

GW – 028

**FACILITY-WIDE
GROUND WATER
MONITORING
PLAN**

2011

Chavez, Carl J, EMNRD

From: Chavez, Carl J, EMNRD
Sent: Thursday, February 23, 2012 7:39 AM
To: Tsinnajinnie, Leona, NMENV
Cc: Cobrain, Dave, NMENV
Subject: Artesia Refinery 1-mo. Extension Request 2011 Annual Ground Water Monitoring Report Submittal

Leona:

OCD is ok with the request for 30 additional days. Thanks.

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2012 FEB 22 A 11: 27

Mr. David Cobrain
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, NM 87505

Subject:

Request for Extension for the 2011 Annual Groundwater Monitoring Report
Navajo Refining Company, Artesia Refinery
RCRA Permit No. NMD048918817
Discharge Permit GW-028

Dear Mr. Cobrain and Mr. Chavez:

On behalf of the Navajo Refining Company (Navajo), ARCADIS U.S. Inc. (ARCADIS) respectfully requests an extension to the required submittal deadline of February 28, 2012 for the 2011 Annual Groundwater Monitoring Report. This report is required by both the RCRA Permit and the Discharge Permit and is to be submitted by February 28 of each year. The reason for this extension request is that the New Mexico Environment Department (NMED) published a new risk assessment guidance document on February 14, 2012. Included with that guidance document are updated screening levels for several of the constituents of concern for the Artesia Refinery. Therefore, ARCADIS requests an additional 30 days to incorporate the updated screening levels into the annual report.

Sincerely,

ARCADIS U.S., Inc.

Pamela R. Krueger
Senior Project Manager

Copies:

Mr. Johnny Lackey, Navajo Refining Company

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ENVIRONMENT

Date:

February 20, 2012

Contact:

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Our ref:

TX000836.0005

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Infrastructure · Water · Environment · Buildings

Mr. John E. Kieling
New Mexico Environment Department
Hazardous Waste Bureau
2905 Rodeo Park Drive East, Building 1
Santa Fe, NM 87505-6303

Subject:

**Response to Approval with Modifications, 2011 Facility Wide Groundwater
Monitoring Workplan
Navajo Refining Company, Artesia Refinery
EPA ID No. NMD048918817
HWB-NRC-11-004**

Dear Mr. Kieling:

This letter is being submitted on behalf of the Navajo Refining Company (Navajo) by ARCADIS U.S. Inc. (ARCADIS) in response to your letter dated September 1, 2011 regarding the report titled *2011 Facility Wide Groundwater Monitoring Workplan* (FWGMWP) dated June 2011. As requested, the comments made in the New Mexico Environment Department (NMED) letter are presented in this response letter, followed by the appropriate response. Replacement pages for the report, where required, are included as Attachment A to this response letter. A redline/strikeout version of the revised report is being submitted in electronic format only.

Comment 1

Section 1 (Introduction), page 1-2, the Permittee describes the locations of the Tetraethyl Lead (TEL) Impoundment and the North Colony Landfarm (NCL). Provide a replacement page that references the locations on Figure 2 (Well Locations).

Response to Comment 1

A reference to Figure 2 has been provided in Section 1. Replacement pages are provided as Attachment A to this response letter.

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2011 OCT 11
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Our ref:
TX000888

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Comment 2

Sections 4.1 (New Monitoring Wells) and 4.2 (Well Abandonments), pages 4-1 and 4-2, the

Permittee discusses the installation of new monitoring wells, MW-109 and MW-110, and the replacement of monitoring wells, MW 46R and KWB 10R, as well as the abandonment of the damaged monitoring wells, MW 46 and KWB 10. The Permittee does not reference a letter or indicate if the activities were part of another investigation that required the installation of the new monitoring wells and replacement of the two monitoring wells. The Permittee must provide a reference in Section 4.1 as well as a separate reference section as replacement pages with the response letter.

Section 4.2 also states that "no formal plugging reports were completed" for MW 46 and KWB 10. In addition, the Permittee did not abandon MW 46 because the monitoring well could not be located. Sections 6.1.b.vii, 6.2.b.vii and 6.3.b.vii (Well Replacement and Abandonment) of the December 2010 Post Closure Care Permit (Permit) requires that the Permittee obtain approval from NMED and the New Mexico Office of the State Engineer to abandon wells from the monitoring program. The Permittee must plug and abandon the wells in accordance with 19.27.4 NMAC (Rules and Regulations Governing Well Driller Licensing Construction, Repair, and Plugging of Wells). The Permittee must submit the abandonment report for KWB 10 with the response letter. In the future, the Permittee must notify and receive approval from NMED and the New Mexico Office of the State Engineer prior to conducting abandonment activities for all monitoring wells.

Response to Comment 2

MW-46 and KWB-10 were replaced voluntarily because they had been damaged beyond use. MW-109 and MW-110 were installed as part of the SWMU/AOC Group 3 Corrective Action Investigation. References to the relevant work plan and approval of the work plan for SWMU/AOC Group 3 Corrective Action Investigation have been added to the text of Section 4.1. Replacement pages are provided in Attachment A to this letter.

Navajo will re-locate MW-46 using previously surveyed location information. If at all possible, the well will be located and properly plugged and abandoned according to the regulations and Navajo will provide the well

abandonment report to NMED. KWB-10 was plugged using bentonite, as reported in the FWGMWP.

It is assumed that references to the Post-Closure Care Permit (Permit) in Comment 2 should be to Sections 4.6.1.b.vii, 4.6.2.b.vii and 4.6.3.vii since there is no Section 6 to the Permit. It should be noted that all three of these references are within subsections that refer to specific permitted units. Section 4.6.1 refers to the North Colony Landfarm, Section 4.6.2 refers to the Tetra-Ethyl Lead Impoundment and Section 4.6.3 refers to the Evaporation Ponds. Neither MW-46 nor KWB-10 is associated with these specific units. The updated Permit was issued in December 2010, which is after the date that the replacement wells were installed.

Navajo understands that NMED and OCD wish to be informed prior to abandonment of monitoring wells and will strive to ensure that such notification is made in the future. Although monitoring wells are installed in such a fashion as to avoid damage, it is not possible to ensure that no damage occurs. In the event that a well is damaged beyond the ability to use it for monitoring purposes, it may be necessary to abandon the well. Navajo will notify NMED and OCD in the event that such a situation arises in the future and will also notify the agencies if the well is to be replaced or whether Navajo believes other wells in the vicinity provide adequate monitoring coverage.

Comment 3

Sections 5.3.2 (Revised Groundwater Monitoring Program), 5.3.2.1 (Additions to the Monitoring Network), and 5.3.2.2 (Total and Dissolved Metals) discuss the removal of dissolved metals from the analytical suite for the 2011 groundwater monitoring program. Based on discussions with OCD, the Permittee will be required to analyze the groundwater monitoring well samples per the schedule listed in the 2010 and 2011 FWGMWPs under the following conditions:

- a. Groundwater monitoring wells sampled semiannually would require total metals analyses twice per year and dissolved metals analysis once per year.*
- b. Groundwater monitoring wells sampled annually or biennially would require both total and dissolved metals analyses.*

- c. *Total metals analytical results will be compared to WQCC dissolved metals standards or to the EPA MCL if a WQCC standard does not exist. If neither a WQCC standard or MCL exist, the NMED risk based tap water screening level will be used for comparison to provide a conservative evaluation of the potential exposure concentration.*

Revise the FWGMWP accordingly.

Response to Comment 3

Section 5.3.2.2 has been updated to reflect the requirement to analyze samples for dissolved metals and the frequency at which the dissolved metals will be analyzed. The discussion of comparison of the analytical data from the dissolved and total metals results has been added to Section 5.3.2.2. Table 1 has been updated to reflect these changes. Replacement pages for Section 5.3.2.2 and for Table 1 have been included in Attachment A to this letter.

Comment 4

Provide replacement pages for the following comments that address Table 1 (Revised Monitoring Program and Schedule):

- a. *Several monitoring wells are missing installation dates and screened interval information on Table 1. Provide this information or explain why this information is not included. In addition, provide a notation in the Footnotes section of page 6 to identify and explain monitoring wells with missing data.*
- b. *Some monitoring wells are no longer being monitored because they are damaged or have been dropped from the monitoring program. Provide the date or year that the last sample was collected on Table 1 and if a well is damaged, explain how the monitoring well was damaged.*
- c. *Section 4.1 (New Monitoring Wells) discusses the replacement of MW-46 and KWB-10 because these monitoring wells were damaged. There are additional monitoring wells on Table 1 that also have been damaged. Indicate if these wells will be replaced and provide a schedule for abandonment and the replacement of these monitoring wells. A work plan must be submitted describing the proposed activities for installing*

replacement wells and abandoning the damaged monitoring wells. The Permittee must plug and abandon the wells in accordance with 19.27.4 NMAC of the Rules and Regulations Governing Well Driller Licensing, Construction, Repair, and Plugging of Wells (see Comment 2).

- d. *Footnote 5 from Table 1 only describes the total metals analysis being conducted during the 2011 groundwater monitoring events. In the revised FWGMWP, the Permittee must revise the footnote in Table 1 to be consistent with the conditions in Comment 3.*

Response to Comment 4

- a. Well construction data has been provided where available, as noted in Footnote (a) of Table 1. Additional well logs were obtained from the driller and a former consultant, and the newly obtained information has been added to Table 1. However, the well logs for the following monitoring wells have still not been located:

- KWB-2R
- KWB-13
- KWB-P2
- KWB-P3
- KWB-P4
- KWB-P5
- MW-2A
- MW-3
- MW-4A
- MW-4B
- MW-5A
- MW-6A
- MW-6B
- MW-7A
- MW-10
- MW-30
- MW-40
- MW-42
- MW-48
- MW-49
- MW-50
- MW-52
- MW-68
- MW-70

- MW-71
- NCL-44
- MCL-49
- NP-8
- NP-9
- OCD-1R
- OCD-2A
- OCD-3
- OCD-4
- OCD-5
- OCD-6
- OCD-8A

In addition, there is no data available for irrigation wells RA-314, RA-3353 or RA-3723 and construction details are not available for any of the recovery wells that provide the screened interval of the recovery points. Navajo will continue to research files and other sources to attempt to find missing well logs.

- b. Not all analytical data is readily available for all of the wells installed at the Navajo Refinery. Data that is readily available includes data summarized in the Subsurface Investigation Report prepared in 1992, the Phase II and Phase III RFI reports for Three Mile Ditch and the Evaporation Ponds (1992 and 1993), and the annual groundwater monitoring reports for 2005 through 2010. The 2005 groundwater report includes data that was obtained during the period of 2000 through 2005. Data included in those reports was reviewed and used to prepare a response to this comment.

The wells listed in Table 1 that are not sampled as part of the monitoring program include the following:

- KWB-1B: This well has not been sampled. According to the report titled *Investigation of the Subsurface Hydrocarbon Plume at the Navajo Refinery, Artesia, New Mexico* (K.W. Brown Environmental Services, May 1992), it was installed near KWB-1A and screened in the same interval with the purpose of conducting aquifer tests. Because of the relative location to KWB-1A, Navajo does not believe that KWB-1B should be included in the analytical monitoring program.

- KWP-P3 – No analytical data could be found on this well. Water level measurements were taken during 2008 through 2010. This well is located downgradient from “clean” wells and thus should not be included in the analytical monitoring program. The well does provide valuable data for evaluation of the potentiometric surface and thus continued gauging is included in the monitoring program.
- KWB-P5 – No analytical data could be found on this well. The field notes from 2008 indicated that the field crew could not locate the well. Navajo personnel stated that the well was covered over by the road crew when Highway 82 was re-surfaced, but a specific date for this could not be determined. No replacement well is required due to the locations of other wells in the area.
- MW-2B: Analytical data from this well was included in the report titled RCRA Facility Investigation, Three-Mile Ditch & Evaporation Ponds, Phase III Report (Revised) (Los Alamos Technical Associates (January 1996). A sample was collected from this well in November 1994 and analyzed for organic and inorganic parameters. In that report, the 1994 arsenic data was compared to a sample collected in December 1992 from the same well. No subsequent analytical data was found for this well. This well is not included in the analytical monitoring program based on the location and depth of the screened interval.
- MW-9: Analytical data from this well was included in the report titled RCRA Facility Investigation, Three-Mile Ditch & Evaporation Ponds, Phase III Report (Revised) (Los Alamos Technical Associates (January 1996). A sample was collected from this well in November 1994 and analyzed for organic and inorganic parameters. No subsequent analytical data was found for this well. This well is not included in the analytical monitoring program due to the proximity of other wells which are included in the analytical monitoring program.
- MW-12: No analytical data was found for this well. This well is not included in the analytical monitoring program based on the location,

which is opposite the Pecos River from the Evaporation Ponds, and the direction of groundwater flow, which is away from the well.

- MW-13: No analytical data was found for this well. This well is not included in the analytical monitoring program based on the location, which is opposite the Pecos River from the Evaporation Ponds, and the direction of groundwater flow (away from the well).
- MW-14: Analytical data from this well was included in the report titled RCRA Facility Investigation, Three-Mile Ditch & Evaporation Ponds, Phase III Report (Revised) (Los Alamos Technical Associates (January 1996). A sample was collected from this well in November 1994 and analyzed for organic and inorganic parameters. No subsequent analytical data was found for this well. This well is not included in the analytical monitoring program based on the location, which is opposite the Pecos River from the Evaporation Ponds, and the infiltration of Pecos River water into the aquifer.
- MW-17: This well was last sampled in September 2009. This well is not included in the analytical monitoring program due to the location, which is north of Three Mile Ditch across the Pecos River. The analytical samples have not shown impacts to this well, which is cross-gradient to Three Mile Ditch and upgradient from the Evaporation Ponds.
- MW-18T: This well was installed adjacent to MW-18B and screened at the same interval as MW-18B for the purposes of aquifer testing. No analytical samples have been collected from this well. Because of the relative location to MW-18B, Navajo does not believe that MW-18T should be included in the analytical monitoring program.
- MW-19: No analytical data could be found for this well. The well is located immediately south of NCL-31 and is screened at the same interval as NCL-31. As a result, Navajo does not believe that MW-19 should be included in the analytical monitoring program.
- MW-24: No analytical data was found for this well. This well is not included in the analytical monitoring program based on the location,

which is opposite the Pecos River from the Evaporation Ponds, and the infiltration of Pecos River water into the aquifer.

- MW-30: Analytical data from this well was included in the report titled RCRA Facility Investigation, Three-Mile Ditch & Evaporation Ponds, Phase III Report (Revised) (Los Alamos Technical Associates (January 1996). A sample was collected from this well in November 1994 and analyzed for organic and inorganic parameters. No subsequent analytical data was found for this well. The well is not included in the analytical monitoring program due to the proximity of MW-56, which is slightly upgradient from MW-30.
- MW-63: This well was last sampled in September 2008. Analytical results were included in the annual groundwater monitoring reports for 2006 through 2008. The well was inaccessible during 2009 and 2010 due to refinery expansion construction activities. The well has been covered over and cannot currently be located. As stated in the response to comments for the October 7, 2011 letter to NMED providing responses to comments made in the NMED Approval with Modifications letter regarding the 2010 Annual Groundwater Monitoring Report, Navajo will attempt to locate MW-63 and properly plug and abandon the well. If it is not possible to access the well location, information will be provided to NMED, including a sketch and photographs of the location. A replacement well is not required since MW-106 is located immediately downgradient of the former MW-63 location.
- MW-69: Well MW-69 was originally designated as MW-23 but was re-numbered when a duplication of numbering was identified. Analytical data from this well (MW-23) was included in the report titled RCRA Facility Investigation, Three-Mile Ditch & Evaporation Ponds, Phase III Report (Revised) (Los Alamos Technical Associates (January 1996). A sample was collected from this well in November 1994 and analyzed for organic and inorganic parameters. No subsequent analytical data was found for this well. This well is not included in the analytical monitoring program based on the location, which is opposite the Pecos River from the Evaporation Ponds, and the direction of groundwater flow, which is away from the well.

- MW-100: This well was last sampled in March 2010. Analytical results were included in the annual groundwater monitoring reports for 2008 through 2010. The well was scheduled to be plugged and abandoned in 2010 due to refinery expansion construction activities. The well has been covered over and cannot currently be located. As stated in the response to comments for the October 7, 2011 letter to NMED providing responses to comments made in the NMED Approval with Modifications letter regarding the 2010 Annual Groundwater Monitoring Report, Navajo will attempt to locate MW-100 and properly plug and abandon the well. If it is not possible to access the well location, information will be provided to NMED, including a sketch and photographs of the location. A replacement well is not required because of the proximity of MW-28.
- NP-2: This well was last sampled in October 2010. Analytical results were included in the annual groundwater monitoring reports for 2005 through 2010. The well was removed from the analytical monitoring program based on historic data and the location of the well to documented impacts to groundwater.
- NP-3: This well was last sampled in October 2010. Analytical results were included in the annual groundwater monitoring reports for 2006 through 2010. The well was removed from the analytical monitoring program based on historic data and the location of the well to documented impacts to groundwater.
- NP-4: This well was last sampled in October 2010. Analytical results were included in the annual groundwater monitoring reports for 2007 through 2010. The well was removed from the analytical monitoring program based on historic data and the location of the well to documented impacts to groundwater.
- NP-7: No analytical data was found for this well. The response to comments regarding the 2006 annual groundwater report indicate that the well was covered with up to 3 feet of soil when the landowner regraded in the area. Navajo attempted to relocate the well but could not.

- NP-8: This well was last sampled in October 2010. Analytical results were included in the annual groundwater monitoring reports for 2007 through 2010. The well was removed from the analytical monitoring program based on historic data and the location of the well to documented impacts to groundwater.
- NP-9: This well was last sampled in September 2010. Analytical results were included in the annual groundwater monitoring reports for 2006 through 2010. The well was removed from the analytical monitoring program based on historic data and the location of the well to documented impacts to groundwater.
- OCD-2B: This well was last sampled in October 2010. Analytical results were included in the annual groundwater monitoring reports for 2007 through 2010. The well was removed from the analytical monitoring program based on historic data and the location of the well to documented impacts to groundwater.
- OCD-7C: This well was last sampled in October 2010. Analytical results were included in the annual groundwater monitoring reports for 2007 through 2010. The well was removed from the analytical monitoring program based on historic data and the location of the well to documented impacts to groundwater.
- LaRue Well: This well was last sampled in September 2009. Analytical results were included in the annual groundwater monitoring reports for 2006 through 2009. The well was removed from the analytical monitoring program based on historic data and accessibility issues (lack of landowner cooperation).
- RA-3353: This well was last sampled in October 2007. Analytical results were included in the annual groundwater monitoring reports for 2006 and 2007. The well was removed from the analytical monitoring program because the landowner has removed the power source and no longer operates the irrigation well.
- RA-3723: This well was last sampled in December 2006. Analytical results were included in the annual groundwater monitoring report for 2006. The well was removed from the analytical monitoring program

because the landowner has removed the pump and no longer operates the irrigation well.

- RW-3: This recovery well was last sampled in April 2005 and the analytical data was reported in the 2005 annual groundwater report. The recovery well did not produce any water or product in 2006 or 2007. This recovery well was backfilled between September 2008 and March 2009. A replacement recovery well is not required.
- c. See the response to item b above.
- d. Table 1 has been updated to reflect the requirement to analyze samples for dissolved metals on a periodic basis. See response to Comment 3.

Comment 5

Figure 2 (Well Locations) is a 2011 updated map depicting all the monitoring wells on the refinery property. Provide a revised approximate 33 inch by 22 inch map with the response letter.

Response to Comment 5

A larger copy of Figure 2 has been provided in Attachment A to this letter.

Comment 6

Appendix A (Well Completion Logs) provides boring logs and well completion logs from ARCADIS and Safety & Environmental Solutions, Inc. Safety & Environmental Solutions, Inc. includes the depth to water on the well completion logs and notes if product was encountered in the newly installed wells. ARCADIS does not provide this information on boring logs or well construction diagrams. In the response letter, provide replacement pages for the ARCADIS boring logs that include depth to water and product information. In future documents, all boring logs and well completion logs must include this information.

Response to Comment 6

The initial depth to water and product information has been added to the ARCADIS well completion logs and replacement pages are provided in Attachment A to this letter. Please note that the initial depth to water and product information will not match the information obtained following development of a well.

OCD Comment

Several monitoring wells within the vicinity of the Pecan Orchard were not sampled because farm equipment and debris prevented access, the pump(s) were removed from the agricultural well(s), or the well was damaged by farm equipment. All future Groundwater Monitoring Plans must include prior notification to all well owners in advance of monitoring and sampling events so all monitoring wells can be accessed and monitored/sampled. If access continues to be a problem, then the Permittee may have to install additional monitoring wells in the vicinity of current monitoring wells and abandon the use of those that have become inaccessible.

Response to OCD Comment

While every effort has been made to install wells in such a manner that damage does not occur, it cannot be prevented. Navajo will notify both NMED and OCD in the event that a well is damaged, including the type and extent of damage. Plans to repair or replace the well or to drop the well from the monitoring program will be submitted to both NMED and OCD.

Notification is provided to landowners prior to every sampling event. However, Navajo has no control over whether a landowner elects to discontinue use of irrigation wells or pumping equipment. Every effort will be made to obtain samples according to the monitoring plan; however, NMED and OCD must understand that Navajo does not own the irrigation wells or water rights and may not be able to obtain a sample from the offsite irrigation wells.

The requested replacement pages are included as Attachment A to this response letter. Replacement pages have been noted by including the text "Updated October 2011" in the footer. The following table describes the replacement pages:

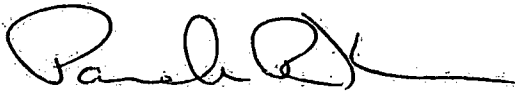
Section/Table	Remove Page(s)	Insert Page(s)	Reason
Table of Contents	ii	ii	New page numbering due to revisions to the text.
Section 1	1-2	1-2	Revisions to text to reference Figure 2
Sections 4.1 and 4.2	4-1 and 4-2	4-1 and 4-2	Revisions to text to describe the installation of new and replacement wells. Due to the text revisions the page numbering of the later section must be revised as well.
Section 5.3.2.2	5-6	5-6	Revisions to text to discuss the analysis requirements for total and dissolved metals.
Figure 2	Figure 2	Revised Figure 2	Revision to include a larger copy of the figure.
Table 1	Table 1	Revised Table 1	Revisions include a variety of items as discussed in the responses to Comments 3 and 4.
Appendix A	Well/Boring Log MW-109 and MW-110	Well/Boring Log MW-109 and MW-110	Revisions to include the depth to water and depth to product elevations

Additionally, an electronic copy of the redline/strikeout version of revisions to the text of the FWGMWP has been included for your files.

If you have any questions or comments regarding this response letter or the replacement pages provided as an attachment, please feel free to contact Darrell Moore at 575.746.5281 or Pam Krueger at 713.953.4816.

Sincerely,

ARCADIS U.S., Inc.

A handwritten signature in black ink, appearing to read 'Pamela R. Krueger', with a long horizontal flourish extending to the right.

Pamela R. Krueger
Senior Project Manager

Copies:

Mr. Darrell Moore, Navajo
Mr. Johnny Lacky, Navajo

Attachment

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Appendices

A	Well Completion Logs
B	Field Forms

- The inactive Evaporation Ponds (EP); and
- The impacted vadose zone located beneath the Refinery, extending east along the direction of flow.

The closed TEL Impoundment is located near the eastern boundary of the active Refinery and south of Eagle Creek (Figure 2). The inactive NCL is located near the northwestern corner of the Refinery (Figure 2). The inactive EP area is located approximately three miles east of the active Refinery, south and west of the Pecos River. The impacted vadose zone is located beneath the Refinery and extends to the east from the active Refinery in the direction of groundwater flow.

This FWGMWP describes the planned activities that will be conducted in 2011 to continue monitoring the groundwater and continue interim recovery of phase separate hydrocarbons (PSH). The format of this FWGMWP follows the general outline specified for a workplan in Appendix E of the PCC, while incorporating the requirements of Sections 20 and 22 of the Discharge Permit.

4. Modifications to the Groundwater Monitoring Network

This section of the FWGMWP discusses the modifications to the groundwater monitoring network that have occurred since submittal of the 2010 workplan.

4.1 New Monitoring Wells

In October 2010 two monitoring wells (MW-46R and KWB-10R) were installed to replace two damaged monitoring wells. In January 2011 two new wells (MW-109 and MW-110) were installed as part of the investigation of areas of concern (AOCs). The boring logs and well completion reports have been included in Appendix A of this FWGMWP. The locations of the new wells are shown in Figure 2.

Replacement well MW-46R is located east of the North Refinery and just south of Eagle Draw. MW-46 had been damaged by farm equipment and had not been sampled since 2006. Therefore, Navajo elected to replace the well in order to continue to provide adequate monitoring coverage along Eagle Draw and the former Three Mile Ditch. MW-46R is a 2 inch well installed to a total depth of approximately 19.4 ft bgs. MW-46R is located approximately 30 feet east of the former MW-46.

Replacement well KWB-10R is located east of the Refinery and north of US Highway 82. KWB-10 had been damaged by farm equipment prior to the second semiannual sampling event in 2009 and has not been sampled since that event. Therefore, Navajo elected to replace the well in order to continue to provide adequate monitoring coverage in the field east of the Refinery. KWB-10R is a 4 inch well installed to a total depth of approximately 30.14 ft bgs. KWB-10R is located approximately 30 feet north-northwest of the former KWB-10.

MW-109 and MW-110 were installed according to the *SWMU/AOC Group 3 Corrective Action Investigation Workplan – Revised* (ARCADIS, August 2010) and the Approval with Modifications of that document issued by NMED on September 22, 2010. As requested in Comment 8 of the September 22, 2010 letter, MW-109 is located on the east side of a warehouse owned by Navajo while MW-110 is located on the west side of the warehouse. The warehouse is located on the south side of US Highway 82. Both MW-109 and MW-110 are 2 inch wells installed to a total depth of approximately 30 ft bgs.

4.2 Well Abandonments

Wells MW-46 and KWB-10 were abandoned when their respective replacement wells we installed in October 2010, as described in Section 4.1. No formal plugging reports were completed but a brief description of the plugging activities has been included in this section.

The concrete pad surrounding MW-46 had been broken and moved away from the well location prior to beginning abandonment activities. The well riser pipe was broken at the surface and dirt and debris plugged the pipe in the ground. The well could not be located during the well replacement so no actual plugging activities occurred.

The concrete pad at KWB-10 had been broken by a wheel for the center pivot irrigation equipment in the area. The well was plugged with 5 bags of Hole Plug bentonite and 1/2 bag of cement at the surface. No formal plugging report was filed.

As described above, the results of a 'totals metals analysis' should be the most conservative result when compared to a dissolved metal standard. Therefore, Navajo proposes to collect only unfiltered samples for analysis of total metals.

Upon further discussion with NMED and OCD, OCD required that dissolved metals analyses continue to be performed on a periodic basis, as follows:

- Groundwater monitoring wells which are sampled semiannually and include metal COCs in the analytical suite will be analyzed for total metals twice per year and will also be analyzed for dissolved metals once per year.
- Groundwater monitoring wells which are sampled annually or biennially and include metal COCs in the analytical suite will be analyzed for both total and dissolved metals during each sampling event.

The results of both the dissolved and totals metals analyses will be compared to the WQCC standards or to the EPA Maximum Contaminant Level (MCL) if a WQCC standard does not exist. If neither a WQCC standard or MCL exist, the results will be compared to either the NMED or EPA tap water screening levels.

The required metal COCs and frequency of analysis are shown in Table 1.

Table 1
Revised Monitoring Program and Schedule
Navajo Refining Company - Artesia Refinery, Artesia, New Mexico

Well ID	Well Type	Location Information		Well Construction Information ^a								PSH Expected? ^b	Gauging Frequency	Analytical Suite and Frequency ^c									
		Associated Area of Concern	Approximate Location	Date Installed	Diameter (in)	Top of Casing (ft MSL)	Ground Surface (ft MSL)	Total Depth (ft btoc)	Screen Interval (ft bgs)	Surface Finish	Purge Parameters			DRO	VOCs	Metals (As, Ba, Cr, Fe, Pb, Mn, Se)	Metals (Hg, Ni, Va)	Cyanide	Cations/Anions	Nitrates / Nitrites	Total Dissolved Solids		
KWB-1A	Monitoring	Downgradient	S of ED, W of BR	Feb-92	2	3353.46	3351.25	33.57	18 to 32	stickup	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA			
KWB-1B	Monitoring	Downgradient	S of ED, W of BR	Feb-92	4	3352.83	3351.14	34.45	18 to 32	stickup	SA	No analytical samples to be collected											
KWB-1C	Monitoring	Downgradient	S of ED, W of BR	Sep-92	4	3351.38	3351.18	52.51	30.5 to 49.5	stickup	SA	B	B	B	B	B	-	-	B	B	B		
KWB-2R	Monitoring	S Refinery	S of US82 on Armstrong & Son	NI	2	3364.32	3364.56	39.90	NI	flush mount	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA		
KWB-3AR	Monitoring	Downgradient	S of US82, replaced KWB #3R	Sep-03	2	3347.08	3347.36	33.41	17 to 33	flush mount		SA	SA	SA	SA	SA	SA	SA	SA	SA	SA		
KWB-4	Monitoring	S Refinery	N of US82, W of BR	Feb-92	2	3370.25	3368.36	41.75	20 to 39	stickup	Y	SA	SA ^d	SA ^d	SA ^d	SA ^d	-	-	SA ^d	SA ^d	SA ^d		
KWB-5	Monitoring	S Refinery	N of US82, W of BR	Feb-92	2	3364.72	3362.60	37.69	24.7 to 38.7	stickup	Y	SA	SA ^d	SA ^d	SA ^d	SA ^d	-	-	SA ^d	SA ^d	SA ^d		
KWB-6	Monitoring	S Refinery	N of US82, W of BR	Feb-92	2	3360.30	3358.02	36.41	17.5 to 36.5	stickup	Y	SA	SA ^d	SA ^d	SA ^d	SA ^d	-	-	SA ^d	SA ^d	SA ^d		
KWB-7	Monitoring	Downgradient	N of US82, between BR & Dirt Rd	Feb-92	2	3346.16	3343.00	34.61	18 to 32	stickup		SA	SA	SA	SA	SA	SA	SA	SA	SA	SA		
KWB-8	Monitoring	Field E of Refinery	N of US82, between BR & Dirt Rd	Feb-92	2	3350.41	3347.90	38.16 (3/08)	15 to 34	stickup	Y	SA	SA ^d	SA ^d	SA ^d	SA ^d	SA ^d	SA ^d	SA ^d	SA ^d	SA ^d		
KWB-9	Monitoring	Downgradient	S of US82, E of BR	Feb-92	2	3354.53	3351.81	37.26	20 to 34	stickup		SA	SA	SA	SA	SA	SA	SA	SA	SA	SA		
KWB-10R	Monitoring	Downgradient	S of ED, N of US82	Oct-10	4	3350.97	3351.23	30.15	9 to 29	flush mount		SA	SA	SA	SA	SA	-	-	SA	SA	SA		
KWB-11A	Monitoring	Downgradient	N of US82, between BR & Dirt Rd	Oct-92	4	3348.72	3346.13	42.03	30 to 39.5	stickup		SA	SA	SA	SA	SA	SA	SA	SA	SA	SA		
KWB-11B	Monitoring	Downgradient	N of US82, between BR & Dirt Rd	Oct-92	4	3348.03	3345.91	72.20	50 to 69.5	stickup		SA	SA	SA	SA	SA	SA	SA	SA	SA	SA		
KWB-12A	Monitoring	Downgradient	S of US82, E of BR	Oct-92	4	3351.81	3352.01	24.85	15.5 to 24.5	flush mount		SA	SA	SA	SA	SA	SA	SA	SA	SA	SA		
KWB-12B	Monitoring	Downgradient	S of US82, E of BR	Oct-92	4	3351.63	3351.84	39.21	25.5 to 39.5	flush mount		SA	SA	SA	SA	SA	SA	SA	SA	SA	SA		
KWB-13	Monitoring	Crossgradient	S of US82, W of BR	NI	2	3365.67	3366.02	33.03	NI	flush mount		SA	A	A	A	A	A	A	A	A	A		
KWB-P2	Monitoring	Downgradient	E of Dirt Rd, N of US82	NI	2	3338.97	3339.32	33.41	NI	flush mount		SA	SA	SA	SA	SA	SA	SA	SA	SA	SA		
KWB-P3	Monitoring	Downgradient	Art Prod Line	NI	2	3308.50	3305.95	29.13 (9/09)	NI	NI		Not included in monitoring program due to distance from impacts											
KWB-P4	Monitoring	Downgradient	Haines House	NI	2	3305.39	3305.76	30.14 (9/09)	NI	NI		B	B	B	B	B	-	-	-	-	-		
KWB-P5	Monitoring	Downgradient	N of US82, E of BR - destroyed by road work	NI	NI	NI	NI	NI	NI	NI		Drop from monitoring program, well destroyed by road work											
MW-1R	Monitoring	EP	W of the EPs	Sep-03	2	3313.28	3311.58	20.56	8 to 23	flush mount		SA	A	A	A	A	-	-	A	A	A		
MW-2A	Monitoring	EP	W of the EPs	NI	2	3312.97	3310.55	17.06	NI	stickup		SA	SA	SA	SA	SA	-	-	SA	SA	SA		
MW-2B	Monitoring	EP	W of the EPs	Dec-92	2	3312.49	3309.94	51.74	38.5 to 47.5	stickup		SA	No analytical samples to be collected										
MW-3	Monitoring	EP	S of EP 1 & 2	NI	2	3310.32	3309.07	20.11	NI	stickup		SA	SA	SA	SA	SA	-	-	SA	SA	SA		
MW-4A	Monitoring	EP	S of EP 1 & 2	NI	4	3312.71	3308.64	22.15	NI	stickup		SA	SA	SA	SA	SA	-	-	SA	SA	SA		
MW-4B	Monitoring	EP	S of EP 1 & 2	NI	4	3312.01	3308.73	72.04	NI	stickup		SA	B	B	B	B	-	-	B	B	B		
MW-5A	Monitoring	EP	S of EP 2	NI	2	3308.62	3306.59	19.79	NI	stickup		SA	SA	SA	SA	SA	-	-	SA	SA	SA		
MW-5B	Monitoring	EP	S of EP 2	Dec-92	2	3308.95	3306.71	53.08	41.5 to 50.5	stickup		SA	B	B	B	B	-	-	B	B	B		
MW-5C	Monitoring	EP	S of EP 2	Jan-95	2	3309.28	3306.55	71.43	59.25 to 68.75	stickup		SA	B	B	B	B	-	-	B	B	B		
MW-6A	Monitoring	EP	S of EP 1	NI	2	3313.46	3310.40	18.76	NI	stickup		SA	A	A	A	A	-	-	A	A	A		
MW-6B	Monitoring	EP	S of EP 1	NI	2	3313.35	3310.09	52.00	NI	stickup		SA	B	B	B	B	-	-	B	B	B		
MW-7A	Monitoring	EP	S of EP 3	NI	2	3309.24	3306.04	17.07	NI	stickup		SA	SA	SA	SA	SA	-	-	SA	SA	SA		
MW-7B	Monitoring	EP	S of EP 3	Dec-92	2	3307.87	3306.05	52.17	39.5 to 48.5	stickup		SA	B	B	B	B	-	-	B	B	B		
MW-8	Monitoring	TMD	S of ED between BR & HR	Jun-86	2	3336.42	3334.81	20.11	NI	stickup		SA	SA	SA	SA	SA	-	-	SA	SA	SA		
MW-9	Monitoring	TMD	S of ED between BR & HR	Jun-86	2	3336.20	3334.50	19.99	NI	stickup		SA	No analytical samples to be collected										
MW-10	Monitoring	Downgradient	S of EPs	NI	2	3304.76	3304.14	18.32	NI	stickup		SA	SA	SA	SA	SA	-	-	SA	SA	SA		

Revised Monitoring Program and Schedule

Navajo Refining Company - Artesia Refinery, Artesia, New Mexico

Table 1

Well ID	Well Type	Location Information		Well Construction Information ^a							PSH Expected? ^b	Gauging Frequency	Analytical Suite and Frequency ^c									
		Associated Area of Concern	Approximate Location	Date Installed	Diameter (in)	Top of Casing (ft MSL)	Ground Surface (ft MSL)	Total Depth (ft btoc)	Screen Interval (ft bgs)	Surface Finish			Purge Parameters	DRO	GRO	VOCs	Metals (As, Ba, Cr, Fe, Pb, Mn, Se)	Metals (Hg, Ni, Va)	Cyanide	Cations/Anions	Nitrates / Nitrites	Total Dissolved Solids
MW-11B	Monitoring	EP	NE of EP 6	Dec-92	2	3310.76	3308.34	46.95	35.5 to 44.5	stickup	B	B	B	B	B	-	-	-	B	B	B	
MW-12	Monitoring	EP	N of OCD #1	Dec-92	4	3312.73	3310.37	10.38	6.5 to 15.5	stickup	Not included in monitoring program due to location (north of river)											
MW-13	Monitoring	EP	N of EP 1	Dec-92	4	3314.24	3311.95	20.82	9.5 to 18.5	stickup	Not included in monitoring program due to location (north of river)											
MW-14	Monitoring	EP	E of OCD #7	Dec-92	4	3311.84	3309.44	11.71	5.5 to 19.5	stickup	Not included in monitoring program due to location (north of river)											
MW-15	Monitoring	EP	W of EP 1	Dec-92	4	3313.72	3310.97	21.43	9 to 18.5	stickup	A	A	A	A	A	-	-	A	A	A	A	
MW-16	Monitoring	TMD	E of HR, N of ED	Jan-93	4	3316.12	3313.50	20.98	8.5 to 18	stickup	A	A	-	A	A	-	-	A	A	A	A	
MW-17	Monitoring	Crossgradient	NE of Artesia POTW	Jan-93	4	3322.01	3319.43	35.08	17 to 31.3	stickup	Not included in monitoring program due to distance from impacts											
MW-18	Monitoring	NCL	N Refinery, E of NCL	Jun-82	8	3365.42	3363.06	22.27	15 to 19	stickup	SA	SA	-	SA	SA	SA	SA	SA	SA	SA	SA	
MW-18A	Monitoring	EP	S of EPs	Jan-93	4	3308.58	3306.33	22.05	10 to 19.5	stickup	SA	SA	-	SA	SA	SA	SA	SA	SA	SA	SA	
MW-18B	Monitoring	EP	S of EPs	Jan-93	2	3308.74	3306.23	50.24	37 to 46.5	stickup	SA	B	B	B	B	B	-	-	B	B	B	
MW-18T	Monitoring	EP	S of EPs	Jan-93	4	3308.55	3306.30	50.55	37 to 46.5	stickup	No analytical samples to be collected											
MW-19	Monitoring	NCL	S of NCL	Jan-93	4	3368.00	3366.00	22.00	5 to 19.5	stickup	No analytical samples to be collected											
MW-20	Monitoring	TMD	E of BR, S of ED	Jan-93	4	3340.91	3338.43	26.61	9.5 to 23.5	stickup	SA	A	-	A	A	-	-	A	A	A	A	
MW-21	Monitoring	TMD	S of ED between BR & HR	Jan-93	4	3337.31	3334.65	24.90	7.5 to 22	stickup	SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA	
MW-22A	Monitoring	EP	S of EPs	Jan-93	4	3307.62	3305.24	22.33	5.5 to 20	stickup	SA	SA	SA	SA	SA	SA	-	-	A	A	A	
MW-22B	Monitoring	EP	S of EPs	Jan-93	2	3307.63	3305.08	54.31	42.3 to 51.8	stickup	SA	B	B	B	B	B	-	-	B	B	B	
MW-23	Monitoring	N Refinery	W of TEL	Jun-82	6	3368.38	3365.09	19.95	15 to 20	stickup	SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA	
MW-24	Monitoring	EP	E of OCD #6	Jul-82	6	3312.85	3310.33	23.25	15 to 20	stickup	Not included in monitoring program due to location (east of river)											
MW-25	Monitoring	TMD / EP	S of ED, E of HR	Jan-95	2	3312.29	3310.35	27.81	15.75 to 25.25	stickup	SA	A	-	A	A	-	-	A	A	A	A	
MW-26	Monitoring	TMD	S of ED, E of HR	Jan-95	2	3314.87	3312.08	27.31	15.25 to 24.25	stickup	SA	A	-	A	A	-	-	A	A	A	A	
MW-27	Monitoring	TMD	E of HR, S of ED	Jan-95	2	3320.85	3319.46	30.04	18.25 to 27.75	stickup	SA	A	-	A	A	-	-	A	A	A	A	
MW-28	Monitoring	S Refinery	E of SE Tankfarm	Jul-82	6	3370.27	3366.79	34.10	25 to 30	stickup	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	
MW-29	Monitoring	N Refinery	N of TEL	Jan-95	2	3360.64	3359.79	21.82	9.75 to 19.25	stickup	SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA	
MW-30	Monitoring	N Refinery / TMD	W of BR	NI	8	3354.33	3353.60	21.35	NI	stickup	No analytical samples to be collected											
MW-39	Monitoring	N Refinery	N of TEL	Jun-84	2	3358.79	3357.94	25.34	14 to 24	stickup	SA	SA ^d	SA ^d	SA ^d	SA ^d	SA ^d	-	-	SA ^d	SA ^d	SA ^d	
MW-40	Monitoring	N Refinery	N of TEL	NI	2	3356.93	3356.56	24.81	NI	stickup	SA	A	A	A	A	A	-	-	A	A	A	
MW-41	Monitoring	N Refinery	N of TEL	Jun-84	2	3356.58	3356.38	22.51	14 to 19	stickup	SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA	
MW-42	Monitoring	N Refinery	N of TEL	NI	2	3358.59	3356.66	23.40	NI	stickup	SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA	
MW-43	Monitoring	N Refinery	NW of TEL	Jul-84	6	3365.49	3363.38	21.22	15.5 to 20.5	stickup	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	
MW-45	Monitoring	N Refinery / TMD	E of Refinery, S of ED	Aug-84	2	3351.51	3351.32	15.65	10.5 to 15.5	stickup	SA	SA	-	SA	SA	SA	SA	SA	SA	SA	SA	
MW-46R	Monitoring	N Refinery / TMD	E of Refinery, S of ED	Oct-10	2	3350.11	3350.41	19.40	3.5 to 18.5	flush mount	SA	SA	-	SA	SA	SA	-	-	SA	SA	SA	
MW-48	Monitoring	S Refinery	S of SE Tankfarm	NI	2	3362.97	3363.04	32.47	NI	flush mount	SA	SA ^d	SA ^d	SA ^d	SA ^d	SA ^d	-	-	SA ^d	SA ^d	SA ^d	
MW-49	Monitoring	Central Refinery	E Refinery, midway from ED to US82	NI	2	3359.77	3359.69	33.04	NI	flush mount	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	
MW-50	Monitoring	Central Refinery	W of Refinery, E of US285, N of US 82	NI	2	3371.05	3368.91	28.27	NI	stickup	SA	SA	-	SA	SA	SA	-	-	SA	SA	SA	
MW-52	Monitoring	S Refinery	S of Refinery & US82	NI	2	3368.30	3368.36	34.50	NI	flush mount	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	
MW-53	Monitoring	Upgradient	W of Refinery, E of rail	Jun-95	2	3368.73	3368.86	23.65	13.8 to 23.8	flush mount	SA	A	-	A	A	-	-	A	A	A	A	
MW-54A	Monitoring	NCL	NW of NCL	Dec-95	2	3366.49	3363.55	31.06	12.7 to 27.7	stickup	SA	SA	-	SA	SA	SA	-	-	SA	SA	SA	
MW-54B	Monitoring	NCL	NW of NCL	Dec-95	2	3366.47	3363.47	46.80	33.8 to 43.8	stickup	SA	R	R	R	R	R	-	-	R	R	R	

Table 1
Revised Monitoring Program and Schedule
Navajo Refining Company - Artesia Refinery, Artesia, New Mexico

Well ID	Well Type	Location Information		Well Construction Information ^a							PSH Expected? ^b	Gauging Frequency	Analytical Suite and Frequency ^c									
		Associated Area of Concern	Approximate Location	Date Installed	Diameter (in)	Top of Casing (ft MSL)	Ground Surface (ft MSL)	Total Depth (ft btoc)	Screen Interval (ft bgs)	Surface Finish			Purge Parameters	DRO	VOCs	Metals (As, Ba, Cr, Fe, Pb, Mn, Se)	Metals (Hg, Ni, Va)	Cyanide	Cations/Anions	Nitrates / Nitrites	Total Dissolved Solids	
MW-55	Monitoring	N Refinery	E of NCL	Aug-95	2	3364.77	3361.90	26.82	13.7 to 23.7	stickup	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA		
MW-56	Monitoring	N Refinery / TMD	NE of Refinery	Aug-95	2	3357.44	3354.84	26.40	13.4 to 23.4	stickup	SA	SA	-	SA	SA	-	-	SA	SA	SA		
MW-57	Monitoring	Downgradient	S BR	Sep-03	4	3350.91	3350.95	30.00	15 to 30	flush mount	SA	SA	SA	SA	SA	SA	-	SA	SA	SA		
MW-58	Monitoring	Downgradient	S of US82, W of BR	Sep-03	4	3362.22	3362.56	32.90	15 to 30	flush mount	SA	SA	-	SA	SA	SA	SA	SA	SA	SA		
MW-59	Monitoring	N Refinery	Boneyard	Sep-03	4	3354.78	3354.97	29.72	10 to 30	flush mount	SA	A	A	A	A	-	-	A	A	A		
MW-60	Monitoring	N Refinery	Boneyard	Sep-03	4	3354.33	3354.36	34.30	13 to 28	flush mount	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA		
MW-61	Monitoring	N Refinery	SW of TEL	Apr-05	4	3369.47	3369.45	28.97	14 to 29	flush mount	SA	SA	SA	SA	SA	SA	-	SA	SA	SA		
MW-62	Monitoring	N Refinery	SW of TEL	Apr-05	4	3371.29	3369.01	31.94	14 to 29	flush mount	SA	SA	SA	SA	SA	SA	-	SA	SA	SA		
MW-63	Monitoring	N Refinery	SW of TEL	Apr-05	4	NI	NI	8.18 (9/08)	14 to 29	flush mount	Damaged during refinery construction											
MW-64	Monitoring	S Refinery	SW of SE Tankfarm	Apr-05	4	3369.52	3365.56	34.15	15 to 30	flush mount	Y	SA	SA ^d	SA ^d	SA ^d	SA ^d	-	-	SA ^d	SA ^d		
MW-65	Monitoring	S Refinery	S of SE Tankfarm	Apr-05	4	3363.60	3363.84	29.35	14.5 to 29.5	flush mount	Y	SA	SA ^d	SA ^d	SA ^d	SA ^d	-	-	SA ^d	SA ^d		
MW-66	Monitoring	S Refinery	E of SE Tankfarm	Apr-05	4	3363.46	3363.66	29.67	14.6 to 29.6	flush mount		SA	SA	SA	SA	SA	SA	SA	SA	SA		
MW-67	Monitoring	N Refinery	E of Diesel Tank Farm	Apr-05	4	3365.45	3365.59	27.17	12 to 27	flush mount		SA	SA	SA	SA	SA	SA	SA	SA	SA		
MW-68	Monitoring	TMD	S of ED, between HR & Dirt Rd	NI	2	3328.21	3325.81	26.51	NI	stickup		SA	A	A	-	A	-	A	A	A		
MW-69	Monitoring	EP	N River, formerly MW #23	Jan-93	4	3313.86	3311.40	10.88 (9/09)	5 to 19.5	stickup		SA	Not included in monitoring program due to location (north of river)									
MW-70	Monitoring	EP	S of EPs, formerly MW #19	NI	4	3306.30	3303.84	21.77	NI	stickup		SA	SA	SA	SA	SA	-	-	A	A		
MW-71	Monitoring	TMD	S of ED, formerly MW #29	NI	2	3335.29	3332.99	21.57	NI	stickup		SA	SA	-	SA	SA	SA	SA	SA	SA		
MW-72	Monitoring	EP	EP 6	Mar-07	4	3308.45	3306.40	13.70	2 to 12	stickup		SA	SA	SA	SA	SA	-	-	SA	SA		
MW-73	Monitoring	EP	EP 3	Mar-07	4	3310.18	3308.02	19.38	2 to 17	stickup		SA	SA	SA	SA	SA	-	-	SA	SA		
MW-74	Monitoring	EP	EP 2	Mar-07	4	3310.03	3307.78	19.89	2 to 17	stickup		SA	SA	SA	SA	SA	-	-	SA	SA		
MW-75	Monitoring	EP	EP 2	Mar-07	4	3310.21	3307.80	23.45	3 to 18	stickup		SA	SA	SA	SA	SA	-	-	SA	SA		
MW-76	Monitoring	EP	EP 2	Mar-07	4	3311.84	3309.70	20.08	3 to 18	stickup		SA	SA	SA	SA	SA	-	-	SA	SA		
MW-77	Monitoring	EP	EP 2	Mar-07	4	3310.07	3307.97	20.26	3 to 18	stickup		SA	SA	SA	SA	SA	SA	SA	SA	SA		
MW-78	Monitoring	EP	EP 2	Mar-07	4	3310.14	3307.94	19.35	2 to 17	stickup		SA	A	A	A	A	-	-	A	A		
MW-79	Monitoring	EP	EP 5	Mar-07	4	3311.43	3309.08	19.05	2 to 17	stickup		SA	SA	SA	SA	SA	-	-	SA	SA		
MW-80	Monitoring	EP	EP 5	Mar-07	4	3310.79	3308.73	19.61	2 to 17	stickup		SA	A	A	A	A	-	-	A	A		
MW-81	Monitoring	EP	EP 5	Mar-07	4	3312.34	3310.19	18.41	2 to 17	stickup		SA	A	A	A	A	-	-	A	A		
MW-82	Monitoring	EP	EP 1	Mar-07	4	3310.75	3308.64	19.77	2 to 17	stickup		SA	SA	SA	SA	SA	-	-	A	A		
MW-83	Monitoring	EP	EP 1	Mar-07	4	3310.19	3307.93	19.68	2 to 17	stickup		SA	SA	SA	SA	SA	-	-	SA	SA		
MW-84	Monitoring	EP	EP 1	Mar-07	4	3311.59	3309.83	20.21	2 to 17	stickup		SA	SA	SA	SA	SA	-	-	A	A		
MW-85	Monitoring	EP	EP 1	Mar-07	4	3311.09	3308.99	20.27	3 to 18	stickup	Y	SA	SA ^d	SA ^d	SA ^d	SA ^d	-	-	SA ^d	SA ^d		
MW-86	Monitoring	EP	EP 1	Mar-07	4	3311.06	3308.98	19.28	2 to 17	stickup	Y	SA	SA ^d	SA ^d	SA ^d	SA ^d	SA ^d	SA ^d	SA ^d	SA ^d		
MW-87	Monitoring	EP	S of EPs	Mar-07	4	3307.64	3305.42	20.07	2 to 17	stickup		SA	SA	SA	SA	SA	-	-	A	A		
MW-88	Monitoring	EP	S of EPs	Mar-07	4	3308.68	3306.43	20.03	3 to 18	stickup		SA	SA	SA	SA	SA	-	-	A	A		
MW-89	Monitoring	TMD	S of ED, E of HR	Mar-07	4	3318.32	3316.38	19.99	2 to 17	stickup		SA	A	-	A	A	-	-	A	A		
MW-90	Monitoring	N Refinery	S of Diesel Tankfarm	Jun-07	4	3369.42	3367.13	22.69	5 to 20	stickup		SA	SA	SA	SA	SA	-	-	SA	SA		
MW-91	Monitoring	N Refinery	S of Diesel Tankfarm	Jun-07	4	3367.73	3365.72	25.26	7 to 22	stickup		SA	SA	SA	SA	SA	-	-	SA	SA		
MW-92	Monitoring	N Refinery	S of ED, N of NAPI	Jun-07	4	3368.72	3366.75	22.53	5 to 20	stickup		SA	A	A	A	A	-	-	A	A		

Table 1

Revised Monitoring Program and Schedule

Navajo Refining Company - Artesia Refinery, Artesia, New Mexico

Well ID	Well Type	Location Information		Well Construction Information ^a							PSH Expected? ^b	Analytical Suite and Frequency ^c										
		Associated Area of Concern	Approximate Location	Date Installed	Diameter (in)	Top of Casing (ft MSL)	Ground Surface (ft MSL)	Total Depth (ft btoc)	Screen Interval (ft bgs)	Surface Finish		Purge Parameters	DRO	GRO	VOCs	Metals (As, Ba, Cr, Fe, Pb, Mn, Se)	Metals (Hg, Ni, Va)	Cyanide	Cations/Anions	Nitrates / Nitrites	Total Dissolved Solids	
MW-93	Monitoring	N Refinery	S of ED, NE of NAPI	Jun-07	4	3363.79	3364.22	20.10	5 to 20	flush mount		SA	SA	SA	SA	SA	-	-	SA	SA	SA	
MW-94	Monitoring	N Refinery	SE of Diesel Tankfarm, N of ED	Jul-07	4	3367.97	3365.82	23.79	5 to 20	stickup	Y	SA	SA ^d	SA ^d	SA ^d	SA ^d	-	-	SA ^d	SA ^d	SA ^d	
MW-95	Monitoring	N Refinery	NE of Diesel Tankfarm	Jul-07	4	3368.70	3366.48	25.32	7 to 22	stickup		SA	A	A	A	A	-	-	A	A	A	
MW-96	Monitoring	N Refinery	S of Diesel Tankfarm	Jul-07	4	3368.92	3366.83	25.47	7 to 22	flush mount		SA	SA	SA	SA	SA	-	-	SA	SA	SA	
MW-97	Monitoring	N Refinery	SE of NAPI	Jul-07	4	3365.92	3366.38	21.93	8 to 23	flush mount	Y	SA	SA ^d	SA ^d	SA ^d	SA ^d	-	-	SA ^d	SA ^d	SA ^d	
MW-98	Monitoring	N Refinery	E of Former Diesel Storage Tank Area	Jul-07	4	3361.36	3358.96	26.62	13 to 23	stickup		SA	SA	SA	SA	SA	-	-	SA	SA	SA	
MW-99	Monitoring	S Refinery	NE of Loading Rack	Jul-07	4	3364.07	3362.33	28.26	12 to 27	flush mount		SA	SA	SA	SA	SA	-	-	SA	SA	SA	
MW-100	Monitoring	S Refinery	SE corner of SE Tankfarm	Jul-07	4	3364.51	3365.11	30.48 (9/09)	9 to 24	flush mount	Abandoned for refinery construction											
MW-101	Monitoring	S Refinery	E Loading Rack	Jul-07	4	3364.23	3362.07	26.70	8 to 23	stickup	Y	SA	SA	SA	SA	SA	-	-	SA	SA	SA	
MW-102	Monitoring	S Refinery	E West Firewater Pond	Jul-07	4	3367.64	3365.51	26.44	12 to 27	stickup		SA	SA ^d	SA ^d	SA ^d	SA ^d	-	-	SA ^d	SA ^d	SA ^d	
MW-103	Monitoring	S Refinery	Old Rail ROW	Aug-08	4	3372.47	3370.89	25.10	7 to 22	flush mount		SA	A	A	A	A	-	-	A	A	A	
MW-104	Monitoring	S Refinery	Old Rail ROW	Aug-08	4	3371.43	3369.41	21.82	3 to 18	flush mount		SA	SA	SA	SA	SA	-	-	SA	SA	SA	
MW-105	Monitoring	Central Refinery	W of Crude Tankfarm	Feb-09	4	3364.99	3365.20	17.13	8 to 18	flush mount	Y	SA	SA ^d	SA ^d	SA ^d	SA ^d	-	-	SA ^d	SA ^d	SA ^d	
MW-106	Monitoring	Central Refinery	E of Crude Tankfarm	Feb-09	4	3358.98	3359.29	22.70	0 to 11	flush mount		SA	SA	SA	SA	SA	-	-	SA	SA	SA	
MW-107	Monitoring	S Refinery	NE of SE Tankfarm	Feb-09	4	3359.44	3359.63	18.96	12 to 22	flush mount		SA	SA	SA	SA	SA	-	-	SA	SA	SA	
MW-108	Monitoring	NCL	S of NCL	Jul-09	4	3369.11	3366.25	26.80	9 to 24	stickup		SA	SA	SA	-	SA	-	-	SA	SA	SA	
MW-109	Monitoring	S Refinery	S of Highway 82 at warehouse	Jan-11	2	3368.09	3368.27	30.00	15 to 29.5	flush mount		SA	SA	SA	SA	SA	-	-	SA	SA	SA	
MW-110	Monitoring	S Refinery	S of Highway 82 at warehouse	Jan-11	2	3368.03	3368.46	30.00	15 to 29.5	flush mount		SA	SA	SA	SA	SA	-	-	SA	SA	SA	
NCL-31	Monitoring	NCL	NCL	Oct-82	2	3367.54	3366.21	20.10	13 to 18	stickup		SA	SA	SA	-	SA	-	-	SA	SA	SA	
NCL-32	Monitoring	NCL	NCL	Oct-82	2	3364.91	3364.96	17.31	17 to 22	stickup		SA	SA	SA	-	SA	-	-	SA	SA	SA	
NCL-33	Monitoring	NCL	NCL	Oct-82	2	3363.97	3364.26	20.47	13 to 18	stickup		SA	SA	SA	-	SA	-	-	SA	SA	SA	
NCL-34A	Monitoring	NCL	NCL	Oct-82	2	3365.49	3364.82	19.25	16 to 21	stickup		SA	SA	SA	-	SA	-	-	SA	SA	SA	
NCL-34B	Monitoring	NCL	NCL	Oct-82	2	3366.06	3364.70	NI	NI	stickup		SA	B	B	-	B	-	-	B	B	B	
NCL-44	Monitoring	NCL	NCL	NI	2	3364.45	3364.01	21.58	NI	stickup		SA	SA	SA	-	SA	-	-	SA	SA	SA	
NCL-49	Monitoring	NCL	NCL	NI	2	3371.13	3368.26	31.98	NI	stickup		SA	SA	SA	-	SA	-	-	SA	SA	SA	
NP-1	Monitoring	TMD	S of ED, E of BR	Jan-93	2	3342.40	3339.69	21.64	9.5 to 18.5	stickup		SA	SA	-	SA	-	-	-	A	A	A	
NP-2	Monitoring	TMD	S of ED, E of BR	Jan-93	2	3342.77	3340.58	21.25	9.5 to 18.5	stickup		SA	No analytical samples to be collected									
NP-3	Monitoring	TMD	N of ED, NE of BR	Jan-93	2	3342.93	3340.40	21.65	9.5 to 18.5	stickup		SA	No analytical samples to be collected									
NP-4	Monitoring	TMD	NE of NP #3	Jan-93	2	3345.73	3343.24	36.75	24.5 to 33.5	stickup		SA	No analytical samples to be collected									
NP-5	Monitoring	Crossgradient	S of RR, N of ED, W of BR	Jan-95	2	3349.29	3346.31	24.89	10.25 to 19.75	stickup		SA	A	A	-	A	-	-	A	A	A	
NP-6	Monitoring	TMD	S of ED, W of BR	Jan-95	2	3338.05	3336.31	20.07	8.75 to 18	stickup		SA	A	-	-	A	-	-	-	-	-	
NP-7	Monitoring	TMD	In Pecan Orchard, destroyed by landowner	Jan-95	2	3329.65	3326.84	NI	25.25 to 34.75	NI		Drop from monitoring program, destroyed by landowner										
NP-8	Monitoring	TMD	S of ED, E of HR	NI	2	3314.67	3310.53	14.88	NI	stickup		SA	No analytical samples to be collected									
NP-9	Monitoring	TMD	S of RR, N of ED, W of BR	NI	2	3360.62	3357.86	25.86	NI	NI		SA	No analytical samples to be collected									
OCD-1R	Monitoring	EP	NW of EP 6, replaced OCD-1	NI	2	3314.27	3310.69	23.60	NI	stickup		SA	SA	SA	SA	SA	-	-	A	A	A	
OCD-2A	Monitoring	EP	N of EP 6	NI	2	3314.16	3310.83	27.27	NI	stickup		SA	SA	SA	SA	SA	-	-	A	A	A	
OCD-2B	Monitoring	EP	N of EP 6	Dec-92	2	3313.07	3310.66	50.58	38.5 to 47.5	stickup		SA	No analytical samples to be collected									
OCD-3	Monitoring	EP	NE of EP 6	NI	2	3314.43	3310.89	25.16	NI	stickup		SA	SA	SA	SA	SA	-	-	A	A	A	

Table 1

Revised Monitoring Program and Schedule

Navajo Refining Company - Artesia Refinery, Artesia, New Mexico

Well ID	Well Type	Location Information		Well Construction Information ^a							PSH Expected? ^b	Analytical Suite and Frequency ^c									
		Associated Area of Concern	Approximate Location	Date Installed	Diameter (in)	Top of Casing (ft MSL)	Ground Surface (ft MSL)	Total Depth (ft btoc)	Screen Interval (ft bgs)	Surface Finish		Purge Parameters	DRO	GRO	VOCs	Metals (As, Ba, Cr, Fe, Pb, Mn, Se)	Metals (Hg, Ni, Va)	Cyanide	Cations/Anions	Nitrates / Nitrites	Total Dissolved Solids
OCD-4	Monitoring	EP	NE of EP 6	NI	2	3313.68	3310.31	25.12	NI	stickup	SA	SA	SA	SA	SA	-	-	-	A	A	A
OCD-5	Monitoring	EP	NE of EP 6	NI	2	3311.27	3308.76	25.13	NI	stickup	SA	SA	SA	SA	SA	-	-	-	A	A	A
OCD-6	Monitoring	EP	E of EP 6	NI	2	3311.40	3308.11	26.51	NI	stickup	SA	SA	SA	SA	SA	-	-	-	A	A	A
OCD-7AR	Monitoring	EP	SE of EP 6	Dec-92	4	3310.03	3308.86	21.01	5.5 to 19.5	stickup	SA	SA	SA	SA	SA	-	-	-	A	A	A
OCD-7B	Monitoring	EP	SE of EP 6	Dec-92	2	3310.26	3307.57	56.51	43.5 to 52.5	stickup	SA	SA	SA	SA	SA	-	-	-	A	A	A
OCD-7C	Monitoring	EP	SE of EP 6	Jan-95	2	3310.10	3307.74	71.73	60.25 to 69.75	stickup	SA	B	B	B	B	B	-	-	B	B	B
OCD-8A	Monitoring	EP	SE of EP 3	NI	2	3308.72	3306.43	21.35	NI	stickup	SA	SA	SA	SA	SA	SA	SA	SA	A	A	A
OCD-8B	Monitoring	EP	SE of EP 3	Dec-92	2	3309.19	3306.11	56.24	43.5 to 52.5	stickup	SA	B	B	B	B	B	-	-	B	B	B
TEL-1	Monitoring	TEL	E of TEL cap	May-90	2	3358.23	3356.79	26.90	13 to 23	stickup	SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
TEL-2	Monitoring	TEL	E of TEL cap	May-90	2	3359.12	3356.80	27.08	13 to 23	stickup	SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
TEL-3	Monitoring	TEL	E of TEL cap	May-90	2	3358.33	3356.43	27.18	13 to 23	stickup	SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
TEL-4	Monitoring	TEL	W of TEL cap	May-90	2	3360.24	3358.21	27.16	13 to 23	stickup	SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
UG-1	Monitoring	Upgradient	W of Refinery, James Street	Jul-08	4	3372.94	3373.02	24.01	8 to 23	flush mount	A	A	A	A	A	A	A	A	A	A	A
UG-2	Monitoring	Upgradient	W of Refinery, Roselawn	Jul-08	4	3380.41	3380.30	29.03	15 to 30	flush mount	A	A	A	A	A	A	A	A	A	A	A
UG-3R	Monitoring	Upgradient	W of Refinery, 7th Street	Sep-08	4	3384.08	3384.62	38.32	17 to 37	flush mount	A	A	A	A	A	A	A	A	A	A	A
LaRue Well	Irrigation	Offsite	S of US82	NI	NI	NI	NI	NI	NI	irrigation well	Drop from monitoring program based on historic data (no organic impacts) and lack of consistency										
RA-313	Irrigation	S Refinery	N of US82, W of BR	Oct-40	10	3370.62	3369.96	1157	904 to 1157	irrigation well	NA	A	-	A	-	-	-	-	A	A	A
RA-314	Irrigation	S Refinery	N of US82, W of BR	NI	10	3363.82	3363.51	NI	no data	irrigation well	NA	A	-	A	-	-	-	-	A	A	A
RA-1227	Irrigation	SE of Refinery	S of US82, E of BR	Dec-35	10 / 8	3352.80	3352.27	246	194 to 246	irrigation well	NA	SA	-	SA	-	-	-	-	SA	SA	SA
RA-3156	Irrigation	Downgradient	S of US82, E of BR	Nov-53	4	3353.28	3353.02	NI	182 to ?	irrigation well	NA	SA	-	SA	-	-	-	-	SA	SA	SA
RA-3353	Irrigation	Downgradient	S of US82, E of BR, electricity disconnected 2009	NI	10	NI	NI	NI	NI	irrigation well	Drop from monitoring program since electricity has been cut and well is inoperable										
RA-3723	Irrigation	S Refinery	N of US82, W of BR, inoperable in 2009	NI	10	3358.66	3357.33	NI	NI	irrigation well	Drop from monitoring program since well is inoperable										
RA-4196	Irrigation	Field E of Refinery	N of US82, E of BR	Apr-60	8	3351.52	3350.75	294	280 to 292	irrigation well	NA	SA	-	SA	-	-	-	-	SA	SA	SA
RA-4798	Irrigation	Field E of Refinery	E of BR, N of US82	May-63	7	3348.31	3347.65	850	840 to 850	irrigation well	NA	SA	-	SA	-	-	-	-	SA	SA	SA
RW-1	Recovery ^d	N Refinery	S of ED, NW portion of Refinery	NI	36	3367.03	3365.29	18.73	NI	recovery well	Y	SA	A ^d	A ^d	A ^d	A ^d	-	-	A ^d	A ^d	A ^d
RW-2	Recovery ^d	N Refinery	S of ED, NW portion of Refinery	NI	36	3368.43	3365.88	19.28	NI	recovery well		SA	A ^d	A ^d	A ^d	A ^d	-	-	A ^d	A ^d	A ^d
RW-3	Recovery ^d	N Refinery	Between ED and TEL, backfilled	NI	36	3364.91	3362.92	10.97 (9/08)	NI	recovery well	Backfilled, inoperable										
RW-4	Recovery ^d	S Refinery	NW of SE Tankfarm	NI	36	3364.86	3364.41	20.97	NI	recovery well		SA	A	A	-	A	-	-	A	A	A
RW-5	Recovery ^d	S Refinery	SE Tankfarm	NI	36	3363.81	3362.79	17.46	NI	recovery well	Y	SA	A ^d	A ^d	-	A ^d	-	-	A ^d	A ^d	A ^d
RW-6	Recovery ^d	S Refinery	W of SE Tankfarm	NI	36	3368.36	3366.03	17.06	NI	recovery well	Y	SA	A ^d	A ^d	-	A ^d	-	-	A ^d	A ^d	A ^d
RW-7	Recovery ^d	N Refinery	N of ED, NW portion of Refinery	NI	36	3367.09	3365.03	20.65	NI	recovery well		SA	A	A	A	A	-	-	A	A	A
RW-8	Recovery ^d	N Refinery	N of ED, S of NCL	NI	36	3368.10	3364.89	14.34	NI	recovery well	Y	SA	A ^d	A ^d	-	A ^d	-	-	A ^d	A ^d	A ^d
RW-9	Recovery ^d	N Refinery	N of TEL	NI	36	3359.51	3356.30	21.85	NI	recovery well		SA	A	A	A	A	-	-	A	A	A
RW-10	Recovery ^d	N Refinery	N of TEL	NI	36	3360.61	3356.12	23.73	NI	recovery well		SA	A	A	A	A	-	-	A	A	A
RW-11 ^e	Recovery ^d	S Refinery	S of US82, W side of BR	NI	36	3353.95	3351.48	22.93	NI	recovery well		SA	A	A	-	A	-	-	A	A	A
RW-12	Recovery ^d	Field E of Refinery	N of US 82, W of BR	NI	36	3352.55	3351.17	22.95	NI	recovery well		SA	A	A	-	A	-	-	A	A	A
RW-13	Recovery ^d	Field E of Refinery	N of US 82, W of BR	NI	36	3351.95	3349.87	26.21	NI	recovery well	Y	SA	A ^d	A ^d	-	A ^d	-	-	A ^d	A ^d	A ^d
RW-14	Recovery ^d	Field E of Refinery	N of US 82, W of BR	NI	36	3351.48	3347.95	23.75	NI	recovery well	Y	SA	A ^d	A ^d	-	A ^d	-	-	A ^d	A ^d	A ^d

Table 1

Revised Monitoring Program and Schedule

Navajo Refining Company - Artesia Refinery, Artesia, New Mexico

Well ID	Well Type	Location Information		Well Construction Information ^a							PSH Expected? ^b	Gauging Frequency	Analytical Suite and Frequency ^c									
		Associated Area of Concern	Approximate Location	Date Installed	Diameter (in)	Top of Casing (ft MSL)	Ground Surface (ft MSL)	Total Depth (ft btoc)	Screen Interval (ft bgs)	Surface Finish			Purge Parameters	DRO	GRO	VOCs	Metals (As, Ba, Cr, Fe, Pb, Mn, Se)	Metals (Hg, Ni, Va)	Cyanide	Cations/Anions	Nitrates / Nitrites as Nitrogen	Total Dissolved Solids
RW-15 ^e	Recovery ^d	S Refinery	S of SE Tankfarm	NI	36	3361.41	3362.65	21.46	NI	recovery well	A ^d	A ^d	-	A ^d	A ^d	-	-	A ^d	A ^d	A ^d		
RW-16 ^e	Recovery ^d	N Refinery / TMD	NE of Refinery, S of ED	NI	36	3360.97	3357.20	17.52	NI	recovery well	A	A	-	A	A	-	-	A	A	A		
RW-17 ^e	Recovery ^d	N Refinery	N of ED, E of NCL	NI	36	3364.72	3362.76	16.00	NI	recovery well	A	A	A	A	A	-	-	A	A	A		
RW-18 ^e	Recovery ^d	Field E of Refinery	S of ED, W of BR	NI	36	3350.84	3349.04	17.62	NI	recovery well	A	-	-	A	A	-	-	A	A	A		

Footnotes:

- A = Annual (March/April event)

B = Biennial (starts March/April 2011)

BR = Bolton Road

DRO = Diesel Range Organics

E = East

EP = Evaporation Ponds

ft bgs = feet below ground surface

ft btoc = feet below top of casing

ft MSL = feet Mean Sea Level

GRO = Gasoline Range Organics

HR = Haldeman Road

in = inches

N = North

NA = Not accessible

NAPI = North API Separator

NCL = North Colony Landfarm

NE = Northeast

NI = No Information Available
- NS = Not surveyed yet

NW = Northwest

OCD = Oil Conservation District

PSH = Phase Separated Hydrocarbons

ROW = right of way

RR = Richey Road

S = South

SA = Semi-annual (September/October event)

SE = Southeast

SW = Southwest

TMD = Three Mile Ditch

TEL = Tetra Ethyl Lead Impoundment

UG = Upgradient

US285 = U.S. Highway 285

US82 = U.S. Highway 82

VOCs = Volatile Organic Compounds

W = West

Y = Yes
- ^a Well construction information provided where available. Top of casing and ground surface elevations from February 2010 survey. Total depth from 4/2010 measurements unless otherwise noted.

^b PSH was present during March 2010 groundwater monitoring event or a recovery pump is in place. Note that recovery wells are also gauged at least monthly.

^c Analytical Suite to include the following:

1. Purge parameters to be measured and recorded in the field will include pH, temperature, specific conductivity, dissolved oxygen, and oxygen-reduction potential.

2. DRO by Method 8015Mod.

3. GRO by Method 8015Mod.

4. VOCs by Method 8260, to include methyl tert butyl ether (MTBE) and naphthalene.

5. Metals:

a. Samples will be collected for total metals analyses for every event at frequency shown in table.

b. Samples will be collected for dissolved metals analyses during Biennial, Annual and First Semiannual (March/April) events.

c. Dissolved metals samples will be field filtered using a 0.10 micron filter.

6. Cyanide by Method SM4500.

7. Cations/anions to include Calcium, Potassium, and Sodium by Method 6010 or 6020 and Sulfate, Chloride and Fluoride by Method 300.

8. Nitrates/Nitrites as Nitrogen by Method 300.

9. Total Dissolved Solids by Method 2540C.

"-" indicates parameter not required.

Note - samples will not be collected from any well where PSH is measured to be 0.03 feet thick or greater.

^d Samples to be collected at frequency indicated if <0.03 feet of PSH is present.

^e Recovery trenches 11, 15, 16, 17 and 18 have multiple "wells". Gauging and sampling points are as follows: RW #11-0, RW #15C, RW #16B, RW #17A and RW #18A.

Date Start/Finish: 1/5/11
Drilling Company: Atkins
Driller's Name: Mort Bates
Drilling Method: Hollow Stem Auger
Sampling Method: Core Barrel
Rig Type: NA

Northing: 670174.25
Easting: 523065.52
Casing Elevation: 3368.09' amsl

Borehole Depth: 30' bgs
Surface Elevation: 3368.27' amsl

Descriptions By: R. Lang

Well/Boring ID: MW-109
Client: Navajo Refining Company

Location: Navajo Refinery
 Artesia, N.M.

DEPTH	ELEVATION	Sample Run Number	Sample/Int/Type	PID (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Well/Boring Construction
3370								
0							SANDSTONE, 7.5YR 8/4 pink 35% fine grained, 35% firm, caliche 2.5YR 8/1 white, asphalt paving debris 7.5YR 2.5/1 black, 30% moist	Concrete Pad and Flush Mount Casing
							Hydrovac excavated for clearance	Portland Cement (0'-5' bgs)
3365		1	HV	-				
5								
		2	DP	0.5			CLAY, 2.5Y reddish brown, plastic, fat clay, moist	
3360								2" PVC Pipe (0'-15' bgs)
		3	DP	0.2				Bentonite Chips (5'-12' bgs)
10								
		4	DP	0.0				
							color change to 5YR 8/4 pink, plastic, moist	
3355		5	DP	0.3				
15		6	DP	1441			SANDSTONE, Gley 2 7/1, light bluish grey, fine to medium sandstone, moderately sorted, argillaceous, moist, odor	

Remarks: bgs = below ground surface; amsl = above mean sea level; HV = hydrovac; ppm = parts per million; NA = not applicable/available; DP = Direct Push;

Northing and Easting data based on New Mexico State Plane System, Eastern Zone NAD 83. Elevation NAVD 88 referenced to NGS benchmark G-416



Client: Navajo Refining Company

Well/Boring ID: MW-109

Site Location:

Navajo Refinery
Artesia, N.M.

Borehole Depth: 30' bgs

DEPTH	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Well/Boring Construction
		7	DP	1627					
3350		8	DP	827				CLAY, Gley 2 7/1, light bluish grey, crumbly, arenaceous, odor	
20		9	DP	1998				CLAY, 2.5R 5/6 greyish crimson, 2.5YR 8/4 pink, plastic, mottled, odor	
3345		10	DP	2061				SANDSTONE, 2.5YR 5/6 red and 2.5YR 8/4 pink, fine grained, poorly sorted, soft, silty, odor	
25		11	DP	1549					
		12	DP	1309					
3340		13	DP	54				CLAY, 2.5YR 7/1 light reddish grey, plastic, wet	
30								Borehole terminated at 30'	
3335									
35									

Remarks: bgs = below ground surface; amsl = above mean sea level; HV = hydrovac; ppm = parts per million; NA = not applicable/available; DP = Direct Push;

Northing and Easting data based on New Mexico State Plane System, Eastern Zone NAD 83. Elevation NAVD 88 referenced to NGS benchmark G-416

▼ Product Level - observed only during installation of well and not observed in subsequent sampling events.

▽ Measured Water Level 1/7/2001



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Infrastructure, environment, buildings

Date Start/Finish: 1/6/11
Drilling Company: Atkins
Driller's Name: Mort Bates
Drilling Method: Hollow Stem Auger
Sampling Method: Core Barrel
Rig Type: NA

Northing: 670174.33
Easting: 522796.69
Casing Elevation: 3368.03' amsl

Borehole Depth: 30' bgs
Surface Elevation: 3368.46' amsl

Descriptions By: R. Lang

Well/Boring ID: MW-110

Client: Navajo Refining Company

Location: Navajo Refinery
 Artesia, N.M.

DEPTH	ELEVATION	Sample Run Number	Sample/Int/Type	PID (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Well/Boring Construction
3370								
30					X		SANDSTONE, 10R 6/6 light red, fine grained, well sorted, soft, argillaceous, trace (~10%) broken pavement	Concrete Pad and Flush Mount Casing
							Hydrovac excavated for clearance	Portland Cement (0'-5' bgs)
3365		1	HV	-				
5								
		2	GP	1.0			CLAY, 2.5YR 5/8 red, plastic, moist	2" PVC Pipe (0'-15' bgs)
3360								
		3	GP	0.8			SANDSTONE, 2.5YR 7/4 light reddish brown, medium grained to silt, poorly sorted, soft, dry	Bentonite Chips (5'-13' bgs)
10								
		4	GP	42.6			CLAY, Gley 2 7/1 5PB light bluish grey, plastic, odor, some clay 10R 8/1 white, mottled, contains gypsum crystals	
3355								
		5	GP	1444				
15								
		6	GP	1118				

Remarks: bgs = below ground surface; amsl = above mean sea level; HV = hydrovac; ppm = parts per million; NA = not applicable/available; DP = Direct Push;

Northing and Easting data based on New Mexico State Plane System, Eastern Zone NAD 83. Elevation NAVD 88 referenced to NGS benchmark G-416



Client: Navajo Refining Company

Well/Boring ID: MW-110

Site Location:

Navajo Refinery
Artesia, N.M.

Borehole Depth: 30' bgs

DEPTH	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Well/Boring Construction
		7	GP	2588					
3350		8	GP	2055					
20		9	GP	2293				SANDSTONE, Gley 1 4/N very dark grey, fine grained, well sorted, firm, very argillaceous, odor, very moist	
		10	GP	322					
3345		11	GP	1828				CLAY, 2.5YR 5/4 reddish brown, soft, arenaceous, silty	
25		12	GP	2231					
		13	GP	19.3				CLAY, 10R 5/6 red, firm, plastic, silty, arenaceous	
3340									
30								Borehole terminated at 30'	
3335									
35									

Sand Pack 8/16
(13'-30' bgs)

2" Sch 40 PVC
0.010" Slot
Screen (15'-29.5'
bgs)

6" Cap



ARCADIS

Infrastructure, environment, buildings

Remarks: bgs = below ground surface; amsl = above mean sea level; HV = hydrovac; ppm = parts per million; NA = not applicable/available; DP = Direct Push;

Northing and Easting data based on New Mexico State Plane System, Eastern Zone
NAD 83. Elevation NAVD 88 referenced to NGS benchmark G-416

Σ Measured Water Level - 1/10/2011

Chavez, Carl J, EMNRD

From: Chavez, Carl J, EMNRD
Sent: Thursday, September 01, 2011 9:31 AM
To: 'Krueger, Pamela'
Cc: Tsinnajinnie, Leona, NMENV; Cobrain, Dave, NMENV; Moore, Darrell
Subject: RE: Summary of Conference Call regarding Navajo FWGMWP

Pam:

Please find OCD responses to your remaining FWGMWP questions in red text below.

Please contact me if you have questions. Thank you.

Carl J. Chavez, CHMM
New Mexico Energy, Minerals & Natural Resources Dept.
Oil Conservation Division, Environmental Bureau
1220 South St. Francis Dr., Santa Fe, New Mexico 87505
Office: (505) 476-3490
Fax: (505) 476-3462
E-mail: CarlJ.Chavez@state.nm.us

Website: <http://www.emnrd.state.nm.us/o cd/>

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<http://www.emnrd.state.nm.us/o cd/environmental.htm#environmental>)

From: Krueger, Pamela [<mailto:pam.krueger@arcadis-us.com>]
Sent: Wednesday, August 31, 2011 12:43 PM
To: Chavez, Carl J, EMNRD
Cc: Tsinnajinnie, Leona, NMENV; Cobrain, Dave, NMENV; Moore, Darrell
Subject: Summary of Conference Call regarding Navajo FWGMWP

Carl –

Thank you for the prompt response regarding the routine monitoring program for dissolved metals.

There are two remaining issues that we need to address:

1. Cadmium was removed from the monitoring program in 2010 based on the historical results presented in the 2010 work plan and summarized in the 8/23/2011 email. Does OCD still approve of the removal of Cadmium from the monitoring program? Yes, but when releases occur at the facility, the entire analytical suites need to be analyzed to characterize each release. Releases continue to occur at the facility that could contain Cadmium and other unanalyzed parameters in the FWGMWP. Therefore, depending on a release or discovery of a major release that contains parameters not monitored for under the FWGMWP, we may need to add them during the FWGMWP revision period. Please let the agencies know I you are aware of any major releases in the past year that may require certain parameters to be added to the FWGMWP and this should part of the evaluation each year when any changes are proposed to the FWGMWP. Thank you.
2. You raised the question of PAH compounds during the call on 8/23/2011. Historically, the semiannual groundwater monitoring program has not included analysis of PAHs with the exception of naphthalene, which is included in the VOC analysis by method 8260. During initial investigations of various areas of concern, SVOCs have been analyzed in groundwater samples. Upon review of the data from various investigations, we determined that naphthalene is the most prevalent SVOC present, with sporadic detections of phenol above screening levels and one instance of pentachlorophenol detection above screening levels. The remaining SVOC and PAH compounds were either not detected or were below

screening levels, where screening levels are available. In every instance where phenol or pentachlorophenol was detected above a screening level, the DRO concentration was above the screening level. In most of those instances, naphthalene was also detected above the screening level. As a result, DRO and naphthalene are believed to be adequate screening parameters for routine monitoring of potential PAH constituents. Does OCD concur with continuing the monitoring program using DRO and naphthalene as representative parameters for PAHs? Same answer as provided above.

Pamela R. Krueger | Senior Project Manager | pam.krueger@arcadis-us.com

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From: Chavez, Carl J, EMNRD [<mailto:CarlJ.Chavez@state.nm.us>]
Sent: Wednesday, August 24, 2011 10:19 AM
To: Moore, Darrell
Cc: Krueger, Pamela; Tsinnajinnie, Leona, NMENV; Cobrain, Dave, NMENV; VonGonten, Glenn, EMNRD
Subject: FW: Summary of Conference Call regarding Navajo FWGMWP

Darrell:

The agencies approve "Option 2" below in Ms. Krueger's 8/23/2011 e-mail communiqué describing the telephone conference call options from OCD and Navajo Refining Company/Arcadis meeting on 8/23/2011.

Please contact me if you have questions. Thank you.

Carl J. Chavez, CHMM
New Mexico Energy, Minerals & Natural Resources Dept.
Oil Conservation Division, Environmental Bureau
1220 South St. Francis Dr., Santa Fe, New Mexico 87505
Office: (505) 476-3490
Fax: (505) 476-3462
E-mail: CarlJ.Chavez@state.nm.us

Website: <http://www.emnrd.state.nm.us/ocd/index.htm>

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<http://www.emnrd.state.nm.us/ocd/environmental.htm#environmental>)

From: Tsinnajinnie, Leona, NMENV
Sent: Wednesday, August 24, 2011 9:15 AM
To: Chavez, Carl J, EMNRD; VonGonten, Glenn, EMNRD
Cc: Cobrain, Dave, NMENV
Subject: RE: Summary of Conference Call regarding Navajo FWGMWP

Hi Carl-

NMED is fine with option 2. I have not sent out NMED's response to Navajo's FWGMWP and will incorporate option 2 in my comments.

Thanks,
Leona

From: Chavez, Carl J, EMNRD
Sent: Tuesday, August 23, 2011 2:17 PM
To: Tsinnajinnie, Leona, NMENV; Cobrain, Dave, NMENV
Cc: VonGonten, Glenn, EMNRD
Subject: FW: Summary of Conference Call regarding Navajo FWGMWP

Leona and Dave:

After discussing the metals (dissolved vs. total) inquiry from the FWGMWP with the operator and then with Glenn, OCD is thinking option number 2 may work. Please let me know if you have any issues with the OCD allowing option number 2 below.

If you have no issues to discuss, OCD will inform Arcadis and the operator?

Thank you.

Carl J. Chavez, CHMM
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From: Krueger, Pamela [mailto:pam.krueger@arcadis-us.com]
Sent: Tuesday, August 23, 2011 11:24 AM
To: Chavez, Carl J, EMNRD
Cc: Moore, Darrell
Subject: Summary of Conference Call regarding Navajo FWGMWP

Carl –

As we just discussed, Navajo is requesting consideration of one of the following options regarding the facility wide groundwater monitoring work plan (FWGMWP):

1. Continue monitoring wells as per the schedule listed in the 2010 and 2011 FWGMWP, analyzing the metals samples as totals (unfiltered) only, then comparing the total metals results to the WQCC dissolved metals standards or to the EPA MCL if a WQCC standard does not exist. If neither an WQCC standard or MCL does not exist, the NMED risk-based tapwater screening value will be used for comparison. This provides a conservative evaluation of the potential exposure concentration, under the assumption that the groundwater might be directly consumed.
2. Continue monitoring wells as per the schedule listed in the 2010 and 2011 FWGMWP, analyzing the metals samples as totals (unfiltered) for the purposes of the RCRA permit, and analyze metals samples collected during the more comprehensive (annual) event for dissolved metals (filtered samples), then compare to the same standards described in option 1. To clarify this option:
 - a. Wells that are sampled twice per year would only have filtered samples collected for dissolved metals analysis once per year but would have total metals analyses twice per year;
 - b. Wells that are sampled once per year would have both total and dissolved metals analyses; and
 - c. Wells that are sampled biennially would have both total and dissolved metals analyses.

3. Revise the monitoring program to include collection of filtered samples for dissolved metals analyses from select wells (downgradient sentinel wells and select wells within the identified plume areas) during each sampling event, and compare to the same standards described in option 1.

Regarding your questions on PAHs and Cadmium, I reviewed the summary table that was included as Appendix A of the 2010 FWGMWP. That appendix presents all of the TPH, metals, VOCs, and water quality parameter data collected from all of the wells from 2005 through 2009, where available. Based on installation dates and sampling schedules, the majority of the data is from 2007 through 2009. The table does not list SVOCs or PAHs, so I will need to do a bit of research and data compilation to confirm my statement that naphthalene is the only PAH that has been reported above screening standards historically.

For Cadmium, there were a total of 650 sample results included in the table and 649 were below the laboratory detection limit. The one detected concentration was reported as 0.00102 mg/L (MW-45 in 9/2006), which is below the EPA MCL of 0.005 mg/L. Subsequent samples from MW-45 were all not detected, with the detection limits ranging from 0.00015 to 0.002 mg/L. The historic data with a lack of reportable concentrations was the reason that Cadmium was dropped from the sampling plan in 2010.

Pamela R. Krueger | Senior Project Manager | pam.krueger@arcadis-us.com

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Chavez, Carl J, EMNRD

From: Chavez, Carl J, EMNRD
Sent: Wednesday, August 24, 2011 9:18 AM
To: Moore, Darrell
Cc: 'Krueger, Pamela'; Tsinnajinnie, Leona, NMENV; Cobrain, Dave, NMENV; VonGonten, Glenn, EMNRD
Subject: FW: Summary of Conference Call regarding Navajo FWGMWP

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New Mexico Energy, Minerals & Natural Resources Dept.
Oil Conservation Division, Environmental Bureau
1220 South St. Francis Dr., Santa Fe, New Mexico 87505
Office: (505) 476-3490
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Sent: Tuesday, August 23, 2011 2:17 PM
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Cc: VonGonten, Glenn, EMNRD
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To: Chavez, Carl J, EMNRD
Cc: Moore, Darrell
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0.00015 to 0.002 mg/L. The historic data with a lack of reportable concentrations was the reason that Cadmium was dropped from the sampling plan in 2010.

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Mr. Dave Cobrain
New Mexico Environment Department
Hazardous Waste Bureau
2905 Rodeo Park Drive East, Building 1
Santa Fe, NM 87505-6303

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

ENVIRONMENT

Subject:

**2011 Facility Wide Groundwater Monitoring Work Plan
Navajo Refining Company, Artesia Refinery
EPA ID#: NMD048918817
HWB-NRC-10-001**

Date:

June 28, 2011

Contact:

Pamela Krueger

Phone:

713.953.4816

Email:

pam.krueger@arcadis-us.com

Our ref:

TX000836.0004

Dear Mr. Cobrain and Mr. Chavez:

ARCADIS is submitting the enclosed annual update to the Facility Wide Groundwater Monitoring Work Plan (FWGMWP) on behalf of the Navajo Refining Company (Navajo). This update has been prepared and is being submitted according to the requirements of the Post-Closure Care Permit issued by the New Mexico Environment Department (NMED) Hazardous Waste Bureau. The FWGMWP also incorporates the requirements of the Discharge Permit issued by the New Mexico Energy, Minerals and Natural Resources Department Oil Conservation Division. The updated FWGMWP is being submitted in both hard copy and electronic format.

Sincerely,

ARCADIS U.S., Inc.

Pamela Krueger
Senior Project Manager

Copies:

Darrell Moore, Navajo
Johnny Lackey, Navajo

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**2011 Facility Wide Groundwater
Monitoring Workplan
NMD048918817 and DP GW-028**

June 2011



A handwritten signature in black ink, appearing to read 'Darrell Moore'.

Darrell Moore
Environmental Manager – Water and Waste, Navajo Refining

A handwritten signature in black ink, appearing to read 'Pamela R. Krueger'.

Pamela R. Krueger
Senior Project Manager, ARCADIS

**2011 Facility Wide
Groundwater Monitoring
Workplan
NMD048918817
and DP GW-028**

Prepared for
New Mexico Environment Department,
Hazardous Waste Bureau

Prepared by
ARCADIS
2929 Briarpark
Suite 300
Houston
Texas 77042
Tel 713.953.4800
Fax

Our Ref
TX00836.0004

Date
June 28, 2011

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---------	--------------------------------

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Appendices

A	Well Completion Logs
B	Field Forms

Acronyms and Abbreviations

bgs	Below Ground Surface
CMI	Corrective Measures Implementation
DO	Dissolved Oxygen
DRO	Diesel Range Organics
EP	Evaporation Ponds
EPA	Environmental Protection Agency
GRO	Gasoline Range Organics
HSWA	Hazardous and Solid Waste Amendment
mg/L	milligrams per liter
mm	millimeters
MTBE	Methyl tert butyl ether
NCL	North Colony Landfarm
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
OCD	Oil Conservation Division
ORP	Oxygen Reduction Potential
PCC	Post Closure Care
ppm	parts per million
PSH	Phase Separated Hydrocarbons
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
SVOC	Semivolatile Organic Compounds
TDS	Total Dissolved Solids
TEL	Tetra ethyl lead
TMD	Three Mile Ditch
VOC	Volatile Organic Compounds
WQCC	Water Quality Control Commission

Executive Summary

The Navajo Refining Company (Navajo) owns and operates the Artesia Refinery (Refinery), which is located in Artesia, New Mexico. The facility has been in operation since the 1920's and processes crude oil into asphalt, fuel oil, gasoline, diesel, jet fuel and liquefied petroleum gas. Recently, the refinery completed expansion projects that increased the processing capacity to 100,000 barrels of crude oil per day.

In October 2003, the Secretary of the New Mexico Environment Department (NMED) issued a Post-Closure Care Permit (PCC Permit) for the Artesia Refinery, which has U.S. Environmental Protection Agency (EPA) ID Number NMD048918817. The PCC Permit was modified in December 2010. Among other action items, the PCC Permit authorizes and requires Navajo (the Permittee) to conduct facility wide groundwater monitoring. The purpose of the groundwater monitoring program is to evaluate for the presence, nature and extent of hazardous and regulated constituents pursuant to Section 20.4.1.500 of the New Mexico Administrative Code (NMAC) and the Water Quality Control Commission (WQCC) standards included in 20 NMAC 6.2.

The New Mexico Oil Conservation Division (OCD) issued a renewal to Discharge Permit GW-028 dated August 20, 2008. Among other requirements, the Discharge Permit requires semiannual facility wide groundwater monitoring and submittal of an annual report summarizing the groundwater monitoring and remediation conducted throughout each year.

This update to the Facility Wide Groundwater Monitoring Workplan (FWGMWP) is being submitted as per the requirements of Section 4.7.6.a of the updated PCC Permit. This FWGMWP is an update of the previous workplan submitted to NMED and OCD in January 2010 and revised in October 2010. The purpose of this FWGMWP is to direct the observation and characterization of the nature and extent of groundwater contamination beneath or migrating from the Refinery. This FWGMWP contains all groundwater monitoring activities that will be conducted to satisfy both the NMED PCC Permit and the OCD Discharge Permit requirements.

The groundwater monitoring program is focused specifically on monitoring the following areas:

- The closed Tetra Ethyl Lead (TEL) Impoundment;
- The inactive North Colony Landfarm (NCL);



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- The inactive Evaporation Ponds (EP); and
- The impacted vadose zone located beneath the Refinery, extending east along the direction of flow.

This FWGMWP follows the general outline suggested for a workplan provided in Appendix E of the PCC Permit, while incorporating the requirements of Sections 20 and 22 of the Discharge Permit.

1. Introduction

The Navajo Refining Company (Navajo) owns and operates the Artesia Refinery, which is located in Artesia, New Mexico (Figure 1). The facility has been in operation since the 1920's and processes crude oil into asphalt, fuel oil, gasoline, diesel, jet fuel and liquefied petroleum gas.

In October 2003, the Secretary of the New Mexico Environment Department (NMED) issued a Resource Conservation and Recovery Act (RCRA) Post-Closure Care Permit (PCC Permit) for the Artesia Refinery, which has U.S. Environmental Protection Agency (EPA) ID Number NMD048918817. The PCC Permit was modified in December 2010. Among other action items, the PCC Permit authorizes and requires Navajo (the Permittee) to conduct facility wide groundwater monitoring. The purpose of the groundwater monitoring program is to evaluate for the presence, nature and extent of hazardous and regulated constituents pursuant to Section 20.4.1.500 of the New Mexico Administrative Code (NMAC) and the Water Quality Control Commission (WQCC) standards included in 20 NMAC 6.2.

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The groundwater monitoring program is focused specifically on monitoring the following areas:

- The closed Tetra Ethyl Lead (TEL) Impoundment;
- The inactive North Colony Landfarm (NCL);

- The inactive Evaporation Ponds (EP); and
- The impacted vadose zone located beneath the Refinery, extending east along the direction of flow.

The closed TEL Impoundment is located near the eastern boundary of the active Refinery and south of Eagle Creek. The inactive NCL is located near the northwestern corner of the Refinery. The inactive EP area is located approximately three miles east of the active Refinery, south and west of the Pecos River. The impacted vadose zone is located beneath the Refinery and extends to the east from the active Refinery in the direction of groundwater flow.

This FWGMWP describes the planned activities that will be conducted in 2011 to continue monitoring the groundwater and continue interim recovery of phase separate hydrocarbons (PSH). The format of this FWGMWP follows the general outline specified for a workplan in Appendix E of the PCC, while incorporating the requirements of Sections 20 and 22 of the Discharge Permit.

2. Background

Navajo Refining Company operates a 100,000 barrel-per-day petroleum Refinery located at 501 East Main Street in the city of Artesia, Eddy County, New Mexico. The facility has been in operation since the 1920's and processes crude oil into asphalt, fuel oil, gasoline, diesel, jet fuel, and liquefied petroleum gas. The refinery is an active, growing industrial facility. There are no plans to close the facility or reduce the size of the operation.

In recent years Navajo has made significant investments in the facility to increase production, make low sulfur gasoline and diesel and other clean fuels, and reduce air emissions. While not possible to accurately predict the lifespan of the facility, it has been in operation for over 80 years and could easily remain in operation for that many more years given the demand and supply for refined fuel products in the U.S.

The Navajo Refinery is regulated under the Resource Conservation and Recovery Act (RCRA), having EPA ID Number NMD 048918817. The NMED issued a Hazardous Waste Facility Permit to Navajo effective August 21, 1989.

Included as part of the 1989 Hazardous Waste Facility Permit was a Hazardous and Solid Waste Amendment (HSWA) Permit issued by the EPA. This permit required Navajo to identify all historical and current non-hazardous SWMUs and investigate those that had the potential to pose a threat to human health or the environment. SWMUs which pose a potential threat must undergo additional investigation (a RCRA Facility Investigation [RFI] and possibly Corrective Measures Implementation [CMI]) to minimize the threat.

Following completion of the Phase I RFI in December, 1990, it was agreed by EPA and NMED that additional investigations were required for the Three Mile Ditch (TMD) and Evaporation Ponds (EPs) located east of the refinery. The second phase of investigation of those areas was conducted from 1991 through 1993, resulting in the RFI Phase II Report finalized in November, 1993. A final Phase III Investigation Report addressing comments from the EPA and NMED was submitted in January 1996 along with a proposed workplan for removal of waste soils from TMD. In December 1997, a consolidated report was submitted to NMED that summarized the various investigations performed up to that time along with recommendations for corrective actions in the TMD and the EP areas.

At the request of NMED, Navajo submitted a Post-Closure Permit Application in June 1998. The original intent of this application, to address only closure and post-closure activities at the EPs and TMD, was expanded to include a complete RCRA Permit renewal application.

The Secretary of the NMED issued a Post-Closure Care Permit (PCC Permit) to Navajo Refining Company, the owner and operator of the Artesia Refinery Facility (EPA ID number NMD 048918817) effective October 5, 2003. The PCC Permit was modified in December 2010. The PCC Permit authorizes and requires the Permittee to monitor the groundwater, maintain all groundwater monitoring wells and comply with applicable regulations of 20.4.1.500 NMAC during the post-closure period. Specific groundwater monitoring requirements are included in the PCC Permit for the areas of the TEL Impoundment, the NCL, the EP area, and other areas identified through implementation of the investigations of various SWMUs.

The OCD issued a renewal of Discharge Permit GW-028 dated August 20, 2008. The Discharge Permit authorizes and requires the Permittee to maintain PSH recovery systems and to conduct semiannual groundwater monitoring. The Discharge Permit requires submittal of an annual report summarizing the results of the monitoring and recovery programs.

In 2006, Navajo submitted a Groundwater Monitoring Workplan that combined the requirements of the two permits into a comprehensive monitoring program. An updated Groundwater Monitoring Workplan was submitted in January 2010 and submitted in revised form in October 2010. This FWGMWP is the annual update of the workplan, as required by Section 4.7.6.a of the PCC Permit. This Workplan includes a revised monitoring schedule based on changes to the groundwater monitoring network and a critical evaluation of the sample parameters, as described in the following sections.

3. Site Conditions

3.1 Surface Conditions

3.1.1 Area Land Uses

The area north, south and east of the facility is sparsely populated and used primarily for agricultural and ranching purposes. The primary business and residential areas of the City of Artesia are located to the west, southwest and northwest of the Refinery. There are a few commercial businesses south of the Refinery along Highway 82, including an oil-field pipe company located at the southeast corner of the plant. Much of the property for one-half mile north to East Richey Avenue and east toward Bolton Road is owned by Navajo. Much of the area east and northeast to Haldeman Road is a cultivated pecan orchard or used for other agricultural and ranching purposes.

The active Refinery and much of the surrounding property owned by Navajo is fenced and guarded with controlled entry points.

3.1.2 Topography

The Refinery is located on the east side of the City of Artesia in the broad Pecos River Valley of Eastern New Mexico. The topography of the site and surrounding areas is shown in Figure 1. The average elevation of the city is 3,380 feet above mean sea level. The plain on which Artesia is located slopes eastward at about 20 feet per mile.

3.1.3 Surface Water Drainage Features

Surface drainage in the area is dominated by small ephemeral creeks and arroyos that flow eastward to the Pecos River, located three miles east of the city.

Natural surface drainage at the Refinery is to the north and east. The major drainage in the immediate area of the site is Eagle Creek (or Eagle Draw), an ephemeral watercourse normally flowing only following rain events, that runs southwest to northeast through the northern process area of the Refinery and then eastward to the Pecos River. Upstream of the Refinery, Eagle Draw functions as a major stormwater conveyance for the community. It also drains outlying areas west of the city and is periodically scoured by intense rain events.

The elevation of Eagle Draw is 3,360 feet at its entrance to the Refinery and decreases to approximately 3,305 feet at its confluence with the Pecos River. Eagle Draw was channelized from west of Artesia to the Pecos River to help control and minimize flood events. In the vicinity of the refinery, the Eagle Draw channel was cemented to provide further protection during flood events. A check dam was also constructed west of Artesia along Eagle Draw. At this time, federal floodplain maps indicate that most of the city and the refinery have been effectively removed from the 100 year floodplain.

3.2 Subsurface Conditions

3.2.1 Soils

Soils at the Refinery are primarily of the Pima and Karro series. Soils characterized for permitting the NCL were about 60% Pima and 40% Karro soils. The Pima and Karro soils have similar properties. Pima soils are deep, well drained, dark colored, calcareous soils, which occur on floodplains of narrow drainageways (e.g. – Eagle Creek). These soils have moderate shrink-swell potential and were subject to periodic flooding. Runoff from Pima soils is slow, permeability is moderately low and the water-holding capacity is high. The effective rooting depth is greater than five feet and the water table is deeper than five feet.

The Karro soils are highly calcareous. Calcium carbonate typically accumulates as caliche at a depth of about 45 inches. These soils are found on level to gently sloping terrains and are susceptible to wind erosion. Runoff is slow and water-holding capacity is high. Permeability is moderate and the effective rooting depth and depth to groundwater are both over five feet.

3.2.2 Regional Geology

Navajo Refinery is located on the northwest shelf of the Permian Basin. In this region, the deposits are comprised of approximately 250 to 300 feet of Quaternary alluvium unconformably overlying approximately 2,000 feet of Permian clastic and carbonate rocks. These Permian deposits unconformably overlie Precambrian syenite, gneiss and diabase crystalline rocks. The relationships between the sedimentary deposits are discussed below.

3.2.2.1 Quaternary Alluvium

The Quaternary alluvium in the Refinery area is dominantly comprised of clays, silts, sands and gravels deposited in the Pecos River Valley. These “valley fill” deposits extend in a north-south belt approximately 20 miles wide, generally west of the Pecos River. The thickness of the valley fill varies from a thin veneer on the western margins of the Pecos River valley to a maximum of 300 feet in depressions, one of which is located beneath the Refinery. These depressions have resulted from dissolution of the underlying Permian carbonates and evaporites. The sedimentology and mineralogy of the valley fill deposits can be divided into three units: the uppermost carbonate gravel unit, the interbedded clay unit, and the underlying quartzose unit.

The carbonate gravel unit blankets the other valley fill units and forms a fairly uniform slope from the Permian rock outcrop areas on the west side of the Permian Valley east to the Pecos River floodplain. The unit consists of coarse-grained carbonate gravel deposits along major drainage ways to the Pecos River, which grade into brown calcareous silts and thin masses of caliche in the interstream regions. The carbonate gravel unit includes the Orchard Park, Blackdom and Lakewood terrace deposits of Fielder and Nye as well as Holocene and Pleistocene Pecos River alluvial deposits.

The agricultural land around Artesia is part of the Orchard Park terrace deposit, which forms a thin veneer overlying older valley fill alluvium. The Orchard Park terrace surface gently rises in elevation to between 5 and 25 feet above the Lakewood terrace. The Orchard Park is generally less than 20 feet in thickness in the Refinery area and is comprised of silt interbedded with poorly sorted lenses of mixed size pebbles in a silt and sand matrix. Chalky caliche commonly occurs in the upper layers.

The Blackdom terrace is about 40 to 50 feet in elevation above the Orchard Park terrace west of Artesia. However, the deposits associated with the Blackdom terrace are generally less than 20 feet in thickness. The Blackdom terrace deposits are coarser grained than the deposits associated with the Orchard Park and Lakewood terraces. In addition, the caliche soils have a higher density than those developed on the Orchard Park terrace.

The Lakewood deposits, the lowest of the three terrace units, are essentially the current alluvial sediments in the floodplain along the river. They consist of brown sandy silt interbedded with lenses of gravel and sand and some localized caliche in higher parts. The Lakewood terrace is confined to the area immediately adjacent to

the river and is underlain by Pleistocene alluvium deposited by the Pecos River and its tributaries.

The clay unit is not laterally continuous throughout the valley fill deposits, but occurs in isolated lenses generally overlying the quartzose unit. The clay unit is comprised of light-to-medium-gray clays and silts deposited in localized ponds and lakes. These ponds and lakes may have formed in conjunction with dissolution and collapse of the underlying Permian rocks.

The quartzose unit consists primarily of fragments of quartz and igneous rocks cemented by calcium carbonate. This unit is laterally contiguous throughout the Pecos River Valley and is generally less than 250 feet thick. The quartzose unit unconformably overlies Permian Rocks and lower quartzose gravels are commonly used for groundwater production.

3.2.2.2 Permian Artesian Group

The Permian Artesian Group is comprised of five formations (from shallowest to deepest): the Tansill, Yates, Seven Rivers, Queen and Grayburg Formations. The Tansill and Yates Formations outcrop at the surface east of the Pecos River and are not present in the vicinity of the Refinery.

The uppermost Permian formation in the Artesia area is the Seven Rivers Formation, which outcrops east of the Pecos River. This eastward-dipping formation is eroded and buried by the valley fill alluvium at a depth of 300 feet in the area between the river and the Refinery. Nearer the Refinery, the formation thins and disappears farther west. Where the formation is present, it consists of a sequence of evaporites, carbonates, gypsum and shale with isolated sand and fractured anhydrite/gypsum lenses.

An examination of available borehole logs by IT Corporation, in the mid-80s provided no indication that the Seven Rivers formation has been encountered beneath the Refinery. However, the lithologic logs of wells completed in the Refinery area describe unconsolidated alluvial deposits from depths of about 20 feet to over 250 feet.

In the area of the Refinery, the Queen and Grayburg Formations have been mapped as a single unit by geologists as consisting of about 700 feet of interbedded dolomite and calcareous dolomite, gypsum, fine-grained sandstone, carbonates, siltstone and mudstone. In locations where the Seven Rivers Formation is absent, the upper portion

of the Queen Formation acts as a confining bed between the deep artesian aquifer and the valley fill aquifer.

3.2.2.3 *San Andres Formation*

The San Andres Formation lies beneath the Grayburg and Queen Formations and immediately above the Precambrian crystalline basement rocks. The San Andres Formation is composed mainly of limestone and dolomite containing irregularly and erratic solution cavities, which range up to several feet in diameter. Its thickness is greater than 700 feet. The upper portion of the formation is composed of oolitic dolomite with some anhydrite cement.

3.2.3 *Regional Groundwater*

The principal aquifers in the Artesia area are within the San Andres Formation and the valley fill alluvium. In the vicinity of the Refinery process area is a near-surface water-bearing zone, apparently limited in vertical extent that is shallow with respect to the surface yet exhibits artesian properties at some monitoring wells. The deeper carbonate aquifer is referred to as the deep artesian aquifer, whereas the water-bearing zones of the shallower alluvial fill aquifer are referred to as the valley fill aquifer. Adjacent to the Refinery, the first water-bearing zone in the valley fill aquifer is referred to as the near-surface saturated zone.

3.2.3.1 *Near-Surface Saturated Zone*

Lithologic logs from monitor wells installed near the Refinery process area document a near-surface saturated zone overlying the main valley fill alluvium and containing water of variable quality in fractured caliche and sand and gravel lenses at depths of 15 to 30 feet below ground surface. This water is under artesian pressure for at least some or most of the year with static water levels 3 to 5 feet above the saturated zones.

Figure 2 depicts the monitoring wells installed in the area of the Refinery and the Evaporation Ponds east of the Refinery. Isopleths of the potentiometric surface, as measured in September and October 2010 in the near-surface saturated zone, are shown in Figure 3. The general direction of flow in this near-surface saturated zone is to the east toward the Pecos River.

Locally, this uppermost water zone is likely connected to Eagle Creek west of the Refinery and most likely discharges to marshes and shallow alluvium along the west

side of the Pecos River. The most probable sources of the water are thought to be recharge from Eagle Creek and lawn watering runoff from the grass-covered urban park that occupies the Eagle Creek Channel immediately upstream of the Refinery.

The water in the near surface saturated zone is highly variable in quality, volume, areal extent and saturated thickness. Concentrations of total dissolved solids (TDS) exceeding 2,000 milligrams per liter (mg/L) and sulfate exceeding 500 mg/L have been recorded on the northwest side of the Refinery near the NCL.

As reported in the *2010 Annual Groundwater Report* (ARCADIS, February 2010), the shallow groundwater beneath the Refinery and beneath the EPs is impacted with constituents typically associated with hydrocarbons. Concentrations of the organic constituents in the shallow groundwater exhibit a stable or declining trend (ARCADIS, February 2010).

3.2.3.2 Valley Fill Aquifer

Quaternary alluvial deposits of sand, silt, clay and gravel are the main components of the valley fill aquifer. These sediments are about 300 feet thick in the area between the City of Artesia near the Refinery and the Pecos River. The three principal units in the valley fill are the carbonate gravel, clay and quartzose.

The carbonate gravel unit, described in an earlier section, is the uppermost alluvial unit in the valley fill. Coarse-grained gravels deposited in the major tributaries to the Pecos River grade to calcareous silts and thin zones of caliche in the interstream areas. Near the surface, groundwater is localized in thin discontinuous gravel beds typical of braided channel material deposited during flood events originating in the foothills and Sacramento Mountains to the west.

Wells completed in the valley fill aquifer typically are screened across from one to five water-producing zones. Thicknesses of up to 170 feet have been reported for water-production zones, but most are less than 20 feet. Producing zones are principally sand and gravel separated by less permeable lenses of silt and clay. Wells in the valley fill range from 40 to 60 feet below ground level and the formation yields water containing 500 to 1,500 parts per million (ppm) TDS. The average transmissivity of the alluvium has been estimated at 100,000 to 150,000 gallons per day per square foot.

Recharge of the shallow valley fill aquifer is generally attributed to irrigation return flow from pumpage of the aquifers and from infiltration from the Pecos River. In areas of

the valley where the San Andres and valley fill aquifers are hydraulically connected in the subsurface, water tends to flow up from the deep to the shallow aquifer except in areas of heavy San Andres pumpage. The general direction of groundwater flow in the valley fill aquifer follows the regional stratigraphic dip eastward toward the Pecos River, then southward subparallel to the river.

North of Artesia, the river has been a gaining stream for most of the period of record. The potentiometric surface of the shallow aquifer slopes gently east and southeast, following regional stratigraphic dips.

However, south of Artesia in the vicinity and immediately east of Highway 285, heavy pumping between 1938 and 1975 reversed the hydraulic gradient. In this area the surface forms a shallow trough due to extensive water use for irrigation.

Adjacent to the Pecos River, the valley fill alluvium contains groundwater beginning at a depth of 6 to 12 feet. The alluvium is predominately silty sand, which possibly contains lenses of higher permeability material. Groundwater flow is subparallel to the Pecos River Valley and is generally toward the river, although during periods of high river flow, the hydraulic gradient may be away from the river into the alluvium.

Silt and clay deposits in the valley fill aquifer are not continuous, but occur as isolated lenses, generally overlying the quartzose unit. Most logs of wells located immediately to the north and east of the Refinery show considerable thicknesses of clays or clay mixtures. However, these clays may be more closely related to the fine-grained materials of the carbonate gravel unit found in the interstream areas between the major drainage ways.

The thickness of these clay/clay mixtures ranges from 20 to 160 feet. The intervals of occurrence differ from well to well, and thin zones or gravels are interspersed in the upper 100 feet. Drillers seeking deep artesian water drill through the valley fill zone and usually log large intervening zones as "clay and cap". This lack of detail makes it difficult to correlate specific zones of coarse-grained sediments within the silt and clay deposits.

The quartzose unit is considered the primary production unit in the valley fill aquifer. Away from the Pecos River, the unit consists of fragments of sandstone, quartzite, quartz chert, igneous and carbonate rocks. The fragments range from medium grained (1/4 mm) to pebble size (16 mm) and are commonly cemented with calcium carbonate.

By contrast, in the vicinity of the river, the unit contains principally medium to coarse uncemented quartz grains.

Seventeen monitoring wells have been installed in the valley fill aquifer in the vicinity of the refinery and the evaporation ponds. The information available on the nearby irrigation wells indicate that at least two of those wells (RA-3156 and RA-3353) are screened in the valley fill aquifer. Historic analytical data from these wells does not indicate the presence of hydrocarbon impacts from refinery operations. As per the 2010 workplan, samples were collected from monitoring wells completed in the valley fill aquifer during the first semiannual monitoring event of 2011. The results of these samples will be submitted with and discussed in the 2011 annual report.

3.2.3.3 *Deep Artesian Aquifer*

The deep artesian aquifer is closely related to the Permian San Andres Limestone and generally consists of one or more water producing zones of variable permeability located in the upper portion of the carbonate rocks. However, in the Artesia area, the producing interval rises stratigraphically and includes the lower sections of the overlying Grayburg and Queen formations. Near the Refinery, the depth to the top of the producing interval is estimated to be about 440 feet. The Seven Rivers formation and the other members of the Artesia Group are generally considered confining beds although some pumpage occurs locally from fractures and secondary porosity in the lower Grayburg and Queen members.

The deep artesian aquifer has been extensively developed for industrial, municipal and agricultural use. The quality of water from this aquifer ranges from 500 ppm to more than 5,000 ppm TDS depending on location. In the Artesia area, water is generally derived from depths ranging from 850 feet to 1,250 feet below ground surface. The aquifer recharge is in the Sacramento Mountains to the west of Artesia. Extensive use of this aquifer in recent decades has lowered the potentiometric head in the aquifer in some locations from 50 to 80 feet below ground level, although extensive rainfall in some years may bring the water levels in some wells close to the surface.

Information available for irrigation well RA-4798 indicates that it is screened at 840 to 850 feet below ground surface, in the deep artesian aquifer. Historic analytical data from this well does not indicate the presence of hydrocarbon impacts from refinery operations.

4. Modifications to the Groundwater Monitoring Network

This section of the FWGMWP discusses the modifications to the groundwater monitoring network that have occurred since submittal of the 2010 workplan.

4.1 New Monitoring Wells

In October 2010 two monitoring wells (MW-46R and KWB-10R) were installed to replace two damaged monitoring wells. In January 2011 two new wells (MW-109 and MW-110) were installed as part of the investigation of areas of concern (AOCs). The boring logs and well completion reports have been included in Appendix A of this FWGMWP. The locations of the new wells are shown in Figure 2.

Replacement well MW-46R is located east of the North Refinery and just south of Eagle Draw. MW-46 had been damaged by farm equipment and had not been sampled since 2006. MW-46R is a 2 inch well installed to a total depth of approximately 19.4 ft bgs. MW-46R is located approximately 30 feet east of the former MW-46.

Replacement well KWB-10R is located east of the Refinery and north of US Highway 82. KWB-10 had been damaged by farm equipment prior to the second semiannual sampling event in 2009 and has not been sampled since that event. KWB-10R is a 4 inch well installed to a total depth of approximately 30.14 ft bgs. KWB-10R is located approximately 30 feet north-northwest of the former KWB-10.

MW-109 and MW-110 are located south of the Refinery and south of US Highway 82. MW-109 is located on the east side of a warehouse owned by Navajo while MW-110 is located on the west side of the warehouse. Both are 2 inch wells installed to a total depth of approximately 30 ft bgs.

4.2 Well Abandonments

Wells MW-46 and KWB-10 were abandoned when their respective replacement wells were installed in October 2010, as described in Section 4.1. No formal plugging reports were completed but a brief description of the plugging activities has been included in this section.

The concrete pad surrounding MW-46 had been broken and moved away from the well location prior to beginning abandonment activities. The well riser pipe was broken at



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the surface and dirt and debris plugged the pipe in the ground. The well could not be located during the well replacement so no actual plugging activities occurred.

The concrete pad at KWB-10 had been broken by a wheel for the center pivot irrigation equipment in the area. The well was plugged with 5 bags of Hole Plug bentonite and 1/2 bag of cement at the surface. No formal plugging report was filed.



5. Scope of Services

This section of the FWGMWP provides a detailed description of groundwater monitoring activities to be conducted.

5.1 Health and Safety Considerations

Groundwater monitoring activities will be performed in both active and historic process areas of the refinery, in the inactive EP area, along Three Mile Ditch, and in agricultural fields adjacent to the refinery. The primary health and safety considerations associated with the monitoring activities include the potential for the presence of harmful vapors and environmental hazards.

Any deviations from proposed sample collection procedures due to health and safety considerations will be documented and discussed in the annual monitoring report.

5.2 Routine Monitoring Activities

The groundwater monitoring program includes the following activities:

- Semiannual gauging of monitoring and recovery wells.
- Semiannual collection of analytical samples from monitoring wells as well as from select recovery and irrigation wells.
- Collection and disposal of purge water generated during sample collection and decontamination water generated during gauging and sample collection.

5.3 Groundwater Sample Analyses

5.3.1 2010 Groundwater Analytical Requirements

The 2010 workplan included the following general sampling and analysis plan described below:

- All active and accessible monitoring and recovery wells will be gauged semiannually with an oil/water interface probe to monitor the presence and thickness of PSH and to measure the depth to groundwater and total depth of each well.

- Monitoring wells that contain PSH, as indicated by an oil/water interface probe, will not be sampled during any event that PSH is present with a thickness of 0.03 feet or greater.
- Monitoring wells located along or near the downgradient edges of the impacted areas will be sampled semiannually.
- Select monitoring wells within the impacted areas will be sampled semiannually to monitor the concentrations within the dissolved phase plume areas. The wells selected to be sampled on a semiannual basis should provide adequate information to assess the fate of dissolved phase constituents within known impacted areas.
- Wells within the center of impacted areas will be sampled annually to monitor the concentrations throughout the dissolved phase plume areas.
- Upgradient wells will be sampled annually.
- Active and accessible irrigation wells will be sampled either semiannually or annually.
- Recovery wells will be sampled annually, if PSH is not present or is present with a thickness of less than 0.03 feet.
- Wells completed in the deeper aquifer will be sampled biennially, beginning in the spring of 2011.

The 2010 workplan required wells to be analyzed for some or all of the following parameters:

- Volatile organic compounds (VOCs) by EPA Method 8260;
- Diesel Range Organics (DRO) by EPA Method 8015B;
- Gasoline Range Organics (GRO) by EPA Method 8015B;
- Total Metals (arsenic, barium, chromium, lead, selenium, iron, manganese, mercury, nickel and vanadium);

- Dissolved Metals (arsenic, barium, chromium, lead, selenium, iron, manganese, nickel and vanadium);
- Cyanide;
- Major cations and anions;
- Total dissolved solids; and,
- Nitrates/nitrites.

Not all wells were required to be analyzed for all of the parameters listed above. For instance, the wells designated “KWB” are not required to be analyzed for GRO. Table 1 of the 2010 workplan summarized the analyses performed under that monitoring plan.

5.3.2 Revised Groundwater Monitoring Program

Based on the historic data and current conditions, Navajo proposes to revise the monitoring program beginning with the second semiannual event of 2011. The general monitoring plan presented in the 210 workplan and discussed above will remain the same. Proposed revisions include the addition of monitoring wells KWB-10R, MW-46R, MW-109 and MW-110 to the monitoring network and the removal of dissolved metals from the workplan.

5.3.2.1 Additions to the Monitoring Network

Table 1 presents a detailed summary of the revised monitoring schedule and program. The table provides the following information:

- Well identification;
- Approximate location of the well and the area of concern associated with the well;
- Well construction details (date installed, diameter, total depth, screened interval if available);
- Sampling frequency; and

- Analytical suite.

As shown on Table 1, MW-109 and MW-110 will be gauged and purge parameters will be collected on a semiannual basis. In addition, these wells will be sampled on a semiannual basis for the following parameters:

- DRO;
- GRO;
- VOCs;
- Total Metals (arsenic, barium, chromium, iron, lead, manganese, and selenium);
- Cations/Anions;
- Nitrates/nitrites; and
- Total dissolved solids.

As shown on Table 1, MW-46R and KWB-10R will be gauged and purge parameters will be collected on a semiannual basis. In addition, MW-46R and KWB-10R will be sampled on a semiannual basis for the following parameters:

- DRO;
- VOCs;
- Total Metals (arsenic, barium, chromium, iron, lead, manganese, and selenium);
- Cations/Anions;
- Nitrates/nitrites; and
- Total dissolved solids.

Figure 4 depicts the current known extent of PSH and dissolved phase organic impacts in groundwater. This figure also graphically summarizes the revised monitoring program, with distinct symbols indicating those wells that will not be sampled, those wells that will be sampled semiannually, those wells that will be sampled annually, and those wells that will be sampled biennially.

5.3.2.2 *Total and Dissolved Metals*

NMED and OCD previously requested that all metals analyses be performed on both a total and dissolved basis. The RCRA regulations require that a groundwater monitoring program perform analyses of metals on a total basis. The New Mexico regulations that provide the driver for the OCD monitoring program provide groundwater standards based on dissolved phase concentrations, with the exception of mercury. It is unnecessary and costly to collect and analyze both total and dissolved metals samples from the wells.

The total concentration of metals in water samples includes the metals both dissolved in the water and present in or on the particulates or colloids in the water. The USEPA prepared a guidance document that addresses this issue (*RCRA Groundwater Monitoring Technical Enforcement Guidance Document*, 1986, USEPA-OWPE, OSWER-9950.1, P. 114). According to this document, a 'total metals analysis' consists of collecting an unfiltered sample, properly preserving and preparing the sample and analyzing it for the concentration of metals. Typically a 'dissolved metals analysis' of a water sample is performed by removing the particulates with a filter during sample collection, then preserving, preparing and analyzing the filtered water for the concentration of metals. The most common filters used for this purpose have a 0.45 micron pore size.

Total metals analysis results should always be greater than or equal to dissolved metals analysis results, because dissolved metals is a subset of total metals. The USEPA (1986) states that when both filtered and non-filtered samples are collected that "Any difference in concentrations between the total and dissolved fraction may be attributed to the original metallic ion content of the particles and any sorption of ions to the particles." An exception to this rule may exist when the true concentration of a metal in a sample is at or very near the detection limit of the analytical method. In this instance, the reported 'dissolved metals analysis' concentration may be greater than the reported 'totals metals analysis' concentration, with the difference within the uncertainty of the measurement.



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As described above, the results of a 'totals metals analysis' should be the most conservative result when compared to a dissolved metal standard. Therefore, Navajo proposes to collect only unfiltered samples for analysis of total metals.

6. Groundwater Sampling Methodology

This section provides a summary of the procedures that will be used to implement this FWGMWP.

6.1 Well Gauging

At the beginning of each semiannual sampling event, all monitoring and recovery wells listed on Table 1 will be gauged to record the depth to PSH (if present), the depth to water, and the total depth of the well. The gauging will be performed using an oil/water interface probe attached to a measuring tape capable of recording measurements to the nearest 0.01 foot. All readings will be made in relation to the marked survey datum at the top of casing of each well. All survey measurements were made at the northern edge of each well casing. In the event that the survey datum mark is not present, the measurements will be made at the top of the well casing, on the northern side of well casing.

In order to provide accurate data for development of groundwater potentiometric surface contours, the groundwater gauging will be performed within two 48-hour periods. All wells located within the Refinery security fence, wells located immediately south of the Refinery and those wells located east of the Southeast Tank Farm will be gauged within one 48-hour period. All remaining wells, including those wells in and near the Evaporation Ponds and those wells between the Refinery and the Evaporation Ponds, will be gauged within a second 48-hour period. Every effort will be made to ensure that the two 48-hour gauging periods are sequential.

Gauging measurements will be recorded on a field gauging form, which consists of a subset of the information contained in Table 1 and is updated for each monitoring event. A typical page of the field gauging form is contained in Appendix B.

Any weather events that occur during and/or between the gauging periods will be recorded on the daily log sheet. A copy of the daily log sheet is provided in Appendix B. The daily log sheets and field gauging forms are provided to the field crew in a bound field logbook.

Data obtained from the gauging will be reported in the annual groundwater monitoring report. The data will be used to develop groundwater contour maps and PSH thickness isopleths, which will also be included in the annual report.

6.2 Well Purging

All zones in each monitoring well shall be purged by removing groundwater prior to sampling in order to ensure that formation water is being sampled. Purging will be accomplished with the use of either a peristaltic or submersible electric sampling pump.

The peristaltic pump will be used where practical to apply low-flow purging and sampling procedures.

The submersible electric sampling pump will be used where the depth to water in a monitoring well is greater than 25 feet (limitation of peristaltic pump) and for sample collection from recovery wells. When this pump is used to purge a well, a minimum of three well casing volumes will be removed. In the event that purge parameters do not stabilize, as specified below, a maximum of 10 well casing volumes will be removed prior to sample collection.

Irrigation wells located on adjacent property are included in the groundwater monitoring program. These wells have dedicated electric pumps and do not have access to allow for gauging of the water level; thus, the volume of water present in the well casing cannot be calculated. If access is available and power is provided to the pump, these wells will be purged using the irrigation pump. Purging will continue until the purge parameters stabilize, as described below.

Purge volumes shall be determined by monitoring, at a minimum, groundwater pH, specific conductance, temperature, dissolved oxygen (DO) concentrations, and oxidation-reduction potential (ORP) during purging. These measurements will be made using appropriate equipment, such as a multiparameter water quality monitoring meter such as a YSI 600XL or similar device, and a flow-through cell. The readings and the volume of water purged between intervals will be obtained at routine intervals during the purging process and recorded on the field log. A sample field log is provided in Appendix B.

Purging will be considered complete when four of the five purge parameters have stabilized. The specified stabilization criteria for pH, temperature and DO are plus or minus 0.2 units (standard pH units for pH, degrees Celcius for temperature, and milligrams per liter for DO), specific conductance is plus or minus 0.02 units (Siemens per meter or milliSiemens per centimeter) and ORP is plus or minus 20 units (millivolts). The units used for measurement of purge parameters will be recorded on the well sampling sheet.

If a well should purge dry, then it will be allowed to recover. When the water level has returned to a minimum of 75 percent of the level measured at the beginning of the sampling event, a sample will be collected for analysis.

The equipment used for the field measurements (such as a YSI multiparameter water quality meter or similar device) will be calibrated at least once during each day of the sampling event. Calibration will be performed according to the equipment manufacturer's directions. Calibration data will be recorded in the daily field notes.

Purged groundwater will be collected and disposed of properly, as described in Section 6.7.

6.3 Groundwater Sample Collection and Handling

Samples will be collected following purging and will consist of pumping groundwater directly into the laboratory provided sample containers. Dedicated tubing will be used for each well to prevent the potential for cross-contamination. Unfiltered samples will be collected for organic and total metals analyses.

Containers will be labeled and placed into appropriate containers (coolers) with ice for shipment to the analytical laboratory. Each label will clearly identify the sample identifier, the date and time of collection, the analytical method to be performed, and the sampler's initials. Separate sample identifications will be used to indicate filtered samples for analysis of dissolved metals.

Shipping containers (coolers) will be packed with ice or similar cooling materials to maintain appropriate sample temperatures. Adequate padding will be provided to prevent breakage or puncture of sample containers during shipment. The containers will be shipped via express courier to the laboratory for analyses. Chain-of-custody forms will be shipped inside each container to properly track the samples in each container. A chain-of-custody seal will be placed on each shipping container and inspected upon arrival at the laboratory to ensure the integrity of the shipped samples.

6.4 Analytical Methods

The groundwater samples will be analyzed for the parameters listed in Table 1, which include the following COCs:

- DRO;
- GRO;
- VOCs;
- Metals (arsenic, barium, chromium, iron, lead, manganese and selenium; mercury, nickel, and vanadium in select wells);
- Cyanide;
- Major cations and anions (calcium, chloride, fluoride, potassium, sodium, sulfate);
- Nitrates/nitrites (as nitrogen); and
- Total dissolved solids.

Not all of the COCs will be analyzed for every sample or during every sampling event. Table 1 summarizes which samples will be analyzed for which parameters during each event.

6.5 Quality Assurance/Quality Control Samples

QA/QC samples will be collected to monitor the validity of the sample collection procedures. The following samples will be collected for QA/QC purposes:

- Field duplicates will be collected at a rate of 10 percent, or 1 field duplicate for every 10 groundwater samples. Field duplicates will be analyzed for the same COCs as the parent sample.
- Equipment blanks will be collected from non-dedicated sampling apparatus at a frequency of 5 percent, with a minimum of 1 equipment blank per day.

Equipment blank samples will be analyzed for the same COCs as the sample associated with the equipment blank (sample collected immediately prior to the equipment blank). When dedicated sampling materials are used, such as dedicated tubing and a peristaltic pump, no equipment blank samples will be collected.

- Trip blanks will accompany each shipping container (cooler) that contains samples to be analyzed for VOCs.

Laboratory QA/QC samples will be performed according to the EPA test methodologies specified for each method run on a field sample. The laboratory QA/QC samples will include reagent or method blanks, surrogates, matrix spike/matrix spike duplicates, blank spike/blank spike duplicates and/or laboratory duplicates, as appropriate for each method. The laboratory QA/QC samples will be run at the frequency specified by each method.

6.6 PSH Sample Collection

In the event that PSH is present in any of the monitoring wells that have not historically contained PSH, samples may be collected when sufficient volume is present for adequate fingerprint analysis. A minimum of 10 mL is required for fingerprint analysis.

PSH samples will be collected using a hand bailer. The bailer will be lowered into the well slightly into the PSH and water column. The bailer will be slowly removed and groundwater decanted from the bottom of the bailer. The PSH remaining in the bailer will then be placed into the sample container, and the container will be sealed and properly labeled for shipment. Excess groundwater and PSH will be collected and disposed of in the Refinery wastewater treatment system, upstream of the API separator.

6.7 Decontamination Procedures and Investigation Derived Wastes

6.7.1 Liquid Wastes

All reusable groundwater sampling and gauging equipment will be decontaminated prior to coming in contact with the sample media to minimize the potential for cross-contamination of samples. This equipment includes all downhole well gauging devices, submersible pumps, water quality parameter meters and flow-through cell. The equipment will be washed with a brush in a bath of soap and water then rinsed

twice with distilled water. The soap and water bath will consist of clean water and a non-phosphate detergent such as Liquinox™ or Alconox™ or similar.

Decontamination fluids will be contained and placed in a 55 gallon drum for later disposal in the plant wastewater treatment system, upstream of the API separator.

Groundwater removed from each temporary well during development and purging will be containerized in a labeled drum then disposed of within the plant wastewater treatment system, upstream of the API separator.

6.7.2 Solid Wastes

Dedicated disposable sampling equipment, including tubing and bailers, will be disposed of in the plant hazardous waste bins. The specific rolloff container(s) that solid wastes are placed in will be recorded and this information will be included in annual monitoring report.

All sampling personnel will wear disposable latex or nitrile gloves while collecting and handling samples. Gloves will be replaced prior to collection of each sample in order to ensure that field-induced cross-contamination does not affect the monitoring results. Gloves will be collected and disposed of along with tubing and bailers in the hazardous waste bins.

Waste disposal records are maintained at the Refinery.

7. Reporting

Both the PCC Permit and the Discharge Permit require submittal of an annual report that summarizes the results of the groundwater monitoring program as well as remediation activities conducted for groundwater. Navajo currently submits a combined annual report that meets the requirements of both permits. The report follows the general outline provided in Appendix E of the PCC Permit and incorporates the requirements of 20.B, 22.B, and 22.F of the Discharge Permit.

At a minimum, the report will contain the following:

- Description of groundwater monitoring and remediation activities conducted throughout the reporting period, including sample collection procedures, decontamination procedures, sample handling procedures and management of wastes;
- Summary table of semiannual groundwater and PSH gauging data, with corrected water table elevation for all wells containing PSH;
- Summary table of groundwater quality parameters recorded in the field (purge parameters);
- Summary of laboratory analytical data with comparison to screening levels;
- Summary of QA/QC data review and validation;
- Groundwater contour maps depicting the groundwater gradient for each semiannual monitoring event of the reporting period, including site features and the direction and magnitude of the hydraulic gradient;
- PSH thickness isopleths maps for each semiannual monitoring event during the reporting period;
- Isoconcentration maps for major constituents of concern;
- Plots of static water elevation versus time in key wells, specifically those that contain PSH;



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- Tabulation of the monthly and cumulative volume of PSH removed from recovery wells or monitoring wells throughout the reporting period; and
- Recommendations, including any recommended changes to the groundwater monitoring program.

The annual report will be submitted in hardcopy and electronic format to both NMED and OCD for their review.

8. Schedule

The groundwater monitoring program is conducted on a semiannual basis. The first semiannual event will occur no more than 30 days prior to the start of the irrigation season but no later than April 30 of each year. Typically, the first semiannual event occurs in March or April of each calendar year.

The second semiannual event will occur no later than 30 days after the conclusion of the irrigation season or November 15 each year. Typically, the second semiannual event occurs in September or October of each calendar year.

The wells that will be sampled on an annual basis only will be sampled during the first semiannual event of each calendar year.

Wells that are to be sampled biennially will be sampled every other year, beginning in the first semiannual event of 2011.

Navajo will notify both NMED and OCD at least 15 calendar days prior to the initiation of each semiannual sampling event.

The annual groundwater monitoring report will be submitted to NMED and OCD no later than February 28 of the calendar year following sample collection.

Table 1
Revised Monitoring Program and Schedule
Navajo Refining Company - Artesia Refinery, Artesia, New Mexico

Well ID	Well Type	Location Information		Well Construction Information ^a							PSH Expected? ^b	Gauging Frequency	Analytical Suite and Frequency ^c										
		Associated Area of Concern	Approximate Location	Date Installed	Diameter (in)	Top of Casing (ft MSL)	Ground Surface (ft MSL)	Total Depth (ft btoc)	Screen Interval (ft bgs)	Surface Finish			Purge Parameters	DRO	GRO	VOCs	Metals (As, Ba, Cr, Fe, Pb, Mn, Se)	Metals (Hg, Ni, Va)	Cyanide	Cations/Anions	Nitrates / Nitrites as Nitrogen	Total Dissolved Solids	
KWB-1A	Monitoring	Downgradient	S of ED, W of BR	Feb-92	2	3353.46	3351.25	33.57	18 to 32	stickup		SA	SA	SA	-	SA	SA	SA	SA	SA	SA	SA	
KWB-1B	Monitoring	Downgradient	S of ED, W of BR	Feb-92	4	3352.83	3351.14	34.45	18 to 32	stickup		SA	No analytical samples to be collected										
KWB-1C	Monitoring	Downgradient	S of ED, W of BR	Sep-92	4	3351.38	3351.18	52.51	30.5 to 49.5	stickup		SA	B	B	-	B	B	-	-	B	B	B	
KWB-2R	Monitoring	S Refinery	S of US82 on Armstrong & Son		2	3364.32	3364.56	39.90		flush mount		SA	SA	SA	-	SA	SA	-	-	SA	SA	SA	
KWB-3AR	Monitoring	Downgradient	S of US82, replaced KWB #3R		2	3347.08	3347.36	33.41		flush mount		SA	SA	SA	-	SA	SA	SA	SA	SA	SA	SA	
KWB-4	Monitoring	S Refinery	N of US82, W of BR	Feb-92	2	3370.25	3368.36	41.75	20 to 39	stickup	Y	SA	SA ^d	SA ^d	-	SA ^d	SA ^d	-	-	SA ^d	SA ^d	SA ^d	
KWB-5	Monitoring	S Refinery	N of US82, W of BR	Feb-92	2	3364.72	3362.60	37.69	24.7 to 38.7	stickup	Y	SA	SA ^d	SA ^d	-	SA ^d	SA ^d	-	-	SA ^d	SA ^d	SA ^d	
KWB-6	Monitoring	S Refinery	N of US82, W of BR	Feb-92	2	3360.30	3358.02	36.41	17.5 to 36.5	stickup	Y	SA	SA ^d	SA ^d	-	SA ^d	SA ^d	-	-	SA ^d	SA ^d	SA ^d	
KWB-7	Monitoring	Downgradient	N of US82, between BR & Dirt Rd	Feb-92	2	3346.16	3343.00	34.61	18 to 32	stickup		SA	SA	SA	-	SA	SA	SA	SA	SA	SA	SA	
KWB-8	Monitoring	Field E of Refinery	N of US82, between BR & Dirt Rd	Feb-92	2	3350.41	3347.90	--	15 to 34	stickup	Y	SA	SA ^d	SA ^d	-	SA ^d	SA ^d	SA ^d	SA ^d	SA ^d	SA ^d	SA ^d	
KWB-9	Monitoring	Downgradient	S of US82, E of BR	Feb-92	2	3354.53	3351.81	37.26	20 to 34	stickup		SA	SA	SA	-	SA	SA	SA	SA	SA	SA	SA	
KWB-10R	Monitoring	Downgradient	S of ED, N of US82	Oct-10	4	3350.97	3351.23	30.15	9 to 29	flush mount		SA	SA	SA	-	SA	SA	-	-	SA	SA	SA	
KWB-11A	Monitoring	Downgradient	N of US82, between BR & Dirt Rd	Oct-92	4	3348.72	3346.13	42.03	30 to 39.5	stickup		SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	
KWB-11B	Monitoring	Downgradient	N of US82, between BR & Dirt Rd	Oct-92	4	3348.03	3345.91	72.20	50 to 69.5	stickup		SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	
KWB-12A	Monitoring	Downgradient	S of US82, E of BR	Oct-92	4	3351.81	3352.01	24.85	15.5 to 24.5	flush mount		SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	
KWB-12B	Monitoring	Downgradient	S of US82, E of BR	Oct-92	4	3351.63	3351.84	39.21	25.5 to 39.5	flush mount		SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	
KWB-13	Monitoring	Crossgradient	S of US82, W of BR		2	3365.67	3366.02	33.03		flush mount		SA	A	A	-	A	A	A	A	A	A	A	
KWB-P2	Monitoring	Downgradient	E of Dirt Rd, N of US82		2	3338.97	3339.32	33.41		flush mount		SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	
KWB-P3	Monitoring	Downgradient	Art Prod Line		2	3308.50	3305.95	--		--		Not included in monitoring program due to distance from impacts											
KWB-P4	Monitoring	Downgradient	Haines House		2	3305.39	3305.76	--		--		B	B	B	-	B	-	-	-	-	-	-	
KWB-P5	Monitoring	Downgradient	N of US82, E of BR - destroyed by road work									Drop from monitoring program, well destroyed by road work											
MW-1R	Monitoring	EP	W of the EPs		2	3313.28	3311.58	20.56		stickup		SA	A	A	-	A	A	-	-	A	A	A	
MW-2A	Monitoring	EP	W of the EPs		2	3312.97	3310.55	17.06		stickup		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA	
MW-2B	Monitoring	EP	W of the EPs		2	3312.49	3309.94	51.74		stickup		SA	No analytical samples to be collected										
MW-3	Monitoring	EP	S of EP 1 & 2		2	3310.32	3309.07	20.11		stickup		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA	
MW-4A	Monitoring	EP	S of EP 1 & 2		4	3312.71	3308.64	22.15		stickup		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA	
MW-4B	Monitoring	EP	S of EP 1 & 2		4	3312.01	3308.73	72.04		stickup		SA	B	B	B	B	B	-	-	B	B	B	
MW-5A	Monitoring	EP	S of EP 2		2	3308.62	3306.59	19.79		stickup		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA	
MW-5B	Monitoring	EP	S of EP 2	Dec-92	2	3308.95	3306.71	53.08	41.5 to 50.5	stickup		SA	B	B	B	B	B	-	-	B	B	B	
MW-5C	Monitoring	EP	S of EP 2	Jan-95	2	3309.28	3306.55	71.43	59.25 to 68.75	stickup		SA	B	B	B	B	B	-	-	B	B	B	
MW-6A	Monitoring	EP	S of EP 1		2	3313.46	3310.40	18.76		stickup		SA	A	A	A	A	A	-	-	A	A	A	
MW-6B	Monitoring	EP	S of EP 1		2	3313.35	3310.09	52.00		stickup		SA	B	B	B	B	B	-	-	B	B	B	
MW-7A	Monitoring	EP	S of EP 3		2	3309.24	3306.04	17.07		stickup		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA	
MW-7B	Monitoring	EP	S of EP 3		4	3307.87	3306.05	52.17		stickup		SA	B	B	B	B	B	-	-	B	B	B	
MW-8	Monitoring	TMD	S of ED between BR & HR	Jun-86	2	3336.42	3334.81	20.11	--	stickup		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA	
MW-9	Monitoring	TMD	S of ED between BR & HR	Jun-86	2	3336.20	3334.50	19.99	--	stickup		SA	No analytical samples to be collected										
MW-10	Monitoring	Downgradient	S of EPs		2	3304.76	3304.14	18.32		stickup		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA	

Table 1
Revised Monitoring Program and Schedule
Navajo Refining Company - Artesia Refinery, Artesia, New Mexico

Well ID	Well Type	Location Information		Well Construction Information ^a							PSH Expected? ^b	Gauging Frequency	Analytical Suite and Frequency ^c										
		Associated Area of Concern	Approximate Location	Date Installed	Diameter (in)	Top of Casing (ft MSL)	Ground Surface (ft MSL)	Total Depth (ft btoc)	Screen Interval (ft bgs)	Surface Finish			Purge Parameters	DRO	GRO	VOCs	Metals (As, Ba, Cr, Fe, Pb, Mn, Se)	Metals (Hg, Ni, Va)	Cyanide	Cations/Anions	Nitrates / Nitrites as Nitrogen	Total Dissolved Solids	
MW-11A	Monitoring	EP	NE of EP 6		4	3310.76	3308.42	21.75		stickup		SA	A	A	A	A	A	-	-	SA	SA	SA	
MW-11B	Monitoring	EP	NE of EP 6		2	3310.76	3308.34	46.95		stickup		SA	B	B	B	B	B	-	-	B	B	B	
MW-12	Monitoring	EP	N of OCD #1		4	3312.73	3310.37	10.38		stickup		SA	Not included in monitoring program due to location (north of river)										
MW-13	Monitoring	EP	N of EP 1		4	3314.24	3311.95	20.82		stickup		SA	Not included in monitoring program due to location (north of river)										
MW-14	Monitoring	EP	E of OCD #7		4	3311.84	3309.44	11.71		stickup		SA	Not included in monitoring program due to location (north of river)										
MW-15	Monitoring	EP	W of EP 1		4	3313.72	3310.97	21.43		stickup		SA	A	A	A	A	A	-	-	A	A	A	
MW-16	Monitoring	TMD	E of HR, N of ED		4	3316.12	3313.50	20.98		stickup		SA	A	A	-	A	A	-	-	A	A	A	
MW-17	Monitoring	Crossgradient	NE of Artesia POTW		4	3322.01	3319.43	--		stickup		Not included in monitoring program due to distance from impacts											
MW-18	Monitoring	NCL	N Refinery, E of NCL	Jun-82	8	3365.42	3363.06	22.27	15 to 19	stickup		SA	SA	SA	-	SA	SA	SA	SA	SA	SA	SA	
MW-18A	Monitoring	EP	S of EPs		4	3308.58	3306.33	22.05		stickup		SA	SA	SA	-	SA	SA	SA	SA	SA	SA	SA	
MW-18B	Monitoring	EP	S of EPs		2	3308.74	3306.23	50.24		stickup		SA	B	B	B	B	B	-	-	B	B	B	
MW-18T	Monitoring	EP	S of EPs		4	3308.55	3306.30	50.55		stickup		SA	No analytical samples to be collected										
MW-19	Monitoring	NCL	S of NCL		2	3368.00	3366.00	22.00		stickup		SA	No analytical samples to be collected										
MW-20	Monitoring	TMD	E of BR, S of ED	Jan-93	4	3340.91	3338.43	26.61	9.5 to 23.5	stickup		SA	A	A	-	A	A	-	-	A	A	A	
MW-21	Monitoring	TMD	S of ED between BR & HR	Jan-93	4	3337.31	3334.65	24.90	7.5 to 22	stickup		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA	
MW-22A	Monitoring	EP	S of EPs		4	3307.62	3305.24	22.33		stickup		SA	SA	SA	SA	SA	SA	-	-	A	A	A	
MW-22B	Monitoring	EP	S of EPs		2	3307.63	3305.08	54.31				SA	B	B	B	B	B	-	-	B	B	B	
MW-23	Monitoring	N Refinery	W of TEL	Jun-82	6	3368.38	3365.09	19.95	15 to 20	stickup		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA	
MW-24	Monitoring	EP	E of OCD #6	Jul-82	6	3312.85	3310.33	23.25	15 to 20	stickup		SA	Not included in monitoring program due to location (east of river)										
MW-25	Monitoring	TMD / EP	S of ED, E of HR	Jan-95	2	3312.29	3310.35	27.81	15.75 to 25.25	stickup		SA	A	A	-	A	A	-	-	A	A	A	
MW-26	Monitoring	TMD	S of ED, E of HR	Jan-95	2	3314.87	3312.08	27.31	15.25 to 24.25	stickup		SA	A	A	-	A	A	-	-	A	A	A	
MW-27	Monitoring	TMD	E of HR, S of ED	Jan-95	2	3320.85	3319.46	30.04	18.25 to 27.75	stickup		SA	A	A	-	A	A	-	-	A	A	A	
MW-28	Monitoring	S Refinery	E of SE Tankfarm	Jul-82	6	3370.27	3366.79	34.10	25 to 30	stickup		SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	
MW-29	Monitoring	N Refinery	N of TEL	Jan-95	2	3360.64	3359.79	21.82	9.75 to 19.25	stickup		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA	
MW-30	Monitoring	N Refinery / TMD	W of BR		8	3354.33	3353.60	21.35		stickup		SA	No analytical samples to be collected										
MW-39	Monitoring	N Refinery	N of TEL	Jun-84	2	3358.79	3357.94	25.34	14 to 24	stickup	Y	SA	SA ^d	SA ^d	SA ^d	SA ^d	SA ^d	-	-	SA ^d	SA ^d	SA ^d	
MW-40	Monitoring	N Refinery	N of TEL		2	3356.93	3356.56	24.81		stickup		SA	A	A	A	A	A	-	-	A	A	A	
MW-41	Monitoring	N Refinery	N of TEL	Jun-84	2	3356.58	3356.38	22.51	14 to 19	stickup		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA	
MW-42	Monitoring	N Refinery	N of TEL		2	3358.59	3356.66	23.40		stickup		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA	
MW-43	Monitoring	N Refinery	NW of TEL	Jul-84	6	3365.49	3363.38	21.22	15.5 to 20.5	stickup		SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	
MW-45	Monitoring	N Refinery / TMD	E of Refinery, S of ED	Aug-84	2	3351.51	3351.32	15.65	10.5 to 15.5	stickup		SA	SA	SA	-	SA	SA	SA	SA	SA	SA	SA	
MW-46R	Monitoring	N Refinery / TMD	E of Refinery, S of ED	Oct-10	2	3350.11	3350.41	19.40	3.5 to 18.5	flush mount		SA	SA	SA	-	SA	SA	-	-	SA	SA	SA	
MW-48	Monitoring	S Refinery	S of SE Tankfarm		2	3362.97	3363.04	32.47		flush mount	Y	SA	SA ^d	SA ^d	SA ^d	SA ^d	SA ^d	-	-	SA ^d	SA ^d	SA ^d	
MW-49	Monitoring	Central Refinery	E Refinery, midway from ED to US82		2	3359.77	3359.69	33.04		flush mount		SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	
MW-50	Monitoring	Central Refinery	W of Refinery, E of US285, N of US 82		2	3371.05	3368.91	28.27		stickup		SA	SA	SA	-	SA	SA	-	-	SA	SA	SA	
MW-52	Monitoring	S Refinery	S of Refinery & US82		2	3368.30	3368.36	34.50		flush mount		SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	
MW-53	Monitoring	Upgradient	W of Refinery, E of rail		2	3368.73	3368.86	23.65	13.8 to 23.8	flush mount		SA	A	A	-	A	A	-	-	A	A	A	

Table 1
Revised Monitoring Program and Schedule
Navajo Refining Company - Artesia Refinery, Artesia, New Mexico

Well ID	Well Type	Location Information		Well Construction Information ^a							PSH Expected? ^b	Gauging Frequency	Analytical Suite and Frequency ^c										
		Associated Area of Concern	Approximate Location	Date Installed	Diameter (in)	Top of Casing (ft MSL)	Ground Surface (ft MSL)	Total Depth (ft btoc)	Screen Interval (ft bgs)	Surface Finish			Purge Parameters	DRO	GRO	VOCs	Metals (As, Ba, Cr, Fe, Pb, Mn, Se)	Metals (Hg, Ni, Va)	Cyanide	Cations/Anions	Nitrates / Nitrites as Nitrogen	Total Dissolved Solids	
MW-54A	Monitoring	NCL	NW of NCL		2	3366.49	3363.55	31.06	12.7 to 27.7	stickup		SA	SA	SA	-	SA	SA	-	-	SA	SA	SA	
MW-54B	Monitoring	NCL	NW of NCL		2	3366.47	3363.47	46.80	33.8 to 43.8	stickup		SA	B	B	B	B	B	-	-	B	B	B	
MW-55	Monitoring	N Refinery	E of NCL		2	3364.77	3361.90	26.82	13.7 to 23.7	stickup		SA	SA	SA	SA	SA	SA	SA	SA	SA	SA		
MW-56	Monitoring	N Refinery / TMD	NE of Refinery		2	3357.44	3354.84	26.40	13.4 to 23.4	stickup		SA	SA	SA	-	SA	SA	-	-	SA	SA	SA	
MW-57	Monitoring	Downgradient	S BR		2	3350.91	3350.95	--		flush mount		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA	
MW-58	Monitoring	Downgradient	S of US82, W of BR		4	3362.22	3362.56	32.90		flush mount		SA	SA	SA	-	SA	SA	SA	SA	SA	SA	SA	
MW-59	Monitoring	N Refinery	Boneyard		2	3354.78	3354.97	29.72		flush mount		SA	A	A	A	A	A	-	-	A	A	A	
MW-60	Monitoring	N Refinery	Boneyard		2	3354.33	3354.36	34.30		flush mount		SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	
MW-61	Monitoring	N Refinery	SW of TEL	Apr-05	4	3369.47	3369.45	28.97	14 to 29	flush mount		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA	
MW-62	Monitoring	N Refinery	SW of TEL	Apr-05	4	3371.29	3369.01	31.94	14 to 29	flush mount		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA	
MW-63	Monitoring	N Refinery	SW of TEL	Apr-05	4			--	14 to 29	--	Damaged during refinery construction												
MW-64	Monitoring	S Refinery	SW of SE Tankfarm	Apr-05	4	3369.52	3365.56	34.15	15 to 30	flush mount	Y	SA	SA ^d	SA ^d	SA ^d	SA ^d	SA ^d	-	-	SA ^d	SA ^d	SA ^d	
MW-65	Monitoring	S Refinery	S of SE Tankfarm	Apr-05	4	3363.60	3363.84	29.35	14.5 to 29.5	flush mount	Y	SA	SA ^d	SA ^d	SA ^d	SA ^d	SA ^d	-	-	SA ^d	SA ^d	SA ^d	
MW-66	Monitoring	S Refinery	E of SE Tankfarm	Apr-05	4	3363.46	3363.66	29.67	14.6 to 29.6	flush mount		SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	
MW-67	Monitoring	N Refinery	E of Diesel Tank Farm	Apr-05	4	3365.45	3365.59	27.17	12 to 27	flush mount		SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	
MW-68	Monitoring	TMD	S of ED, between HR & Dirt Rd		2	3328.21	3325.81	26.51		stickup		SA	A	A	-	A	A	-	-	A	A	A	
MW-69	Monitoring	EP	N River, formerly MW #23		2	3313.86	3311.40	10.66		stickup		SA	Not included in monitoring program due to location (north of river)										
MW-70	Monitoring	EP	S of EPs, formerly MW #19		4	3306.30	3303.84	21.77		stickup		SA	SA	SA	SA	SA	SA	-	-	A	A	A	
MW-71	Monitoring	TMD	S of ED, formerly MW #29		2	3335.29	3332.99	21.57		stickup		SA	SA	SA	-	SA	SA	SA	SA	SA	SA	SA	
MW-72	Monitoring	EP	EP 6	Mar-07	4	3308.45	3306.40	13.70	2 to 12	stickup		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA	
MW-73	Monitoring	EP	EP 3	Mar-07	4	3310.18	3308.02	19.38	2 to 17	stickup		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA	
MW-74	Monitoring	EP	EP 2	Mar-07	4	3310.03	3307.78	19.89	2 to 17	stickup		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA	
MW-75	Monitoring	EP	EP 2	Mar-07	4	3310.21	3307.80	23.45	3 to 18	stickup		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA	
MW-76	Monitoring	EP	EP 2	Mar-07	4	3311.84	3309.70	20.08	3 to 18	stickup		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA	
MW-77	Monitoring	EP	EP 2	Mar-07	4	3310.07	3307.97	20.26	3 to 18	stickup		SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	
MW-78	Monitoring	EP	EP 2	Mar-07	4	3310.14	3307.94	19.35	2 to 17	stickup		SA	A	A	A	A	A	-	-	A	A	A	
MW-79	Monitoring	EP	EP 5	Mar-07	4	3311.43	3309.08	19.05	2 to 17	stickup		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA	
MW-80	Monitoring	EP	EP 5	Mar-07	4	3310.79	3308.73	19.61	2 to 17	stickup		SA	A	A	A	A	A	-	-	A	A	A	
MW-81	Monitoring	EP	EP 5	Mar-07	4	3312.34	3310.19	18.41	2 to 17	stickup		SA	A	A	A	A	A	-	-	A	A	A	
MW-82	Monitoring	EP	EP 1	Mar-07	4	3310.75	3308.64	19.77	2 to 17	stickup		SA	A	A	A	A	A	-	-	A	A	A	
MW-83	Monitoring	EP	EP 1	Mar-07	4	3310.19	3307.93	19.68	2 to 17	stickup		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA	
MW-84	Monitoring	EP	EP 1	Mar-07	4	3311.59	3309.83	20.21	2 to 17	stickup		SA	SA	SA	SA	SA	SA	-	-	A	A	A	
MW-85	Monitoring	EP	EP 1	Mar-07	4	3311.09	3308.99	20.27	3 to 18	stickup	Y	SA	SA ^d	SA ^d	SA ^d	SA ^d	SA ^d	-	-	SA ^d	SA ^d	SA ^d	
MW-86	Monitoring	EP	EP 1	Mar-07	4	3311.06	3308.98	19.28	2 to 17	stickup	Y	SA	SA ^d	SA ^d	SA ^d	SA ^d	SA ^d	SA ^d	SA ^d	SA ^d	SA ^d	SA ^d	
MW-87	Monitoring	EP	S of EPs	Mar-07	4	3307.64	3305.42	20.07	2 to 17	stickup		SA	SA	SA	SA	SA	SA	-	-	A	A	A	
MW-88	Monitoring	EP	S of EPs	Mar-07	4	3308.68	3306.43	20.03	3 to 18	stickup		SA	SA	SA	SA	SA	SA	-	-	A	A	A	
MW-89	Monitoring	TMD	S of ED, E of HR	Mar-07	4	3318.32	3316.38	19.99	2 to 17	stickup		SA	A	A	-	A	A	-	-	A	A	A	

Table 1
Revised Monitoring Program and Schedule
Navajo Refining Company - Artesia Refinery, Artesia, New Mexico

Well ID	Well Type	Location Information		Well Construction Information ^a							PSH Expected? ^b	Gauging Frequency	Analytical Suite and Frequency ^c										
		Associated Area of Concern	Approximate Location	Date Installed	Diameter (in)	Top of Casing (ft MSL)	Ground Surface (ft MSL)	Total Depth (ft btoc)	Screen Interval (ft bgs)	Surface Finish			Purge Parameters	DRO	GRO	VOCs	Metals (As, Ba, Cr, Fe, Pb, Mn, Se)	Metals (Hg, Ni, Va)	Cyanide	Cations/Anions	Nitrates / Nitrites as Nitrogen	Total Dissolved Solids	
MW-90	Monitoring	N Refinery	S of Diesel Tankfarm	Jun-07	4	3369.42	3367.13	22.69	5 to 20	stickup		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA	
MW-91	Monitoring	N Refinery	S of Diesel Tankfarm	Jun-07	4	3367.73	3365.72	25.26	7 to 22	stickup		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA	
MW-92	Monitoring	N Refinery	S of ED, N of NAPI	Jun-07	4	3368.72	3366.75	22.53	5 to 20	stickup		SA	A	A	A	A	A	-	-	A	A	A	
MW-93	Monitoring	N Refinery	S of ED, NE of NAPI	Jun-07	4	3363.79	3364.22	20.10	5 to 20	flush mount		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA	
MW-94	Monitoring	N Refinery	SE of Diesel Tankfarm, N of ED	Jul-07	4	3367.97	3365.82	23.79	5 to 20	stickup	Y	SA	SA ^d	SA ^d	SA ^d	SA ^d	SA ^d	-	-	SA ^d	SA ^d	SA ^d	
MW-95	Monitoring	N Refinery	NE of Diesel Tankfarm	Jul-07	4	3368.70	3366.48	25.32	7 to 22	stickup		SA	A	A	A	A	A	-	-	A	A	A	
MW-96	Monitoring	N Refinery	S of Diesel Tankfarm	Jul-07	4	3368.92	3366.83	25.47	7 to 22	flush mount		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA	
MW-97	Monitoring	N Refinery	SE of NAPI	Jul-07	4	3365.92	3366.38	21.93	8 to 23	flush mount	Y	SA	SA ^d	SA ^d	SA ^d	SA ^d	SA ^d	-	-	SA ^d	SA ^d	SA ^d	
MW-98	Monitoring	N Refinery	E of Former Diesel Storage Tank Area	Jul-07	4	3361.36	3358.96	26.62	13 to 23	stickup		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA	
MW-99	Monitoring	S Refinery	NE of Loading Rack	Jul-07	4	3364.07	3362.33	28.26	12 to 27	flush mount		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA	
MW-100	Monitoring	S Refinery	SE corner of SE Tankfarm	Jul-07	4	3364.51	3365.11	- -	9 to 24	flush mount	Plugged and abandoned for refinery construction												
MW-101	Monitoring	S Refinery	E Loading Rack	Jul-07	4	3364.23	3362.07	26.70	8 to 23	stickup		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA	
MW-102	Monitoring	S Refinery	E West Firewater Pond	Jul-07	4	3367.64	3365.51	26.44	12 to 27	stickup	Y	SA	SA ^d	SA ^d	SA ^d	SA ^d	SA ^d	-	-	SA ^d	SA ^d	SA ^d	
MW-103	Monitoring	S Refinery	Old Rail ROW	Aug-08	4	3372.47	3370.89	25.10	7 to 22	flush mount		SA	A	A	A	A	A	-	-	A	A	A	
MW-104	Monitoring	S Refinery	Old Rail ROW	Aug-08	4	3371.43	3369.41	21.82	3 to 18	flush mount		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA	
MW-105	Monitoring	Central Refinery	W of Crude Tankfarm	Feb-09	4	3364.99	3365.20	17.13	8 to 18	flush mount	Y	SA	SA ^d	SA ^d	SA ^d	SA ^d	SA ^d	-	-	SA ^d	SA ^d	SA ^d	
MW-106	Monitoring	Central Refinery	E of Crude Tankfarm	Feb-09	4	3358.98	3359.29	22.70	0 to 11	flush mount		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA	
MW-107	Monitoring	S Refinery	NE of SE Tankfarm	Feb-09	4	3359.44	3359.63	18.96	12 to 22	flush mount		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA	
MW-108	Monitoring	NCL	S of NCL	Jul-09	4	3369.11	3366.25	26.80	9 to 24	stickup		SA	SA	SA	-	SA	SA	-	-	SA	SA	SA	
MW-109	Monitoring	S Refinery	S of Highway 82 at warehouse	Jan-11	2	3368.09	3368.27	30.00	15 to 29.5	flush mount		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA	
MW-110	Monitoring	S Refinery	S of Highway 82 at warehouse	Jan-11	2	3368.03	3368.46	30.00	15 to 29.5	flush mount		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA	
NCL-31	Monitoring	NCL	NCL	Oct-82	2	3367.54	3366.21	20.10	13 to 18	stickup		SA	SA	SA	-	SA	SA	-	-	SA	SA	SA	
NCL-32	Monitoring	NCL	NCL	Oct-82	2	3364.91	3364.96	17.31	17 to 22	stickup		SA	SA	SA	-	SA	SA	-	-	SA	SA	SA	
NCL-33	Monitoring	NCL	NCL	Oct-82	2	3363.97	3364.26	20.47	13 to 18	stickup		SA	SA	SA	-	SA	SA	-	-	SA	SA	SA	
NCL-34A	Monitoring	NCL	NCL	Oct-82	2	3365.49	3364.82	19.25	16 to 21	stickup		SA	SA	SA	-	SA	SA	-	-	SA	SA	SA	
NCL-34B	Monitoring	NCL	NCL	Oct-82	2	3366.06	3364.70			stickup		SA	B	B	-	B	B	-	-	B	B	B	
NCL-44	Monitoring	NCL	NCL		2	3364.45	3364.01	21.58		stickup		SA	SA	SA	-	SA	SA	-	-	SA	SA	SA	
NCL-49	Monitoring	NCL	NCL		2	3371.13	3368.26	31.98		stickup		SA	SA	SA	-	SA	SA	-	-	SA	SA	SA	
NP-1	Monitoring	TMD	S of ED, E of BR		2	3342.40	3339.69	21.64		stickup		SA	SA	-	-	SA	-	-	-	A	A	A	
NP-2	Monitoring	TMD	S of ED, E of BR	Jan-93	2	3342.77	3340.58	21.25	9.5 to 18.5	stickup		SA	No analytical samples to be collected										
NP-3	Monitoring	TMD	N of ED, NE of BR	Jan-93	2	3342.93	3340.40	21.65	9.5 to 18.5	stickup		SA	No analytical samples to be collected										
NP-4	Monitoring	TMD	NE of NP #3	Jan-93	2	3345.73	3343.24	36.75	24.5 to 33.5	stickup		SA	No analytical samples to be collected										
NP-5	Monitoring	Crossgradient	S of RR, N of ED, W of BR		2	3349.29	3346.31	24.89		stickup		SA	A	A	-	A	A	-	-	A	A	A	
NP-6	Monitoring	TMD	S of ED, W of BR		2	3338.05	3336.31	20.07		stickup		SA	A	-	-	A	-	-	-	-	-	-	
NP-7	Monitoring	TMD	In Pecan Orchard, destroyed by landowner					3329.65	3326.84			Drop from monitoring program, destroyed by landowner											
NP-8	Monitoring	TMD	S of ED, E of HR		2	3314.67	3310.53	14.88		stickup		SA	No analytical samples to be collected										
NP-9	Monitoring	TMD	S of RR, N of ED, W of BR		2	3360.62	3357.86	25.86				SA	No analytical samples to be collected										

Table 1
Revised Monitoring Program and Schedule
Navajo Refining Company - Artesia Refinery, Artesia, New Mexico

Well ID	Well Type	Location Information		Well Construction Information ^a							PSH Expected? ^b	Gauging Frequency	Analytical Suite and Frequency ^c									
		Associated Area of Concern	Approximate Location	Date Installed	Diameter (in)	Top of Casing (ft MSL)	Ground Surface (ft MSL)	Total Depth (ft btoc)	Screen Interval (ft bgs)	Surface Finish			Purge Parameters	DRO	GRO	VOCs	Metals (As, Ba, Cr, Fe, Pb, Mn, Se)	Metals (Hg, Ni, Va)	Cyanide	Cations/Anions	Nitrates / Nitrites as Nitrogen	Total Dissolved Solids
OCD-1R	Monitoring	EP	NW of EP 6, replaced OCD-1		2	3314.27	3310.69	23.60		stickup		SA	SA	SA	SA	SA	SA	-	-	A	A	A
OCD-2A	Monitoring	EP	N of EP 6		2	3314.16	3310.83	27.27		stickup		SA	SA	SA	SA	SA	SA	-	-	A	A	A
OCD-2B	Monitoring	EP	N of EP 6		2	3313.07	3310.66	50.58		stickup		SA	No analytical samples to be collected									
OCD-3	Monitoring	EP	NE of EP 6		2	3314.43	3310.89	25.16		stickup		SA	SA	SA	SA	SA	SA	-	-	A	A	A
OCD-4	Monitoring	EP	NE of EP 6		2	3313.68	3310.31	25.12		stickup		SA	SA	SA	SA	SA	SA	-	-	A	A	A
OCD-5	Monitoring	EP	NE of EP 6		2	3311.27	3308.76	25.13		stickup		SA	SA	SA	SA	SA	SA	-	-	A	A	A
OCD-6	Monitoring	EP	E of EP 6		2	3311.40	3308.11	26.51		stickup		SA	SA	SA	SA	SA	SA	-	-	A	A	A
OCD-7AR	Monitoring	EP	SE of EP 6	Dec-92	4	3310.03	3308.86	21.01	5.5 to 19.5	stickup		SA	SA	SA	SA	SA	SA	-	-	A	A	A
OCD-7B	Monitoring	EP	SE of EP 6	Dec-92	2	3310.26	3307.57	56.51	43.5 to 52.5	stickup		SA	B	B	B	B	B	-	-	B	B	B
OCD-7C	Monitoring	EP	SE of EP 6	Jan-95	2	3310.10	3307.74	71.73	60.25 to 69.75	stickup		SA	No analytical samples to be collected									
OCD-8A	Monitoring	EP	SE of EP 3		2	3308.72	3306.43	21.35		stickup		SA	SA	SA	SA	SA	SA	SA	SA	A	A	A
OCD-8B	Monitoring	EP	SE of EP 3		2	3309.19	3306.11	56.24		stickup		SA	B	B	B	B	B	-	-	B	B	B
TEL-1	Monitoring	TEL	E of TEL cap	May-90	2	3358.23	3356.79	26.90	13 to 23	stickup		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
TEL-2	Monitoring	TEL	E of TEL cap	May-90	2	3359.12	3356.80	27.08	13 to 23	stickup		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
TEL-3	Monitoring	TEL	E of TEL cap	May-90	2	3358.33	3356.43	27.18	13 to 23	stickup		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
TEL-4	Monitoring	TEL	W of TEL cap	May-90	2	3360.24	3358.21	27.16	13 to 23	stickup		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
UG-1	Monitoring	Upgradient	W of Refinery, James Street	Jul-08	4	3372.94	3373.02	24.01	8 to 23	flush mount		A	A	A	A	A	A	A	A	A	A	A
UG-2	Monitoring	Upgradient	W of Refinery, Roselawn	Jul-08	4	3380.41	3380.30	29.03	15 to 30	flush mount		A	A	A	A	A	A	A	A	A	A	A
UG-3R	Monitoring	Upgradient	W of Refinery, 7th Street	Sep-08	4	3384.08	3384.62	38.32	17 to 37	flush mount		A	A	A	A	A	A	A	A	A	A	A
LaRue Well	Irrigation	Offsite	S of US82	--	--	--	--	--	--	irrigation well		Drop from monitoring program based on historic data (no organic impacts) and lack of consistent										
RA-313	Irrigation	S Refinery	N of US82, W of BR	Oct-40	10	3370.62	3369.96	1157	904 to 1157	irrigation well		NA	A	-	-	A	-	-	-	A	A	A
RA-314	Irrigation	S Refinery	N of US82, W of BR	--	10	3363.82	3363.51	no data	no data	irrigation well		NA	A	-	-	A	-	-	-	A	A	A
RA-1227	Irrigation	SE of Refinery	S of US82, E of BR	Dec-35	10 / 8	3352.80	3352.27	246	194 to 246	irrigation well		NA	SA	-	-	SA	-	-	-	SA	SA	SA
RA-3156	Irrigation	Downgradient	S of US82, E of BR	Nov-53	4	3353.28	3353.02	unknown	182 to ?	irrigation well		NA	SA	-	-	SA	-	-	-	SA	SA	SA
RA-3353	Irrigation	Downgradient	S of US82, E of BR, electricity disconnected 2	--	10	--	--	--	--	irrigation well		Drop from monitoring program since electricity has been cut and well is inoperable										
RA-3723	Irrigation	S Refinery	N of US82, W of BR, inoperable in 2009	--	10	3358.66	3357.33	--	--	irrigation well		Drop from monitoring program since well is inoperable										
RA-4196	Irrigation	Field E of Refinery	N of US82, E of BR	Apr-60	8	3351.52	3350.75	294	280 to 292	irrigation well		NA	SA	-	-	SA	-	-	-	SA	SA	SA
RA-4798	Irrigation	Field E of Refinery	E of BR, N of US82	May-63	7	3348.31	3347.65	850	840 to 850	irrigation well		NA	SA	-	-	SA	-	-	-	SA	SA	SA
RW-1	Recovery ^d	N Refinery	S of ED, NW portion of Refinery		36	3367.03	3365.29	18.73		recovery well	Y	SA	A ^d	A ^d	A ^d	A ^d	A ^d	-	-	A ^d	A ^d	A ^d
RW-2	Recovery ^d	N Refinery	S of ED, NW portion of Refinery		36	3368.43	3365.88	19.28		recovery well		SA	A ^d	A ^d	A ^d	A ^d	A ^d	-	-	A ^d	A ^d	A ^d
RW-3	Recovery ^d	N Refinery	Between ED and TEL, backfilled		36	3364.91	3362.92	--		recovery well		Backfilled, inoperable										
RW-4	Recovery ^d	S Refinery	NW of SE Tankfarm		36	3364.86	3364.41	20.97		recovery well		SA	A	A	-	A	A	-	-	A	A	A
RW-5	Recovery ^d	S Refinery	SE Tankfarm		36	3363.81	3362.79	17.46		recovery well	Y	SA	A ^d	A ^d	-	A ^d	A ^d	-	-	A ^d	A ^d	A ^d
RW-6	Recovery ^d	S Refinery	W of SE Tankfarm		36	3368.36	3366.03	17.06		recovery well	Y	SA	A ^d	A ^d	-	A ^d	A ^d	-	-	A ^d	A ^d	A ^d
RW-7	Recovery ^d	N Refinery	N of ED, NW portion of Refinery		36	3367.09	3365.03	20.65		recovery well		SA	A	A	A	A	A	-	-	A	A	A
RW-8	Recovery ^d	N Refinery	N of ED, S of NCL		36	3368.10	3364.89	14.34		recovery well	Y	SA	A ^d	A ^d	-	A ^d	A ^d	-	-	A ^d	A ^d	A ^d
RW-9	Recovery ^d	N Refinery	N of TEL		36	3359.51	3356.30	21.85		recovery well		SA	A	A	A	A	A	-	-	A	A	A

Table 1
Revised Monitoring Program and Schedule
Navajo Refining Company - Artesia Refinery, Artesia, New Mexico

Well ID	Well Type	Location Information		Well Construction Information ^a							PSH Expected? ^b	Gauging Frequency	Analytical Suite and Frequency ^c									
		Associated Area of Concern	Approximate Location	Date Installed	Diameter (in)	Top of Casing (ft MSL)	Ground Surface (ft MSL)	Total Depth (ft btoc)	Screen Interval (ft bgs)	Surface Finish			Purge Parameters	DRO	GRO	VOCs	Metals (As, Ba, Cr, Fe, Pb, Mn, Se)	Metals (Hg, Ni, Va)	Cyanide	Cations/Anions	Nitrates / Nitrites as Nitrogen	Total Dissolved Solids
RW-10	Recovery ^d	N Refinery	N of TEL		36	3360.61	3356.12	23.73		recovery well		SA	A	A	A	A	A	-	-	A	A	A
RW-11 ^e	Recovery ^d	S Refinery	S of US82, W side of BR		36	3353.95	3351.48	22.93		recovery well		SA	A	A	-	A	A	-	-	A	A	A
RW-12	Recovery ^d	Field E of Refinery	N of US 82, W of BR		36	3352.55	3351.17	22.95		recovery well		SA	A	A	-	A	A	-	-	A	A	A
RW-13	Recovery ^d	Field E of Refinery	N of US 82, W of BR		36	3351.95	3349.87	26.21		recovery well	Y	SA	A ^d	A ^d	-	A ^d	A ^d	-	-	A ^d	A ^d	A ^d
RW-14	Recovery ^d	Field E of Refinery	N of US 82, W of BR		36	3351.48	3347.95	23.75		recovery well	Y	SA	A ^d	A ^d	-	A ^d	A ^d	-	-	A ^d	A ^d	A ^d
RW-15 ^e	Recovery ^d	S Refinery	S of SE Tankfarm		36	3361.41	3362.65	21.46		recovery well	Y	SA	A ^d	A ^d	-	A ^d	A ^d	-	-	A ^d	A ^d	A ^d
RW-16 ^e	Recovery ^d	N Refinery / TMD	NE of Refinery, S of ED		36	3360.97	3357.20	17.52		recovery well		SA	A	A	-	A	A	-	-	A	A	A
RW-17 ^e	Recovery ^d	N Refinery	N of ED, E of NCL		36	3364.72	3362.76	16.00		recovery well		SA	A	A	A	A	A	-	-	A	A	A
RW-18 ^e	Recovery ^d	Field E of Refinery	S of ED, W of BR		36	3350.84	3349.04	17.62		recovery well		SA	A	-	-	A	A	-	-	A	A	A

A = Annual (March/Aprnl event)
B = Biennial (starts March/Aprnl 2011)
BR = Bolton Road
DRO = Diesel Range Organics
E = East
EP = Evaporation Ponds
ft bgs = feet below ground surface
ft btoc = feet below top of casing
ft MSL = feet Mean Sea Level
GRO = Gasoline Range Organics
HR = Haldeman Road
in = inches
N = North
NA = Not accessible
NAPI = North API Separator
NCL = North Colony Landfarm
NE = Northeast
NS = Not surveyed yet

NW = Northwest
OCD = Oil Conservation District
PSH = Phase Separated Hydrocarbons
ROW = right of way
RR = Richey Road
S = South
SA = Semi-annual (September/October event)
SE = Southeast
SW = Southwest
TMD = Three Mile Ditch
TEL = Tetra Ethyl Lead Impoundment
UG = Upgradient
US285 = U.S Highway 285
US82 = U.S Highway 82
VOCs = Volatile Organic Compounds
W = West
Y = Yes

Footnotes:

^a Well construction information provided where available Top of casing and ground surface elevations from February 2010 survey. Total depth based on 4/2010 measurements

^b PSH was present during March 2010 groundwater monitoring event or a recovery pump is in place. Note that recovery wells are also gauged at least monthly

^c Analytical Suite to include the following

1. Purge parameters to be measured and recorded in the field will include pH, temperature, specific conductivity, dissolved oxygen, and oxygen-reduction potential

2. DRO by Method 8015Mod.

3. GRO by Method 8015Mod.

4. VOCs by Method 8260, to include methyl tert butyl ether (MTBE).

5. Total metals by Method 6010/6020 and/or 7470 Specific metals shown in heading, abbreviations from pernodic chart.

6. Cyanide by Method SM4500

7. Cations/anions to include Calcium, Potassium, and Sodium by Method 6010 or 6020 and Sulfate, Chloride and Fluoride by Method 300

8. Nitrates/Nitrites as Nitrogen by Method 300

9. Total Dissolved Solids by Method 2540C.

"-" indicates parameter not required

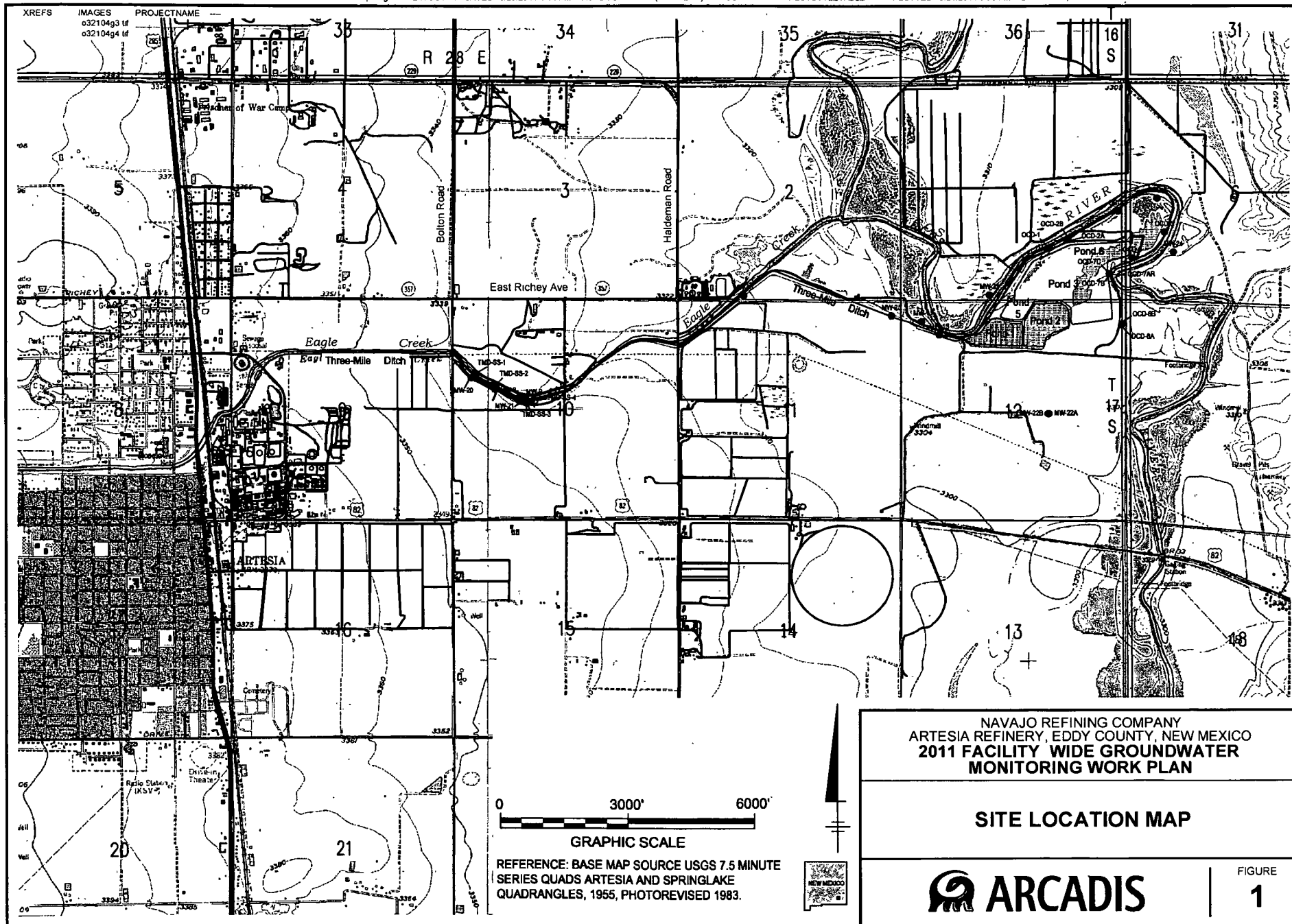
Note - samples will not be collected from any well where PSH is measured to be 0.03 feet thick or greater.

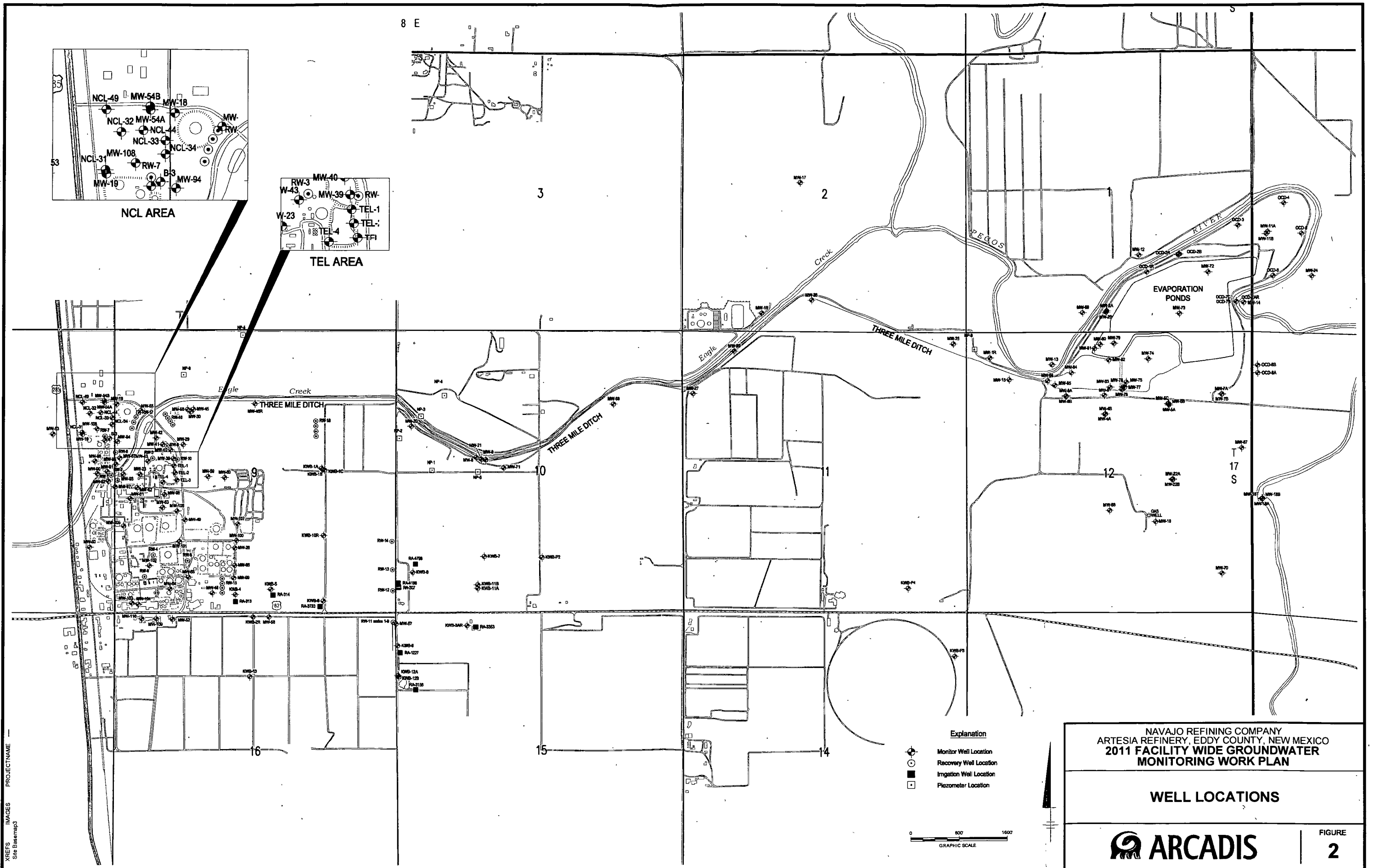
^d Samples to be collected at frequency indicated if <0.03 feet of PSH is present.

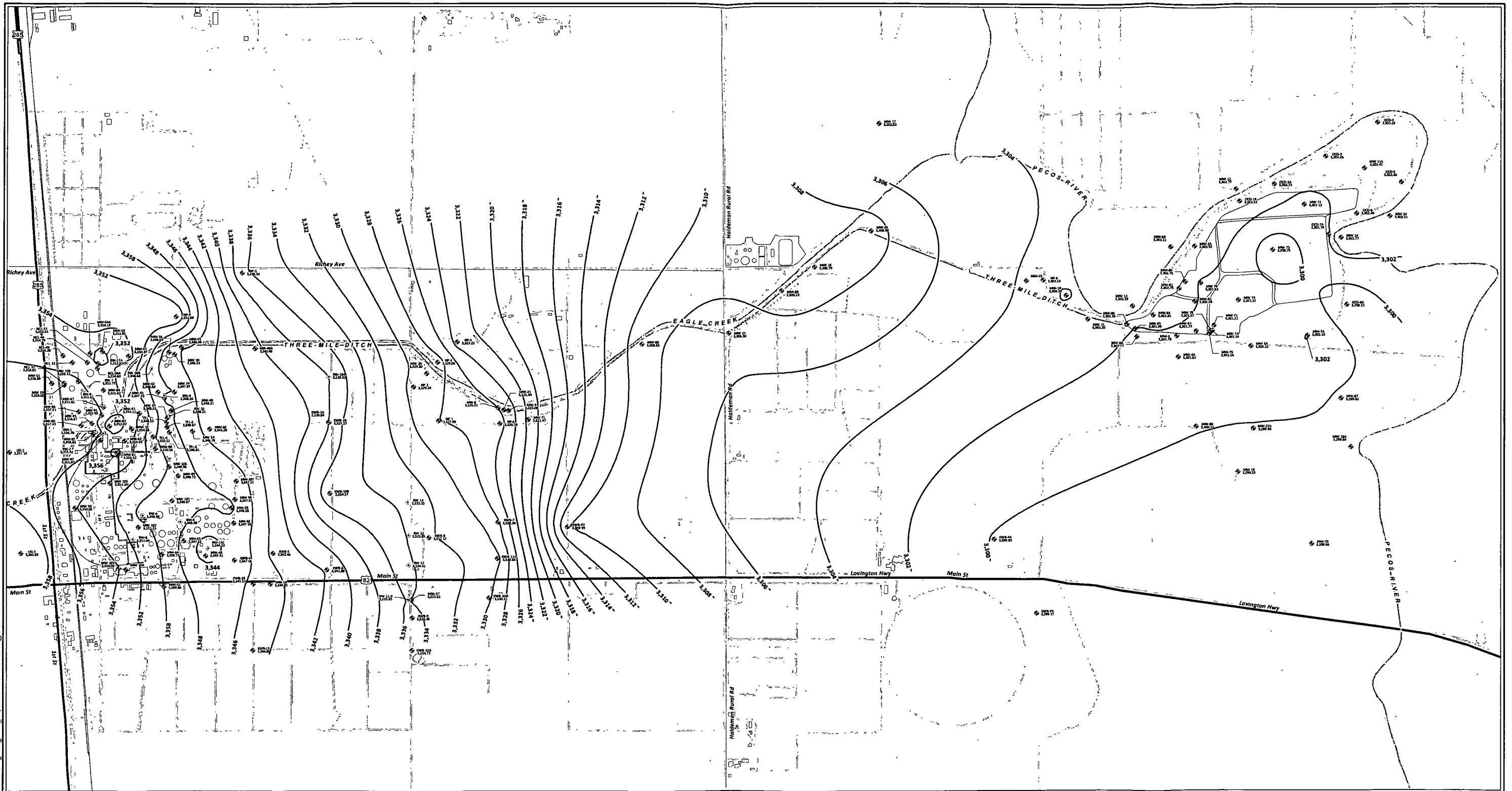
^e Recovery trenches 11, 15, 16, 17 and 18 have multiple "wells" Gauging and sampling points are as follows RW #11-0, RW #15C, RW #16B, RW #17A and RW #18A

Revised as of 06/2011

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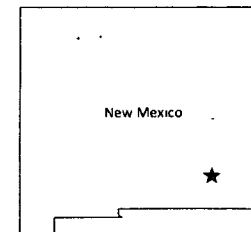
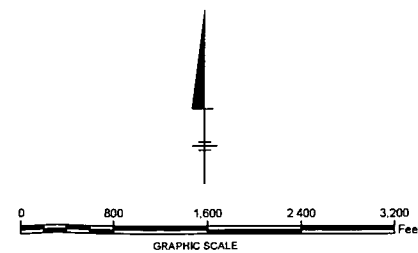






LEGEND

- ◆ MONITORING WELL
- RECOVERY WELL
- IRRIGATION WELL
- ABANDONED WELL
- SHALLOW AQUIFER POTENTIOMETRIC SURFACE CONTOURS



NAVAJO REFINING COMPANY
ARTESIA REFINERY, EDDY COUNTY, NEW MEXICO
2011 FACILITY-WIDE GROUNDWATER MONITORING WORKPLAN

**SHALLOW AQUIFER
POTENTIOMETRIC SURFACE MAP
2ND SEMI-ANNUAL EVENT, SEPTEMBER 2010**

ARCADIS

FIGURE
3



Appendix A

Well Completion Logs

Date Start/Finish: 1/5/11
Drilling Company: Atkins
Driller's Name: Mort Bates
Drilling Method: Hollow Stem Auger
Sampling Method: Core Barrel
Rig Type: NA

Northing: 670174.25
Easting: 523065.52
Casing Elevation: 3368.09' amsl

Borehole Depth: 30' bgs
Surface Elevation: 3368.27' amsl

Descriptions By: R. Lang

Well/Boring ID: MW-109

Client: Navajo Refining Company

Location: Navajo Refinery
 Artesia, N.M.

DEPTH	ELEVATION	Sample Run Number	Sample/Int/Type	PID (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Well/Boring Construction
3370								
0							SANDSTONE, 7 5YR 8/4 pink 35% fine grained, 35% firm, caliche 2 5YR 8/1 white, asphalt paving debns 7 5YR 2 5/1 black, 30% moist	Concrete Pad and Flush Mount Casing
							Hydrovac excavated for clearance	Portland Cement (0'-5' bgs)
3365		1	HV					
5								
		2	DP	0.5			CLAY, 2 5Y reddish brown, plastic, fat clay, moist	2" PVC Pipe (0'-15' bgs)
3360		3	DP	0.2				Bentonite Chips (5'-12' bgs)
10		4	DP	0.0				
		5	DP	0.3			color change to 5YR 8/4 pink, plastic, moist	
3355		6	DP	1441			SANDSTONE, Gley 2 7/1, light bluish grey, fine to medium sandstone, moderately sorted, argillaceous, moist, odor	
15								



Remarks: bgs = below ground surface; amsl = above mean sea level; HV = hydrovac; ppm = parts per million; NA = not applicable/available; DP = Direct Push;

Northing and Easting data based on New Mexico State Plane System, Eastern Zone NAD 83. Elevation NAVD 88 referenced to NGS benchmark G-416

Site Location:

Navajo Refinery
Artesia, N.M.

Borehole Depth: 30' bgs

DEPTH	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Well/Boring Construction
3350		7	DP	1627					
20		8	DP	827				CLAY, Gley 2 7/1, light bluish grey, crumbly, arenaceous, odor	
		9	DP	1998				CLAY, 2 5R 5/6 greyish crimson, 2 5YR 8/4 pink, plastic, mottled, odor	
3345		10	DP	2061					
25		11	DP	1549				SANDSTONE, 2 5YR 5/6 red and 2 5YR 8/4 pink, fine grained, poorly sorted, soft, silty, odor	
		12	DP	1309					
3340		13	DP	54				CLAY, 2 5YR 7/1 light reddish grey, plastic, wet	
30								Borehole terminated at 30'	
3335									
35									

Sand Pack 8/16
(12'-30' bgs)2" Sch 40 PVC
0.010" Slot
Screen (15'-29' 5'
bgs)

6" Cap



Remarks: bgs = below ground surface; amsl = above mean sea level; HV = hydrovac; ppm = parts per million; NA = not applicable/available; DP = Direct Push;

Northing and Easting data based on New Mexico State Plane System, Eastern Zone NAD 83. Elevation NAVD 88 referenced to NGS benchmark G-416

Date Start/Finish: 1/6/11
Drilling Company: Atkins
Driller's Name: Mort Bates
Drilling Method: Hollow Stem Auger
Sampling Method: Core Barrel
Rig Type: NA

Northing: 670174.33
Easting: 522796.69
Casing Elevation: 3368.03' amsl

Borehole Depth: 30' bgs
Surface Elevation: 3368.46' amsl

Descriptions By: R. Lang

Well/Boring ID: MW-110

Client: Navajo Refining Company

Location: Navajo Refinery
 Artesia, N.M.

DEPTH	ELEVATION	Sample Run Number	Sample/Int/Type	PID (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Well/Boring Construction
3370								
3365		1	HV				SANDSTONE, 10R 6/6 light red, fine grained, well sorted, soft, argillaceous, trace (~10%) broken pavement Hydrovac excavated for clearance	Concrete Pad and Flush Mount Casing Portland Cement (0'-5' bgs)
3360		2	GP	10			CLAY, 2 5YR 5/8 red, plastic, moist	2" PVC Pipe (0'-15' bgs)
3355		3	GP	08			SANDSTONE, 2 5YR 7/4 light reddish brown, medium grained to silt, poorly sorted, soft, dry	Bentonite Chips (5'-13' bgs)
		4	GP	42.6			CLAY, Gley 2 7/1 5PB light bluish grey, plastic, odor, some clay 10R 8/1 white, mottled, contains gypsum crystals	
		5	GP	1444				
		6	GP	1118				



Remarks: bgs = below ground surface; amsl = above mean sea level; HV = hydrovac; ppm = parts per million; NA = not applicable/available; DP = Direct Push;

 Northing and Easting data based on New Mexico State Plane System, Eastern Zone NAD 83. Elevation NAVD 88 referenced to NGS benchmark G-416

Site Location:

Navajo Refinery
Artesia, N.M.

Borehole Depth: 30' bgs

DEPTH	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Well/Boring Construction
3350		7	GP		2588				
20		8	GP		2055			SANDSTONE, Gley 1 4/N very dark grey, fine grained, well sorted, firm, very argillaceous, odor, very moist	
		9	GP		2293				
3345		10	GP		322				
25		11	GP		1828			CLAY, 2 5YR 5/4 reddish brown, soft, arenaceous, silty	
		12	GP		2231				
3340		13	GP		193			CLAY, 10R 5/6 red, firm, plastic, silty, arenaceous	
30								Borehole terminated at 30'	
3335									
35									

Sand Pack 8/16
(13'-30' bgs)

2" Sch 40 PVC
0.010" Slot
Screen (15'-29' 5'
bgs)

6" Cap



Remarks: bgs = below ground surface; amsl = above mean sea level; HV = hydrovac, ppm = parts per million; NA = not applicable/available; DP = Direct Push;

Northing and Easting data based on New Mexico State Plane System, Eastern Zone NAD 83. Elevation NAVD 88 referenced to NGS benchmark G-416



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LOG OF BORING MW-46R

(Page 1 of 1)

Monitor Well 46R
Navajo Refining Company, Artesia Refinery
SW/4 NE/4 Section 9, T17S, R26E
Eddy County, New Mexico
N32° 51' 12.5", W104° 23' 11.4"

Date/Time Started : 10/18/10, 1415
Date/Time Completed : 10/18/10, 1600
Hole Diameter : 8 1/4 in.
Drilling Method : Hollow Stem Auger
Drilling Equipment : Foremost-Mobile B-57

Drilled By : Eco/Enviro Drilling
Sampling Method : 5 ft. core barrel
Logged By : David Boyer, PG

Depth in Feet	Sample Method	Sample Recovery (ft.)	USCS	GRAPHIC	Sample Method: SS Split Spoon (18" or 24") CB Core Barrel (2.5' or 5') CT Auger Cuttings NR No recovery	DESCRIPTION	PID (ppm)	Lab No.	TPH (mg/Kg)	GRO (mg/Kg)28	DRO (mg/Kg)	Benzene (mg/Kg)	Ethyl Benzene (mg/Kg)	Toluene (mg/Kg)	Total Xylenes (mg/Kg)
0						0-5 ft. CLAYEY SILT and CALICHE GRAVEL. Silt light brown, dry, caliche white, angular. Stiff brown clay at bottom, no H/C staining or odor									
	CB	1.5	ML/CA												
5						5-10 ft. CLAY, light brown with rust color in spots, slightly damp, plastic, no H/C staining or odor	0.0	1010741-01	--	--	--	--	--	--	--
	CB	2.0	CL												
10						10-10.7 ft. CLAY, light brown, soft, plastic	0.0	1010741-02	<1.7	<0.050	<1.7	<0.005	<0.005	<0.005	<0.015
			CL												
			SC			10.7-11.4 ft. CLAYEY SAND, yellowish-brown, fine grained, clay light brown, H2O saturated, no H/C staining or odor									
	CB	5.0	CL			11.4-14 ft. CLAY, light brown with occasional rust colored inclusions, plastic, no H/C staining or odor									
						14-15 ft. CLAY, very light brown to creme color, slightly moist, plastic, no H/C staining or odor									
15						15-18.7 ft. CLAY, light brown, moist to wet in spots, no H/C staining or odor.	0.0	1010741-03	<1.7	<0.050	<1.7	<0.005	<0.005	<0.005	<0.015
	CB	1.6	CL												
						18.7-19 ft. CALICHE GRAVEL to 3/4 in., angular, no H/C staining or odor	0.0	1010741-04	<1.7	<0.050	<1.7	<0.005	<0.005	<0.005	<0.015
			CA												
20															

Notes:

H/C - Petroleum hydrocarbon

Water at about 6.7 feet below surface, no product.

Sample 4-5 ft. not analyzed

Completed as Monitor Well 46. See completion log for screen and completion details.

Z:\Company Files\Navajo\2010 Cleanups\NAV-10-008 MW Replacement\MW-46R boring log.bor



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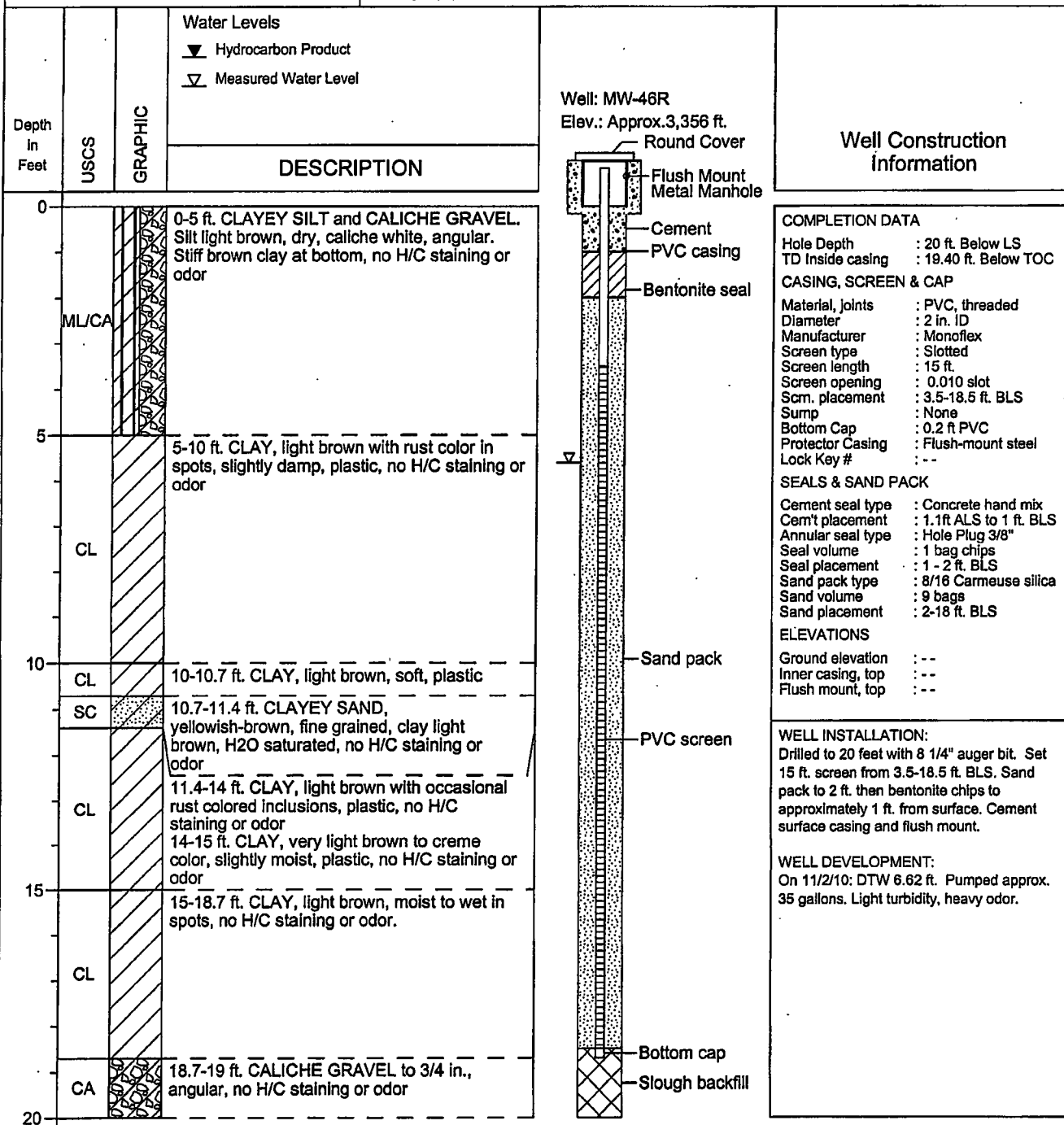
WELL COMPLETION LOG MW-46R

(Page 1 of 1)

Monitor Well 46R
Navajo Refining Company, Artesia Refinery
SW/4 NE/4 Section 9, T17S, R26E
Eddy County, New Mexico
N32° 51' 12.5", W104° 23' 11.4"

Date/Time Started : 10/18/10, 1415
Date/Time Completed : 10/18/10, 1600
Hole Diameter : 8 1/4 in.
Drilling Method : Hollow Stem Auger
Drilling Equipment : Foremost-Mobile B-57

Drilled By : Eco/Enviro Drilling
Sampling Method : 5 ft. core barrel
Logged By : David Boyer, PG



Notes:

Replacement for MW-46 run over and destroyed; caved in no plugging done.
Water at about 6.7 feet below surface, no product.
Completed as Monitor Well 48. See boring log for soil sampling details.
H/C - Petroleum hydrocarbon



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LOG OF BORING KWB-10R

(Page 1 of 1)

Monitor Well KWB-10R
Navajo Refining Company, Artesia Refinery
NE/4 SE/4 Section 9, T17S, R26E
Eddy County, New Mexico
N32° 50' 47.85", W104° 22' 57.4"

Date/Time Started : 10/11/10, 1415
Date/Time Completed : 10/11/10, 1700
Hole Diameter : 8 1/4 In.
Drilling Method : Hollow Stem Auger
Drilling Equipment : Foremost-Mobile B-57

Drilled By : Eco/Enviro Drilling
Sampling Method : 5 ft. core barrel
Logged By : David Boyer, PG

Depth in Feet	Sample Method	Sample Recovery (ft.)	USCS	GRAPHIC	Sample Method: SS Split Spoon (18" or 24") CB Core Barrel (2.5' or 5') CT Auger Cuttings NR No recovery	PID (ppm)	Lab No.	TPH (mg/Kg)	GRO (mg/Kg)28	DRO (mg/Kg)	Benzene (mg/Kg)	Ethyl Benzene (mg/Kg)	Toluene (mg/Kg)	Total Xylenes (mg/Kg)
					DESCRIPTION									
0	CB	4.0	CL/CH		0-4 ft. SILTY CLAY at top grading to FAT CLAY at base, brown, dry, very stiff, crumbly in places, no H/C staining or odor	9.4	1010474-01	<1.7	<0.050	<1.7	<0.005	<0.005	<0.005	<0.015
5	CB	1.0	CL		5-8 ft. SILTY CLAY, brown, stiff, dry, crumbly 8-10 ft. SILTY CLAY, black, strong H/C odor	181	1010474-02	129	47	82	130	6,800	120	5,100
10	CB	3.8	CL		10-10.8 ft. CLAY, gray to black 10.8-11.7 ft. CLAY, black, strong H/C odor 14-15 ft. CLAY, gray, hard, very stiff, strong H/C odor	1,394	1010474-03	470	100	370	<50	21,000	800	41,000
15	CB	4.8	CL		15-17.7 ft. CLAY, brown with gray/white caliche inclusions	1,469	1010474-04	1,610	210	1,400	1,900	61,000	20,000	120,000
20	CB	5.0	CL		17.7-19.8 ft. SANDY CLAY, very fine grained, mottled light brown. Gasoline odor, trace of product on outside of core.	178	1010474-05	3.48	0.68	2.8	<5.0	<5.0	<5.0	<15
25	CB	1.0	CL		20-21.5 ft. SANDY CLAY, soft, moist, beige/tan color, very fine grained, strong H/C odor 21.5-24 ft. SILTY CLAY, tan 24-25 ft. CLAY, grayish tan, stiff, plastic, H/C odor 25-30 ft. H2O saturated 28-30 ft. Cuttings sloppy with show of product. 1 ft. recovery in core barrel, remainder in core sloppy with water 29-30 ft. Clay, limey, white, with very small caliche gravels or very coarse sand.	219	1010474-06	0.35	0.35	<1.7	9.4	86	11	180
30														
35														

Notes:

Replacement for KWB-10 damaged by irrigation center pivot wheel.

Limey mud, white, occasional show of product on auger flights when pulling augers.

Water at about 15 feet below surface, no measurable product at time of completion.

Completed as KWB-10R. See completion log for screen and completion details.

H/C - Petroleum hydrocarbon



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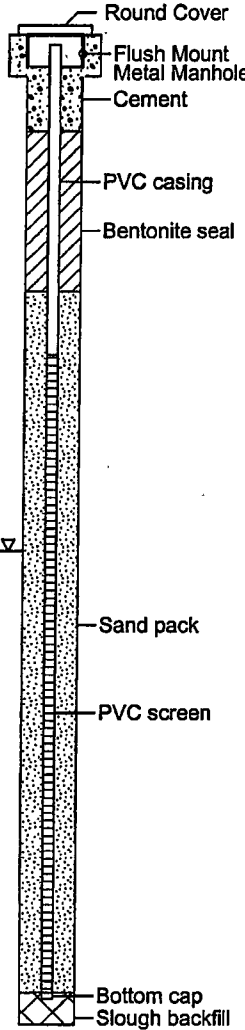
WELL COMPLETION LOG KWB-10R

(Page 1 of 1)

Monitor Well KWB-10R
Navajo Refining Company, Artesia Refinery
NE/4 SE/4 Section 9, T17S, R26E
Eddy County, New Mexico
N32° 50' 47.85", W104° 22' 57.4"

Date/Time Started : 10/11/10, 1415
Date/Time Completed : 10/11/10, 1700
Hole Diameter : 8 1/4 in.
Drilling Method : Hollow Stem Auger
Drilling Equipment : Foremost-Mobile B-57

Drilled By : Eco/Enviro Drilling
Sampling Method : 5 ft. core barrel
Logged By : David Boyer, PG

Depth in Feet	USCS	GRAPHIC	Water Levels	DESCRIPTION		Well Construction Information
			<p>▼ Hydrocarbon Product</p> <p>▽ Measured Water Level</p>			
0	CL/CH			0-4 ft. SILTY CLAY at top grading to FAT CLAY at base, brown, dry, very stiff, crumbly in places, no H/C staining or odor	Round Cover	COMPLETION DATA Hole Depth : 30 ft. Below LS TD Inside casing : 30.14 ft. Below TOC CASING, SCREEN & CAP Material, joints : PVC, threaded Diameter : 4 in. ID Manufacturer : Cuvo Environmental Screen type : Slotted Screen length : 20 ft. Screen opening : 0.020 slot Scrn. placement : 9-29 ft. BLS Sump : None Bottom Cap : 0.2 ft PVC Protector Casing : Flush-mount steel Lock Key # : -- SEALS & SAND PACK Cement seal type : Concrete hand mix Cement volume : 2.5 bags Cem't placement : 1 ft. ALS to 2 ft. BLS Annular seal type : Hole Plug 3/8" Seal volume : 3 bags chips Seal placement : 2 - 7 ft. BLS Sand pack type : 8/16 Carmeuse silica Sand volume : 7 bags Sand placement : 7 - 29 ft. BLS ELEVATIONS Ground elevation : -- Inner casing, top : -- Flush mount, top : -- WELL INSTALLATION: Drilled to 30 feet with 8 1/4" auger bit. Set 20 ft. screen from 9 to 29 ft. BLS. Sand pack to 7 ft. then bentonite chips to 2 ft. from surface. Cement surface casing and flush mount. WELL DEVELOPMENT: On 10/12/10: DTW 15.80 ft. below top of casing. Total depth 27.8 ft. in mud. Pumped approx. 100 gallons water and mud to sample trailer. At completion of pumping DTW 15.90 ft. BTC, total depth 30.14 ft. BTC, product on probe.
5	CL			5-8 ft. SILTY CLAY, brown, stiff, dry, crumbly 8-10 ft. SILTY CLAY, black, strong H/C odor	Flush Mount Metal Manhole Cement	
10	CL			10-10.8 ft. CLAY, gray to black 10.8-11.7 ft. CLAY, black, strong H/C odor 14-15 ft. CLAY, gray, hard, very stiff, strong H/C odor	PVC casing	
15	CL			15-17.7 ft. CLAY, brown with gray/white caliche inclusions	Bentonite seal	
20	CL			17.7-19.8 ft. SANDY CLAY, very fine grained, mottled light brown. Gasoline odor, trace of product on outside of core.		
25	CL			20-21.5 ft. SANDY CLAY, soft, moist, beige/tan color, very fine grained, strong H/C odor		
30	CL			21.5-24 ft. SILTY CLAY, tan		
35	CL			24-25 ft. CLAY, grayish tan, stiff, plastic, H/C odor 25-30 ft. H2O saturated 28-30 ft. Cuttings sloppy with show of product. 1 ft. recovery in core barrel, remainder in core sloppy with water 29-30 ft. Clay, limey, white, with very small caliche gravels or very coarse sand.	Sand pack	
					PVC screen	
					Bottom cap	
					Slough backfill	

Notes:

Replacement for KWB-10 damaged by irrigation center pivot wheel.
Plugged back original KWB-10 with 5 bags bentonite, hydrated, 1/2 bag cement.
Limey mud, white, occasional show of product on auger flights when pulling augers.
Water at about 15 feet below surface, no measurable product at time of completion.

Completed as KWB-10R. See boring log for soil sampling details.
H/C - Petroleum hydrocarbon

Appendix B

Field Forms

Navajo Refinery Monitor Well Sampling Form

Project #: NAV-06-003

Well ID.: _____

Date: _____

Time on location: _____

Samplers: _____

Time off location: _____

Measuring Point: _____

Low Flow or pump: _____

Measured Well Depth (W_1): _____

Height of water column ($H_1=W_1-W_2$): _____

Sample Date Depth to Water: (W_2): _____

Well Diameter: _____

* Low flow: New pump tubing each location. Tubing length in well: Height water column $H_1/2 + W_2$.
Run 15 minutes minimum. Sample when specific conductance, temperature, DO and turbidity are within 10% of previous reading and pH is within 0.5 pH units.

For 2" wells: One casing volume = $0.163 \times H_1$ = _____ gallons; 3 casing volumes = _____ gallons

For 4" wells: One casing volume = $0.653 \times H_1$ = _____ gallons; 3 casing volumes = _____ gallons

For 6" wells: One casing volume = $1.469 \times H_1$ = _____ gallons; 3 casing volumes = _____ gallons

(Hint: An acceptable short cut:

For 2" wells, take the height of the water column and divide by 2 for three casing volumes.

For 4" wells, take the height of the water column and multiply by 2 for three casing volumes.)

* Sub. Pump: A minimum of 3 casing volumes will be removed prior to sampling unless the well can be bailed/pumped dry. Sampling should begin after the water level has recovered to at least 75% of its original level.

* Both methods: Measurements of pH, specific conductance, temperature, dissolved oxygen, and ORP will be recorded for each one-half casing volume removed. Should pH, specific conductance, temperature not stabilize; additional casing volumes to a maximum of ten will be removed during purging.

Sample for VOCs(3) _____ Metals(1) _____ GRO(3) _____ DRO(2) _____ SVOC(2) _____ Cation/Anions/TDS/ NO_3 (3) _____

Note - For Cation/Anions/TDS/ NO_3 check these boxes: Anions/Alk, Cations, TDS, Nitrate/Nitrite

Purging and Sampling Record:

To Purge: _____ gallons

No. Gallons	pH (SU)	Cond [units] (_____)	Turb (ntu)	DO (mg/L)	Temp (°C)	ORP (mv)	LF Depth to Water (ft.)

Notes:

Taken at this location: Equipment Blank: _____ Field Blank: _____

Sample Time: _____

Daily Log Sheet

Date _____

This sheet shall document observations and field activities not otherwise reported on well sampling forms

Date _____

September-October 2010 Monitoring Program Summary
Navajo Refining Company - Artesia Refinery, Artesia, New Mexico

Well ID	Diameter (in)	PSH Expected?	Date (2010)	Initials	Depth to Product (ft btoc)	Depth to Water (ft btoc)	Total Depth (ft btoc)	Technician Comments	Purge Parameters	DRO	GRO	VOCs	Metals (As, Ba, Cr, Fe, Pb, Mn, Se)	Metals (Hg, Ni, Va)	Cyanide	Cations/Anions	Nitrates / Nitrites as Nitrogen	Total Dissolved Solids
MW #25	2								-	-	-	-	-	-	-	-	-	-
MW #26	2								-	-	-	-	-	-	-	-	-	-
MW #27	2								-	-	-	-	-	-	-	-	-	-
MW #28	6								X	X	X	X	X	X	X	X	X	X
MW #29	2								X	X	X	X	X	-	-	X	X	X
MW #30	8								No analytical samples to be collected									
MW #39	2	Y							X ^a	X ^a	-	X ^a	X ^a	-	-	X ^a	X ^a	X ^a
MW #40	2								-	-	-	-	-	-	-	-	-	-
MW #41	2								X	X	X	X	X	-	-	X	X	X
MW #42	2								X	X	X	X	X	-	-	X	X	X
MW #43	6								X	X	X	X	X	X	X	X	X	X
MW #45	2								X	X	-	X	X	X	X	X	X	X
MW #46	2								X	X	-	X	X	-	-	X	X	X
MW #48	2	Y							X ^a	X ^a	X ^a	X ^a	X ^a	-	-	X ^a	X ^a	X ^a
MW #49	2								X	X	X	X	X	X	X	X	X	X
MW #50	2								X	X	-	X	X	-	-	X	X	X
MW #52	2								X	X	X	X	X	X	X	X	X	X
MW #53	2								-	-	-	-	-	-	-	-	-	-
MW #54A	2								X	X	-	X	X	-	-	X	X	X
MW #54B	2								-	-	-	-	-	-	-	-	-	-
MW #55	2								X	X	X	X	X	X	X	X	X	X
MW #56	2								X	X	-	X	X	-	-	X	X	X
MW #57	2								X	X	X	X	X	-	-	X	X	X
MW #58	4								X	X	-	X	X	X	X	X	X	X
MW #59	2								-	-	-	-	-	-	-	-	-	-
MW #60	2								X	X	X	X	X	X	X	X	X	X
MW #61	4								X	X	X	X	X	-	-	X	X	X
MW #62	4								X	X	X	X	X	-	-	X	X	X
MW #64	4	Y							X ^a	X ^a	X ^a	X ^a	X ^a	-	-	X ^a	X ^a	X ^a
MW #65	4	Y							X ^a	X ^a	X ^a	X ^a	X ^a	-	-	X ^a	X ^a	X ^a

^a Sample to be collected if PSH <0.03 feet thick.

Field gauging form to be updated for each event - one page provided as example only.



SUSANA MARTINEZ
Governor

JOHN A. SANCHEZ
Lieutenant Governor

**NEW MEXICO
ENVIRONMENT DEPARTMENT**

Hazardous Waste Bureau

2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
Phone (505) 476-6000 Fax (505) 476-6030
www.nmenv.state.nm.us



DAVE MARTIN
Cabinet Secretary

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

January 14, 2011

Darrell Moore
Navajo Refining Company
PO Box 159
Artesia, New Mexico 88211-0159

**RE: REQUIREMENT TO SUBMIT A WORK PLAN
FOR A SUBSURFACE INVESTIGATION
TO CHARACTERIZE OFF-SITE CONTAMINANT MIGRATION
NAVAJO REFINING COMPANY, ARTESIA REFINERY
EPA ID NO: NMD048918817
HWB-NRC-11-001**

Dear Mr. Moore:

The New Mexico Environment Department (NMED) requires Navajo Refining Company (the Permittee) to submit a Work Plan to characterize off-site migration of refinery-related contamination and subsurface soils to depths below the water table along the eastern and southeastern refinery boundary. NMED reviewed the monitoring well logs and groundwater data in the vicinity of the eastern and southeastern portion of the refinery and determined that some monitoring wells are screened below the water table (e.g., KWB-1A and KWB-1 are screened below the water table and at the same depth). Therefore, separate phase hydrocarbons (SPH), if present on the water table, cannot be detected. The Permittee must submit a Work Plan to perform a geoprobe investigation along the eastern refinery boundary to characterize subsurface soils and off-site contaminant migration to include, but not limited to, the following:

- a. Place geoprobe borings every 50 feet in a line beginning at US 82 north to Eagle Draw east of the most recent line of monitoring wells (KWB-4, MW-100, MW-66, MW-28, MW-107, and MW-46).

Navajo Refining Company

January 14, 2011

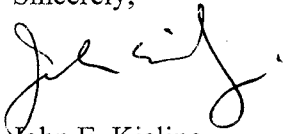
Page 2

- b. Place ten geoprobe borings on the north side of US 82, between MW-52 to KWB-2R.
- c. All geoprobe borings must be advanced to depths ten to 15 feet below the water table.
- d. All geoprobe borings must be continuously sampled and logged for the purpose of soil characterization.
- e. Soil samples must be collected from all geoprobe borings from the soils intersecting the water and analyzed for gasoline range organics and diesel range organics extended.
- f. The purpose of this geoprobe investigation is to characterize soils, determine contaminant migration pathways, and determine potential locations for monitoring wells and assess remediation alternatives to eliminate the off-site contaminant migration.

The Permittee must also submit well logs and construction diagrams for the following monitoring wells as an attachment to the Work Plan: MW-30, MW-48, MW-49, MW-52, MW-59, MW-60, KWB-2R, and KWB-13.

The Permittee must submit a Work Plan to NMED no later than April 4, 2011. Please contact Hope Monzeglio of my staff at 505-476-6045 if you have questions regarding this letter.

Sincerely,



John E. Kielling

Program Manager

Permits Management Program

Hazardous Waste Bureau

cc: D. Cobrain, NMED HWB
H. Monzeglio NMED HWB
C. Chavez, OCD
J. Lackey, Navajo
P. Krueger, ARCADIS
File: Reading and NRC 2010
HWB-NRC-11-001