.88	3351.57	--
Shallow	NCL-44	673986.41	522062.11	3364.45	unknown	9/13/2012	--	10.10	3354.35	--
Shallow	NCL-49	674099.16	521648.40	3371.13	16.83 to 26.83	3/22/2012	--	19.58	3351.55	--
Shallow	NCL-49	674099.16	521648.40	3371.13	16.83 to 26.83	9/13/2012	--	16.98	3354.15	--
Shallow	NP-1	672992.73	528035.04	3342.40	9.5 to 18.5	3/21/2012	--	15.26	3327.14	--
Shallow	NP-1	672992.73	528035.04	3342.40	9.5 to 18.5	9/11/2012	--	16.05	3326.35	--
Shallow	NP-2	673571.19	527611.64	3342.77	9.5 to 18.5	3/21/2012	--	12.13	3330.64	--
Shallow	NP-2	673571.19	527611.64	3342.77	9.5 to 18.5	9/11/2012	--	14.62	3328.15	--
Shallow	NP-3	673990.66	528019.54	3342.93	9.5 to 18.5	3/21/2012	--	12.37	3330.56	--
Shallow	NP-3	673990.66	528019.54	3342.93	9.5 to 18.5	9/11/2012	--	16.45	3326.48	--
Shallow	NP-4	674337.35	528351.85	3345.73	24.5 to 33.5	3/21/2012	--	24.32	3321.41	--
Shallow	NP-4	674337.35	528351.85	3345.73	24.5 to 33.5	9/11/2012	--	27.28	3318.45	--
Shallow	NP-5	675512.24	524698.19	3349.29	10.25 to 19.75	3/22/2012	--	14.33	3334.96	--
Shallow	NP-5	675512.24	524698.19	3349.29	10.25 to 19.75	9/13/2012	--	13.16	3336.13	--
Shallow	NP-6	672945.23	529083.91	3338.05	8.75 to 18	3/21/2012	--	13.31	3324.74	--
Shallow	NP-6	672945.23	529083.91	3338.05	8.75 to 18	9/11/2012	--	13.80	3324.25	--
Shallow	NP-8	675399.60	538245.49	3314.67	unknown	3/20/2012	--	12.91	3301.76	--
Shallow	NP-8	675399.60	538245.49	3314.67	unknown	9/10/2012	--	Dry	--	--
Shallow	NP-9	674767.14	523571.69	3360.62	unknown	3/22/2012	--	12.24	3348.38	--
Shallow	OCD-1R	676741.31	541568.00	3314.27	unknown	3/20/2012	--	12.11	3302.16	--
Shallow	OCD-1R	676741.31	541568.00	3314.27	unknown	9/10/2012	--	13.90	3300.37	--
Shallow	OCD-2A	677036.12	542157.14	3314.16	8.5 to 23.5	3/20/2012	--	12.18	3301.98	--
Shallow	OCD-2A	677036.12	542157.14	3314.16	8.5 to 23.5	9/10/2012	--	14.09	3300.07	--
Valley Fill	OCD-2B	677034.65	542167.57	3313.07	38.5 to 47.5	3/20/2012	--	11.74	3301.33	--
Valley Fill	OCD-2B	677034.65	542167.57	3313.07	38.5 to 47.5	9/10/2012	--	13.47	3299.60	--
Shallow	OCD-3	677516.31	543024.47	3314.43	6.5 to 21.5	3/20/2012	--	12.74	3301.69	--
Shallow	OCD-3	677516.31	543024.47	3314.43	6.5 to 21.5	9/10/2012	--	14.58	3299.85	--
Shallow	OCD-4	678099.52	543893.55	3313.68	6.5 to 21.5	3/20/2012	--	12.17	3301.51	--
Shallow	OCD-4	678099.52	543893.55	3313.68	6.5 to 21.5	9/10/2012	--	13.68	3300.00	--
Shallow	OCD-5	677081.54	544295.35	3311.27	unknown	3/20/2012	--	10.74	3300.53	--
Shallow	OCD-5	677081.54	544295.35	3311.27	unknown	9/10/2012	--	12.18	3299.09	--
Shallow	OCD-6	676538.82	543540.03	3311.40	8 to 23	3/20/2012	--	10.84	3300.56	--
Shallow	OCD-6	676538.82	543540.03	3311.40	8 to 23	9/10/2012	--	12.42	3298.98	--
Shallow	OCD-7AR	676169.74	543071.88	3310.03	5.5 to 19.5	3/20/2012	--	9.78	3300.25	--
Shallow	OCD-7AR	676169.74	543071.88	3310.03	5.5 to 19.5	9/10/2012	--	11.72	3298.31	--
Valley Fill	OCD-7B	676157.36	543081.99	3310.26	43.5 to 52.5	3/20/2012	--	9.69	3300.57	--
Valley Fill	OCD-7B	676157.36	543081.99	3310.26	43.5 to 52.5	9/10/2012	--	11.13	3299.13	--
Valley Fill	OCD-7C	676155.95	543069.21	3310.10	60.25 to 69.75	3/20/2012	--	9.37	3300.73	--
Valley Fill	OCD-7C	676155.95	543069.21	3310.10	60.25 to 69.75	9/10/2012	--	10.93	3299.17	--
Shallow	OCD-8A	674976.41	543376.95	3308.72	3 to 18	3/20/2012	--	10.06	3298.66	--
Shallow	OCD-8A	674976.41	543376.95	3308.72	3 to 18	9/10/2012	--	11.68	3297.04	--
Valley Fill	OCD-8B	674992.24	543375.06	3309.19	43.5 to 52.5	3/20/2012	--	9.16	3300.03	--
Valley Fill	OCD-8B	674992.24	543375.06	3309.19	43.5 to 52.5	9/10/2012	--	10.69	3298.50	--
Shallow	RW-1	672825.27	522204.68	3367.03	unknown	3/22/2012	13.68	13.87	3353.31	0.19
Shallow	RW-1	672825.27	522204.68	3367.03	unknown	9/14/2012	11.82	11.87	3355.20	0.05
Shallow	RW-2	672781.86	522337.29	3368.17	unknown	3/22/2012	15.23	18.84	3352.22	3.61
Shallow	RW-2	672781.86	522337.29	3368.17	unknown	9/14/2012	13.80	13.90	3354.35	0.10
Shallow	RW-4	671378.27	523010.47	3364.86	unknown	3/23/2012	18.38	18.97	3346.36	0.59
Shallow	RW-4	671378.27	523010.47	3364.86	unknown	9/14/2012	17.66	17.80	3347.17	0.14
Shallow	RW-5	671271.08	523652.31	3363.81	unknown	3/23/2012	--	Dry	--	--
Shallow	RW-5	671271.08	523652.31	3363.81	unknown	9/14/2012 (c)			Not measured	
Shallow	RW-5R	671258.01	523662.01	3368.56	13 to 33	3/22/2012 (d)	19.00	21.60	3349.04	2.60
Shallow	RW-5R	671258.01	523662.01	3368.56	13 to 33	9/10/2012 (d)	21.70	26.00	3346.00	4.30
Shallow	RW-6	670969.39	522843.22	3368.36	unknown	3/23/2012	--	Dry	--	--
Shallow	RW-6	670969.39	522843.22	3368.36	unknown	9/14/2012	--	Dry	--	--
Shallow	RW-7	673579.35	522098.94	3367.09	unknown	3/22/2012	14.25	17.58	3352.17	3.33
Shallow	RW-7	673579.35	522098.94	3367.09	unknown	9/13/2012	11.62	11.66	3355.46	0.04
Shallow	RW-8	673266.20	522321.21	3368.10	unknown	3/22/2012	14.90	17.10	3352.76	2.20
Shallow	RW-8	673266.20	522321.21	3368.10	unknown	9/13/2012	--	14.08	3354.02	--
Shallow	RW-9	673423.49	523371.16	3359.51	unknown	3/23/2012	--	11.06	3348.45	--
Shallow	RW-9	673423.49	523371.16	3359.51	unknown	9/13/2012	--	11.31	3348.20	--
Shallow	RW-10	673076.17	523469.29	3360.61	unknown	3/23/2012	--	11.76	3348.85	--
Shallow	RW-10	673076.17	523469.29	3360.61	unknown	9/13/2012	--	11.68	3348.93	--
Shallow	RW-11-0	669938.15	527541.66	3353.95	unknown	3/21/2012	--	Dry	--	--
Shallow	RW-11-0	669938.15	527541.66	3353.95	unknown	9/13/2012	--	21.22	3332.73	--
Shallow	RW-12	670533.38	527533.00	3352.55	unknown	3/21/2012	--	Dry	--	--
Shallow	RW-12	670533.38	527533.00	3352.55	unknown	9/13/2012	21.08	21.18	3331.45	0.10
Shallow	RW-12R	670542.50	527519.20	3350.58	15 to 35	3/22/2012 (d)	--	25.60	3324.98	--
Shallow	RW-12R	670542.50	527519.20	3350.58	15 to 35	9/10/2012 (d)	22.60	22.90	3327.92	0.30
Shallow	RW-13	671041.58	527528.79	3351.95	unknown	3/21/2012	23.38	24.38	3328.37	1.00
Shallow	RW-13	671041.58	527528.79	3351.95	unknown	9/13/2012	20.40	21.04	3331.42	0.64
Shallow	RW-13R	671049.37	527506.74	3349.60	15 to 35	3/22/2012 (d)	23.60	24.20	3325.88	0.60
Shallow	RW-13R	671049.37	527506.74	3349.60	15 to 35	9/10/2012 (d)	22.00	25.85	3326.83	3.85
Shallow	RW-14	671603.65	527519.99	3351.48	unknown	3/21/2012 (c)			Not measured	
Shallow	RW-14	671603.65	527519.99	3351.48	unknown	9/13/2012	19.15	20.21	3332.12	1.06
Shallow	RW-14R	671592.73	527504.45	3347.39	15 to 35	3/22/2012 (d)	19.40	22.00	3327.47	2.60
Shallow	RW-14R	671592.73	527504.45	3347.39	15 to 35	9/10/2012 (d)	18.10	19.45	3329.02	1.35
Shallow	RW-15C	670820.45	524123.41	3361.41	unknown	3/21/2012 (c)			Not measured	
Shallow	RW-15C	670820.45	524123.41	3361.41	unknown	9/13/2012	--	Dry	--	--

Table 1 - Well Information and Gauging Data

2012 Annual Groundwater Report

Navajo Refinery, Artesia, New Mexico

Water-Bearing Zone (a)	Well ID	Northing	Easting	TOC Elevation (ft amsl)	Screen Interval (ft bgs)	Date Measured	Depth to PSH (ft btoc)	Depth to Water (ft btoc)	Water Elevation (b) (ft amsl)	PSH Thickness (ft)
Shallow	RW-16B	673876.71	523156.09	3360.97	unknown	3/23/2012	--	13.52	3347.45	--
Shallow	RW-16B	673876.71	523156.09	3360.97	unknown	9/13/2012	--	12.19	3348.78	--
Shallow	RW-17A	673978.33	522723.59	3364.72	unknown	3/22/2012	--	13.13	3351.59	--
Shallow	RW-17A	673978.33	522723.59	3364.72	unknown	9/13/2012	--	10.43	3354.29	--
Shallow	RW-18A	673750.19	526188.64	3350.84	unknown	3/22/2012	--	10.08	3340.76	--
Shallow	RW-18A	673750.19	526188.64	3350.84	unknown	9/14/2012	--	13.33	3337.51	--
Shallow	RW-19	670611.43	524592.99	3367.09	15 to 35	9/10/2012 (d)	--	26.00	3341.09	--
Shallow	RW-20	671035.50	527791.29	3348.44	unknown	3/22/2012 (c) (d)	Not measured			
Shallow	RW-20	671035.50	527791.29	3348.44	unknown	9/10/2012 (d)	17.40	17.80	3330.96	0.40
Shallow	RW-22	671009.70	527889.44	3347.17	14 to 34	3/22/2012 (d)	24.20	28.10	3322.19	3.90
Shallow	RW-22	671009.70	527889.44	3347.17	14 to 34	9/10/2012 (d)	18.50	21.20	3328.13	2.70
Shallow	TEL-1	672966.33	523412.82	3358.23	13.36 to 23.36	3/23/2012	--	9.52	3348.71	--
Shallow	TEL-1	672966.33	523412.82	3358.23	13.36 to 23.36	9/14/2012	--	8.83	3349.40	--
Shallow	TEL-2	672885.90	523419.29	3359.12	12.67 to 22.67	3/23/2012	--	10.42	3348.70	--
Shallow	TEL-2	672885.90	523419.29	3359.12	12.67 to 22.67	9/14/2012	--	9.32	3349.80	--
Shallow	TEL-3	672796.06	523459.33	3358.33	12.75 to 22.75	3/23/2012	--	9.71	3348.62	--
Shallow	TEL-3	672796.06	523459.33	3358.33	12.75 to 22.75	9/14/2012	--	8.01	3350.32	--
Shallow	TEL-4	672715.99	523181.18	3360.24	12.59 to 22.59	3/23/2012	--	11.40	3348.84	--
Shallow	TEL-4	672715.99	523181.18	3360.24	12.59 to 22.59	9/14/2012	--	10.50	3349.74	--
Shallow	UG-1	672453.27	520746.73	3372.94	8 to 23	3/22/2012	--	18.88	3354.06	--
Shallow	UG-1	672453.27	520746.73	3372.94	8 to 23	9/13/2012	--	18.07	3354.87	--
Shallow	UG-2	670726.77	520942.36	3380.41	15 to 30	3/22/2012	--	22.44	3357.97	--
Shallow	UG-2	670726.77	520942.36	3380.41	15 to 30	9/13/2012	--	22.12	3358.29	--
Shallow	UG-3R	671992.70	519424.77	3384.08	17 to 37	3/22/2012	--	32.10	3351.98	--
Shallow	UG-3R	671992.70	519424.77	3384.08	17 to 37	9/13/2012	--	30.92	3353.16	--

Definitions:

-- = not applicable
amsl = above mean sea level
bgs = below ground surface
btoc = below top of casing
Dry = no water present in casing
ft = feet
PSH = phase separated hydrocarbons
unknown = screen interval not readily availble
TOC = top of casing

Footnotes:

(a) Wells screened in the shallow water-bearing zone are typically screened at depths of 20 to 25 ft bgs. The shallow water-bearing zone varies between confined and unconfined conditions. Wells screened in the valley fill zone are typically screened at depths ranging between 35 and 70 ft bgs. The clay lens separating the shallow and valley fill zones is discontinuous in some locations and thus, in some areas, there is connectivity between the two zones.

(b) Water elevations are adjusted for PSH, if present, using an assumed specific gravity of 0.8.

(c) Wells were not measured or measurements were determined to be anomolous as described: MW-39: PSH was detected but due to a probe malfunction the PSH/water interface could not be determined; MW-58: PSH was detected but the depth to PSH was not recorded; RW-5 and RW-14: PSH was detected but no water was detected because the water level was below the bottom of the casing; RW-15C: depth to PSH and water could not be measured due to the presence of a pump in the well; RW-20: depth to water was not

(d) Depth to water and depth to PSH were not measured during the respective semiannual gauging events but were gauged at similar times by a separate technician as part of the recovery system operation and

Date Start/Finish: 8/24/2011
Drilling Company: SESI
Drilling Method: Hollow Stem Auger

Sampling Method: Split Spoon
Rig Type: 3368.56

Northing: 671258.01
Easting: 523662.01
Casing Elevation: 3368.56

Borehole Depth: 39' bgs
Surface Elevation: --

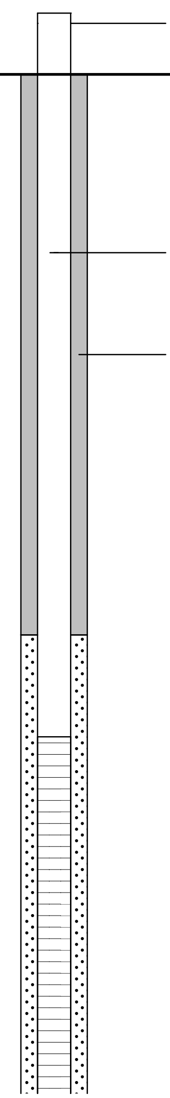
Descriptions By: Joe Boldt

Well/Boring ID: **RW-5R**

Client: Navajo Refining Company

Location: Navajo Refinery
Artesia, New Mexico

DEPTH	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Well/Boring Construction
0	0							CLAYEY SILT	
		1							
5	-5								
		2							
10	-10								
		3						High product odor	
15	-15								
		4						Cobbles	
20	-20								



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Remarks: bgs = below ground surface; amsl = above mean sea level; HA = Hand Auger; ppm = parts per million; NA = not applicable/available; SS = split spoon, ags = above ground surface

Northing and Easting data based on New Mexico State Plane System, Eastern Zone NAD 83. Elevation NAVD 88 referenced to NGS benchmark G-416. Temporary well casing elevations were estimated by adding a measured stick-up height to the

Date Start/Finish: 8/24/2011 **Drilling Company:** SESI **Drilling Method:** Hollow Stem Auger **Sampling Method:** Split Spoon **Rig Type:** 3368.56	**Northing:** 671258.01 **Easting:** 523662.01 **Casing Elevation:** 3368.56 **Borehole Depth:** 39' bgs **Surface Elevation:** -- **Descriptions By:** Joe Boldt	**Well/Boring ID:** **RW-5R** **Client:** Navajo Refining Company **Location:** Navajo Refinery Artesia, New Mexico

DEPTH	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Well/Boring Construction
20	-20	5							
25	-25	6							
30	-30	7							
35	-35	8						COARSE SAND	
								SLOUGH	

Well/Boring Construction:
- 8/16 Silica Sand Pack (11'-36.5' bgs)
- 0.020" Schedule 40 0.010" Slot Screen (13'-33' bgs)
- Slough (36.5'-39' bgs)

ARCADIS

Remarks: bgs = below ground surface; amsl = above mean sea level; HA = Hand Auger; ppm = parts per million; NA = not applicable/available; SS = split spoon, ags = above ground surface

Northing and Easting data based on New Mexico State Plane System, Eastern Zone NAD 83. Elevation NAVD 88 referenced to NGS benchmark G-416. Temporary well casing elevations were estimated by adding a measured stick-up height to the

Date Start/Finish: 8/21/2011
Drilling Company: SESI
Drilling Method: Hollow Stem Auger

Sampling Method: Split Spoon
Rig Type: 3351.54

Northing: 670542.50
Easting: 527519.20
Casing Elevation: 4'4"

Borehole Depth: 40' bgs
Surface Elevation: 3350.58

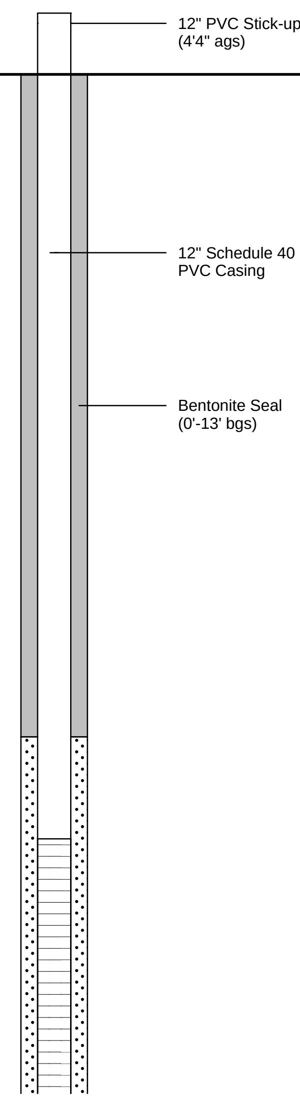
Descriptions By: Joe Boldt

Well/Boring ID: **RW-12R**

Client: Navajo Refining Company

Location: Navajo Refinery
Artesia, New Mexico

DEPTH	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Well/Boring Construction
0	0							SILTY CLAY with SAND	
		1							
5	-5								
		2							
10	-10							FINE SAND	
		3							
15	-15								
		4						CLAYEY SAND with SILT Cobbles Encountered	
20	-20								



ARCADIS

Remarks: bgs = below ground surface; amsl = above mean sea level; HA = Hand Auger; ppm = parts per million; NA = not applicable/available; SS = split spoon, ags = above ground surface

Northing and Easting data based on New Mexico State Plane System, Eastern Zone NAD 83. Elevation NAVD 88 referenced to NGS benchmark G-416. Temporary well casing elevations were estimated by adding a measured stick-up height to the

Date Start/Finish: 8/21/2011 **Drilling Company:** SESI **Drilling Method:** Hollow Stem Auger **Sampling Method:** Split Spoon **Rig Type:** 3351.54	**Northing:** 670542.50 **Easting:** 527519.20 **Casing Elevation:** 4'4" **Borehole Depth:** 40' bgs **Surface Elevation:** 3350.58 **Descriptions By:** Joe Boldt	**Well/Boring ID: RW-12R** **Client:** Navajo Refining Company **Location:** Navajo Refinery Artesia, New Mexico

DEPTH	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Well/Boring Construction
20	-20							Product Vapor Detected	
		5						Lost Water ~1 ft lost in bin	
25	-25								8/16 Silica Sand Pack (13'-36' bgs) 0.020" Schedule 40 0.010" Slot Screen (15'-35' bgs)
		6							
30	-30								
		7							
35	-35								
		8						SLOUGH	Slough
40	-40								

ARCADIS

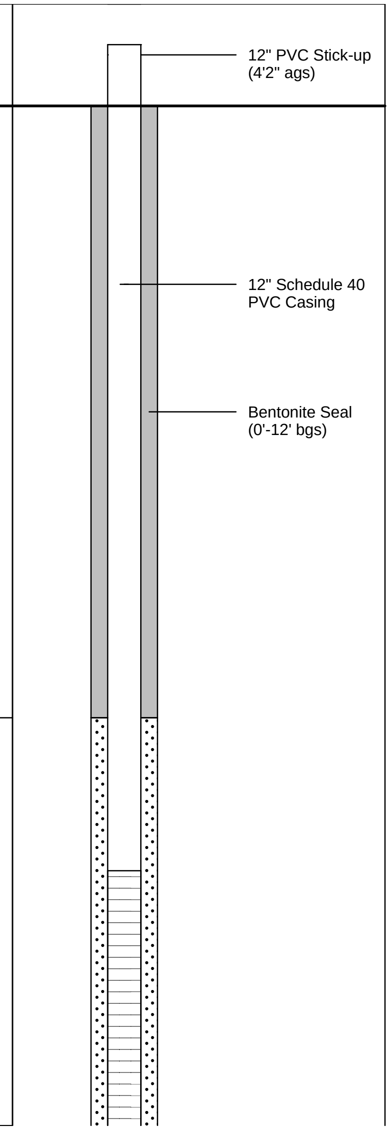
Remarks: bgs = below ground surface; amsl = above mean sea level; HA = Hand Auger; ppm = parts per million; NA = not applicable/available; SS = split spoon, ags = above ground surface

Northing and Easting data based on New Mexico State Plane System, Eastern Zone NAD 83. Elevation NAVD 88 referenced to NGS benchmark G-416. Temporary well casing elevations were estimated by adding a measured stick-up height to the

Date Start/Finish: 8/20/2011	**Northing:** 671049.37	**Well/Boring ID:** **RW-13R**	
Drilling Company: SESI	**Easting:** 527506.74	**Client:** Navajo Refining Company	
Drilling Method: Hollow Stem Auger	**Casing Elevation:** 4'2"	**Location:** Navajo Refinery, Artesia, New Mexico	
Sampling Method: Split Spoon	**Borehole Depth:** 47' bgs		
Rig Type: 3351.54	**Surface Elevation:** 3349.60		
	Descriptions By: Joe Boldt		

DEPTH	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description
0	0							SANDY SILT, brown, moist to dry, some gravel 1-2 ft
		1						
5	-5							
		2						
10	-10							
								CLAY AND SAND, light brown to tan, fine grained
		3						Clay turns light gray
15	-15							Begin hydrocarbon odor
		4						
20	-20							

Well/Boring Construction



ARCADIS

Remarks: bgs = below ground surface; amsl = above mean sea level; HA = Hand Auger; ppm = parts per million; NA = not applicable/available; SS = split spoon, ags = above ground surface

Northing and Easting data based on New Mexico State Plane System, Eastern Zone NAD 83. Elevation NAVD 88 referenced to NGS benchmark G-416. Temporary well casing elevations were estimated by adding a measured stick-up height to the

Date Start/Finish: 8/20/2011 **Drilling Company:** SESI **Drilling Method:** Hollow Stem Auger **Sampling Method:** Split Spoon **Rig Type:** 3351.54	**Northing:** 671049.37 **Easting:** 527506.74 **Casing Elevation:** 4'2" **Borehole Depth:** 47' bgs **Surface Elevation:** 3349.60 **Descriptions By:** Joe Boldt	**Well/Boring ID: RW-13R** **Client:** Navajo Refining Company **Location:** Navajo Refinery Artesia, New Mexico

DEPTH	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Well/Boring Construction
20	-20	5						COBBLES, casing hung up on install	
25	-25	6						CLAY AND trace SAND with gravel (10%), GLEY 7/10Y, very stiff, low plasticity, hydrocarbon odor, damp	0.020" Schedule 40 0.010" Slot Screen (15'-35' bgs) 8/16 Silica Sand Pack (12'-42' bgs)
30	-30	7							
35	-35	8						Bottom of well	
40	-40								

ARCADIS

Remarks: bgs = below ground surface; amsl = above mean sea level; HA = Hand Auger; ppm = parts per million; NA = not applicable/available; SS = split spoon, ags = above ground surface

Northing and Easting data based on New Mexico State Plane System, Eastern Zone NAD 83. Elevation NAVD 88 referenced to NGS benchmark G-416. Temporary well casing elevations were estimated by adding a measured stick-up height to the

Date Start/Finish: 8/20/2011 **Drilling Company:** SESI **Drilling Method:** Hollow Stem Auger **Sampling Method:** Split Spoon **Rig Type:** 3351.54	**Northing:** 671049.37 **Easting:** 527506.74 **Casing Elevation:** 4'2" **Borehole Depth:** 47' bgs **Surface Elevation:** 3349.60 **Descriptions By:** Joe Boldt	**Well/Boring ID:** **RW-13R** **Client:** Navajo Refining Company **Location:** Navajo Refinery Artesia, New Mexico

DEPTH	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Well/Boring Construction
		9						Slough	Slough
45	-45								

ARCADIS	**Remarks:** bgs = below ground surface; amsl = above mean sea level; HA = Hand Auger; ppm = parts per million; NA = not applicable/available; SS = split spoon, ags = above ground surface Northing and Easting data based on New Mexico State Plane System, Eastern Zone NAD 83. Elevation NAVD 88 referenced to NGS benchmark G-416. Temporary well casing elevations were estimated by adding a measured stick-up height to the

Date Start/Finish: 8/20/2011
Drilling Company: SESI
Drilling Method: Hollow Stem Auger

Sampling Method: Split Spoon
Rig Type: 3349.37

Northing: 671592.73
Easting: 527504.45
Casing Elevation: 4'2"

Borehole Depth: 47' bgs
Surface Elevation: 3347.39

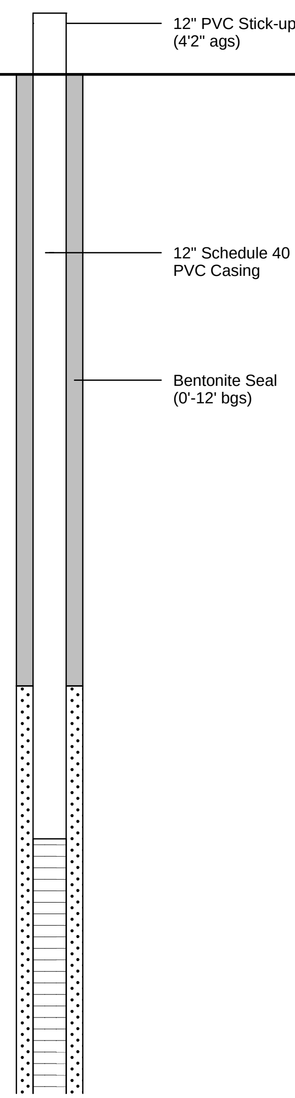
Descriptions By: Joe Boldt

Well/Boring ID: RW-14R

Client: Navajo Refining Company

Location: Navajo Refinery
Artesia, New Mexico

DEPTH	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Well/Boring Construction
0	0							SANDY SILT, brown, moist to dry, some gravel 1-2 ft	
		1							
5	-5								
		2							
10	-10								
		3						CLAY AND SAND, light brown to tan, fine grained	
								Clay turns light gray	
15	-15							Begin hydrocarbon odor	
		4							
20	-20								



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Date Start/Finish: 8/20/2011 **Drilling Company:** SESI **Drilling Method:** Hollow Stem Auger **Sampling Method:** Split Spoon **Rig Type:** 3349.37	**Northing:** 671592.73 **Easting:** 527504.45 **Casing Elevation:** 4'2" **Borehole Depth:** 47' bgs **Surface Elevation:** 3347.39 **Descriptions By:** Joe Boldt	**Well/Boring ID: RW-14R** **Client:** Navajo Refining Company **Location:** Navajo Refinery Artesia, New Mexico

DEPTH	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Well/Boring Construction
20	-20	5						COBBLES, casing hung up on install	
25	-25								0.020" Schedule 40 0.010" Slot Screen (15'-35' bgs)
		6						CLAY AND trace SAND with gravel (10%), GLEY 7/10Y, very stiff, low plasticity, hydrocarbon odor, damp	8/16 Silica Sand Pack (12'-42' bgs)
30	-30	7							
35	-35							Bottom of well	
		8							
40	-40								

Remarks: bgs = below ground surface; amsl = above mean sea level; HA = Hand Auger; ppm = parts per million; NA = not applicable/available; SS = split spoon, ags = above ground surface

Northing and Easting data based on New Mexico State Plane System, Eastern Zone NAD 83. Elevation NAVD 88 referenced to NGS benchmark G-416. Temporary well casing elevations were estimated by adding a measured stick-up height to the

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Date Start/Finish: 8/20/2011 **Drilling Company:** SESI **Drilling Method:** Hollow Stem Auger **Sampling Method:** Split Spoon **Rig Type:** 3349.37	**Northing:** 671592.73 **Easting:** 527504.45 **Casing Elevation:** 4'2" **Borehole Depth:** 47' bgs **Surface Elevation:** 3347.39 **Descriptions By:** Joe Boldt	**Well/Boring ID:** **RW-14R** **Client:** Navajo Refining Company **Location:** Navajo Refinery Artesia, New Mexico

DEPTH	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Well/Boring Construction
		9						Slough	
45	-45								

Remarks: bgs = below ground surface; amsl = above mean sea level; HA = Hand Auger; ppm = parts per million; NA = not applicable/available; SS = split spoon, ags = above ground surface

Northing and Easting data based on New Mexico State Plane System, Eastern Zone NAD 83. Elevation NAVD 88 referenced to NGS benchmark G-416. Temporary well casing elevations were estimated by adding a measured stick-up height to the

Date Start/Finish: 8/20/2011 **Drilling Company:** SESI **Drilling Method:** Hollow Stem Auger **Sampling Method:** Split Spoon **Rig Type:** 3369.11	**Northing:** 670611.43 **Easting:** 524592.99 **Casing Elevation:** 4'2" **Borehole Depth:** 55' bgs **Surface Elevation:** 3367.09 **Descriptions By:** Joe Boldt	**Well/Boring ID:** **RW-19** **Client:** Navajo Refining Company **Location:** Navajo Refinery Artesia, New Mexico

DEPTH	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Well/Boring Construction
0	0							CLAYEY SILT	12" PVC Stick-up (3'8" ags)
		1							12" Schedule 40 PVC Casing
5	-5								Bentonite Seal (0'-11' bgs)
		2							
10	-10								
		3							
15	-15								
		4						COBBLES with increased sand content and decreased clay	
20	-20								

ARCADIS

Remarks: bgs = below ground surface; amsl = above mean sea level; HA = Hand Auger; ppm = parts per million; NA = not applicable/available; SS = split spoon, ags = above ground surface

Northing and Easting data based on New Mexico State Plane System, Eastern Zone NAD 83. Elevation NAVD 88 referenced to NGS benchmark G-416. Temporary well casing elevations were estimated by adding a measured stick-up height to the

Date Start/Finish: 8/20/2011 **Drilling Company:** SESI **Drilling Method:** Hollow Stem Auger **Sampling Method:** Split Spoon **Rig Type:** 3369.11	**Northing:** 670611.43 **Easting:** 524592.99 **Casing Elevation:** 4'2" **Borehole Depth:** 55' bgs **Surface Elevation:** 3367.09 **Descriptions By:** Joe Boldt	**Well/Boring ID:** **RW-19** **Client:** Navajo Refining Company **Location:** Navajo Refinery Artesia, New Mexico

DEPTH	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Well/Boring Construction
20	-20								
		5							
								CLAYEY SAND, light gray	
25	-25								0.020" Schedule 40 0.010" Slot Screen (15'-35' bgs)
		6						Cobbles	8/16 Silica Sand Pack (11'-46' bgs)
30	-30								
		7							
35	-35								
		8							
40	-40								

ARCADIS

Remarks: bgs = below ground surface; amsl = above mean sea level; HA = Hand Auger; ppm = parts per million; NA = not applicable/available; SS = split spoon, ags = above ground surface

Northing and Easting data based on New Mexico State Plane System, Eastern Zone NAD 83. Elevation NAVD 88 referenced to NGS benchmark G-416. Temporary well casing elevations were estimated by adding a measured stick-up height to the

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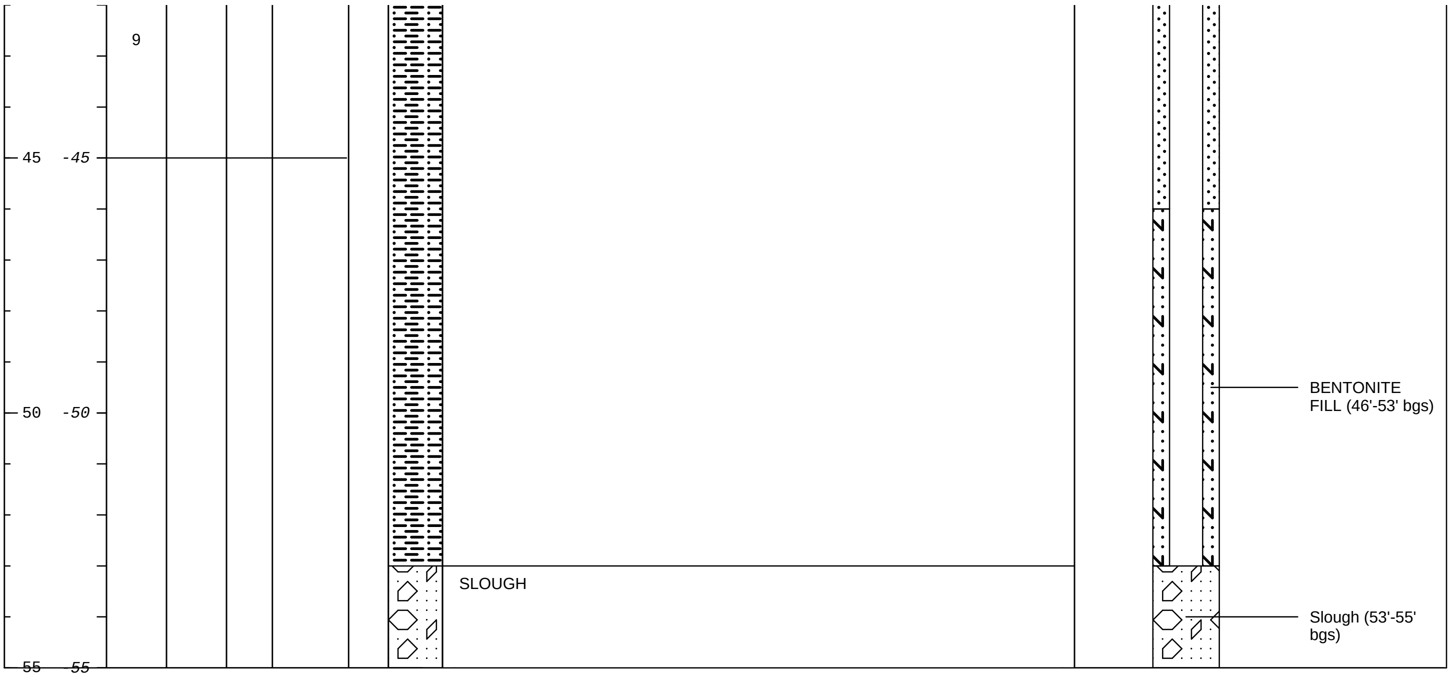
DEPTH	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Well/Boring Construction



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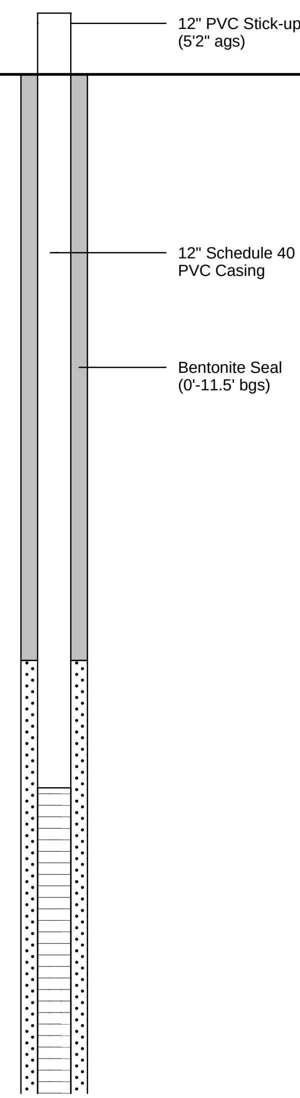
Date Start/Finish: 8/23/2011 **Drilling Company:** SESI **Drilling Method:** Hollow Stem Auger **Sampling Method:** Split Spoon **Rig Type:** CME 85	**Northing:** 671009.70 **Easting:** 527889.44 **Casing Elevation:** 3349.21 **Borehole Depth:** 44' bgs **Surface Elevation:** 3347.17 **Descriptions By:** Joe Boldt	**Well/Boring ID:** **RW-22** **Client:** Navajo Refining Company **Location:** Navajo Refinery Artesia, New Mexico

DEPTH	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Well/Boring Construction
0	0							CLAYEY SILT	
		1							
5	-5							SANDY, SILT CLAY	
		2							
10	-10								
		3							
15	-15								
		4							
20	-20								



ARCADIS

Remarks: bgs = below ground surface; amsl = above mean sea level; HA = Hand Auger; ppm = parts per million; NA = not applicable/available; SS = split spoon, ags = above ground surface

Northing and Easting data based on New Mexico State Plane System, Eastern Zone NAD 83. Elevation NAVD 88 referenced to NGS benchmark G-416. Temporary well casing elevations were estimated by adding a measured stick-up height to the

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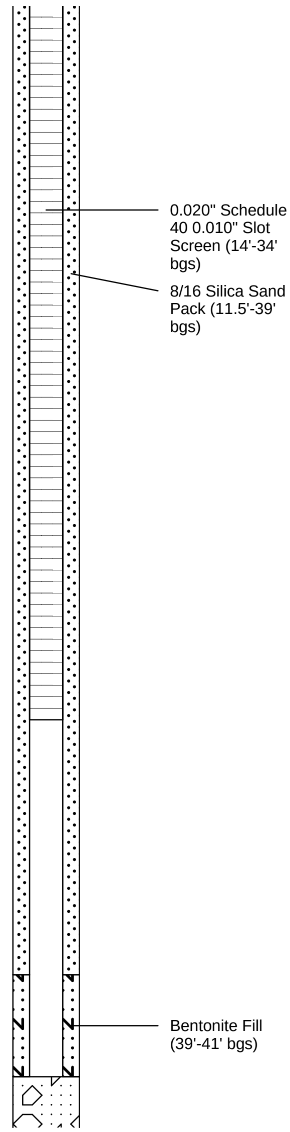
DEPTH	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description
20	-20							
		5						
								SAND
25	-25							
		6						
30	-30							
		7						
35	-35							
		8						
40	-40							
								SLOUGH

Well/Boring Construction



ARCADIS

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DEPTH	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Well/Boring Construction
		9							Slough

Remarks: bgs = below ground surface; amsl = above mean sea level; HA = Hand Auger; ppm = parts per million; NA = not applicable/available; SS = split spoon, ags = above ground surface

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SUSANA MARTINEZ
Governor
JOHN A. SANCHEZ
Lieutenant Governor

RYAN FLYNN
Cabinet Secretary
BUTCH TONGATE
Deputy Secretary

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

April 13, 2015

Mr. Scott Denton
Environmental Manager
Navajo Refining Company
P.O. Box 159
Artesia, New Mexico 88211-0159

RE: APPROVAL WITH MODIFICATIONS
2012 ANNUAL GROUNDWATER REPORT
NAVAJO REFINING COMPANY, ARTESIA REFINERY
EPA ID NO. NMD048918817
HWB-NRC-13-002

Dear Mr. Denton:

The New Mexico Environment Department (NMED) has completed its review of Navajo Refining Company, Artesia Refinery's (Permittee) *2012 Annual Groundwater Report* (Report), dated March 2013. NMED hereby issues this Approval with Modifications with the following comments.

<u>Comment 1</u>

In Section 2.1 (Monitoring Well Installation, Damage, and Repairs), page 3, paragraph 1, the Permittee states that the survey elevation data for the recovery wells installed in late 2011 is inconsistent with previously collected elevation data. The Permittee planned to submit the well completion logs for these recovery wells "under a separate cover when the well elevations have been surveyed." NMED does not have this submittal in our record. Revise Table 1 (Well Information and Gauging Data) with the correct survey information, submit a replacement Table

1 and also provide the well completion logs for the recovery wells installed in late 2011 with the Response Letter. In addition, all future tables must include the most recent, correct survey elevation data for all wells.

Comment 2

In Section 2.4 (Equipment Decontamination Procedures), page 5, paragraph 1, the Permittee describes the decontamination procedure for the probes and states that "[t]he equipment was then rinsed with clean water. The clean water used for washing and rinsing was obtained from the refinery's reverse osmosis (RO) water system." There appears to be a discrepancy with the information provided in Section 2.4, the 2011 and 2012 Facility Wide Groundwater Monitoring Workplans (FWGMWPs). The 2011 and 2012 FWGMWPs state that "[t]he equipment will be washed with a brush in a bath of soap and water then rinsed twice with distilled water." In the Response Letter, provide an explanation for using the water from the RO water system instead of the distilled water for rinsing the equipment. In all future work plans and reports, ensure that the proposed activities in the work plans are followed through during field work activities and that deviations from the work plans are explained in the reports.

Comment 3

In Section 4.2.4 (Former Tetra Ethyl Lead Impoundment Area), page 13, paragraph 1, the Permittee states "PSH was detected in MW-39 just northeast of well TEL-1. Due to a probe malfunction during the 2012 first semiannual event, the PSH/water interface could not be determined." Discuss if PSH/groundwater elevation measurements at other wells were affected and how the situation was remedied in the Response Letter.

Comment 4

In Section 5.3.3.2 (Total Petroleum Hydrocarbons – Diesel Range Organics) on page 25, paragraph 1, the Permittee states that "the DRO concentration in MW-77 increased to 40 mg/L in the sample collected in September 2012; this concentration is one order of magnitude greater than the previously detected concentrations of DRO in this well." In addition to MW-77, monitoring wells MW-74, MW-75, MW-83, and MW-84 also experienced significant increases in DRO concentration in September 2012. Provide an explanation for the increase in DRO concentrations during the September 2012 sampling event, if known, in the Response Letter.

Comment 5

In Figure 2 (Well Locations), the figure depicts all the abandoned, irrigation, monitoring, and recovery well locations from the Refinery to the Evaporation Ponds. However, it is difficult to determine all of the well locations because labels block the well locations and IDs (i.e., Evaporation Ponds). In future work plans and reports, ensure all well locations and IDs are visible on all figures. No response required.

Comment 6

In Appendix A (Field Sampling Notes), *Field Notes 2012 Mar-Apr*, pages 116-118, the Permittee provides three pages of field notes for MW-104-0412 that present the same information. In future reports, ensure that the field notes submitted are not duplicate copies of the same page and that all field notes are submitted for review. No response required.

Comment 7

In Tables B.1 through B.6 of Appendix B (Laboratory Reports and Tabulated Data 2010-2012), the Permittee summarizes analytical data results and groundwater screening levels. There are several instances where groundwater screening levels are not available for the constituents. For example, in Table B.4 (Groundwater Analytical Data 2010-2012: Volatile Organic Compounds), page 29 of 56, there is no groundwater screening level for methyl n-butyl ketone. However, methyl n-butyl ketone is also identified as 2-hexanone which does have an EPA tapwater groundwater screening level. In addition, there are other constituents that have EPA tapwater groundwater screening levels that are not reported in the tables. For example, in Table B.5 (Groundwater Analytical Data 2010-2012: Semivolatile Organic Compounds), page 2 of 3, a groundwater screening level is not reported for analine; however, there is an EPA tapwater groundwater screening level for this constituent. In future reports, the Permittee must ensure screening levels for all constituents are reported, including those constituents with alternate names. Determination of the appropriate screening levels must be in accordance with Section 4.1.1 (Groundwater, Soil and Surface Water Cleanup Levels) of the December 2010 Post-Closure Care Permit. No response required.

The Permittee must address Comments 1 through 4 in a Response Letter contained in this Approval with Modifications. The Response Letter, replacement table and well completion logs required by Comment 1 must be submitted to NMED by **August 28, 2015**.

If you have any questions regarding this letter, please contact Leona Tsinnajinnie of my staff at (505) 476-6057.

Sincerely,

John E. Kieling
Chief
Hazardous Waste Bureau

cc: D. Cobrain, NMED HWB
N. Dhawan, NMED HWB
K. Van Horn, NMED HWB
L. Tsinnajinnie, NMED HWB
C. Chavez, EMNRD OCD
R. Combs, Navajo Refining Company, L.L.C., Artesia Refinery
P. Krueger, ARCADIS

File: Reading and NRC 2015, HWB-NRC-13-002

HOLLYFRONTIER
THE HOLLYFRONTIER COMPANIES

Mr. John E. Kieling
Chief
Hazardous Waste Bureau
New Mexico Environmental Department
2905 Rodeo Park Drive East, Building 1
Santa Fe, NM 87505-6306

Mr. Carl Chavez
New Mexico Energy, Minerals and Natural Resources Department
Oil Conservation Division
1220 South St. Francis Drive
Santa Fe, NM 87505

March 14, 2013

RE: Submittal of the *2012 Annual Groundwater Report* and the *2012 Annual Discharge Permit Report* for the Navajo Refining Company, Artesia Refinery
EPA Facility NMD048918817
Discharge Permit GW-028

Dear Mr. Kieling and Mr. Chavez:

Enclosed are the *2012 Annual Groundwater Report*, which fulfills requirement 4.7.6.b of the Post Closure Care Permit, and the *2012 Annual Discharge Permit Report*, which fulfills requirement 2.F of Discharge Permit GW-028. Enclosed are two paper copies and one electronic copy of the annual groundwater report as well as one paper and one electronic copy of the annual discharge report.

If you have any questions or comments regarding this work plan, please feel free to contact me at 575-746-5487.

Sincerely,

Michael W. Holder
Environmental Manager
Navajo Refining Company, LLC

c: Robert Combs, Navajo
Pamela R. Krueger, ARCADIS

2012 ANNUAL DISCHARGE PERMIT REPORT
NAVAJO REFINING COMPANY-ARTESIA REFINERY
DISCHARGE PERMIT GW-028

EXECUTIVE SUMMARY

This report was prepared to fulfill the requirement of the Navajo Refining Company's Discharge Permit GW-028. The requirement specifies that an Annual Report be submitted by March 15 following the reporting year and should include:

A. Summary of major refinery activities and events.
B. Summary of discharge activities.
C. Summary of all leaks, spills, and releases and corrective actions taken.
D. Summary of discovery of new groundwater contamination.

A. MAJOR REFINERY ACTIVITIES

The Navajo-Artesia refinery conducted normal operations for 2012. The refinery did not undergo any expansions in regards to production capacity, but did make several modifications to improve operability and reliability.

Navajo initiated a capital project to improve aggressive biological treatment within the waste water treatment plant (WWTP) by installing a new equalization tank (T-829), coolers, etc. Construction of this tank was completed in 2012 and should be put in service by the end of 2013. Also included in the work scope is an additional 100,000 barrel (bbl) storm water retention tank (T-830) that was constructed in 2011 and 2012, and should go into service during 2013. Additional improvements in 2013 will include a storm water lift station to reduce the process load on the WWTP during storm events.

A lined 4,000,000 gallon firewater pond was constructed in 2011 and put in service in 2012.

The refinery had a small maintenance turnaround in February 2012 where several process units were shutdown for maintenance activities and catalyst replacement. In the latter part of the year, the refinery made preparations for the maintenance turnaround to take place in January and February 2013. This was a major event that takes place every 5-10 years.

During 2012 the waste storage areas, including the 90-day storage areas and the non-hazardous waste storage area, were fenced and access was limited to designated employees.

In August 2012, OCD issued a new discharge permit to the refinery. One of the major conditions of the permit is to discontinue the discharge of reverse osmosis (RO) reject water to the farm fields within 36 months. The refinery has begun the planning and engineering to achieve this requirement.

In December 2011, construction of the light non-aqueous phase liquid (LNAPL) Recovery System upgrades began, and system operation commenced in April 2012. The system upgrades included demolition of portions of the previous recovery system and replacement of pumps and controls to provide automated operation. Installation of new recovered groundwater and recovered hydrocarbon pipelines, all tied into the existing recovery wells and trenches, were included in this upgrade. Startup of the system occurred in April 2012, following mechanical completion, operator training, etc. The upgraded system has proven to provide more efficient operation and has markedly assisted our remediation efforts. In 2012, a total of 395,102 gallons (~9,400 bbls) of hydrocarbons were recovered and recycled, and 2,739,282 gallons (~65,000 bbls) of groundwater were recovered and processed in the WWTP. Further details of this operation are discussed in Section 6 of the *2012 Annual Groundwater Report*. Planning and design of Phase II of the recovery system upgrades is underway and should be completed in 2013.

B. SUMMARY OF DISCHARGE ACTIVITIES

Navajo's primary discharge is treated wastewater from the WWTP (WWTP effluent) and the RO Reject. The details of each discharge are provided below:

1 Injection Wells

The injection rates, volume, and quality of treated waste water disposed of in the injection wells are reported quarterly in a report to OCD, in addition to monthly C-115 reports. Those reports are included in Appendix A, tab 1. To summarize, the total injected water volume for 2012 was 242,868,714 bbls.

2 Publically Owned Treatment Works

The flow rates, volume, and quality of water discharged to the publically owned treatment works (POTW) are reported semiannually to the City of Artesia; those letter reports are included in Appendix A, tab 2. To summarize, the total transferred water volume for 2012 was 5,028,797 gallons, or 119,733 barrels. The process history data is also provided in Appendix A, tab 2, as well as analytical results.

Navajo continued to discharge the blow-down from the cooling tower to the POTW in 2012. Those analytical results are also included in Appendix A, tab 2.

3 Reverse Osmosis Reject

A secondary waste stream is the RO reject water. This RO process is fed by fresh ground water, provided by either the refinery's agricultural supply wells or purchased water from the City of Artesia. The reject waste stream is comprised of concentrated salts, primarily chloride, fluoride, and sulfate, and is a high total dissolved solids (TDS) waste stream which is discharged to two farm fields. The stream is sampled quarterly (by Navajo) (see Appendix A, tab 3 and Section 5.4 of the *2012 Annual Groundwater Report*). The flow rate is continuously recorded with the Process History Database (PHD), included in Appendix A, tab 3. To summarize, the total discharged water volume for 2012 was 132,237,512 gallons, or 3,148,512 barrels.

C. SUMMARY OF ALL LEAKS, SPILLS, FIRES, AND RELEASES

The Navajo-Artesia facility had several spills, fires and releases in 2012, all of which are described below. There were 7 spills of reportable quantities and 4 fires; it should be mentioned here that this demonstrates the continued improvements compared to previous years (9 spills and 13 fires in 2011; 16 spills and 24 fires in 2010). The refinery aspires to continue this trend for 2013. Appendix B, tab 1 contains information about the spills and Appendix B, tab 2 contains information about the fires.

1 Spills

A January 31, 2012 — FCC Scrubber Water Spill

At approximately 03:30 on 01/31/2012, the FCC Division Control Room notified the Environmental Department that a hose connection had failed on a transfer pump and released an estimated 15 to 20 bbl of water from the FCC flue gas scrubber. The connection was repaired and fastened to prevent a recurrence. Vacuum trucks were dispatched to the area to recover the remaining liquid. The wet soil, 72 cubic yards (cy), was removed and disposed at an appropriate disposal site. The area and waste were sampled and the excavation was backfilled with fresh fill. The Final C-141 report, the Initial C-141 report, analytical results, markup of the affected area, waste manifests and photos are included in Appendix B, tab 1, section A.

B March 26, 2012 — Kerosene Spill at HEP Artesia Manifold

At approximately 11:30 on 03/26/2012, the Holly Energy Partners (HEP) Environmental office notified Navajo Environmental that they had a release of approximately 20 bbl of kerosene at their Artesia Manifold. This manifold is located within the Navajo Artesia Refinery, but is an HEP asset. The release was caused by a bleed valve (probably ¾ inch valve) that was left in the open position. The bleed valve was closed to prevent further releases. The impacted area was approximately 20 feet by 50 feet. By the time the release was discovered, the liquid had been absorbed into the ground; there was no liquid present to recover. The stained area was excavated and sampled by a third party. A Final C-141 form will follow with all other supporting documentation and incident details. The initial C-141 form has been included in Appendix B, tab 1, section B.

C May 11, 2012 — Gasoil Leak at T-110

At approximately 14:30 on 5/11/12, the Oil Movements Manager notified the Environmental Department that a gas oil spill was discovered in the area of T-110 due to a leaking pipe. It was estimated that approximately 10 barrels were released. The line was isolated, clamped, and returned to service. Further leaking has not been observed and the line is scheduled to be replaced. A work authorization was submitted to vacuum the free liquid and remove the contaminated soil. A vacuum truck was dispatched to collect the remaining liquid, but the volume recovered was not recorded. The contaminated soil was removed and disposed at an appropriate disposal facility. A Final C-141 form will follow with all other supporting documentation and incident details. The initial C-141 form has been included in Appendix B, tab 1, section C.

D May 24, 2012 Effluent Pipeline Leaks

At approximately 10:40 on 5/24/12, the FCC Division Control Room notified Environmental that a leak had occurred along the treated waste water effluent pipeline to the injection wells. The operators noticed that the pipeline pressure indicator dropped to 0 pounds per square inch gauge (psig). They promptly shut down the pipeline pumps and a contract employee was dispatched to inspect the pipeline. It was discovered that the fiberglass pipeline had separated in two locations. Once the locations were known, the spill was reported to the agencies listed in the C-141 report included in Appendix B, tab 1, section D. Both leak locations were outside of the refinery property in unpopulated areas. Vacuum trucks were dispatched to recover the freestanding water released, but no volumes were recorded. At both spill locations, the pipeline failed at threaded junctions. The breaches were repaired and the pipeline was returned to service. At this time, the excavations required to facilitate the repairs have been backfilled with clean fill. The excavated soil from the Haldeman Farm location, 84 cy, was disposed at R360. The excavated soil at the BLM site remains at the location, awaiting further discussions with BLM. Once activity in the BLM area is complete, a Final C-141 report will be submitted. Appendix B, tab 1, section D includes markup of the affected area and sample locations, photos of the areas, soil screening tables, analytical reports, and waste manifests.

E September 10, 2012 Fuel Oil at Rail Loading Area

At approximately 13:00 on 9/10/12, the Environmental Department was notified of a fuel oil spill near the rail loading area. The cause of the spill was a valve that was inadvertently left open, causing approximately 15 bbls of fuel oil to be released, of which, approximately 10 bbls were recovered. The affected area was approximately 4 feet by 30 feet. The impacted soil/gravel in the area was removed and disposed at a non-hazardous waste disposal facility. Appendix B, tab 1, section E includes the initial C-141 form, a markup of the affected area and waste manifests. The affected area markup and the waste manifests are combined with the information for the Pitch spill which occurred on 9/22/12. A Final C-141 form will follow with all other supporting documentation and incident details.

F September 22, 2012 Pitch at Rail Loading Area

At approximately 18:00 on 9/22/12, the Environmental Department was notified that a spill of approximately 10 bbls of pitch was released while operators were loading a rail car. When the railcar was full, the operator closed the valve, but the valve failed and continued to fill the car. The area affected was approximately 5 feet by 15 feet. The spilled material quickly hardened as it cooled. The leaking valve was repaired and the area was cleaned up. The spilled material and gravel were removed and disposed at a non-hazardous waste disposal facility. Appendix B, tab 1, section F includes the initial C-141 form, a markup of the affected area and waste manifests. The affected area markup and the waste manifests are combined with the information for the fuel oil spill which occurred on 9/10/12. A Final C-141 form will follow with all other supporting documentation and incident details.

G October 11, 2012 ULSD Spill at T-815

At approximately 20:30 on 10/11/12, the Environmental Department was notified that a spill of ultra low sulfur diesel (ULSD) occurred in the area of T-815. A sample valve was left open after a routine sampling event and was not immediately noticed because the tank liquid level was below the sample port height. When the tank level exceeded the elevation of the sample port, the diesel fuel was released. During the next routine sampling event, the subsequent sampler noticed the stained soil, closed the valve, and reported the release. The affected area was within the T-815 dike with an area of approximately 20 feet by 30 feet. There was also rainwater in the area where a sheen from the release was present. The rainwater was removed with a vacuum truck and the stained soil was removed. The initial C-141 form, a markup of the affected area, and photos are included in Appendix B, tab 1, section G. ARCADIS U.S., Inc. (ARCADIS) representatives were onsite and collected soil samples via hand-auger to determine the vertical extent of the release; the report of their findings is included in Appendix B, tab 1, section G. Confirmation samples will be collected and a Final C-141 report will follow once the investigation is complete. The stained soil (61,660 pounds) was disposed at a hazardous waste disposal facility; the manifests are included in Appendix B, tab 1, section G.

2 Fires

A February 23, 2012 Flange Fire on P-927

At approximately 13:00 on 2/23/12, operators noticed a fire on P-927 (FCC combined feed pump) while making rounds. The operators immediately extinguished the fire with a steam hose. They discovered that a small valve (¼ inch sample valve, petcock) was leaking between a ¾ inch block valve and a pressure gauge on the seal pot of P-927. The leak was stopped by turning off the pump and closing the isolation valve. The temperature of the hydrocarbon feed to the FCC at the local process is 450-500° F, which is above the flashpoint of the fluid. When the liquid dripped off of the leaking valve, it came in contact with a hot pipe flange and ignited. The fire was extinguished with steam. There were no injuries as a result of this small fire and equipment damages (electrical, mechanical, etc.) were limited to the piping insulation in the local area that was replaced. The Final C-141 Report was submitted on February 24, 2012 and has been included in Appendix B, tab 2, section A.

B April 3, 2012 Vacuum Bin Fire

At approximately 10:30 on 4/3/12, there was a small fire at a vacuum bin being used to collect spent sulfur guard catalyst. This was a very brief fire, extinguished within 30 seconds of discovery. The initial C-141 form has been included in Appendix B, tab 2, section B. Navajo conducted a root cause investigation (included in Appendix B, tab 2, section B, April 4 2012 Bin Fire Investigation Final Report). It was determined that the vessel being emptied (D-42, sulfur guard) had not been properly purged, leaving residual hydrocarbons present on the catalyst when vacuumed into the waste bin. The nitrogen purge that was supposed to be present to create an inert atmosphere inside the waste bin had inadvertently been turned off. When air contacted the spent catalyst, a pyrophoric reaction ignited the residual hydrocarbons, causing the fire. The fire was extinguished with handheld fire extinguishers. Several recommendations were provided as a result of the fire, as well as completion dates for each of the action items. The area affected was along Freeman St. on the east side of the Naphtha Hydrotreater (Unit 13, west side of road). There was a small amount of catalyst that spilled to the ground from the back door of the vacuum bin that was shoveled back into the bin. There were no liquids released during the event. The fire damaged the door of the vacuum bin, but there were no injuries as a result of the incident. The catalyst was later transferred to another bin prior to shipment. The final report for this event is included in Appendix B, tab 2, section B.

C April 29, 2012 Insulation Fire at T-1227

At approximately 04:30 on 4/29/12, operators noticed a fire on the top of T-1227 (pitch storage tank). Alarm was sounded and the fire was extinguished by the fire team. During routine operations, gases exiting the tank via the conservation vent condense on top of the tank. Previously, the condensed product was allowed to run down the side of the tank until approximately one year ago, when a catch pan with a down spout was installed under the vent to collect the majority of the condensed produce and divert the free liquid into a barrel at grade. Prior to the event, the nitrogen supply was turned off to allow end-of-month level gauge verification via a hand line. T-1227 was hand gauged at approximately 8:45 on 4/28/12. It is believed that oxygen was drawn into the tank during the end of the month gauge verification (normal inbreathing while tank is being pumped down, under normal circumstances, the volume is offset by the regulated nitrogen supply, not by incoming air through the conservation vent). The oxygen present allowed the hot gases in the tank to combust, causing the tank shell temperature to rise sufficiently to autoignite the hydrocarbon-soaked insulation. There were no injuries as a result of this small fire. The fire team extinguished the fire by applying water supplied by a nearby fire water monitor. The damages on the tank were limited to the tank insulation in the local area where the fire occurred. As a corrective action, hand gauging of the tank will no longer be an acceptable practice for end-of-month level verification; the radar level will be verified by removing a strip of insulation from the tank shell to expose an area for the level to be assessed with an infrared camera as a means to prevent recurrence. The initial and final reports for this event are included in Appendix B, tab 2, section C.

D June 11, 2012 Fire at P-454 (Gasoil Booster Pump)

At 12:12 on 6/11/12, the P-454 Gas Oil Booster Pump began smoking then caught on fire. By 12:20, operations had extinguished the fire with a handheld fire extinguisher. The bearing failed on the electric motor which leaked lube oil and caught on fire. P-454 was blocked in after the fire was put out. This pump P-454 is located south of Tank T-433 and is mounted within a concrete containment. None of the lube oil spilled onto the ground and cleanup was not needed. There were no injuries and other than the pump motor, no equipment was damaged. The Final C-141 Report for this event was submitted on June 25, 2012 and is included in Appendix B, tab 2, section D.

D. SUMMARY OF NEW GROUNDWATER CONTAMINATION

New groundwater contamination and changes in existing constituents are discussed in Section 7 of the *2012 Annual Groundwater Report*, but some conclusions are listed below:

- The PSH plumes remained consistent between 2011 and 2012 except as follows:

  - The thickness of PSH southeast of the NCL treatment unit has decreased somewhat since 2011, but the plume has extended toward the south.

  - The extent of the PSH plume in the South Refinery Area appears fairly consistent, with a slight shift to the south of US-82 at MW-58. The thicknesses of PSH in this area have fluctuated and appear to fluctuate between seasons.

- Groundwater concentrations of organic constituents have generally remained stable or have exhibited slight increasing trends. Benzene exceedances of the CGWSL were observed in monitoring wells located east of Bolton Road in 2011 and were confirmed during the 2012 first and second semiannual events. However, the concentration of benzene in the dissolved phase east of Bolton Road decreased between the 2012 first and second semiannual events.

- The recovery trench system upgrades were completed in 2012 and the operation of the recovery system was more effective than in previous years.

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2012 Annual Groundwater Report
RCRA Permit No. NMD048918817
Discharge Permit GW-028

March 2013

ARCADIS

Pamela Krueger
Senior Project Manager, ARCADIS

2012 Annual Groundwater Report

RCRA Permit No. NMD048918817
Discharge Permit GW-028

Prepared for:

New Mexico Environment Department
Hazardous Waste Bureau
and
New Mexico Energy, Minerals and Natural Resources Department - Oil Conservation Division

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Date:

March 15, 2013

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Tables

Figures

Appendices (all on compact disc)

Certification

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Michael W. Holder
Environmental Manager, Navajo Refining

List of Acronyms

1,2,4-TMB	1,2,4-trimethylbenzene
2011 FWGMWP	2011 Facility-Wide Groundwater Monitoring Work Plan
2012 FWGMWP	2012 Facility-Wide Groundwater Monitoring Work Plan
ARCADIS	ARCADIS U.S., Inc.
CGWSL	Critical Groundwater Screening Level
COC	constituent of concern
DO	dissolved oxygen
DRO	diesel range organics
EP	Evaporation Pond
GRO	gasoline range organics
MCL	Maximum Contaminant Level
mg/L	milligrams per liter
MTBE	methyl tert-butyl ether
Navajo	Navajo Refining Company
NCL	North Colony Landfarm
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
NWS	National Weather Service
OCD	New Mexico Energy, Minerals and Natural Resources Department – Oil Conservation Division
ORP	oxidation-reduction potential
PCC Permit	Post-Closure Permit
PSH	phase-separated hydrocarbon
RCRA	Resource Conservation and Recovery Act
refinery	Artesia Refinery

report	2012 Annual Groundwater Report
RO	reverse osmosis
SESI	Safety and Environmental Solutions, Inc.
TDS	total dissolved solid
TEL	tetra ethyl lead
TMD	Three Mile Ditch
TPH	total petroleum hydrocarbon
VOC	volatile organic compound
WQCC	Water Quality Control Commission
µg/L	micrograms per liter

Executive Summary

Navajo Refining Company (Navajo) owns and operates the Artesia Refinery (refinery) in Artesia, New Mexico (Figure 1). The refinery has been in operation since the 1920s and processes crude oil into asphalt, fuel oil, gasoline, diesel, jet fuel, and liquefied petroleum gas. Navajo maintains a groundwater monitoring program according to the requirements of the Post-Closure Care Permit (PCC Permit), which is administered by the New Mexico Environment Department (NMED) Hazardous Waste Bureau. The PCC Permit (NMED 2010) was modified and reissued in December 2010 with an effective date of January 14, 2011. The PCC Permit (NMED 2010) also requires Navajo (the Permittee) to recover phase-separated hydrocarbons (PSHs), where present, from the shallow groundwater.

The refinery is also regulated by the New Mexico Energy, Minerals and Natural Resources Department – Oil Conservation Division (OCD). The OCD issued a renewal to Discharge Permit GW-028 (OCD 2012) dated August 22, 2012. Among other requirements, the Discharge Permit (OCD 2012) requires semiannual facility-wide groundwater monitoring and submittal of an annual report summarizing the groundwater monitoring and remediation conducted throughout each year.

On behalf of Navajo, ARCADIS U.S., Inc. (ARCADIS) prepared the 2011 Facility-Wide Groundwater Monitoring Work Plan (2011 FWGMWP; ARCADIS 2011b) which was submitted to the NMED and the OCD on June 28, 2011 with revisions submitted on October 14, 2011. The 2011 FWGMWP (ARCADIS 2011b) incorporates provisions of both the PCC Permit (NMED 2010) and the Discharge Permit (OCD 2012) and is updated annually, as required by the PCC Permit (NMED 2010). The first semiannual monitoring event of 2012, conducted between March 20 and April 19, 2012, was performed according to the 2011 FWGMWP (ARCADIS 2011b), as revised, which was approved on September 1, 2011 (NMED 2011).

The 2012 Facility-Wide Groundwater Monitoring Work Plan (2012 FWGMWP; ARCADIS 2012) was updated and submitted to the NMED and the OCD on June 28, 2012, as required by the PCC Permit (NMED 2010). Approval, with modifications, was received from the NMED in a letter dated January 7, 2013 (NMED 2013). The second semiannual monitoring event of 2012, conducted between September 10 and October 10, 2012, was performed according to the 2012 FWGMWP (ARCADIS 2012).

This 2012 Annual Groundwater Report (report) follows the format specified in Appendix E.4 of the PCC Permit (NMED 2010) and summarizes the activities performed throughout 2012 to comply with the 2011 and 2012 FWGMWPs (ARCADIS 2011b and 2012).

The activities performed during 2012 included installation of upgrades to the recovery trench system, repair of MW-42 and RW-2, collection of field data, collection of groundwater samples for chemical analyses, and remediation system monitoring. Section 2.6 of this report describes exceptions to the planned groundwater monitoring.

Field measurements, analytical data, and remediation system documentation are summarized in Sections 4.1, 4.2, 5.3, and 6 of this report. Maps showing the monitoring well locations and depicting the groundwater gradient, thickness of PSH, and diesel range organics, arsenic, benzene, naphthalene and methyl tert-butyl ether groundwater screening level exceedance areas are provided on Figures 2 through 18. Detailed plots of concentrations of constituents of concern in specific monitoring wells through time as well as plots of the static water level in those monitoring well versus time are provided in an appendix to the report.

The following conclusions are based upon the information obtained in 2012 and a comparison to data from prior years:

- Groundwater flow direction and gradient remain generally consistent with measurements obtained in previous years.

- The PSH plumes remained consistent between 2011 and 2012, with the following exceptions:

  - The thickness of PSH southeast of the North Colony Landfarm has decreased slightly since 2011, but the plume has extended toward the south.

  - The extent of the PSH plume in the South Refinery Area appears fairly consistent, with a slight shift to the south of US-82 at MW-58. The thicknesses of PSH in this area have fluctuated and appear to fluctuate between seasons.

- Groundwater concentrations of organic constituents have generally remained stable or have exhibited slight increasing trends. Benzene exceedances of the Critical Groundwater Screening Level were observed in monitoring wells east of Bolton Road in 2011 and were confirmed during the 2012 first and second semiannual events. However, the concentration of benzene in the dissolved phase east of Bolton Road decreased between the 2012 first and second semiannual events.

- The recovery trench system upgrades were completed in 2012 and operation of the recovery system was more effective after the upgrades than during previous years.

According to the requirements of the updated PCC Permit (NMED 2010), an updated FWGMWP will be submitted in June 2013.

1. Introduction

Navajo Refining Company (Navajo) owns and operates the Artesia Refinery (refinery) in Artesia, New Mexico (Figure 1). The refinery has been in operation since the 1920s and processes crude oil into asphalt, fuel oil, gasoline, diesel, jet fuel, and liquefied petroleum gas. The facility is regulated under the Resource Conservation and Recovery Act (RCRA). In October 2003, the Secretary of the New Mexico Environment Department (NMED) issued a Post-Closure Care Permit (PCC Permit) to Navajo for the Artesia Refinery Facility (United States Environmental Protection Agency ID number NMD048918817). The PCC Permit was modified and reissued in December 2010 (NMED 2010), with an effective date of January 14, 2011.

The PCC Permit (NMED 2010) authorizes and requires Navajo (the Permittee) to conduct post-closure care at the closed tetra ethyl lead (TEL) surface impoundment and the North Colony Landfarm (NCL) and to take appropriate actions to achieve RCRA closure of the inactive Evaporation Ponds (EPs). These areas and the locations of all existing monitoring and recovery wells are shown on Figure 2.

Among other action items, the PCC Permit (NMED 2010) requires the Permittee to maintain a groundwater monitoring program to evaluate the effectiveness of the corrective action program for groundwater and to meet the requirements of 20.4.1.500 New Mexico Administrative Code (NMAC) (incorporating 40 Code of Federal Regulations Part 264, Subpart F) during the post-closure care period. The PCC Permit (NMED 2010) also requires the Permittee to recover phase-separated hydrocarbons (PSHs), where present, from the shallow groundwater.

The refinery is also regulated by the New Mexico Energy, Minerals and Natural Resources Department – Oil Conservation Division (OCD). The OCD issued a renewal to Discharge Permit GW-028 (OCD 2012) dated August 22, 2012. Among other requirements, the Discharge Permit (OCD 2012) requires semiannual facility-wide groundwater monitoring and submittal of an annual report summarizing the groundwater monitoring and remediation conducted throughout each year.

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This 2012 Annual Groundwater Report (report) follows the format specified in Appendix E.4 of the PCC Permit (NMED 2010) and summarizes the activities performed throughout 2012 to comply with the 2011 and 2012 FWGMWPs (ARCADIS 2011b and 2012).

2. Scope of Services

This section describes groundwater monitoring and associated activities performed during 2012. The first semiannual sampling event was conducted from March 20 to April 19, 2012. The second semiannual sampling was conducted from September 10 to October 10, 2012.

2.1 Monitoring Well Installation, Damage, and Repairs

No monitoring wells were installed during 2012. However, recovery wells were installed in late 2011 as part of the upgrades to the recovery system. The survey elevation data for these wells is inconsistent with previously collected elevation data. The well completion logs for these recovery wells will be submitted to NMED under separate cover when the well elevations have been re-surveyed.

Damage to existing wells and repairs or adjustments were made in 2012 as described below:

- MW-42 was damaged prior to the first semiannual sampling event. The aboveground casing was repaired and the top of casing was resurveyed prior to the second semiannual sampling event.

- The casings on MW-59 and MW-60 were extended due to the installation of a parking lot soon after completion of the second semiannual sampling event. The new top of casings will be surveyed.

- MW-62 was converted from a stickup to a flush-mount surface completion after conducting the second semiannual sampling event. The new top of casing will be surveyed.

- The aboveground casing for MW-30 was damaged prior to the 2012 second semiannual event. The casing was repaired after the 2012 second semiannual event and the new top of casing will be surveyed.

2.2 Phase-Separated Hydrocarbon and Water Level Measurements

At the beginning of each of the two semiannual sampling events, Safety and Environmental Solutions, Inc. (SESI) measured the depth to PSH, depth to water, and total depth in the monitoring and recovery wells. Measurements were obtained using an oil/water interface probe attached to a measuring tape marked in 0.01-foot increments. The measurements were made in relation to the surveyed datum on each well casing. If the survey datum mark was not visible, measurements were obtained at the northern side of each well riser, which is the default survey datum location. Measurements were recorded on the field data sheets for each event.

Well gauging for the first semiannual sampling event was conducted from March 20 to 24, 2012. No rainfall was recorded at the National Weather Service (NWS) gauging station, located approximately 6 miles south of the refinery, during this time period. A copy of the NWS data for March 2012 and the field sampling notes for this event are provided in Appendix A.

Well gauging for the second semiannual sampling event was conducted from September 10 to 14, 2012. No rainfall was recorded at the NWS gauging station on September 10 or 11, 2012. However, 0.37 inch of rainfall was recorded at the gauging station between September 11 and 14, 2012. A copy of the NWS data for September 2011 is provided in Appendix A.

Table 1 summarizes the gauging data collected during both semiannual sampling events for 2012. Figures 3 through 6 depict the potentiometric surface maps for the shallow saturated zone and valley fill zone based on measurements collected during the two semiannual sampling events.

2.3 Groundwater Sample Collection and Handling

Groundwater samples were collected during each of the two semiannual sampling events. The wells designated for sample collection during the first semiannual sampling event were listed in the 2011 FWGMWP (ARCADIS 2011b). The wells designated for sample collection during the second semiannual sampling event are listed in the 2012 FWGMWP (ARCADIS 2012). According to both the 2011 and 2012 FWGMWPs (ARCADIS 2011b and 2012), if a well designated for sample collection contained more than 0.3 foot of PSH, no sample was collected from that well during that event.

Samples were collected from monitoring wells using low-flow sampling procedures consistent with the 2011 and 2012 FWGMWPs (ARCADIS 2011b and ARCADIS 2012). Samples collected from irrigation wells were collected from a valve in the irrigation piping as near to the well as possible. Table 2 indicates the method by which each well was purged and sampled.

Prior to collection of samples, each monitoring and recovery well was purged by pumping groundwater using a peristaltic pump and dedicated tubing. During the well purging process, water quality parameters, including pH, conductivity, dissolved oxygen (DO), temperature, and oxidation-reduction potential (ORP), were measured at regular intervals using a multiparameter water quality meter. The water quality parameters were recorded on the field log for each well and a copy of the field logs is provided in Appendix A. The final water quality parameters measured at each well are summarized in Table 2.

For monitoring wells that were sampled using low-flow procedures, purging was considered complete when at least four of the purge parameters had stabilized. The specified stabilization criteria are +/- 0.2 standard unit for pH, +/- 0.2 degree Celsius for temperature, +/- 0.2 milligram per liter (mg/L) for DO, +/- 0.02 Siemen per meter for specific conductance, and +/- 20 millivolts for ORP.

Samples were collected by directing the flow of water from the tubing directly into the prepared sample containers. Care was taken to not overflow the containers and potentially remove preservatives from pre-preserved containers.

Collected samples were submitted to an analytical laboratory for analyses of various constituent of concern (COCs) according to the 2011 and 2012 FWGMWPs (ARCADIS 2011b and 2012) and as discussed in Section 5 of this report. The appropriate containers for each set of analyses were shipped to the field by the laboratory. Sample labels were completed for each container and included the well identifier, sample identifier, date and time, sampler's initials, and analytical method(s) to be performed. Glass sample containers were placed in padded packing sleeves to prevent breakage. Sample containers were packed with ice in a shipping container. Shipping containers were sent overnight via Federal Express to the analytical laboratory.

Chain of custody forms were completed for each shipment to indicate which samples were included in that shipment and what analyses to perform for each sample. Copies of the chain of custody forms are included in Appendix B with the analytical data reports.

2.4 Equipment Decontamination Procedures

The oil/water interface probes used to gauge the PSH and water levels were decontaminated between uses in each well. Decontamination of the probes consisted of washing the probe and the attached tape measure in a mixture of water and non-phosphate detergent (Alconox™). The equipment was then rinsed with clean water. The clean water used for washing and rinsing was obtained from the refinery's reverse osmosis (RO) water system.

The flow-through cell used for low-flow purging and sample collection was decontaminated between uses in each well. The probes of the water parameter meters were also decontaminated between uses in each well. Decontamination of this equipment included submersing the flow-through cell in a mixture of water and non-phosphate detergent (Alconox™), washing the cell with a soft brush, submersing the probe end of the meters in the soapy water mixture, and brushing the end of the probe with a soft brush. The equipment was then rinsed with clean water from the refinery's RO water system.

Dedicated tubing was used for sample collection from each well; therefore, decontamination of sample collection tubing was not required. The dedicated tubing was left in the well between sampling events, with the upper portion coiled to ensure that the lower portion did not remain in the water column. At the beginning of each sampling event, the tubing was inspected and replaced if staining or mold was noted.

2.5 Investigation-Derived Waste

All purge water and decontamination liquids were contained in a portable tank in the sampling trailer. The liquids were disposed of daily in the refinery process wastewater system upstream of the API separator, by releasing the liquids into a sump designated by refinery personnel (typically the sump adjacent to the North Bundle Cleaning Pad).

Solid wastes included disposable gloves, paper towels, plastic bags, and used tubing. All solid waste was bagged and placed in the refinery trash receptacles for later disposal.

2.6 Exceptions to Groundwater Monitoring Work Plan

Exceptions to the planned groundwater monitoring are discussed below:

- First semiannual sampling event (March to April 2012):
  - KWB-3AR, KWB-9, and RA-1227 were not sampled because the landowner denied access. The removal of these wells from the sampling program, or the installation of alternate well locations will be addressed in the 2013 update to the FWGMWP scheduled to be submitted to NMED in June 2013.
  - KWB-12A was not sampled because it was dry.

- KWB-P2 was not sampled due to low water volume in the casing. This well is actually a piezometer and had less than 3 feet of water present when gauged. The well purges completely dry using either low-flow or submersible pumps. The removal of this well from the sampling program, or the installation of an alternate well will be addressed in the 2013 update to the FWGMWP scheduled to be submitted to NMED in June 2013.

- The gauging measurement for MW-40 was not included due to an equipment malfunction. PSH was detected in this well; therefore, a sample was not collected.

- MW-42 was sampled but not gauged because the well was damaged and water level measurement could not be determined. MW-42 was repaired prior to the 2012 second semiannual event.

- NCL-32 was not sampled because the well purged completely dry using low-flow pumps. The removal of this well from the sampling program, or the installation of an alternate well will be addressed in the 2013 update to the FWGMWP scheduled to be submitted to NMED in June 2013.

- NCL-34B is listed in the 2011 FWGMWP (ARCADIS 2011b) but does not exist. Therefore, a sample was not collected from this well. NCL-34B was removed from the proposed sampling program in the 2012 FWGMWP (ARCADIS 2012).

- RA 314 was not sampled because the well has been removed from service and no pump or power was available. Navajo does not own this irrigation well and has no authority to require the installation of a pump for sample collection. The removal of this well from the sampling program, or the installation of an alternate well, will be addressed in the 2013 update to the FWGMWP scheduled to be submitted to NMED in June 2013.

- RA-4196 was inadvertently analyzed for total chromium in addition to the analytes required by the 2011 FWGMWP (ARCADIS 2011b).

- RW-5, RW-6, RW-11-0, and RW-12 were not sampled because they were dry.

- The gauging measurement for RW-14 was not included because PSH was detected but no water was found because the water level was below the bottom of the casing.

- RW-15C was not gauged or sampled because a pump was present in the recovery well.

- RW-5R, RW-12R, RW-13R, RW-14R, and RW-22 were not included in the 2011 FWGMWP (ARCADIS 2011b) but were gauged by the recovery system operations and maintenance technicians at the same time as the first semiannual gauging event. These wells were not sampled; however, the gauging information is included in Table 1.

- Second semiannual sampling event (September to October 2012):

  - KWB-3AR, KWB-9, and RA-1227 were not sampled because the landowner denied access. The removal of these wells from the sampling program, or the installation of alternate well locations, will be addressed in the 2013 update to the FWGMWP scheduled to be submitted to NMED by June 28, 2013.

  - KWB-P2 was not sampled due to low water volume in the casing. This well is actually a piezometer and had less than 4 feet of water present when gauged. The well purges completely dry using low-flow procedures. The removal of this well from the sampling program, or the installation of an alternate well, will be addressed in the 2013 update to the FWGMWP scheduled to be submitted to NMED in June 2013.

  - KWB-P3 and MW-17 were inadvertently gauged even though the 2012 FWGMWP (ARCADIS 2012) indicated that these wells were not included in the gauging program.

  - MW-30 could not be gauged because the well was damaged. A sample was not collected from this well per the 2012 FWGMWP (ARCADIS 2012).

  - MW-58 was gauged and PSH was detected; however, due to a field oversight, the depth to PSH was not recorded in the field notes.

– NCL-32 was not sampled because the well purged completely dry using low-flow pumps. The removal of this well from the sampling program, or the installation of an alternate well, will be addressed in the 2013 update to the FWGMWP scheduled to be submitted to NMED in June 2013.

– The gauging measurement for RW-5 was not included because PSH was detected but no water was found because the water level was below the bottom of the casing.

– RW-5R, RW-12R, RW-13R, RW-14R, RW-19, RW-20, and RW-22 were not included in the 2012 FWGMWP (ARCADIS 2012) but were gauged by the recovery system operations and maintenance technicians at the same time as the second semiannual gauging event. These wells were not sampled but the gauging information is included in Table 1.

3. Regulatory Criteria

Regulatory standards used to evaluate the data collected for the groundwater monitoring program are based on the presumption that the shallow groundwater might be used as a source of drinking water. The screening level value used for each COC is the lower value of either the New Mexico Water Quality Control Commission (WQCC) standards from 20.6.2.3103 NMAC or the Maximum Contaminant Level (MCL) from the National Primary Drinking Water Standards. For COCs where neither a WQCC standard or MCL exists, the screening level value used is the NMED Tap Water Standard listed in the Risk Assessment Guidance for Site Investigations and Remediation (NMED 2012). For total petroleum hydrocarbons (TPHs), the TPH Screening Guidelines for Potable Groundwater for unknown oil included in Table 6-2 of the Risk Assessment Guidance for Site Investigations and Remediation (NMED 2012) was used, as corrected by subsequent correspondence from the NMED.

Table 3 lists the screening levels from each source and summarizes the Critical Groundwater Screening Level (CGWSL) for each COC. The CGWSL for each COC is also provided in the data summary tables, which are discussed later in this report.

4. Monitoring Results

Groundwater monitoring events occurred semiannually, as required by the PCC Permit (NMED 2010) and the Discharge Permit (OCD 2012). This section describes the results of the field activities conducted according to the 2011 and 2012 FWGMWPs (ARCADIS 2011b and 2012).

4.1 Groundwater Gauging Results

The first semiannual sampling event was conducted from March 20 to April 19, 2012. The second semiannual sampling event was conducted from September 10 to October 10, 2012. As discussed in Section 2, the depth to PSH (if present) and depth to water was measured in each well at the beginning of each sampling event. These measurements are summarized in Table 1.

The measurements of depth to groundwater and depth to PSH (if present) were used to create groundwater gradient maps and PSH thickness maps for the 2012 semiannual events (Figures 3 through 8). For those wells where PSH was present, the groundwater elevation measurement was adjusted to determine the potentiometric surface elevation, assuming a specific gravity of 0.8 for the PSH. Plots of the groundwater elevation through time are for key monitoring wells provided on CD in Appendix C, at the OCD's request. For these wells with consistent PSH presence, plots of PSH thickness through time are also provided in Appendix C.

The groundwater potentiometric surface for the 2012 first semiannual event is depicted on Figures 3 and 4 for the shallow saturated zone and for the valley fill zone, respectively. The groundwater potentiometric surface for the 2012 second semiannual event is depicted on Figures 5 and 6 for the shallow saturated zone and for the valley fill zone, respectively. As shown on these figures, the groundwater flow direction beneath the refinery is consistently to the east, toward the Pecos River. The groundwater flow direction beneath the EPs is generally to the southeast.

The gradient through the refinery is not uniform and appears to be influenced slightly by the recovery pumps, specifically in the area around RW-1 and RW-2 (northwest portion of refinery), RW-5/RW-5R (southern portion of refinery) and RW-15 (southeastern corner) during both semiannual gauging events. During the second semiannual event there appears to be mounding around MW-28. This gauging data may be anomalous and will be re-evaluated during the 2013 first semiannual event. The gradient becomes more flat in the area beneath the EPs.

4.2 Phase-Separated Hydrocarbons

Isopleths of PSH thickness are shown on Figures 7 and 8 for the 2012 first and second semiannual events, respectively. As shown, PSH is present in five distinct areas at the refinery: three areas in the northern portion of the refinery (NCL treatment unit, TEL surface impoundment, and North Refinery Area), one area in the southeastern portion of the refinery extending to east of the refinery near Bolton Road, and one area on the western end of the EPs near the former discharge point into Pond 1. During the 2012 first semiannual event, PSH was detected in MW-39 near the TEL surface impoundment; however, the measurement was anomalous and is not shown on Figure 7. PSH was detected in MW-39 during the 2012 second semiannual event at 0.04 foot, as shown on Figure 8. Each area of interest is discussed in the following subsections. Additional information on recovery activities is provided in Section 6.

4.2.1 North Colony Landfarm Treatment Unit

As shown in Table 1 and on Figures 7 and 8, PSH was present in NCL-34A at thicknesses of 3.97 feet and 0.16 foot during the 2012 first and second semiannual events, respectively. PSH was not measured in this well prior to 2011, but was measured at thicknesses of greater than 5 feet during the 2011 semiannual events. PSH is being recovered periodically from NCL-34A and placed in the refinery's waste oil system for recycling.

PSH was present south and southeast of the NCL treatment unit. As shown in Table 1 and on Figures 7 and 8, PSH was present in MW-67, MW-91, MW-94, and RW-7 during the 2012 semiannual events. PSH was also detected in RW-8 at a thickness of 2.20 feet during the 2012 first semiannual event, but was not detected during the 2012 second semiannual event.

The PSH thickness decreased between the 2012 first and second semiannual events in MW-67, MW-94, and RW-7 from 2.06 to 1.78 feet in MW-67, 4.21 feet to 0.89 foot in MW-94, and 3.33 feet to 0.04 foot in RW-7. The PSH thickness increased in MW-91 between the 2012 first and second semiannual event from 0.24 to 0.50 foot. Historically, PSH has not been present in MW-91 but was present for the first time in 2011 in RW-7 and MW-67. The detected PSH thicknesses in MW-67 were consistent with the thicknesses detected during 2011. During the 2012 first semiannual event, the measured PSH thickness in RW-7 was greater than the detected thicknesses during the 2011 first and second semiannual events (2.40 feet and 0.93 foot, respectively). However, during the 2012 second semiannual event, the PSH thickness in RW-7 decreased to below the thicknesses detected in 2011.

In September 2010, an increase in PSH thickness in MW-94 was observed and attributed to leaking underground piping in the area. This leak may have caused the presence of PSH in NCL-34A, RW-7, MW-67, and MW-91 because PSH was not observed in these wells prior to 2011.

PSH is being recovered from MW-94, RW-7 and RW-8 periodically by bailing and/or pumping. The PSH thickness in MW-94 decreased from greater than 6 feet during the 2011 semiannual events, to 4.21 feet and 0.89 foot during the 2012 first and second semiannual events, respectively. The PSH thickness measured in RW-7 increased between September 2011 (0.93 foot) and March 2012 (3.33 feet), but decreased to 0.04 foot in September 2012. The PSH thickness measured in RW-8 increased between September 2011 (0.65 foot) and March 2012 (2.20 feet), but was not detected in RW-8 in September 2012. The recovered PSH is placed in the refinery's waste oil system for recycling. The wells in this area will continue to be monitored to evaluate the effectiveness of the recovery efforts.

4.2.2 Former Tetra Ethyl Lead Impoundment Area

As shown in Table 1 and on Figures 7 and 8, no PSH was measured in the TEL wells during either 2012 semiannual event; however, PSH was detected in MW-39 just northeast of well TEL-1. Due to a probe malfunction during the 2012 first semiannual event, the PSH/water interface could not be determined. During the 2012 second semiannual event, a PSH thickness of 0.04 foot was observed, which is consistent with historical measured PSH thicknesses in MW-39.

4.2.3 Evaporation Ponds Area

As shown in Table 1 and on Figures 7 and 8, PSH is present in MW-85 and MW-86, which are located near the original discharge point in EP 1. The PSH thickness measured in March 2012 was 1.73 and 1.12 feet in MW-85 and MW-86, respectively. In September 2012, the PSH thickness was 2.24 and 1.18 feet in MW-85 and MW-86, respectively. The PSH thicknesses in these wells in 2011 ranged from 1 foot to approximately 1.5 feet during the 2012 first and second semiannual events.

PSH is periodically removed from these two wells by bailing and is placed in the refinery's waste oil system for recycling.

4.2.4 Three Mile Ditch

As shown in Table 1 and on Figures 7 and 8, no measurable PSH was present in any wells along Three Mile Ditch (TMD) during 2012.

4.2.5 North Refinery Area

As shown in Table 1 and on Figures 7 and 8, PSH was present in RW-1, RW-2, MW-92, MW-97, and MW-105 in March 2012 with reported thicknesses of 0.19 foot, 3.61 feet, 2.91 feet, 4.87 feet, and 0.60 foot, respectively. In September 2012, PSH was present in RW-1, RW-2, MW-92, MW-97, and MW-105 with reported thicknesses of 0.05 foot, 0.10 foot, 0.27 foot, 2.04 feet, and 0.31 foot, respectively.

Prior to 2011, MW-92 did not contain measurable PSH. The PSH thickness in MW-92 increased from 0.86 foot in September 2011 to 2.91 feet in March 2012, but decreased to 0.27 foot in September 2012. The PSH thickness measured in MW-97 increased between September 2011 (3.57 feet) and March 2012 (4.87 feet), but decreased to 2.04 feet in September 2012. The PSH thicknesses in RW-1 and MW-105 observed in 2012 are generally consistent with the historical PSH thicknesses observed in these wells. The PSH thickness in RW-2 increased from 1.01 feet in September 2011 to 3.61 feet in March 2012, but decreased during the 2012 second semiannual event. Investigations in the area did not indicate the presence of any obvious leaks.

PSH is periodically recovered from MW-97, RW-1, and RW-2 by bailing and/or pumping. The recovered PSH is placed in the refinery's waste oil system for recycling. The wells in this area will continue to be monitored to evaluate the effectiveness of the recovery efforts.

4.2.6 South Refinery Area

As shown in Table 1 and on Figures 7 and 8, PSH was present in RW-4, RW-5R, KWB-2R, KWB-4, KWB-5, MW-48, MW-58, MW-64, MW-65, and MW-102 in March 2012, with reported thicknesses of 0.59 foot, 2.60 feet, 1.25 feet, 3.67 feet, 2.61 feet, 0.28 foot, 0.90 foot, 3.52 feet, 3.69 feet, and 3.06 feet, respectively. PSH was also present in RW-4, RW-5R, KWB-2R, KWB-4, KWB-5, MW-48, MW-64, MW-65, and MW-102 in September 2012, with reported thicknesses of 0.14 foot, 4.30 feet, 0.05 foot, 2.37 feet, 0.05 foot, 0.47 foot, 0.53 foot, 2.02 feet, and 2.24 feet, respectively. PSH was also detected in MW-58 in September 2012, but the PSH thickness was not recorded.

PSH was not detected in MW-58 prior to the 2012 gauging events, and was first detected in KWB-2R in 2011. RW-5R was installed in 2011 as part of the upgrades to the recovery system and was not previously gauged prior to the 2012 gauging events. PSH thicknesses generally increased in most of the locations identified above between September 2011 and March 2012 and then decreased between March and September 2012.

PSH is periodically removed from MW-58, MW-64, MW-65, MW-102, KWB-2R, KWB-4, and KWB-5 by bailing; PSH is removed regularly from RW-5R by pumping. The recovered PSH is placed in the refinery's waste oil system for recycling.

4.2.7 Field East of Refinery

As shown in Table 1 and on Figures 7 and 8, PSH is present in RW-13, RW-13R, RW-14R, KWB-6, KWB-8, and KWB-10R in March 2012 with reported thicknesses of 1.00 foot, 0.60 foot, 2.60 feet, 3.26 feet, 4.08 feet, and 0.35 foot, respectively. PSH was also present in RW-14, but the thickness could not be measured because the water level was below the bottom of the casing. PSH was present in RW-12, RW-12R, RW-13, RW-13R, RW-14, RW-14R, KWB-6, KWB-8, and KWB-10R in September 2012, with reported thicknesses of 0.10 foot, 0.30 foot, 0.64 foot, 3.85 feet, 1.06 feet, 1.35 feet, 1.32 feet, 0.53 foot, and 0.26 foot, respectively.

RW-12R, RW-13R, and RW-14R were installed in 2011 as part of the upgrades to the recovery system and were not previously gauged prior to the 2012 gauging events. Except at KWB-10R, where the PSH thickness remained fairly consistent, PSH thicknesses generally increased in most of the locations identified above between September 2011 and March 2012 and then decreased between March and September 2012. PSH is routinely removed from this plume by bailing and/or pumping, primarily from the newly installed recovery wells and from the "Chase well," which is located just east of Bolton Road and is also referred to as RW-20. The upgraded recovery system began operation in May 2012. The recovered PSH is placed in the refinery's waste oil system for recycling.

5. Chemical Analytical Data

5.1 Sample Analyses

The samples collected during the first semiannual sampling event conducted in March and April 2012 and the second semiannual event conducted in September and October 2012 were analyzed for various COCs, according to the 2011 and 2012 FWGMWPs (ARCADIS 2011b and 2012). The COCs and analytical methods conducted for the first and second semiannual sampling events included the following:

- Total petroleum hydrocarbons - diesel range organics (DRO) by Method 8015 Modified.
- Total petroleum hydrocarbons - gasoline range organics (GRO) by Method 8015 Modified.
- Volatile organic compounds (VOCs) by Method 8260.
- Metals by Methods 6020 and 7470. The standard analyte list included analysis of arsenic, barium, chromium, iron, lead, manganese, and selenium. In select wells, an additional analyte list included analysis of mercury, nickel, and vanadium.
- Cyanide by Method 4500.
- Major cations and anions (calcium, chloride, fluoride, potassium, sodium, sulfate) by Methods 6020 and 300.
- Nitrates/nitrites (as nitrogen) by Method 300.
- Total dissolved solids (TDS) by Method 2540.

Not every sample was analyzed by every method listed above. The specific analytical suite chosen for each sample was based on the 2011 and 2012 FWGMWPs (ARCADILS 2011b and 2012).

The laboratory analytical reports are included in electronic format in Appendix B.

5.2 Data Validation

The analytical data were reviewed and validated following the guidelines of the PCC Permit (NMED 2010). The data validation and a discussion of any data quality exceptions are included on CD in Appendix D. Data qualifier flags were added to the data based on the data validation results and are included in tabulated form in Appendix B.

Although some data quality exceptions were noted, the data are generally usable for the purpose intended.

5.3 Discussion of Analytical Data

The PCC Permit (NMED 2010) requires that this report include the analytical data for the current monitoring event and the three prior sampling events. Because some wells are sampled semiannually, some wells are sampled annually, and some wells are sampled biennially, the timeframe required to provide data for three prior sampling events varies by well. To simplify the data presentation, the monitoring data for 2010 through 2012 are presented in Appendix B for all wells sampled and for all compounds analyzed. This provides data for three prior events for the majority of the wells and at least two prior events for those wells sampled annually. The CGWSL is provided at the top of the data table and exceedances of the CGWSL are highlighted in yellow. The data are presented by well numeric order in the tables in Appendix B. The tables have been divided by major analytical group.

Table 4 summarizes the analytical data for the wells sampled during 2012, sorted by the area in which the well is located. Table 4 includes the following subset of the compounds analyzed:

- GRO
- DRO
- Total metals (arsenic, barium, chromium, iron, lead, manganese, mercury, nickel, selenium, and vanadium)
- VOCs (compounds that have had at least one detected value reported above the CGWSL in more than one well)

- Cyanide
- Major cations and anions (calcium, chloride, fluoride, potassium, sodium, and sulfate)
- Water quality parameters (TDS and nitrate/nitrite)

Data from 2010 through 2012 are provided in Table 4 to provide comparison to at least three prior sampling events for those wells that are sampled semiannually. The CGWSL used for comparison against the analytical results from each well are presented at the top of the table; concentrations of COCs that exceed the screening levels are highlighted.

As required by the Discharge Permit (OCD 2012), historical concentrations from 2004 through 2012 of select COCs that have consistently been detected at concentrations above the groundwater screening levels in samples collected from site wells are presented in trend plots provided on a CD in Appendix C. These plots are organized by well within major areas of interest and include trend plots for the following indicator COCs:

- GRO
- DRO
- Benzene
- Ethylbenzene
- Toluene
- Total xylenes
- Methyl tert-butyl ether (MTBE)
- Naphthalene
- Arsenic

Appendix C also includes trend plots of water level elevations and PSH thicknesses.

Figures 9 through 18 depict the extent of the groundwater screening level exceedance areas for the following major COCs for both the first and second semiannual 2012 sampling events:

- DRO
- Arsenic
- Benzene
- Naphthalene
- MTBE

Slight changes in the concentrations of COCs have occurred through time, but the general shape of the dissolved-phase plumes did not change in 2012 (except for arsenic). The concentrations of total arsenic in some of the wells in the TEL surface impoundment and North Refinery Area were above the CGWSL and generally were not detected above the CGWSL during previous events. Additionally, arsenic was detected in MW-89 along TMD during the 2012 first semiannual event.

During the 2011 second semiannual event, benzene was detected above the CGWSL for the first time in the sample collected from KWB-7. Benzene was detected above the CGWSL during both 2012 semiannual events. The benzene concentration in KWB-7 increased between the 2011 second semiannual event and the 2012 first semiannual event from 41 to 280 micrograms per liter (µg/L), but decreased to 5.6 µg/L during the 2012 second semiannual event. The decrease observed during the 2012 second semiannual event is likely related to the operation of the improved recovery system. It should be noted that benzene has historically been detected in MW-15 along TMD, but was not detected in April 2012.

The analytical results for 2012 are discussed in the following subsections by major area of interest.

5.3.1 North Colony Landfarm Treatment Unit

Groundwater monitoring is ongoing beneath and near the closed NCL treatment unit. As shown in Table 4, concentrations of several COCs exceeded the CGWSL in samples collected during 2012 from wells in and near the NCL treatment unit, as discussed in the following subsections.

5.3.1.1 Total Petroleum Hydrocarbons – Diesel Range Organics

Samples were collected from eight wells in and near the NCL treatment unit during the first semiannual sampling event and analyzed for DRO. These wells included NCL-31, NCL-33, NCL-44, NCL-49, MW-18, MW-54A, MW-108, and RW-17A. DRO concentrations in samples collected from NCL-49 and MW-54A were below the CGWSL, while the DRO concentrations from the other six samples were above the CGWSL.

Samples were collected from seven wells in and near the NCL treatment unit during the second semiannual sampling event and analyzed for DRO. These wells included NCL-31, NCL-33, NCL-44, NCL-49, MW-18, MW-54A, and MW-108. The DRO concentration in the sample collected from NCL-49 was below the CGWSL, while the DRO concentrations in the other six samples were above the CGWSL.

Concentrations in individual wells fluctuated slightly between sampling events, but demonstrate an overall stable to slightly increasing trend.

5.3.1.2 Volatile Organic Compounds

Samples were collected from eight wells in and near the NCL treatment unit and were analyzed for VOCs during the 2012 first semiannual sampling event. These wells included NCL-31, NCL-33, NCL-44, NCL-49, MW-18, MW-54A, MW-108, and RW-17A. Benzene and 1,2,4-trimethylbenzene (1,2,4-TMB) concentrations exceed the CGWSLs in the sample collected from MW-108. The concentrations for benzene and 1,2,4-TMB were below the CGWSLs in samples from all of the other wells in and near the NCL treatment unit.

Samples were collected from seven wells in and near the NCL treatment unit during the 2012 second semiannual sampling event and were analyzed for VOCs. These wells included NCL-31, NCL-33, NCL-44, NCL-49, MW-18, MW-54A, and MW-108. Benzene and 1,2,4-TMB concentrations exceeded the CGWSLs in the sample collected from MW-108. The concentrations of benzene and 1,2,4-TMB were below the CGWSLs in samples from all of the other wells in and near the NCL treatment unit.

The concentrations of VOCs fluctuated between sampling events, but demonstrate an overall stable trend.

5.3.1.3 Total Metals

The same samples collected from wells in and near the NCL treatment unit during the 2012 first and second semiannual events that were analyzed for DRO were also analyzed for the standard analyte list for total metals identified in Section 5.1 (arsenic, barium, chromium, iron, lead, manganese, and selenium). Additionally, well MW-18 was sampled for the additional analyte list for total metals identified in Section 5.1 (mercury, nickel, and vanadium) during both 2012 semiannual events.

No exceedances of the CGWSL were present in any of the samples collected from the wells in and near the NCL treatment unit in 2012 for barium, chromium, lead, mercury, nickel, selenium, or vanadium. Exceedances of the CGWSL occurred for arsenic, iron, and manganese as follows:

- The reported concentration of arsenic exceeded the CGWSL in samples collected from well NCL-44 during the 2012 first and second semiannual events.

- The reported concentrations of iron exceeded the CGWSL in samples collected from NCL-33 and NCL-44 during the 2012 first and second semiannual events.

- The reported concentrations of manganese exceeded the CGWSL in samples collected from wells NCL-31, NCL-44, and MW-54A during the 2012 first and second semiannual events. Manganese exceeded the CGSWL in the sample collected from RW-17A during the 2012 first semiannual event; RW-17A was not sampled during the 2012 second semiannual event.

5.3.1.4 Water Quality Parameters

Concentrations of chloride, fluoride, sulfate, and TDS exceed the respective CGWSL in samples from various wells in and near the NCL treatment unit. The reported concentrations of these constituents exhibit an overall stable trend.

5.3.2 Former Tetra Ethyl Lead Impoundment

Groundwater monitoring beneath the closed TEL surface impoundment is ongoing. Samples were collected from the four TEL wells (TEL-1, TEL-2, TEL-3, and TEL-4) during the 2012 semiannual monitoring events. As shown in Table 4, concentrations of several COCs exceed the CGWSL in samples collected from the TEL wells, as discussed in the following subsections.

5.3.2.1 Total Petroleum Hydrocarbons – Gasoline Range Organics

GRO was reported above detection limits in samples from all four of the TEL wells. The NMED TPH guidance document does not provide a screening value for GRO, but indicates that individual VOCs should be analyzed. The reported concentrations of GRO appear to be stable in samples from this area.

5.3.2.2 Total Petroleum Hydrocarbons – Diesel Range Organics

Reported concentrations for DRO exceed the CGWSL in samples from all four of the TEL wells. Concentrations in samples from individual wells fluctuated between sampling events.

5.3.2.3 Volatile Organic Compounds

Various VOCs were detected in samples from the four TEL wells at concentrations above the respective CGWSLs, as follows:

- Benzene was not detected in the samples collected from TEL-1. Benzene concentrations reported for samples collected from TEL-2, TEL-3, and TEL-4 exceeded the CGWSL.

- 1,2,4- TMB was not detected in the samples collected from TEL-1. 1,2,4-TMB was reported at concentrations above the CGWSL for samples collected from TEL-2, TEL-3, and TEL-4.

- MTBE was either not detected or was detected at concentrations below the CGWSL in the samples collected from the TEL-1, TEL-2, and TEL-3. The reported concentrations of MTBE in the samples collected from TEL-4 were above the CGWSL during the 2012 first semiannual event.

VOC concentrations fluctuated between sampling events, but demonstrate an overall stable trend.

5.3.2.4 Total Metals

Samples were collected from the four TEL wells and analyzed for the standard metals analyte list identified in Section 5.1 including: arsenic, barium, chromium, iron, lead, manganese, mercury, and selenium.

No exceedances of the CGWSL have been reported during the past 3 years for barium, iron, lead, mercury, or selenium in samples from any of the four TEL wells. Exceedances of the CGWSL have not been reported for any analyte in samples from wells TEL-1 and TEL-3. Exceedances of the CGWSL did occur for arsenic, chromium, and manganese as follows:

- The reported concentrations of arsenic exceeded the CGWSL in samples collected from well TEL-2 during the 2012 first and second semiannual events and well TEL-4 during the 2012 second semiannual event.

- The reported concentration of chromium exceeded the CGWSL in the sample collected from well TEL-4 during the 2012 second semiannual event.

- The reported concentrations of manganese exceeded the CGWSL in samples collected from well TEL-4 during the 2012 first and second semiannual events.

The arsenic concentrations reported for the samples from wells TEL-2 and TEL-4 fluctuated between sampling events, but demonstrate an overall stable trend. The chromium and manganese concentrations reported for the samples from TEL-4 collected during the 2012 first and second semiannual events were similar to concentrations reported for previous samples from this well, but the concentrations appear to be fluctuating.

5.3.2.5 Water Quality Parameters

Concentrations of chloride, fluoride, sulfate, and TDS exceeded the respective CGWSL in samples collected from various wells in the TEL surface impoundment. The reported concentrations of these constituents exhibit an overall stable trend except for slight increases in fluoride concentrations observed in samples from TEL-3 and TEL-4 during the past 3 years.

5.3.3 Evaporation Ponds

Groundwater monitoring is ongoing beneath the inactive former EPs. As shown in Table 4, concentrations of several COCs exceed the CGWSL in samples collected from the EP wells, as discussed in the following subsections.

5.3.3.1 Total Petroleum Hydrocarbons – Gasoline Range Organics

Samples were collected from 34 wells in and around the EPs and analyzed for GRO during the 2012 first semiannual sampling event. These wells included MW-2A, MW-3, MW-4A, MW-5A, MW-6A, MW-7A, MW-10, MW-11A, MW-15, MW-22A, MW-70, MW-72, MW-73, MW-74, MW-75, MW-76, MW-77, MW-78, MW-79, MW-80, MW-81, MW-82, MW-83, MW-84, MW-87, MW-88, OCD-1R, OCD-2A, OCD-3, OCD-4, OCD-5, OCD-6, OCD-7AR, and OCD-8A. GRO concentrations were above detection limits in samples collected from 24 of the 34 wells.

Samples were collected from 27 wells in and around the EPs and analyzed for GRO during the 2012 second semiannual sampling event. These wells included MW-2A, MW-3, MW-4A, MW-5A, MW-7A, MW-10, MW-22A, MW-70, MW-72, MW-73, MW-74, MW-75, MW-76, MW-77, MW-79, MW-83, MW-84, MW-87, MW-88, OCD-1R, OCD-2A, OCD-3, OCD-4, OCD-5, OCD-6, OCD-7AR, and OCD-8A. GRO concentrations were above detection limits in samples collected from 20 of the 27 wells.

The NMED (NMED 2012) does not provide a specific screening value for GRO, but indicates that individual VOCs should be analyzed. The reported concentrations of GRO fluctuate through time, but in general show a stable or decreasing trend over the past 3 years.

5.3.3.2 Total Petroleum Hydrocarbons – Diesel Range Organics

Samples were collected from 36 wells in and around the EPs and analyzed for DRO during the 2012 first semiannual sampling event. These wells in included MW-1R, MW-2A, MW-3, MW-4A, MW-5A, MW-6A, MW-7A, MW-10, MW-11A, MW-15, MW-18A, MW-22A, MW-70, MW-72, MW-73, MW-74, MW-75, MW-76, MW-77, MW-78, MW-79, MW-80, MW-81, MW-82, MW-83, MW-84, MW-87, MW-88, OCD-1R, OCD-2A, OCD-3, OCD-4, OCD-5, OCD-6, OCD-7AR, and OCD-8A. The reported DRO concentrations were above the CGWSL in 24 of the samples collected from these 36 wells.

Samples were collected from 27 wells in and around the EPs and analyzed for DRO during the second semiannual sampling event. These wells included MW-2A, MW-3, MW-4A, MW-5A, MW-7A, MW-10, MW-18A, MW-22A, MW-70, MW-72, MW-74, MW-75, MW-76, MW-77, MW-79, MW-83, MW-84, MW-87, MW-88, OCD-1R, OCD-2A, OCD-3, OCD-4, OCD-5, OCD-6, OCD-7AR, and OCD-8A. The reported DRO concentrations were above the CGWSL in 19 of the samples collected from these 27 wells.

In general, the DRO concentrations in groundwater samples collected from the EPs exhibit a stable or increasing trend. It should be noted that the DRO concentration in MW-77 increased to 40 mg/L in the sample collected in September 2012; this concentration is one order of magnitude greater than the previously detected concentrations of DRO in this well. DRO concentrations in MW-77 will be monitored during the 2013 first semiannual event.

5.3.3.3 Volatile Organic Compounds

Samples collected from the 36 wells in and around the EPs during the 2012 first semiannual event that were analyzed for DRO were also analyzed for VOCs. Samples collected from the 27 wells in and around the EPs during the 2012 second semiannual event that were analyzed for DRO were also analyzed for VOCs. Also, one sample was collected from well MW-73 during the 2012 second semiannual event; MW-73 was not tested for DRO during the 2012 second semiannual event.

No VOCs were reported above their respective CGWSL in the samples taken during the 2012 semiannual events.

5.3.3.4 Total Metals

Samples collected from the 36 wells in and around the EPs during the 2012 first semiannual event that were analyzed for DRO were also analyzed for the standard analyte list for total metals identified in Section 5.1 (arsenic, barium, chromium, iron, lead, manganese, and selenium). During the 2012 first semiannual event, three wells (including MW-18A, MW-77, and OCD-8A) were sampled for the additional analyte list for total metals identified in Section 5.1 (mercury, nickel, and vanadium).

Samples collected from the 27 wells in and around the EPs during the 2012 second semiannual event that were analyzed for DRO were also analyzed the standard analyte list for total metals. Also, one sample was collected from well MW-73 during the 2012 second semiannual event; MW-73 was not tested for DRO during the 2012 second semiannual event. During the 2012 second semiannual event, three wells (including MW-18A, MW-77, OCD-8A) were sampled for the additional analyte list for total metals (mercury, nickel, and vanadium).

No exceedances of the CGWSL were present in any of the samples collected from the wells in and near the EPs in 2012 for barium, chromium, lead, mercury, nickel, selenium, or vanadium. Exceedances of the CGWSL did occur for arsenic, iron, and manganese as follows:

- For the 2012 first semiannual sampling event, arsenic concentrations were above the CGWSL in samples collected from 23 of the 36 wells in and near the EPs. For the 2012 second semiannual sampling event, arsenic concentrations were above the CGWSL in samples collected from 22 of the 28 wells in and near the EPs.

- For the 2012 first semiannual sampling event, iron concentrations were above the CGWSL in samples collected from 25 of the 36 wells in and near the EPs. For the 2012 second semiannual sampling event, iron concentrations were above the CGWSL in samples collected from 24 of the 28 wells in and near the EPs.

- For the 2012 first semiannual sampling event, manganese concentrations were above the CGWSL in samples collected from all 36 wells in and near the EPs. For the 2012 second semiannual sampling event, manganese concentrations were above the CGWSL in samples collected from all 28 wells in and near the EPs.

5.3.3.5 Cyanide

Samples collected from three select wells (MW-18A, MW-77, and OCD-8A) in and downgradient from the EPs were analyzed for cyanide. No detectable concentrations of cyanide were present in the samples collected from these wells.

5.3.3.6 Water Quality Parameters

Samples collected from the 36 wells in and around the EPs during the 2012 first semiannual event that were analyzed for DRO, were also analyzed for water quality parameters. During the 2012 second semiannual event, samples collected from 13 of the 27 wells in and around the EPs that were analyzed for DRO were also analyzed for all water quality parameters (except TDSs). These wells included MW-2A, MW-3, MW-4A, MW-5A, MW-7A, MW-18A, MW-72, MW-74, MW-75, MW-76, MW-77, MW-79, and MW-83. Also, one sample was collected from MW-73 and analyzed for water quality parameters (except TDSs).

Samples collected from six wells in and around the EPs during the 2012 second semiannual event that were analyzed for DRO were also analyzed for calcium, potassium, and sodium. These wells included MW-84, OCD-1R, OCD-2A, OCD-3, OCD-6, and OCD-7AR.

A sample collected from MW-10 during the 2012 second semiannual event was analyzed for DRO was also analyzed for chloride, fluoride, and sulfate.

Concentrations of chloride, fluoride, sulfate, and TDS exceeded the respective CGWSL in various wells in and around the EPs. The reported concentrations of these constituents exhibit an overall stable trend.

5.3.4 Three Mile Ditch

Groundwater monitoring is ongoing along the inactive, backfilled TMD. As shown in Table 4, concentrations of several COCs exceed the CGWSL in samples collected from the TMD wells, as discussed in the following subsections.

5.3.4.1 Total Petroleum Hydrocarbons – Gasoline Range Organics

Samples were collected from wells MW-8 and MW-21 along TMD and analyzed for GRO during the 2012 first and second semiannual events. GRO was not detected above the laboratory detection limit for any of the samples collected from these wells during either sampling event.

5.3.4.2 Total Petroleum Hydrocarbons – Diesel Range Organics

Samples were collected from 10 wells along TMD and analyzed for DRO during the 2012 first semiannual sampling event. These wells included MW-8, MW-16, MW-20, MW-21, MW-25, MW-26, MW-27, MW-68, MW-71, and MW-89. Samples were collected from three wells along TMD and analyzed for DRO during the 2012 second semiannual sampling event. These wells included MW-8, MW-21, and MW-71.

DRO was not detected above the CGWSL in any samples collected from wells along TMD. The only reported detection of DRO above the laboratory detection limit was in the sample collected from MW-89 in April 2012.

5.3.4.3 Volatile Organic Compounds

The same samples collected from wells along TMD that were analyzed for DRO, were also analyzed for VOCs. In addition, the samples collected from NP-1 during the 2012 semiannual sampling events and from NP-6 during the 2012 first semiannual sampling event were analyzed for VOCs.

MTBE is the only VOC reported at concentrations above the CGWSL in samples collected from wells along TMD. The reported MTBE concentration exceeded the CGWSL in the sample collected from NP-1 in April 2012, but was below the CGWSL in the sample collected from NP-1 in September 2012. The MTBE concentration in this well fluctuated, but has been relatively stable since 2010. MTBE has not been detected at concentrations exceeding the CGWSL in any of the samples collected from other wells along TMD.

5.3.4.4 Total Metals

The same samples collected from wells along TMD during the 2012 first and second semiannual events that were analyzed for DRO, were also analyzed for the standard analyte list for total metals identified in Section 5.1 (arsenic, barium, chromium, iron, lead, manganese, and selenium). Additionally, MW-71 was sampled for the additional analyte list for total metals identified in Section 5.1 (mercury, nickel, and vanadium) during both the 2012 first and second semiannual events.

No exceedances of the CGWSL were present in any of the samples collected during 2012 from the wells along TMD and analyzed for barium, chromium, iron, lead, mercury, nickel, selenium, or vanadium. The reported concentrations of two metals were above the CGWSL, as follows:

- The concentrations of arsenic reported in the sample collected from well MW-89 during April 2012 exceeded the CGWSL; however, all other reported concentrations of arsenic in samples collected from wells along TMD were below the CGWSL.

- The reported concentrations of manganese exceeded the CGWSL in samples from wells MW-8 and MW-21 during the 2012 first and second semiannual events. The reported concentration of manganese in the sample from well MW-89 exceeded the CGWSL in April 2012. The concentration of manganese has been stable in MW-8 and MW-21 since October 2010 (when analysis of manganese began). Samples from MW-89 show a decrease in manganese concentration.

5.3.4.5 Cyanide

Samples collected from well MW-71 were analyzed for cyanide. Cyanide was not detected in the samples collected from this well.

5.3.4.6 Water Quality Parameters

The same samples collected from wells along TMD that were analyzed for DRO, were also analyzed for water quality parameters. Additionally, NP-1 was analyzed for water quality parameters during the 2012 first semiannual event. During the 2012 second semiannual event, the samples were not analyzed for TDS. Concentrations of chloride, fluoride, sulfate, and TDS exceeded the respective CGWSL in various wells along TMD. The reported concentrations of these constituents exhibit an overall stable trend.

5.3.5 North Refinery Area

Groundwater monitoring is ongoing in the northern portion of the active refinery. As shown in Table 4, concentrations of several COCs exceeded the CGWSL in samples collected from the North Refinery Area, as discussed in the following subsections.

5.3.5.1 Total Petroleum Hydrocarbons – Gasoline Range Organics

Samples were collected from 18 wells in the North Refinery Area and analyzed for GRO during the 2012 first semiannual sampling event. These wells included MW-23, MW-29, MW-40, MW-41, MW-42, MW-43, MW-55, MW-59, MW-60, MW-61, MW-62, MW-90, MW-93, MW-95, MW-96, MW-98, RW-9, and RW-10. GRO was detected in 15 of the 18 samples.

Samples were collected from 13 wells in the North Refinery Area and analyzed for GRO during the 2012 second semiannual sampling event. These wells included MW-23, MW-29, MW-41, MW-42, MW-43, MW-55, MW-60, MW-61, MW-62, MW-90, MW-93, MW-96, and MW-98. GRO was detected in 12 of the 13 samples.

The NMED (NMED 2012) does not provide a specific screening value for GRO, but indicates that individual VOCs should be analyzed. The reported concentrations of GRO fluctuate through time in samples from most of the wells in this area, but in general show a stable trend (except in MW-96 and RW-10). In MW-96, concentrations of GRO decreased during the last 3 years but showed an increase during 2012. Concentrations of GRO were non-detect in historical samples collected from RW-10, but GRO was detected in April 2012.

5.3.5.2 Total Petroleum Hydrocarbons – Diesel Range Organics

Samples were collected from 22 wells in the North Refinery Area and analyzed for DRO during the 2012 first semiannual sampling event. These wells included MW-23, MW-29, MW-40, MW-41, MW-42, MW-43, MW-45, MW-46R, MW-55, MW-56, MW-59, MW-60, MW-61, MW-62, MW-90, MW-93, MW-95, MW-96, MW-98, RW-9, RW-10, and RW-16A. DRO concentrations were reported above the CGWSL in 17 of the 22 samples.

Samples were collected from 16 wells in the North Refinery Area and analyzed for DRO during the 2012 second semiannual sampling event. These wells included MW-23, MW-29, MW-41, MW-42, MW-43, MW-45, MW-46R, MW-55, MW-56, MW-60, MW-61, MW-62, MW-90, MW-93, MW-96, and MW-98. DRO concentrations were reported above the CGWSL in 13 of the 16 samples.

The DRO concentrations in groundwater samples from the North Refinery Area show a stable to slightly increasing trend.

5.3.5.3 Volatile Organic Compounds

The same samples collected from wells in the North Refinery Area that were analyzed for DRO, were also analyzed for VOCs. Various VOCs were present above the CGWSLs, as follows:

- 1,2,4-TMB was present above the CGWSL in the sample collected from well RW-10 during the 2012 first semiannual event; no sample was collected from this well during the 2012 second semiannual event. Concentrations of 1,2,4-TMB were not detected in RW-10 in past samples. 1,2,4-TMB is present above the CGWSL in samples collected during the 2012 first and second semiannual events from wells MW-42, MW-43, MW-61, MW-62, MW-93, and MW-98.

- Benzene was present above the CGWSL in the samples collected from wells MW-40, MW-59, MW-95, and RW-10 during the 2012 first semiannual event; no samples were collected from these wells during the 2012 second semiannual event. Benzene was present above the CGWSL in samples collected from wells MW-23, MW-42, MW-43, MW-60, MW-61, MW-62, MW-93, and MW-98 during the 2012 first and second semiannual events. Benzene is present above the CGWSL in samples collected from wells MW-41 and MW-90 during the 2012 second semiannual event; benzene was not detected in these wells during the 2012 first semiannual event.

- Chloroform is present above the CGWSL in samples collected from well MW-61 during the 2012 first and second semiannual events. The concentrations of chloroform in well MW-61 show a slight decreasing trend.

- Ethylbenzene is present above the CGWSL in samples collected from well MW-98 during the 2012 first and second semiannual events.

- MTBE is present above the CGWSL in samples collected from well MW-96 during the 2012 first and second semiannual events.

- Naphthalene is present above the CGWSL in samples collected from wells MW-23, MW-61, MW-93, and MW-98 during the 2012 first and second semiannual events.

- Total xylenes is present above the CGWSL in samples collected from well MW-98 during the 2012 first and second semiannual events.

The reported concentrations of VOCs have fluctuated through time, but in general appear stable in most of the wells in this area during the past 3 years.

5.3.5.4 Total Metals

The same samples collected from wells in the North Refinery Area during the 2012 first and second semiannual events that were analyzed for DRO, were also analyzed for the standard analyte list for total metals identified in Section 5.1 (arsenic, barium, chromium, iron, lead, manganese, and selenium). Additionally, wells MW-43, MW-45, MW-55, and MW-60 were sampled for the additional analyte list for total metals identified in Section 5.1 (mercury, nickel, and vanadium) during the 2012 first and second semiannual events. A field duplicate collected from MW-56 during the 2012 first semiannual event was inadvertently analyzed for nickel and vanadium.

No exceedances of the CGWSL were present in any of the samples collected from the wells in the North Refinery Area during 2012 for chromium, lead, mercury, nickel, selenium, or vanadium. The following total metals are present above the CGWSLs, as follows:

- The arsenic concentration in the samples collected from wells MW-59 and RW-16A during the 2012 first semiannual event exceeded the CGWSL; samples were not collected from these wells during the 2012 second semiannual event. The arsenic concentrations in the samples collected from wells MW-41 and MW-60 during the 2012 second semiannual event exceeded the CGWSL. The arsenic concentrations in the samples collected from wells MW-23, MW-42, and MW-43 during the 2012 first and second semiannual events exceeded the CGWSL.

- The barium concentrations in the samples collected from MW-23 during the 2012 first and second semiannual events exceeded the CGWSL.

- The iron concentrations in the samples collected from wells MW-45 and RW-9 during the 2012 first semiannual event exceeded the CGWSL; RW-9 was not sampled during the 2012 second semiannual event. The iron concentration in the sample collected from MW-60 during the 2012 second semiannual event exceeded the CGWSL.

- Manganese concentrations exceeded the CGWSL in the samples collected from wells MW-59, RW-9, and RW-10 during the 2012 first semiannual event; no samples were collected from these wells during the 2012 second semiannual event. Manganese concentrations in the samples collected from wells MW-29, MW-41, MW-42, MW-43, MW-45, MW-56, and MW-60 during the 2012 first and second semiannual events exceeded the CGWSL.

5.3.5.5 Cyanide

Samples collected from select wells (MW-43, MW-45, MW-55, and MW-60) were analyzed for cyanide. Cyanide was not detected in the samples collected from these wells.

5.3.5.6 Water Quality Parameters

Concentrations of chloride, fluoride, sulfate, and TDS exceeded the respective CGWSL in various wells in the North Refinery Area. The reported concentrations of these constituents exhibit an overall stable or declining trend.

5.3.6 South Refinery Area

Groundwater monitoring is ongoing in the southern portion of the active refinery. As shown in Table 4, concentrations of several COCs exceed the CGWSL in samples collected from the South Refinery Area, as discussed in the following subsections.

5.3.6.1 Total Petroleum Hydrocarbons – Gasoline Range Organics

Samples were collected from 12 wells in the South Refinery Area and analyzed for GRO during the 2012 first semiannual sampling event. These wells included MW-28, MW-49, MW-52, MW-57, MW-66, MW-101, MW-103, MW-104, MW-106, MW-107, MW-109, and MW-110. GRO was detected in 10 of the 12 samples.

Samples were collected from 11 wells in the South Refinery Area and analyzed for GRO during the 2012 second semiannual sampling event. These wells included MW-28, MW-49, MW-52, MW-57, MW-66, MW-101, MW-104, MW-106, MW-107, MW-109, and MW-110. GRO was detected in nine of the 11 samples.

The NMED (NMED 2012) does not provide a specific screening value for GRO, but indicates that individual VOCs should be analyzed. The reported concentrations of GRO fluctuate through time, but in general show a stable to declining trend during the past 3 years.

5.3.6.2 Total Petroleum Hydrocarbons – Diesel Range Organics

Samples were collected from 13 wells in the South Refinery Area and analyzed for DRO during the 2012 first semiannual sampling event. These wells included MW-28, MW-49, MW-50, MW-52, MW-57, MW-66, MW-101, MW-103, MW-104, MW-106, MW-107, MW-109, and MW-110. DRO concentrations were reported above the CGWSL in eight of the 13 samples.

Samples were collected from 12 wells in the South Refinery Area and analyzed for DRO during the 2012 second semiannual sampling event. These wells included MW-28, MW-49, MW-50, MW-52, MW-57, MW-66, MW-101, MW-104, MW-106, MW-107, MW-109, and MW-110. DRO concentrations were reported above the CGWSL in nine of the 12 samples.

The DRO concentrations in the South Refinery Area show a generally stable trend during the past 3 years, except well MW-49, which shows a slightly increasing trend.

5.3.6.3 Volatile Organic Compounds

The same samples collected from wells in the South Refinery Area that were analyzed for DRO, were also analyzed for VOCs. In addition, samples were collected from an irrigation well, RA-313, located near the southeastern portion of the refinery and analyzed for VOCs during the 2012 first semiannual event. Various VOCs were present above the CGWSLs, as follows:

- 1,2,4-TMB was present above the CGWSL in the samples collected from wells MW-49, MW-106, and MW-107 during the 2012 first and second semiannual events. Additionally, 1,2,4-TMB was present above the CGWSL in samples collected from MW-28 and MW-110 during the 2012 first semiannual event.

- Benzene is present at a concentration above the CGWSL in the sample collected from well MW-103 during the 2012 first semiannual event; no sample was collected during the 2012 second semiannual event. Benzene was present at a concentration above the CGWSL in the samples collected from wells MW-28, MW-49, MW-66, MW-101, MW-104, MW-106, MW-107, MW-109, and MW-110 during the 2012 first and second semiannual events.

- MTBE is present at a concentration above the CGWSL in samples collected from wells MW-28, MW-66, and MW-107 during the 2012 first and second semiannual events.

- Naphthalene concentrations exceeded the CGWSL in the sample collected from well MW-106 during the 2012 first semiannual event. Naphthalene was not detected above the CGWSL in the sample collected from MW-106 during the 2012 second semiannual event. Naphthalene concentrations exceeded the CGWSL in samples collected from wells MW-66 and MW-107 during the 2012 first and second semiannual events.

The reported concentrations of VOCs have fluctuated through time, but in general show a decreasing trend, especially in 1,2,4-TMB concentrations in wells MW-106, MW-107, MW-109, and MW-110 during the past 3 years.

5.3.6.4 Total Metals

The same samples collected from wells in the South Refinery Area during the 2012 first and second semiannual events that were analyzed for DRO, were also analyzed for the standard analyte list for total metals identified in Section 5.1 (arsenic, barium, chromium, iron, lead, manganese, and selenium). Additionally, samples were collected from wells MW-28, MW-49, MW-52, MW-58 and MW-66 and analyzed for the additional list of total metals identified in Section 5.1 (mercury, nickel, and vanadium) during the 2012 first and second semiannual events.

No reported concentrations exceeded of the CGWSL for chromium, mercury, nickel, selenium, or vanadium in any of the samples collected from the South Refinery Area. The following total metals were present above the CGWSLs, as follows:

- Arsenic concentrations exceeded the CGWSL in samples collected from wells MW-101, MW-109, and MW-110 during the 2012 first and second semiannual events. Arsenic was not detected in the sample collected from well MW-107 during the 2012 first semiannual event, but exceeded the CGWSL during the 2012 second semiannual event. The arsenic concentration exceeded the CGWSL in the sample collected from well MW-57 during the 2012 first semiannual event, but was not detected in the sample collected during the 2012 second semiannual event.

- Barium concentrations exceeded the CGWSL in samples collected from MW-66 and MW-107 during the 2012 first and second semiannual events. The barium concentration exceeded the CGWSL in the sample collected from MW-106 during the 2012 second semiannual event, but not during the 2012 first semiannual event.

- Iron concentrations exceeded the CGWSL in samples collected from wells MW-107 and MW-109 during the 2012 first and second semiannual events. Iron concentrations exceeded the CGWSL in samples collected from wells MW-57 and MW-110 during the 2012 first semiannual event; iron was not detected in MW-57 during the 2012 second semiannual event.

- The lead concentration exceeded the CGWSL in the sample collected from well MW-28 during the 2012 first semiannual event.

- The manganese concentration exceeded the CGWSL in the sample collected from well MW-57during the 2012 first semiannual event. Manganese concentrations exceeded the CGWSL in samples collected from wells MW-49, MW-50, MW-66, MW-101, MW-107, MW-109, and MW-110 during the 2012 first and second semiannual events.

5.3.6.5 Cyanide

Samples collected from select wells (MW-28, MW-49, MW-52, and MW-66) were analyzed for cyanide. Cyanide was not detected in the samples collected from these wells.

5.3.6.6 Water Quality Parameters

Concentrations of chloride, fluoride, sulfate, and TDS exceed the respective CGWSL in various wells in the South Refinery Area. The reported concentrations of these constituents exhibit an overall stable or declining trend.

5.3.7 Field East of Refinery

Groundwater monitoring is ongoing in the field east of the refinery, between the refinery and the EPs. As shown in Table 4, concentrations of several COCs exceeded the

CGWSL in samples collected from the field east of the refinery, as discussed in the following subsections.

5.3.7.1 Total Petroleum Hydrocarbons – Gasoline Range Organics

Samples collected from wells KWB-1A, KWB-11A, KWB-11B, and KWB-12B during the 2012 first and second semiannual events were analyzed for GRO. One sample was collected from well KWB-12A during the 2012 second semiannual event and analyzed for GRO; a sample was not collected from this well during the 2012 first semiannual event. GRO was not detected in any of these samples.

5.3.7.2 Total Petroleum Hydrocarbons – Diesel Range Organics

Samples were collected from five wells (KWB-1A, KWB-7, KWB-11A, KWB-11B, and KWB-12B) in the field east of the refinery and analyzed for DRO during the 2012 first semiannual sampling event. DRO was detected in KWB-7 at a concentration below the CGWSL and was not detected above the detection limit in samples collected from the other wells.

Samples were collected from six wells (KWB-1A, KWB-7, KWB-11A, KWB-11B, KWB-12A and KWB-12B) in the field east of the refinery and analyzed for DRO during the 2012 second semiannual sampling event. DRO was not detected in any of the samples.

5.3.7.3 Volatile Organic Compounds

The same samples collected from wells in the field east of the refinery that were analyzed for DRO, were also analyzed for VOCs during the 2012 semiannual sampling events. In addition, samples were collected from RW-18, RA-4196, and RA-4798 during both sampling events and were analyzed for VOCs.

The only VOC concentration reported above the CGWSL was benzene in the sample collected from recovery well KWB-7 during the 2012 first and second semiannual events. Benzene was detected in KWB-7 in September 2011. Samples from KWB-7 collected prior to September 2011 showed no detection of benzene. All other VOCs were either not detected or were detected at concentrations below the CGWSLs.

5.3.7.4 Total Metals

The same samples collected from wells in the field east of the refinery that were analyzed for DRO, were also analyzed for the standard and additional analyte lists for total metals identified in Section 5.1 during the 2012 semiannual sampling events. No reported concentrations exceeded the CGWSLs for arsenic, barium, chromium, iron, lead, mercury, nickel, selenium, or vanadium in any of the samples collected from wells in the field east of the refinery during 2012.

Manganese was detected at concentrations exceeding the CGWSL in samples collected from well KWB-7 during the 2012 first and second semiannual events. The concentration of manganese in this well appears to be stable during the past 3 years.

5.3.7.5 Cyanide

Samples collected from select wells (KWB-1A, KWB-7, KWB-11A, KWB-11B, KWB-12A, and KWB-12B) were analyzed for cyanide. Cyanide was not detected in the samples collected from these wells.

5.3.7.6 Water Quality Parameters

Concentrations of chloride, sulfate, and TDS exceeded the respective CGWSL in various wells in the field east of the refinery. The reported concentrations of these constituents exhibit an overall stable or declining trend. Concentrations of fluoride exceeded the CGWSL in well RW-18, but exhibit a stable trend.

5.3.8 Crossgradient and Upgradient Areas

Groundwater monitoring is ongoing in areas both crossgradient and upgradient from the refinery. The crossgradient wells include KWB-13 located south of the refinery, NP-5 located across Eagle Draw to the north of the refinery, and RA-3156 located southeast of the refinery. Upgradient wells include MW-53, UG-1, UG-2, and UG-3R.

Table 4 shows the analytical results for samples collected from these wells.

Samples collected from upgradient wells UG-1, UG-2, and UG-3R during the 2012 first semiannual event were analyzed for GRO. GRO was not detected in any of these samples.

Samples were collected from six wells (KWB-13, NP-5, MW-53, UG-1, UG-2, and UG-3R) crossgradient and upgradient from the refinery and were analyzed for DRO during the 2012 first semiannual sampling event. DRO was not detected above the detection limit in any of the samples from these wells.

Manganese was detected at concentrations above the CGWSL in the sample collected from upgradient well MW-53 during the 2012 first semiannual event. No sample was collected from this well during the 2012 second semiannual event.

The iron concentration in upgradient well UG-2 exceeded the CGWSL during the 2012 first semiannual event; UG-2 was not sampled during the 2012 second semiannual event.

Sulfate and TDS were present at concentrations exceeding CGWSLs in all of the samples collected from crossgradient and upgradient wells in 2012. Chloride and fluoride were present above the CGWSL in the sample collected from NP-5. Chloride was present above the CGSWL in the sample collected from RA-3156 during the 2012 second semiannual event.

5.4 Reverse Osmosis Reject Water

Navajo sends the reject water from the RO system to agricultural fields to be used as irrigation water.

Samples of the RO reject water are collected and analyzed quarterly for metals and water quality parameters. The analytical results for the RO reject water are summarized in Table 5. The full laboratory analytical reports for the RO reject water are provided in Appendix B.

Fluoride and sulfate were reported at concentrations above the CGWSLs in samples collected during each quarter of 2012. Chloride and TDS concentrations were reported above the CGWSL in the sample collected during the fourth quarter 2012; chloride concentrations were below the CGWSL during the previous quarters and TDS was not analyzed for during the previous quarters.

6. Remediation System Monitoring

The PCC Permit (NMED 2010), Discharge Permit (OCD 2012), and the 2011 and 2012 FWGMWPs (ARCADIS 2011b and 2012) require the recovery of PSH present in the shallow groundwater within and adjacent to the refinery. A system of recovery trenches and recovery wells was installed at the refinery and is used to recover PSH.

6.1 Automated Recovery of Phase Separated Hydrocarbons

During 2011, a preliminary design for upgrading the recovery system was developed, which included new pumps, separate water and PSH piping from each trench, and routing of PSH to a product recovery tank instead of through the API separator. The conceptual design was submitted to the NMED and the OCD in January 2011 (ARCADIS 2011a). Final design of the upgraded system was completed in 2011 and construction of the upgrades began in December 2011 and was completed in April 2012. The system began operation in May 2012 and operated through the remainder of 2012, with intermittent shutdowns for maintenance.

At the beginning of 2012, a dedicated technician monitored and documented the presence of PSH in trenches and recovery wells approximately every week. Pumps in RW-1, RW-2, RW-4, RW-7, and RW-8 were operated manually. The manual operation of the recovery pumps in these wells continued throughout the remainder of 2012 after the recovery system upgrades were complete. Dedicated pumps were present in RW-5, RW-6, RW-12, RW-13, and RW-14; however, these pumps were not operated during 2012. Recovery wells RW-5, RW-12, RW-13, and RW-14 were replaced with new recovery wells RW-5R, RW-12R, RW-13R, and RW-14R as part of the recovery system upgrade. RW-6 did not contain adequate fluid for pumping.

Total fluids removed from RW-4 are placed in a tank, removed via vacuum truck, and processed through the refinery's wastewater treatment system. The remaining recovery trenches that are not part of the upgraded recovery system (RW-1, RW-2, RW-7, and RW-8) are pumped directly to the wastewater treatment system upstream of the oil/water separator.

Once the recovery system upgrades were complete, recovery of PSH in wells RW-5R, RW-12R, RW-13R, RW-14R, RW-15, RW-19, RW-20 (the Chase well), and RW-22 was accomplished through use of dedicated pumps that routed recovered PSH and/or groundwater to the refinery. Both PSH and groundwater pumps are installed in each recovery well to allow for the separate management of PSH and groundwater. The volume of recovered water and PSH from the recovery trench system is summarized in Table 6 and the operation records are provided in Appendix E.

PSH removed from RW-12R, RW-13R, RW-14R, RW-20, and RW-22 is piped to a tank on a skid located along Bolton Road (pump station T5520). PSH removed from RW-5R, RW-15, and RW-19 is piped to a tank on a skid within the refinery (pump station T5521). Each pump station directs the PSH to Tank 49 and then to the Crude Tank (Tank 1225). Groundwater removed from the recovery wells is conveyed directly to the nearest process sewer location and then to the refinery's wastewater treatment plant.

6.2 Manual Recovery of Phase Separated Hydrocarbons

A dedicated technician recovers PSH from select monitoring wells by periodically bailing PSH from the wells. During 2012, PSH was manually bailed from the following wells: KWB-2R, KWB-4, KWB-5, KWB-6, MW-34, MW-58, MW-64, MW-65, MW-67, MW-85, MW-86, MW-91, MW-94, MW-96, MW-97, MW-99, MW-102, MW-105, and NCL-34A. Total fluids and/or PSH removed from any monitoring wells containing PSH are transported to the refinery for disposal or recycling. The volume of recovered PSH and water from these monitoring wells is summarized in Table 6 and the records are contained in Appendix E.

6.3 Estimated Volume of Fluids Recovered

During 2012, an estimated 2,739,933 gallons of groundwater and an estimated 395,174 gallons of PSH were recovered through operation of the recovery system and bailing specific wells. The majority of the PSH recovered came from RW-1, RW-2, RW-5R, RW-7, RW-8, RW-12R, RW-13R, RW-14R, RW-15, and RW-19.

The installation and operation of the upgraded recovery system significantly increased the amount of PSH and groundwater recovered in 2012, compared to the amounts recovered in 2011. Additionally, Navajo has developed a more formalized bailing schedule for the monitoring wells that are not included in the automated recovery system operation. It is expected that the implementation of this bailing schedule will result in the collection of a greater volume of PSH and water from these monitoring wells.

7. Conclusions

The following conclusions are based upon the information obtained during 2012 and comparison to data from prior years:

- Groundwater flow direction and gradient remains generally consistent with that measured during past years.
- The PSH plumes remained consistent between 2011 and 2012 except as follows:
  - The thickness of PSH southeast of the NCL treatment unit has decreased somewhat since 2011, but the plume has extended toward the south.
  - The extent of the PSH plume in the South Refinery Area appears fairly consistent, with a slight shift to the south of US-82 at MW-58. The thicknesses of PSH in this area have fluctuated and appear to fluctuate between seasons.
- Groundwater concentrations of organic constituents have generally remained stable or have exhibited slight increasing trends. Benzene exceedances of the CGWSL were observed in monitoring wells located east of Bolton Road in 2011 and were confirmed during the 2012 first and second semiannual events. However, the concentration of benzene in the dissolved phase east of Bolton Road decreased between the 2012 first and second semiannual events.
- The recovery trench system upgrades were completed in 2012 and the operation of the recovery system was more effective than in previous years.

According to the requirements of the updated PCC Permit (NMED 2010), an updated FWGMWP will be submitted in June 2013.

8. References

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Appendices (all on compact disc)

Appendix A Field Sampling Notes

Appendix B Laboratory Reports and Tabulated Data 2010-2012

Tables:

B.1 Groundwater Analytical Data 2010-2012: Total Petroleum Hydrocarbons

B.2 Groundwater Analytical Data 2010-2012: Total Metals

B.3 Groundwater Analytical Data 2010-2012: Dissolved Metals

B.4 Groundwater Analytical Data 2010-2012: Volatile Organic Compounds

B.5 Groundwater Analytical Data 2010-2012: Semivolatile Organic Compounds

B.6 Groundwater Analytical Data 2010-2012: Water Quality Parameters

2012 Analytical Data Reports

Appendix C Plots of COC Concentrations and Groundwater Elevations Versus Time

Appendix D Data Validation Reports

Appendix E Recovery System Records