GW - 028

FACILITY-WIDE GW MONITORING WORK PLAN (2)

2017

HOLLYFRONTIER.

October 25, 2017

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

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

RE: Submittal of Replacement Pages for the *2017 Facility-Wide Groundwater Monitoring Work Plan* for the HollyFrontier Navajo Refining LLC, Artesia Refinery
RCRA Permit No. NMD048918817
Discharge Permit GW-028

Dear Mr. Kieling and Mr. Chavez:

Enclosed are replacement pages for the *2017 Facility Wide Groundwater Monitoring Work Plan* (2017 Work Plan) for the Artesia Refinery that was originally submitted on June 30, 2017. The replacement pages are being submitted in response to the New Mexico Environment Department's (NMED) letter dated October 11, 2017, which approved the Work Plan with the following modification:

NMED Comment 1: *In Section 5.0 (Monitoring Program Scope of Services), page 5-1, the Permittee proposed to reduce the sampling frequency of monitoring wells MW-56, MW-77, MW-93, MW-107, MW-111, and MW-129 from semi-annual to annual. NMED has reviewed the Permittee's request to reduce the sampling frequency from these six wells and herby approves the proposal for the following monitoring wells: MW-56, MW-77, MW-93, MW-107, and MW-129. The Permittee must continue to sample monitoring well MW-111 semi-annually. Provide replacement pages for the applicable section(s) and table(s) of the Work Plan and ensure future work plans reflect the approved changes.*

As requested, this submittal includes only pages affected by revisions to the proposed sampling frequency for monitoring well MW-111 (pages ii, 5-1, and 5-2; page 2 of Table 1; and Figure 3). These pages are being submitted in hard copy format and should replace the corresponding pages that were submitted in the 2017 Work Plan on June 30, 2017. An electronic copy of the 2017 Work Plan updated with the replacement pages is also being submitted and should supersede the electronic copy submitted on June 30, 2017.

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

Sincerely,

Scott M. Denton
Environmental Manager
HollyFrontier Navajo Refining LLC

cc: HollyFrontier: R. Combs, A. Sahba
TRC: J. Speer, C. Smith

Env.: Env\RCRA\Corrective Actions, Closure, and PCC\Groundwater Monitoring\FWGWMWP\2017 FWGWMWP June 2017

2017 Facility-Wide Groundwater Monitoring Work Plan

NMD048918817 and DP GW-028

HollyFrontier Navajo Refining LLC
Artesia Refinery
Artesia, New Mexico

June 2017

Prepared for:

HOLLYFRONTIER

HollyFrontier Navajo Refining LLC
Artesia, New Mexico

Prepared by:

TRC

TRC Environmental Corporation
Austin, Texas

2017 Facility-Wide Groundwater Monitoring Work Plan

NMD048918817 and DP GW-028

HollyFrontier Navajo Refining LLC
Artesia Refinery
Artesia, New Mexico

Prepared for:

HollyFrontier Navajo Refining LLC
Artesia, New Mexico

Prepared by:

TRC Environmental Corporation
Austin, Texas

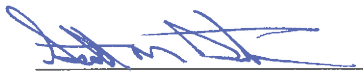
TRC Project No. 249545

June 2017

TRC Principal Lead _____
Julie Speer, Project Manager

Certification

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



Scott Denton

Environmental Manager, HollyFrontier Navajo Refining LLC

EXECUTIVE SUMMARY

This *2017 Facility Wide Groundwater Monitoring Work Plan* (2017 FWGMWP) details the proposed groundwater monitoring program to be implemented at the HollyFrontier Navajo Refining LLC (Navajo) Artesia Refinery (Refinery) located at 501 East Main Street in Artesia, New Mexico. The Refinery is subject to (1) a Post-Closure Care Permit (PCC Permit) issued by the New Mexico Environment Department (NMED) in October 2003 and later modified in December 2010; and (2) the renewed Discharge Permit GW-028 issued by New Mexico Energy, Minerals and Natural Resources Department Oil Conservation Division (OCD) on May 25, 2017. Both the PCC Permit and Discharge Permit requires Navajo to conduct facility wide groundwater monitoring to evaluate the presence, nature, and extent of groundwater impacts. This 2017 FWGMWP details all groundwater monitoring activities that will be conducted to satisfy both the NMED PCC Permit and the OCD Discharge Permit upon approval by NMED and OCD.

This 2017 FWGMWP serves as the annual update to the facility wide groundwater monitoring program required by Section 4.7.6.a of the modified PCC Permit. The groundwater monitoring program covers the following Refinery areas:

- The closed Tetra Ethyl Lead (TEL) Impoundment;
- The closed North Colony Landfarm (NCL);
- The inactive Evaporation Ponds (EP);
- Three Mile Ditch (TMD); and
- The vadose zone located beneath the Refinery.

This 2017 FWGMWP details all groundwater monitoring activities that will be conducted to satisfy both the NMED PCC Permit and the OCD Discharge Permit upon approval by NMED and OCD. This 2017 FWGMWP also describes the procedures to be followed during routine groundwater monitoring activities, including well gauging, groundwater sampling, managing investigation-derived waste (IDW), decontamination, analytical requirements, and quality assurance/quality control (QA/QC) requirements.

No substantial changes to the current facility-wide monitoring program have been proposed in this 2017 FWGMWP. The sampling frequency of the following wells are proposed to be reduced from semi-annual to annual: MW-56, MW-77, MW-93, MW-107, and MW-129.

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LIST OF ACRONYMS AND ABBREVIATIONS

bgs	below ground surface
DO	Dissolved Oxygen
DRO	Diesel Range Organics
EP	Evaporation Ponds
FWGMWP	Facility Wide Groundwater Monitoring Work Plan
GRO	Gasoline Range Organics
HSWA	Hazardous and Solid Waste Amendment
HWB	Hazardous Waste Bureau
IDW	Investigation-Derived Waste
mL	Milliliter
Navajo	HollyFrontier Navajo Refining LLC
NCL	North Colony Landfarm
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
OCD	New Mexico Energy, Minerals and Natural Resources Department Oil Conservation Division
ORP	Oxidation-Reduction Potential
PCC Permit	Post-Closure Care Permit
PIANO	Paraffins, Isoparaffins, Aromatics, Naphthenes, and Olefins
PSH	Phase-Separated Hydrocarbons
QA/QC	Quality Assurance/Quality Control
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigations
RO	Reverse Osmosis
SWMU	Solid Waste Management Units
TDS	Total Dissolved Solids
TEL	Tetra Ethyl Lead
TMD	Three Mile Ditch
TOC	Top of Casing
VOCs	Volatile Organic Compounds
WQCC	Water Quality Control Commission

1.0 INTRODUCTION

This *2017 Facility-Wide Groundwater Monitoring Work Plan* (2017 FWGMWP) details the proposed groundwater monitoring program to be implemented at the HollyFrontier Navajo Refining LLC (Navajo) Artesia Refinery (Refinery) located at 501 East Main Street in Artesia, New Mexico. The location of the Refinery is shown on Figure 1. The Refinery is subject to (1) a Post-Closure Care Permit (PCC Permit) issued by the New Mexico Environment Department (NMED) in October 2003 (NMED 2003) and later modified in December 2010 (NMED 2010); and (2) the renewed Discharge Permit GW-028 issued by New Mexico Energy, Minerals and Natural Resources Department Oil Conservation Division (OCD) on May 25, 2017 (OCD 2017). The PCC Permit authorizes and requires Navajo (the Permittee) to conduct facility-wide groundwater monitoring, with the purpose of evaluating 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 NMAC 20.6.2. The Discharge Permit also requires facility-wide groundwater monitoring to adequately define site conditions and provide necessary data to select and design an effective abatement option.

This 2017 FWGMWP serves as the annual update to the facility-wide groundwater monitoring program required by Section 4.7.6.a of the modified PCC Permit. The previous annual FWGMWP is the *2016 Facility-Wide Groundwater Monitoring Work Plan* which was submitted to NMED and OCD in June 2016 (TRC 2016) and approved on December 7, 2016 (NMED 2016). This 2017 FWGMWP details all groundwater monitoring activities that will be conducted to satisfy both the NMED PCC Permit and the OCD Discharge Permit upon approval by NMED and OCD. This 2017 FWGMWP describes the procedures to be followed during routine groundwater monitoring activities, including well gauging, groundwater sampling, managing investigation-derived waste (IDW), decontamination, analytical requirements, and quality assurance/quality control (QA/QC) requirements. The format of this 2017 FWGMWP follows the general outline specified for an investigation work plan in Appendix E.2 of the PCC Permit, while incorporating the requirements of Section 5 of the Discharge Permit.

The groundwater monitoring program covers the following Refinery areas:

- The closed Tetra Ethyl Lead (TEL) Impoundment;
- The closed North Colony Landfarm (NCL);
- The inactive Evaporation Ponds (EP);
- Three Mile Ditch (TMD); and
- The vadose zone located beneath the Refinery (including the areas referred to as North Refinery, South Refinery, Field East of Refinery, North Reverse Osmosis [RO] Reject

Field, South RO Reject Field, Cross-Gradient of Refinery, and Up-Gradient of Refinery).

The closed TEL Impoundment is an approximately 0.9-acre land treatment unit located along the northern portion of the Refinery to the south and east of Eagle Creek. The closed NCL is an approximately 4.25-acre land treatment unit located near the northwestern corner of the Refinery. The inactive EP area is located approximately three miles east of the active Refinery and immediately south/west of the Pecos River. The locations of these areas and the monitoring wells, recovery wells, and irrigation wells included in the facility-wide groundwater monitoring program are provided on Figure 2.

2.0 SITE BACKGROUND

The Refinery is an active petroleum refinery located at 501 East Main Street in the city of Artesia, Eddy County, New Mexico. The Refinery has been in operation since the 1920's and currently processes crude oil and other feedstocks into asphalt, fuel oil, gasoline, diesel, jet fuel, and liquefied petroleum gas. A site location map is provided as Figure 1. A facility-wide site plan is provided as Figure 2 and shows the locations of wells included in the facility-wide groundwater monitoring program.

The Refinery is regulated under the Resource Conservation and Recovery Act (RCRA) with EPA ID Number NMD 048918817. The NMED issued a Hazardous Waste Facility Permit to Navajo effective August 21, 1989 (NMED 1989), part of which included a Hazardous and Solid Waste Amendment (HSWA) Permit issued by the EPA. The HSWA permit required Navajo to identify all historical and current non-hazardous solid waste management units (SWMUs) and investigate those that had the potential to pose a threat to human health or the environment. RCRA Facility Investigations (RFIs) were conducted at the TMD and EP areas in 1990 (Mariah Associates, Inc. 1990) and from 1991 through 1993 (K.W. Brown Environmental Services 1993). Corrective actions were recommended for soil (K.W. Brown Environmental Services 1996) and groundwater (Foster Wheeler 1997) at the TMD and EP based on the RFI results. RFI activities were conducted at the NCL area from 1994 through 1997 (Covenant Technical Associates, Inc. 1997) and RFI results indicated groundwater impacts associated with historical operations were present at the NCL.

At the request of NMED, Navajo submitted a PCC Permit Application in June 1998 and revisions to the application in 2001 (Navajo 2001). The original intent of this application was to address only closure and post-closure activities at the EPs and TMD, but the application was expanded to include a complete RCRA Permit renewal application. The NMED issued a PCC Permit to Navajo effective October 5, 2003 (NMED 2003). The PCC Permit was modified in December 2010 (NMED 2010). The PCC Permit authorizes and requires the Permittee to monitor the groundwater, maintain all groundwater monitoring wells, and comply with applicable regulations of NMAC 20.4.1.500 during the post-closure period. Specific groundwater monitoring requirements are included in the PCC Permit for the areas of the TMD, NCL, EP, and other areas identified through implementation of the investigations of various SWMUs.

The Refinery applies reject fluids from the RO system to the Refinery North and South RO Reject Fields under Discharge Permit GW-028. The OCD originally issued the Discharge Permit to Navajo on October 21, 1991, and most recently issued a renewal on May 25, 2017 (OCD 2017). The Discharge Permit requires the Permittee to conduct facility-wide groundwater monitoring.

In 2006, Navajo submitted a Groundwater Monitoring Work Plan that combined the requirements of the two permits into a comprehensive facility-wide groundwater monitoring

program (Navajo 2006). This 2017 FWGMWP comprises the annual update of the work plan, as required by Section 4.7.6.a of the PCC Permit.

3.0 SITE CONDITIONS

This section describes the current surface and subsurface conditions at the Refinery.

3.1 Surface Conditions

3.1.1 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 at and surrounding the Refinery is shown on Figure 1. The average elevation of the City of Artesia is 3,380 feet above mean sea level. The plain on which the City of Artesia is located slopes eastward at about 20 feet per mile or 0.378 percent

3.1.2 Surface Water Drainage

Surface drainage in the region is dominated by small ephemeral creeks and arroyos that flow eastward to the Pecos River, located approximately three miles east of the city. The major drainage feature in the immediate area of the Refinery is Eagle Creek (or Eagle Draw), which runs southwest to northeast through the northern process area of the Refinery and then eastward to the Pecos River. Eagle Creek is an ephemeral watercourse that primarily flows only following rain events. Upstream of the Refinery, Eagle Creek functions as a major stormwater conveyance for the city. Eagle Creek also drains outlying areas west of the city and is periodically scoured by intense rain events.

Natural surface drainage at the Refinery is to the north and east. Stormwater within the process areas is captured and routed to the Refinery wastewater treatment system. Stormwater from non-process areas is contained within the Refinery property inside stormwater berms and routed to stormwater retention basins. Stormwater from within the Refinery boundary is not allowed to discharge to Eagle Creek.

The elevation of Eagle Creek 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 Creek was channelized from west of the City of Artesia to the Pecos River to help control and minimize flood events. In the vicinity of the Refinery, the Eagle Creek channel was cemented to provide further protection during flood events. A check dam was also constructed west of the City of Artesia along Eagle Creek. Federal floodplain maps indicate that most of the city and the Refinery have been effectively removed from the 100-year floodplain.

3.1.3 Area Land Uses

The areas north, south and east of the Refinery is sparsely populated and used primarily for agricultural 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 commercial businesses present south of the Refinery along Highway 82, including an oil-field pipe company located at the

southeast corner of the plant. Navajo owns a majority of the land bounded by Highway 82 to the South, East Richey Avenue to the north, Highway 285 to the west, and Bolton Road to the east. A majority of the land located east of the Refinery between Bolton Road and Haldeman Road is cultivated as pecan orchards or used for other agricultural purposes.

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

3.2 Subsurface Conditions

3.2.1 Surficial Soils

Surficial soil at the Refinery is predominantly comprised of approximately 60% Pima series and 40% Karro series. The Pima and Karro series both consist of deep, well drained soils that formed in alluvial settings. They are both calcareous and have slow to medium runoff.

3.2.2 Geology

Artesia is located on the northwest shelf of the Permian Basin. In this region, the deposits comprise of approximately 250 to 300 feet of Quaternary alluvium uncomformably overlying approximately 2,000 feet of Permian clastic and carbonate rocks. These Permian deposits uncomformably overlie Precambrian syenite, gneiss, and diabase crystalline rocks.

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.

3.2.2.2 Permian Artesian Group

The Permian Artesian Group is comprised of the following 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 Seven Rivers Formation is present at an approximate depth of 300 feet in the area between the Pecos River and the Refinery. However, the Seven Rivers Formation thins and pinches to the west and it is not evident based on boring logs that this formation has been encountered beneath the Refinery process areas.

In the area of the Refinery, the Queen and Grayburg Formations have been mapped as a single unit 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 greater than 700 feet thick and composed mainly of limestone and dolomite with irregular and erratic solution cavities ranging up to several feet in diameter. The upper portion of the formation is composed of oolitic dolomite with some anhydrite cement.

3.3 Hydrogeology

The principal aquifers in the Artesia area are within the San Andres Formation and the valley fill alluvium. There are two distinct water-bearing zones within the valley fill alluvium in the vicinity of the Refinery and are referred to as the "shallow saturated zone" and the "valley fill zone". The deeper carbonate aquifer within the San Andres Formation is referred to as the "deep artesian aquifer".

3.3.1 Shallow Saturated Zone

The shallow saturated zone occurs in interbedded sand and gravel channels at 15 to 30 feet below ground surface (bgs). The overlying clays, silts, and caliche undulate at the Refinery, which creates intermittent confined and unconfined groundwater conditions in the shallow saturated zone. Groundwater in this zone is under artesian pressure for some or most of the year, with static water levels measured in groundwater monitoring wells 3 to 5 feet above the shallow saturated zone.

The general direction of flow in this shallow saturated zone is to the east toward the Pecos River. Groundwater flow direction and gradient in the shallow saturated zone have remained generally consistent over time, as documented in previous annual groundwater monitoring reports.

Major sources of water in the shallow saturated zone are likely 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 shallow saturated zone is highly variable in quality, volume, areal extent, and saturated thickness. Concentrations of total dissolved solids (TDS) exceeding 2,000 mg/L and sulfate exceeding 500 mg/L have been recorded northwest (upgradient) of the Refinery.

The shallow saturated zone contains phase-separated hydrocarbon (PSH) and dissolved-phase hydrocarbon constituents, as reported in the *2016 Annual Groundwater Monitoring Report* (TRC 2017). Concentrations of dissolved-phase hydrocarbon constituents in the shallow saturated zone have generally exhibited a stable or decreasing trend over time.

3.3.2 Valley Fill Zone

The valley fill zone underlies the shallow saturated zone and occurs in Quaternary alluvial deposits of sand, silt, clay and gravel. These sediments are about 300 feet thick near the Refinery.

Irrigation and water production wells completed in the valley fill zone are typically screened across one to five water-producing intervals ranging in thickness of 20 to 170 feet, with a majority of the thicknesses being closer to 20 feet. Production intervals are non-continuous, consist principally of sand and gravel, and are separated by less permeable lenses of silt and clay of varying thickness. Based on logs of wells located immediately to the north and east of the Refinery, the thicknesses of silt and clay deposits range from 20 to 160 feet and are interspersed with thin zones of gravels in the upper 100 feet. Wells in the valley fill zone range from 40 to 60 feet bgs and the formation yields water containing TDS ranging from 500 to 1,500 mg/L.

The valley fill zone contains dissolved-phase hydrocarbon constituents, as reported in the *2016 Annual Groundwater Monitoring Report* (TRC 2017). Concentrations of dissolved-phase hydrocarbon constituents in the valley fill zone have generally exhibited a stable or decreasing trend over time.

The valley fill zone and the underlying San Andres aquifer are hydraulically connected in some areas.

3.3.3 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 intervals of variable permeability located in the upper portion of the formation. However, in the Artesia area, the water-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 water-producing interval is estimated to be about 440 feet bgs. 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. TDS in this aquifer ranges from 500 mg/L to more than 5,000 mg/L depending on location. In the Artesia area, water from this aquifer is generally produced from depths ranging from 850 feet to 1,250 feet below ground surface. The aquifer recharges 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 bgs, although extensive rainfall in some years may bring the water levels in some wells close to ground surface.

Available well completion records for irrigation well RA-4798 indicate that it is screened in the deep artesian aquifer from 840 to 850 feet bgs. Historic analytical data from this well does not indicate the presence of hydrocarbon impacts from Refinery operations.

4.0 MODIFICATIONS TO THE GROUNDWATER MONITORING NETWORK

No modifications to the groundwater monitoring network have occurred since submittal of the 2016 FWGMWP. Repairs and/or modifications made to the existing wells are described below.

4.1 New Monitoring Wells

No new monitoring wells have been installed since submittal of the 2016 FWGMWP.

4.2 Well Abandonment

No monitoring wells have been abandoned since submittal of the 2016 FWGMWP.

4.3 Well Repairs and Modifications

The following repairs and/or modifications were made to existing wells since submittal of the 2016 FWGMWP:

- Replaced locking J-plugs and locks on various monitoring wells.
- Installed and maintained PSH-absorbent socks in wells MW-7, MW-64, MW-65, MW-85, MW-86, and KWB-8.
- Redeveloped well NCL-32 to remove silt that had accumulated in the well. The redevelopment was documented in the *2016 Annual Groundwater Monitoring Report* that was submitted to the NMED and OCD in February 2017.

5.0 MONITORING PROGRAM SCOPE OF SERVICES

The proposed groundwater monitoring program will consist of semi-annual gauging of select wells; semi-annual, annual, or biennial groundwater sampling of select wells; and annual reporting. No substantial changes to the previous facility-wide monitoring program have been proposed in this 2017 FWGMWP. The sampling frequency of the following wells has been proposed to be reduced from semi-annual to annual: MW-56, MW-77, MW-93, MW-107, and MW-129. The sampling frequency is proposed to be reduced to an annual basis for each well based on the following rationale:

- MW-56 (NCL): stable dissolved-phase COC concentrations over at least the five most recent semi-annual monitoring events and the presence of down-gradient and cross-gradient wells that are sampled on a semi-annual basis.
- MW-77 (EP): stable dissolved-phase COC concentrations over at least the five most recent semi-annual monitoring events and the presence of nearby wells MW-75 and MW-76 that are sampled on a semi-annual basis (i.e., MW-77 is a redundant well).
- MW-93 (North Refinery): stable to decreasing dissolved-phase COC concentrations over at least the five most recent semi-annual monitoring events and the presence of down-gradient wells MW-23, MW-43, MW-62, and MW-137 and cross-gradient wells MW-61, MW-67, and MW-97that are sampled on a semi-annual basis.
- MW-107 (South Refinery): stable to decreasing dissolved-phase COC concentrations over at least the five most recent semi-annual monitoring events and the presence of down-gradient wells MW-127, MW-128, and KWB-10R and cross-gradient wells MW-28, MW-99, and MW-125 that are sampled on a semi-annual basis.
- MW-129 (Field East of Refinery): stable to decreasing dissolved-phase COC concentrations over at least the five most recent semi-annual monitoring events and the presence of down-gradient wells MW-112 and MW-131 and cross-gradient wells MW-58, MW-128, KWB-2R, and KWB-5 that are sampled on a semi-annual basis.

The above rationale is supported by the time-series plots provided in Appendix C of the *2016 Annual Groundwater Monitoring Report* and in Appendix A of this 2017 FWGMWP.

5.1 Scheduling and Notification

The schedule of the semi-annual groundwater monitoring events is dependent on the flood irrigation season of the pecan orchard located east of the Refinery, which is typically conducted between April and October. The first semi-annual event will be conducted before the start of the flood irrigation (in March or April of each calendar year) and the second semi-annual event will be conducted after completion of the flood irrigation season (in October or November of each

calendar year). Wells that will be sampled on an annual or biennial basis will be sampled during the March or April monitoring event (i.e., the annual event). Biennial events will be completed during odd-numbered calendar years. The NMED and OCD will be notified of the monitoring schedule prior to each monitoring event. The sampling frequency for each well is provided on Table 1 and Figure 3.

5.2 Gauging Requirements

Synoptic fluid level gauging will be completed semi-annually at all active and accessible monitoring and recovery wells. Wells will be gauged for depth to PSH, if present, depth to water, and total depth. Dedicated tubing will remain in the wells during gauging to minimize disturbance to the water column, if possible. All synoptic well gauging will be completed in as short a time-period as possible, typically within 48 hours. Each monitoring well will also be gauged immediately prior to commencing purging/sampling activities.

5.3 Sampling Requirements

Sampling frequency and target analytes for each well were selected based on historical data, dissolved-phase concentration trends, and well location relative to the Refinery and area boundaries. Select groundwater samples will be analyzed for volatile organic compounds (VOCs), diesel range organics (DRO), gasoline range organics (GRO), total metals, dissolved metals (March or April event only), cations, anions, nitrates/nitrites, cyanide, and/or TDS. Wells that contain PSH at measured thicknesses of 0.03 feet or greater will not be sampled during any event. The required sample analytical parameters and sampling frequency for each well are summarized in Table 1.

6.0 GROUNDWATER MONITORING PROCEDURES

Monitoring activities will consist of the following tasks: field documentation, well inspection, well gauging, groundwater purging and sampling, handling of samples for laboratory analysis, QA/QC sampling, and managing IDW. The procedures that will be used to complete each task are described in detail below.

6.1 Field Documentation

Documentation of field activities associated with groundwater monitoring events will be recorded each day in a bound field logbook and associated field sampling forms. Each page of the logbook and field sampling forms will be signed by the person(s) making entries on that page. The following information will be collected during groundwater sampling activities:

- Sampling and oversight personnel identification
- Instrument calibrations
- Well conditions
- Monitoring well measurements including static water level depth, total well depth, and water column height
- Depth to PSH, if present
- Weather conditions at the time of sample collection and throughout the sampling event
- Well purging procedures including: equipment, purge volume, rate, and elapsed time
- Water quality parameters recorded during purging including appearance, odor, pH, temperature, conductivity, TDS, oxidation-reduction potential (ORP), dissolved oxygen (DO), and turbidity
- Sample collection dates and times
- Reasons for deviating from the sampling and analysis plan (if applicable)

6.2 Well Inspection

During each gauging and sampling event, all monitoring and recovery wells will be inspected for well integrity. The information will be recorded on the groundwater gauging form. Each inspection will include:

- Identification of the well
- Inspection of the well pad for deterioration or damage
- Inspection of the protective casing for deterioration or damage
- Inspection of the well casing for deterioration or damage
- Inspection of the presence or absence and condition of the padlock and expandable well cap

- Measurement of the total depth of the well

6.3 Well Gauging

The depth to PSH, if present, and groundwater will be gauged at each monitoring well prior to sampling. The wells that are to be gauged are presented in Table 1 and well locations are depicted on Figure 2. Prior to gauging, each well cap will be removed to allow groundwater to equilibrate with atmospheric pressure. Fluid level measurements will be collected using an oil/water interface probe to an accuracy of 0.01 feet. Measurements will be made from a marked survey datum at the top of casing (TOC). Data will be recorded on a paper field gauging form. The oil/water interface probe will be decontaminated before use and between wells following the procedures outlined in Section 6.8.

6.3.1 Fluid Level Gauging Procedures

The following procedure will be used to measure the depths to PSH and groundwater:

- The probe will be lowered into the well slowly until the probe alarm sounds or light illuminates, withdraw the tape and lower it again slowly until the alarm is again audible or light again illuminates. Check the depth to fluid on the tape and record the depth to within 0.01 feet. Raise and lower the probe again slowly and repeat measurements for accuracy.
- Well identification, date, time, depth to water, depth to PSH (if applicable), and other pertinent observations will be recorded on the field gauging form.

6.3.2 Total Depth Gauging

Total well depth is measured to detect the amount of silt accumulation in a well. This measurement will be collected during sampling events and well inspections. The following procedures will be followed to determine the total depth of the well:

- The oil/water interface probe will be slowly lowered until the bottom of the well is detected.
- The total well depth will be measured when the tape becomes slack for hard bottoms.
- The point of "pick-up" (where the weight of the probe is felt when reeling up the probe) will be used to determine the total depth in the case of soft sediment bottoms.
- The hardness of the bottom of the well will be documented in the field logbook.

6.4 Groundwater Sampling

Groundwater will be purged and sampled from monitoring and recovery wells using low-flow methods in accordance with the NMED Hazardous Waste Bureau (HWB) Position Paper "Use of Low-Flow and Other Non-Traditional Sampling Techniques for Compliance Groundwater

Monitoring" (NMED 2001). Groundwater will be purged and sampled from irrigation wells using standard procedures described below. Data collected during the purging and sampling of each well will be recorded on a paper groundwater sampling form.

Groundwater will be purged and sampled from monitoring and recovery wells using either a peristaltic pump (for sampling depths of approximately 25 feet bgs or less) or a dedicated, stainless steel submersible pump (for sampling depth greater than 25 feet bgs). The locations of monitoring and recovery wells to be purged and sampled are provided on Figure 3. An oil/water interface probe will be lowered into the monitoring well to record the depth to water.

Groundwater will be purged and sampled from irrigation wells by attaching a decontaminated or dedicated hose barb to the available spigot. The spigot will be located at a point before the water supply is introduced into any storage tanks or treatment units. The groundwater will be purged from the spigot so that any stagnant water from the well casing and surface piping is removed.

A multi-parameter water quality meter with flow-through cell and hand-held turbidity meter will be used during the purging process to monitor for field water quality parameters (pH, temperature, conductivity, TDS, ORP, DO, and turbidity) and demonstrate stabilization. Water quality parameters will be recorded approximately every three minutes during purging. Water quality meters used to measure field parameters will be calibrated each day according to the manufacturer's specifications. The make, model, calibration fluids, and calibration results for the water quality meters will be recorded in the field logbook. The turbidity meter test cell will be triple rinsed with groundwater from the next sample aliquot prior to each reading. The water quality parameters and depth to water (in non-irrigation wells only) will be recorded on the Groundwater Sampling Form. A description of the water quality (e.g., turbidity, sheen, odor) will be recorded during the purging process.

The purging process will be considered complete and groundwater sampling will commence when at least four of the seven water quality parameters achieve stabilization within ten percent for three consecutive readings.

If the well goes dry during purging, a sample will be collected as soon after the water level recovers to a level from which a sample can be collected. The samples will be collected in clean, labeled laboratory-supplied containers prepared with the appropriate amount and type of preservative. The groundwater samples will be submitted for laboratory analysis following the schedule in Table 1.

Samples submitted for dissolved metals analysis will be filtered in the field using a new 0.45-micron filter. Filtering methods will be documented on the groundwater sampling form, field logbook, and chain-of-custody.

6.5 Handling of Samples for Laboratory Analysis

Neoprene or nitrile gloves will be worn during sample collection and while handling sample containers. New disposable gloves will be used to collect each sample. The sample containers will be labeled, secured with bubble wrap, placed in a resealable plastic bag, and immediately placed on ice in a cooler and stored below 4° C. The sample labels will include the Permittee name (Navajo), site name (Artesia Refinery), unique sample identification, sample collection time and date, preservatives, and the name(s) of the sampler(s). The samples will be secured with packing material and kept below 4° C with wet ice in accordance with laboratory cooler shipping guidelines. The cooler will be secured with packing tape, and a signed and dated custody seal will be placed over the cooler lid and secured with tape. The samples and a completed chain-of-custody documentation will be shipped via priority overnight delivery to the analytical laboratory. The chain-of-custody forms are to be maintained as a record of sample collection, transfer, shipment, and receipt by the laboratory. At a minimum, all samples will be submitted to the laboratory within 48 hours after collection. The laboratory will be informed that samples are being submitted for analysis and it will be confirmed that the samples were received the following day. If samples are shipped on Friday for Saturday delivery, the receiving laboratory will be contacted so provisions can be made for laboratory sample receipt.

6.6 Quality Assurance/Quality Control Sampling

Field QA/QC samples for groundwater will be collected as follows:

- Duplicates: Collected at a frequency of ten percent at the same time and from the same location as the original sample.
- Equipment blanks: Collected from non-dedicated, decontaminated equipment at a frequency of five percent by pouring distilled water over the equipment and collecting the sample in the appropriate laboratory containers.
- Trip blanks: One included in each cooler shipped to the laboratory that contains samples for VOC analyses. The trip blank consists of two 40-milliliter (mL) vials of reagent water provided by the laboratory that were stored in the sample cooler at all times.

Laboratory QA/QC samples will be performed according to test methodologies specified for each analytical method. The laboratory QA/QC samples may 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.

6.7 PSH Sample Collection

In the event that PSH is present in any of the monitoring or recovery wells that have not historically contained PSH, samples may be collected when sufficient volume (80 mL) is present for collection and analysis. The desired analyses for evaluation of PSH include paraffins, isoparaffins, aromatics, naphthenes, and olefins (PIANO) as well as specific gravity and simulated distillation. Navajo will notify the NMED within seven calendar days if PSH is present in wells where PSH has not previously be encountered, as required by the PCC Permit.

PSH samples will be collected using a disposable, non-dedicated 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 managed per methods discussed in Section 6.9.

6.8 Decontamination

The interface probe and other non-dedicated equipment coming into contact with groundwater will be decontaminated by the following procedures:

1. Remove PSH, if present, with an absorbent pad.
2. Remove any solids to the degree possible with a brush and tap or distilled water. Wash with a brush, laboratory-grade non-phosphate detergent (e.g., Liquinox, Alconox), and potable tap water. Allow excess soap to drain off the equipment when finished.
3. Double rinse with distilled water.

All decontamination fluids will be managed per methods discussed in Section 6.9.

6.9 Investigation Derived Waste Disposal

The IDW (e.g., purge water, decontamination water) generated during monitoring activities will be disposed of at the collected and disposed of in the Refinery wastewater treatment system, upstream of the oil/water separator. Miscellaneous IDW (e.g., gloves, bailers) in contact with investigative material deemed to have no or de minimus contamination will be disposed of in a general refuse container. Any IDW deemed to have greater than de minimus contamination will be stored in labeled drums and disposed appropriately on a per case basis.

7.0 ANNUAL FACILITY-WIDE GROUNDWATER MONITORING REPORT

Groundwater monitoring from each calendar year will be documented in an *Annual Facility-Wide Groundwater Monitoring Report*, in accordance with both the PCC Permit and the Discharge Permit. The *Annual Facility-Wide Groundwater Monitoring Report* will follow the general report format provided in Appendix E of the PCC Permit and incorporate the requirements of Section 2.E of the Discharge Permit. At a minimum, the *Annual Facility-Wide Groundwater Monitoring Report* will include 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 semi-annual 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 semi-annual monitoring event of the reporting period, including site features and the direction and magnitude of the hydraulic gradient;
- PSH thickness isopleths maps for each semi-annual 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;
- 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 Facility-Wide Groundwater Monitoring Report* will be submitted to the NMED and OCD by February 28 of the calendar year following sample collection.

8.0 Schedule

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

The second semi-annual event will occur no later than 30 days after the conclusion of the pecan orchard flood irrigation season or November 15 each year. Typically, the second semi-annual event will occur in October or November of each calendar year.

The wells that are sampled on an annual basis will be sampled during the first semi-annual event of each calendar year.

The wells that are sampled biennially will be sampled every other year. Biennial sampling at the Refinery began in the first semi-annual event of 2011. As such, these wells will be sampled during the first semi-annual event of each odd numbered year.

Navajo will notify both NMED and OCD prior to the initiation of each semi-annual sampling event.

The *Annual Facility-Wide Groundwater Monitoring Report* will be submitted to NMED and OCD no later than February 28 of the calendar year following sample collection.

9.0 References

Covenant Technical Associates, Inc. 1997. Revised RCRA Facility Investigation Phase II Report North Colony Landfarm. November 1997.

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K.W. Brown Environmental Services 1993. RFI Three-Mile Ditch and Evaporation Ponds Phase II Report (Revised). November 1993.

K.W. Brown Environmental Services 1996. RFI Three-Mile Ditch and Evaporation Ponds Phase III Report (Revised), Prepared for Navajo Refining Company, Artesia, New Mexico. January 1996.

Mariah Associates, Inc. 1990. RCRA Facility Investigation, Three-Mile Ditch and Evaporation Ponds, Phase I (Revised). October 1990.

NMED 1989. Hazardous Waste Facility Permit Number NMD048918817-1. January 22, 1988, amended by letters dated December 22, 1988, January 24, 1989, and August 18, 1989.

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NMED 2010. Navajo Refining Company Artesia Refinery Post-Closure Care Permit. December 2010.

NMED 2016. Approval, 2016 Facility Wide Groundwater Monitoring Workplan. December 7, 2016.

Navajo 2001. RCRA Post-Closure Permit Application for the Navajo Refining Company, New Mexico Refinery, Final. June 2001.

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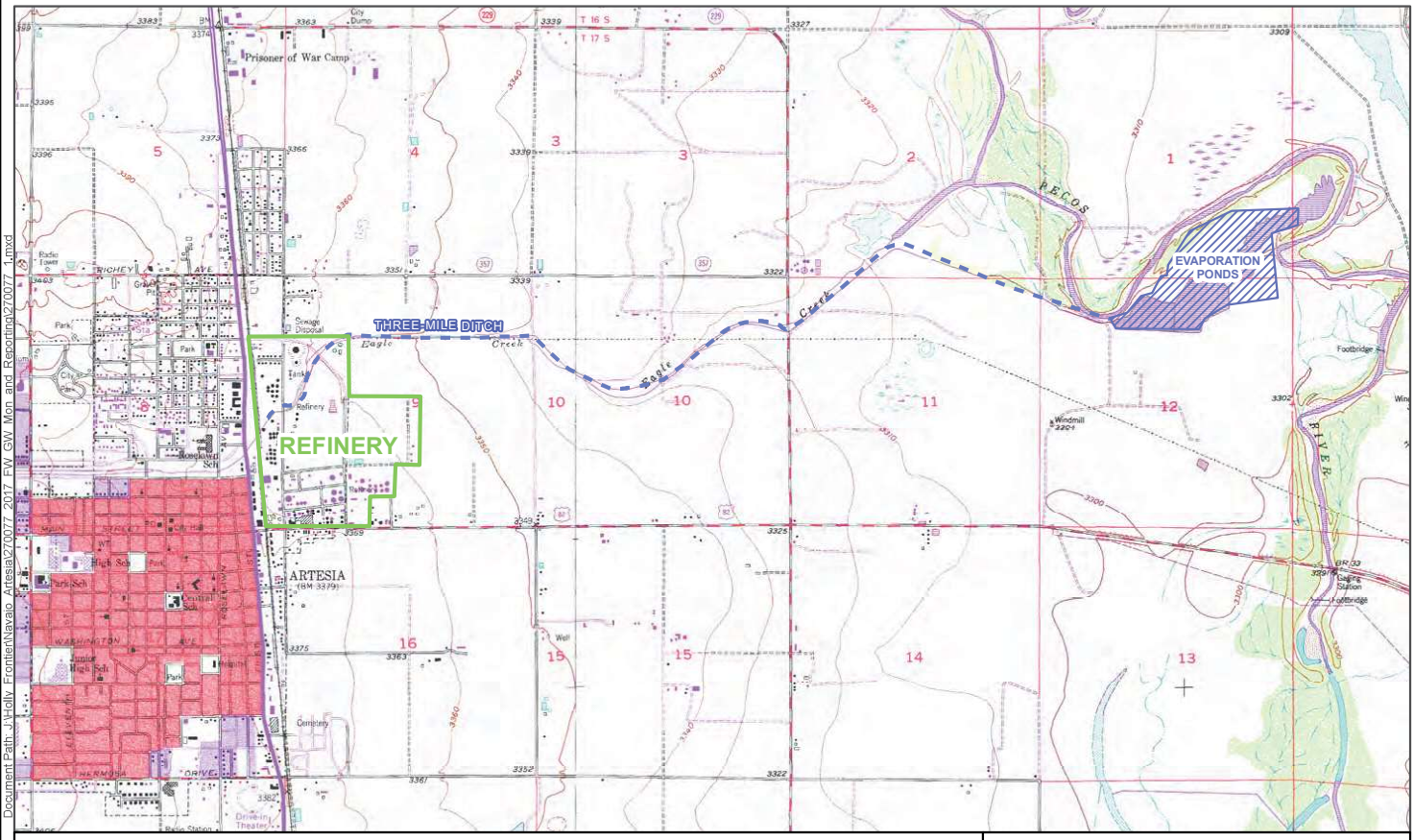
OCD 2017. HollyFrontier Navajo Refining LLC Artesia Refinery, Renewal of Discharge Permit GW-028. May 25, 2017

TRC 2016. 2016 Facility-Wide Groundwater Monitoring Work Plan. June 29, 2016.

TRC 2017. 2017 Annual Groundwater Monitoring Report. February 2017.

FIGURES



Document Path: J:\Holly Frontier\Navajo Artesia\270077 2017 FW GW Mon and Reporting\270077_1.mxd

N

0 1,600 3,200
Feet

SOURCE: BASE MAP USGS 7.5 MINUTE SERIES QUADS, ARTESIA AND SPRINGLAKE QUADRANGLES, 1955, PHOTOREVISED 1983.

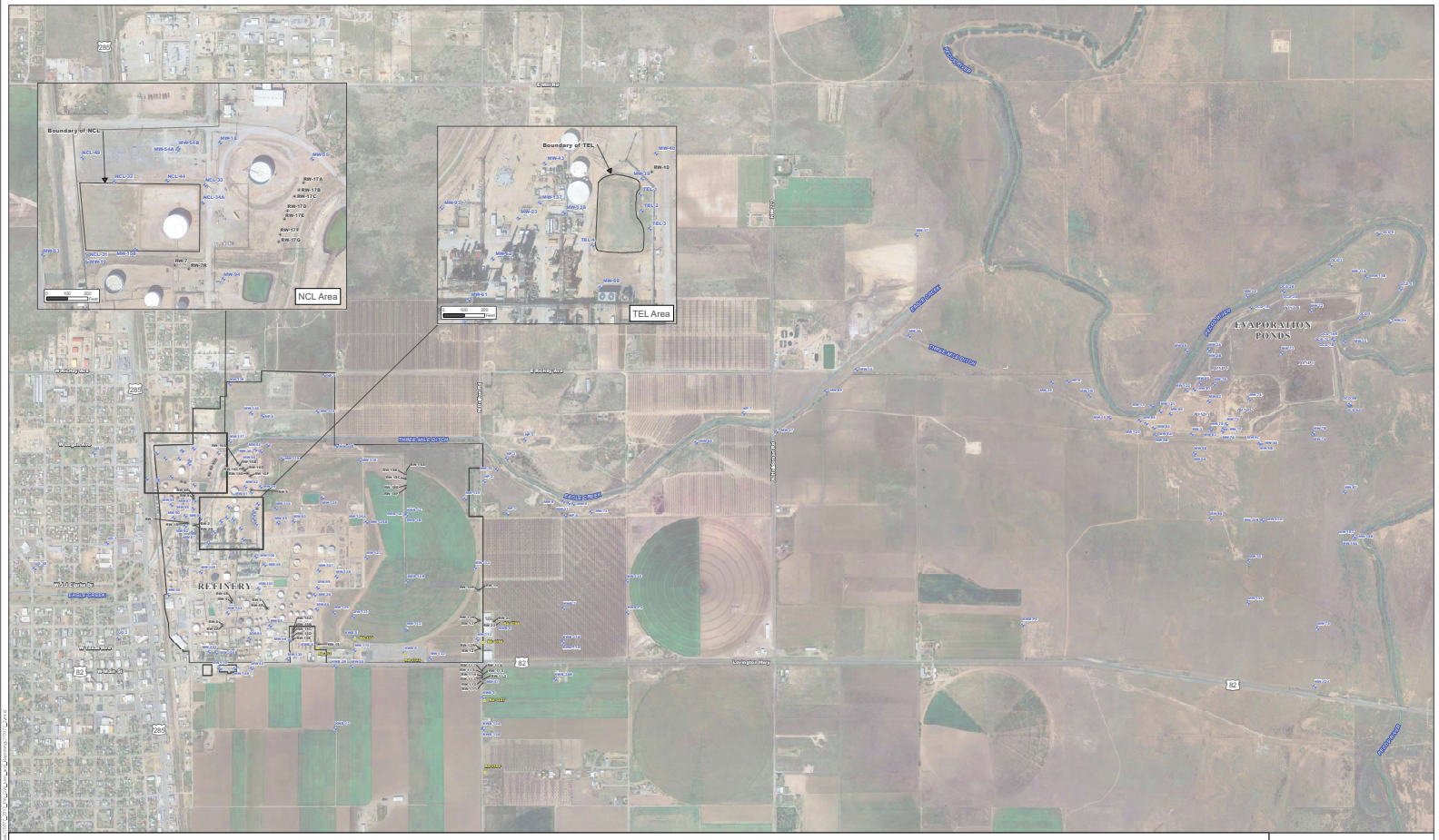
SITE LOCATION MAP

HOLLYFRONTIER NAVAJO REFINING LLC
ARTESIA REFINERY, EDDY COUNTY, NEW MEXICO

PROJECT NUMBER: 270077	FILE NAME: 270077_1
AUTHOR: MLOVELACE	DATE: 6/8/2017

TRC
505 E. HUNTLAND DR.
SUITE 250
AUSTIN, TX 78752
PH:512-329-6080

FIGURE 1



LEGEND

- IRRIGATION WELL
- MONITORING WELL
- RECOVERY WELL
- REFINERY BOUNDARY

AERIAL IMAGERY SOURCE: GOOGLE AND THEIR DATA PARTNERS 2019

N
W E
S

0 750 1,500
Feet

1 IN = 750 FT

New Mexico

WELL LOCATION MAP

HOLLYFRONTIER NAVAJO REFINING LLC
ARTESIA REFINERY, EDDY COUNTY, NEW MEXICO

AUTHOR: MLOVELACE	BASE: AERIAL	REV: XXXX_X

TRC
505 E. HUNTLAND DR.
SUITE 250
AUSTIN, TX 78752
PH 512-329-6080

FIGURE 2

LEGEND

- IRRIGATION WELL NOT INCLUDED IN SAMPLING PLAN
- MONITORING WELL NOT INCLUDED IN SAMPLING PLAN
- RECOVERY WELL NOT INCLUDED IN SAMPLING PLAN
- WELL TO BE SAMPLED ON A SEMI-ANNUAL BASIS
- WELL TO BE SAMPLED ON AN ANNUAL BASIS
- WELL TO BE SAMPLED ON A BIENNIAL BASIS
- REFINERY BOUNDARY

AERIAL IMAGERY SOURCE: GOOGLE AND THEIR DATA PARTNERS 2015

0 750 1,500
Feet
1 IN = 750 FT

NOTES:
1. SAMPLES WILL BE SUBMITTED FOR LABORATORY ANALYSIS IN ACCORDANCE WITH TABLE 1 OF THIS WORK PLAN.
2. SAMPLE POINTS IN RECOVERY TRENCHES 11, 15, 16, 17, AND 18 ARE RW-11-0, RW-15C, RW-16B, RW-17A, AND RW-18-A, RESPECTIVELY.

FACILITY-WIDE GROUNDWATER SAMPLING PLAN

HOLLYFRONTIER NAVAJO REFINING LLC
ARTESIA REFINERY, EDDY COUNTY, NEW MEXICO

AUTHOR: MREEVES	SAVED: 10/16/2017	MXD: 270077_3

TRC
505 E. HUNTLAND DR.
SUITE 250
AUSTIN, TX 78752
PH:512-329-6080

FIGURE 3

Replacement Page - October 2017

TABLES

Table 1. 2017 Facility-Wide Groundwater Monitoring Program and Schedule

HollyFrontier Navajo Refining LLC - Artesia Refinery, Artesia, New Mexico

Well ID	Well Type	Associated Area	Well Construction [a]			Historic PSH? [b]	Gauging Frequency	Analytical Suite and Frequency [c]									
			Well Diameter (in)	Screen Interval (ft bgs)	Water Bearing Zone			Purge Parameters	DRO	GRO	VOCs	Metals		Cyanide	Cations/Anions	Nitrate / Nitrite as Nitrogen	Total Dissolved Solids
												As, Ba, Cr, Fe, Pb, Mn, Se	B, Cd, Co, Hg, Ni, U, Va				
KWB-13	Monitoring	Crossgradient	2		Shallow		SA	A	A	-	A	A	A	A	A	A	A
MW-136	Monitoring	Crossgradient	2	10 to 25	Shallow		SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
NP-5	Monitoring	Crossgradient	2	10.25 to 20	Shallow		SA	B	B	-	B	B	-	-	B	B	B
MW-1R	Monitoring	EP	2	8 to 23	Shallow		SA	A	A	-	A	A	-	-	A	A	A
MW-2A	Monitoring	EP	2		Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-2B	Monitoring	EP	2	38.5 to 48	Valley Fill		SA	No samples to be collected									
MW-3	Monitoring	EP	2		Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-4A	Monitoring	EP	4		Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-4B	Monitoring	EP	4	60.25 to 70	Valley Fill		SA	B	B	B	B	B	-	-	B	B	B
MW-5A	Monitoring	EP	2		Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-5B	Monitoring	EP	2	41.5 to 50.5	Valley Fill		SA	B	B	B	B	B	-	-	B	B	B
MW-5C	Monitoring	EP	2	59.25 to 68.75	Valley Fill		SA	B	B	B	B	B	-	-	B	B	B
MW-6A	Monitoring	EP	2		Shallow		SA	A	A	A	A	A	-	-	A	A	A
MW-6B	Monitoring	EP	2	39.5 to 49	Valley Fill		SA	B	B	B	B	B	-	-	B	B	B
MW-7A	Monitoring	EP	2		Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-7B	Monitoring	EP	4	39.5 to 49	Valley Fill		SA	B	B	B	B	B	-	-	B	B	B
MW-10	Monitoring	EP	2		Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-11A	Monitoring	EP	4	5.5 to 20	Shallow		SA	A	A	A	A	A	-	-	SA	SA	SA
MW-11B	Monitoring	EP	2	35.5 to 45	Valley Fill		SA	B	B	B	B	B	-	-	B	B	B
MW-12	Monitoring	EP	4	6.5 to 16	Shallow		SA	No samples to be collected									
MW-13	Monitoring	EP	4	9.5 to 19	Shallow		SA	No samples to be collected									
MW-14	Monitoring	EP	4	5.5 to 20	Shallow		SA	No samples to be collected									
MW-15	Monitoring	EP	4	9 to 19	Shallow		SA	A	A	A	A	A	-	-	A	A	A
MW-18A	Monitoring	EP	4	10 to 20	Shallow		SA	SA	SA	-	SA	SA	SA	SA	SA	SA	SA
MW-18B	Monitoring	EP	2	37 to 47	Valley Fill		SA	B	B	B	B	B	-	-	B	B	B
MW-18T	Monitoring	EP	4	37 to 47	Valley Fill		SA	No samples to be collected									
MW-22A	Monitoring	EP	4	5.5 to 20.5	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-22B	Monitoring	EP	2	42.3 to 52	Valley Fill		SA	B	B	B	B	B	-	-	B	B	B
MW-24	Monitoring	EP	6	15 to 20	Shallow		SA	No samples to be collected									
MW-69	Monitoring	EP	2	5 to 20	Shallow		SA	No samples to be collected									
MW-70	Monitoring	EP	4	5 to 20	Shallow		SA	SA	SA	SA	SA	SA	-	-	A	A	A
MW-72	Monitoring	EP	4	2 to 12	Shallow		SA	A	A	A	A	A	-	-	A	A	A
MW-73	Monitoring	EP	4	2 to 17	Shallow		SA	A	A	A	A	A	-	-	A	A	A
MW-74	Monitoring	EP	4	2 to 17	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-75	Monitoring	EP	4	3 to 18	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-76	Monitoring	EP	4	3 to 18	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-77	Monitoring	EP	4	3 to 18	Shallow		SA	A	A	A	A	A	-	-	A	A	A
MW-78	Monitoring	EP	4	2 to 17	Shallow		SA	A	A	A	A	A	-	-	A	A	A
MW-79	Monitoring	EP	4	2 to 17	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-80	Monitoring	EP	4	2 to 17	Shallow		SA	A	A	A	A	A	-	-	A	A	A
MW-81	Monitoring	EP	4	2 to 17	Shallow		SA	A	A	A	A	A	-	-	A	A	A
MW-82	Monitoring	EP	4	2 to 17	Shallow		SA	A	A	A	A	A	-	-	A	A	A
MW-83	Monitoring	EP	4	2 to 17	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-84	Monitoring	EP	4	2 to 17	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-85	Monitoring	EP	4	3 to 18	Shallow	Y	SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-86	Monitoring	EP	4	2 to 17	Shallow	Y	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
MW-87	Monitoring	EP	4	2 to 17	Shallow		SA	SA	SA	SA	SA	SA	-	-	A	A	A
MW-88	Monitoring	EP	4	3 to 18	Shallow		SA	SA	SA	SA	SA	SA	-	-	A	A	A
MW-120	Monitoring	EP	2	10 to 25	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-121	Monitoring	EP	2	10 to 25	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-122	Monitoring	EP	2	10 to 20	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-123	Monitoring	EP	2	10 to 25	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-124	Monitoring	EP	2	5 to 20	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
OCD-1R	Monitoring	EP	2		Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
OCD-2A	Monitoring	EP	2	8.5 to 23.5	Shallow		SA	SA	SA	SA	SA	SA	-	-	A	A	A
OCD-2B	Monitoring	EP	2	38.5 to 48	Valley Fill		SA	No samples to be collected									
OCD-3	Monitoring	EP	2	6.5 to 21.5	Shallow		SA	SA	SA	SA	SA	SA	-	-	A	A	A
OCD-4	Monitoring	EP	2	6.5 to 21.5	Shallow		SA	SA	SA	SA	SA	SA	-	-	A	A	A
OCD-5	Monitoring	EP	2		Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
OCD-6	Monitoring	EP	2	8 to 23	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
OCD-7AR	Monitoring	EP	4	5.5 to 19.5	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
OCD-7B	Monitoring	EP	2	43.5 to 52.5	Valley Fill		SA	B	B	B	B	B	-	-	B	B	B
OCD-7C	Monitoring	EP	2	60.25 to 69.75	Valley Fill		SA	No samples to be collected									
OCD-8A	Monitoring	EP	2	3 to 18	Shallow		SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
OCD-8B	Monitoring	EP	2	43.5 to 53	Valley Fill		SA	B	B	B	B	B	-	-	B	B	B

Table 1. 2017 Facility-Wide Groundwater Monitoring Program and Schedule

HollyFrontier Navajo Refining LLC - Artesia Refinery, Artesia, New Mexico

Well ID	Well Type	Associated Area	Well Construction [a]			Historic PSH? [b]	Gauging Frequency	Analytical Suite and Frequency [c]									
												Metals					
			Well Diameter (in)	Screen Interval (ft bgs)	Water Bearing Zone			Purge Parameters	DRO	GRO	VOCs	As, Ba, Cr, Fe, Pb, Mn, Se	B, Cd, Co, Hg, Ni, U, Va	Cyanide	Cations/Anions	Nitrate / Nitrite as Nitrogen	Total Dissolved Solids
KWB-1A	Monitoring	Field E of Refinery	2	18 to 32	Shallow		SA	SA	SA	-	SA	SA	SA	SA	SA	SA	SA
KWB-1B	Monitoring	Field E of Refinery	4	18 to 32	Shallow		SA	No samples to be collected									
KWB-1C	Monitoring	Field E of Refinery	4	30.5 to 49.5	Valley Fill		SA	B	B	-	B	B	-	-	B	B	B
KWB-2R	Monitoring	Field E of Refinery	2		Shallow	Y	SA	SA	SA	-	SA	SA	-	-	SA	SA	SA
KWB-3AR	Monitoring	Field E of Refinery	2	17 to 33	Shallow		SA [e]	SA [e]	SA [e]	-	SA [e]	SA [e]	SA [e]	SA [e]	SA [e]	SA [e]	SA [e]
KWB-5	Monitoring	Field E of Refinery	2	24.7 to 38.7	Shallow	Y	SA	SA	SA	-	SA	SA	-	-	SA	SA	SA
KWB-6	Monitoring	Field E of Refinery	2	17.5 to 36.5	Shallow		SA	SA	SA	-	SA	SA	-	-	SA	SA	SA
KWB-7	Monitoring	Field E of Refinery	2	18 to 32	Shallow	Y	SA	SA	SA	-	SA	SA	SA	SA	SA	SA	SA
KWB-8	Monitoring	Field E of Refinery	2	15 to 34	Shallow	Y	SA	SA	SA	-	SA	SA	SA	SA	SA	SA	SA
KWB-9	Monitoring	Field E of Refinery	2	20 to 34	Shallow		SA [e]	A [e]	A [e]	-	A [e]	A [e]	A [e]	A [e]	A [e]	A [e]	A [e]
KWB-10R	Monitoring	Field E of Refinery	4	9 to 29	Shallow	Y	SA	SA	SA	-	SA	SA	-	-	SA	SA	SA
KWB-11A	Monitoring	Field E of Refinery	4	30 to 39.5	Shallow		SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
KWB-11B	Monitoring	Field E of Refinery	4	50 to 69.5	Valley Fill		SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
KWB-12A	Monitoring	Field E of Refinery	4	15.5 to 24.5	Shallow		SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
KWB-12B	Monitoring	Field E of Refinery	4	25.5 to 39.5	Valley Fill		SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
KWB-P4	Monitoring	Field E of Refinery	2		Shallow		B	B	B	-	B	-	-	-	-	-	-
MW-57	Monitoring	Field E of Refinery	2	10 to 30	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-58	Monitoring	Field E of Refinery	4	13 to 28	Shallow	Y	SA	SA	SA	-	SA	SA	SA	SA	SA	SA	SA
MW-111	Monitoring	Field E of Refinery	2	25 to 40	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-112	Monitoring	Field E of Refinery	2	25 to 35	Shallow	Y	SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-113	Monitoring	Field E of Refinery	2	20 to 35	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-125	Monitoring	Field E of Refinery	2	15 to 25	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-126A	Monitoring	Field E of Refinery	2	19 to 34	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-126B	Monitoring	Field E of Refinery	2	40 to 50	Valley Fill		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-127	Monitoring	Field E of Refinery	2	20 to 50	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-128	Monitoring	Field E of Refinery	2	15 to 35	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-129	Monitoring	Field E of Refinery	2	20 to 50	Shallow	Y	SA	A	A	A	A	A	-	-	A	A	A
MW-131	Monitoring	Field E of Refinery	2	20 to 50	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-132	Monitoring	Field E of Refinery	2	15 to 40	Shallow	Y	SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-133	Monitoring	Field E of Refinery	2	15 to 35	Shallow	Y	SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-134	Monitoring	Field E of Refinery	2	20 to 30	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-135	Monitoring	Field E of Refinery	2	35 to 65	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
RA-1227	Irrigation	Field E of Refinery	10 / 8	194 to 246	Artesian		NA	A [e]	-	-	A [e]	-	-	-	A [e]	A [e]	A [e]
RA-3156	Irrigation	Field E of Refinery	4	182 to ?	Artesian		NA	A	-	-	A	-	-	-	A	A	A
RA-4196	Irrigation	Field E of Refinery	8	280 to 292	Artesian		NA	SA	-	-	SA	-	-	-	SA	SA	SA
RA-4798	Irrigation	Field E of Refinery	7	840 to 850	Artesian		NA	SA	-	-	SA	-	-	-	SA	SA	SA
RW-11 [d]	Recovery	Field E of Refinery	36		Shallow		SA	A	A	-	A	A	-	-	A	A	A
RW-12R	Recovery	Field E of Refinery	12	15 to 35	Shallow	Y	SA	A	A	-	A	A	-	-	A	A	A
RW-13R	Recovery	Field E of Refinery	12	15 to 35	Shallow	Y	SA	A	A	-	A	A	-	-	A	A	A
RW-14R	Recovery	Field E of Refinery	12	15 to 35	Shallow	Y	SA	A	A	-	A	A	-	-	A	A	A
RW-18 [d]	Recovery	Field E of Refinery	36		Shallow		SA	A	-	-	A	A	-	-	A	A	A
RW-20	Recovery	Field E of Refinery	4		Shallow	Y	SA	A	A	-	A	A	-	-	A	A	A
RW-22	Recovery	Field E of Refinery	12	11.5 to 39	Shallow	Y	SA	A	A	-	A	A	-	-	A	A	A
MW-23	Monitoring	N Refinery	6	15 to 20	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-29	Monitoring	N Refinery	2	9.75 to 19.25	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-30	Monitoring	N Refinery	8		Shallow		SA	No samples to be collected									
MW-39	Monitoring	N Refinery	2	14 to 24	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-40	Monitoring	N Refinery	2		Shallow		SA	A	A	A	A	A	-	-	A	A	A
MW-41	Monitoring	N Refinery	2	14 to 19	Shallow		SA	A	A	A	A	A	-	-	A	A	A
MW-42	Monitoring	N Refinery	2		Shallow		SA	A	A	A	A	A	-	-	A	A	A
MW-43	Monitoring	N Refinery	6	15.5 to 20.5	Shallow		SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
MW-59	Monitoring	N Refinery	2	15 to 30	Shallow		SA	A	A	A	A	A	-	-	A	A	A
MW-60	Monitoring	N Refinery	2	15 to 30	Shallow		SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
MW-61	Monitoring	N Refinery	4	14 to 29	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-62	Monitoring	N Refinery	4	14 to 29	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-67	Monitoring	N Refinery	4	12 to 27	Shallow		SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
MW-90	Monitoring	N Refinery	4	5 to 20	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-91	Monitoring	N Refinery	4	7 to 22	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-92	Monitoring	N Refinery	4	5 to 20	Shallow	Y	SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-93	Monitoring	N Refinery	4	5 to 20	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-94	Monitoring	N Refinery	4	5 to 20	Shallow	Y	SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-95	Monitoring	N Refinery	4	7 to 22	Shallow		SA	A	A	A	A	A	-	-	A	A	A
MW-96	Monitoring	N Refinery	4	7 to 22	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-97	Monitoring	N Refinery	4	8 to 23	Shallow	Y	SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-98	Monitoring	N Refinery	4	13 to 23	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA

Table 1. 2017 Facility-Wide Groundwater Monitoring Program and Schedule

HollyFrontier Navajo Refining LLC - Artesia Refinery, Artesia, New Mexico

Well ID	Well Type	Associated Area	Well Construction [a]			Historic PSH? [b]	Gauging Frequency	Analytical Suite and Frequency [c]									
			Well Diameter (in)	Screen Interval (ft bgs)	Water Bearing Zone			Purge Parameters	DRO	GRO	VOCs	Metals		Cyanide	Cations/Anions	Nitrate / Nitrite as Nitrogen	Total Dissolved Solids
												As, Ba, Cr, Fe, Pb, Mn, Se	B, Cd, Co, Hg, Ni, U, Va				
MW-137	Monitoring	N Refinery	2	10 to 30	Shallow		SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
MW-138	Monitoring	N Refinery	2	TBD	Shallow		SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
RW-1R	Recovery	N Refinery	12	15 to 35	Shallow	Y	SA	A	A	A	A	A	-	-	A	A	A
RW-2R	Recovery	N Refinery	12	14.5 to 34.5	Shallow	Y	SA	A	A	A	A	A	-	-	A	A	A
RW-7R	Recovery	N Refinery	12	14.5 to 34.5	Shallow	Y	SA	A	A	A	A	A	-	-	A	A	A
RW-8R	Recovery	N Refinery	12	14.5 to 34.5	Shallow	Y	SA	A	A	-	A	A	-	-	A	A	A
RW-9	Recovery	N Refinery	36		Shallow		SA	A	A	A	A	A	-	-	A	A	A
RW-10	Recovery	N Refinery	36		Shallow		SA	A	A	A	A	A	-	-	A	A	A
RW-16 [d]	Recovery	N Refinery	36		Shallow		SA	A	A	-	A	A	-	-	A	A	A
RW-17 [d]	Recovery	N Refinery	36		Shallow		SA	A	A	A	A	A	-	-	A	A	A
MW-117	Monitoring	N RO Reject Field	2	10 to 25	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-118	Monitoring	N RO Reject Field	2	10 to 25	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-119	Monitoring	N RO Reject Field	2	10 to 25	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-18	Monitoring	NCL	8	15 to 19	Shallow		SA	A	A	-	A	A	A	A	A	A	A
MW-19	Monitoring	NCL	2		Shallow		SA	No samples to be collected									
MW-45	Monitoring	NCL	2	10.5 to 15.5	Shallow		SA	SA	SA	-	SA	SA	SA	SA	SA	SA	SA
MW-53	Monitoring	NCL	2	13.8 to 23.8	Shallow		SA	A	A	-	A	A	-	-	A	A	A
MW-54A	Monitoring	NCL	2	12.7 to 27.7	Shallow		SA	SA	SA	-	SA	SA	-	-	SA	SA	SA
MW-54B	Monitoring	NCL	2	33.8 to 43.8	Valley Fill		SA	B	B	B	B	B	-	-	B	B	B
MW-55	Monitoring	NCL	2	13.7 to 23.7	Shallow		SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
MW-56	Monitoring	NCL	2	13.4 to 23.4	Shallow		SA	A	A	-	A	A	-	-	A	A	A
MW-108	Monitoring	NCL	4	9 to 24	Shallow		SA	SA	SA	-	SA	SA	-	-	SA	SA	SA
NCL-31	Monitoring	NCL	2	13 to 18	Shallow		SA	SA	SA	-	SA	SA	-	-	SA	SA	SA
NCL-32	Monitoring	NCL	2	17 to 22	Shallow		SA	SA	SA	-	SA	SA	-	-	SA	SA	SA
NCL-33	Monitoring	NCL	2	13 to 18	Shallow		SA	SA	SA	-	SA	SA	-	-	SA	SA	SA
NCL-34	Monitoring	NCL	2	16 to 21	Shallow		SA	SA	SA	-	SA	SA	-	-	SA	SA	SA
NCL-44	Monitoring	NCL	2		Shallow		SA	SA	SA	-	SA	SA	-	-	SA	SA	SA
NCL-49	Monitoring	NCL	2	16.8 to 17.8	Shallow		SA	SA	SA	-	SA	SA	-	-	SA	SA	SA
KWB-4	Monitoring	S Refinery	2	20 to 39	Shallow	Y	SA	SA	SA	-	SA	SA	-	-	SA	SA	SA
MW-28	Monitoring	S Refinery	6	25 to 30	Shallow		SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
MW-48	Monitoring	S Refinery	2	19 to 34	Shallow	Y	SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-50	Monitoring	S Refinery	2	12 to 27	Shallow		SA	SA	SA	-	SA	SA	-	-	SA	SA	SA
MW-52	Monitoring	S Refinery	2	19 to 34	Shallow		SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
MW-64	Monitoring	S Refinery	4	15 to 30	Shallow	Y	SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-65	Monitoring	S Refinery	4	14.5 to 29.5	Shallow	Y	SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-66	Monitoring	S Refinery	4	14.6 to 29.6	Shallow		SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
MW-99	Monitoring	S Refinery	4	12 to 27	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-101	Monitoring	S Refinery	4	8 to 23	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-102	Monitoring	S Refinery	4	12 to 27	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-103	Monitoring	S Refinery	4	7 to 22	Shallow		SA	A	A	A	A	A	-	-	A	A	A
MW-104	Monitoring	S Refinery	4	3 to 18	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-105	Monitoring	S Refinery	4	8 to 18	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-106	Monitoring	S Refinery	4	0 to 11	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-107	Monitoring	S Refinery	4	12 to 22	Shallow		SA	A	A	A	A	A	-	-	A	A	A
MW-109	Monitoring	S Refinery	2	15 to 29.5	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-110	Monitoring	S Refinery	2	15 to 29.5	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-130	Monitoring	S Refinery	2	30 to 45	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
RA-313	Irrigation	S Refinery	10	904 to 1157	Artesian		NA	A	-	-	A	-	-	-	A	A	A
RW-4R	Recovery	S Refinery	12	14.5 to 34.5	Shallow	Y	SA	A	A	-	A	A	-	-	A	A	A
RW-5R	Recovery	S Refinery	12	13 to 33	Shallow	Y	SA	A	A	-	A	A	-	-	A	A	A
RW-6R	Recovery	S Refinery	12	14.5 to 34.5	Shallow	Y	SA	A	A	-	A	A	-	-	A	A	A
RW-15 [d]	Recovery	S Refinery	36		Shallow	Y	SA	A	A	-	A	A	-	-	A	A	A
RW-19	Recovery	S Refinery	12	11 to 46	Shallow	Y	SA	A	A	-	A	A	-	-	A	A	A
MW-114	Monitoring	S RO Reject Field	2	20 to 35	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-115	Monitoring	S RO Reject Field	2	10 to 25	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-116	Monitoring	S RO Reject Field	2	10 to 25	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-49	Monitoring	TEL	2	19 to 34	Shallow		SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
TEL-1	Monitoring	TEL	2	13 to 23	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
TEL-2	Monitoring	TEL	2	13 to 23	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
TEL-3	Monitoring	TEL	2	13 to 23	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
TEL-4	Monitoring	TEL	2	13 to 23	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-8	Monitoring	TMD	2		Shallow		SA	A	A	A	A	A	-	-	A	A	A
MW-9	Monitoring	TMD	2		Shallow		SA	No samples to be collected									
MW-16	Monitoring	TMD	4	8.5 to 19	Shallow		SA	A	A	-	A	A	-	-	A	A	A
MW-20	Monitoring	TMD	4	9.5 to 23.5	Shallow		SA	A	A	-	A	A	-	-	A	A	A

Table 1. 2017 Facility-Wide Groundwater Monitoring Program and Schedule
HollyFrontier Navajo Refining LLC - Artesia Refinery, Artesia, New Mexico

Well ID	Well Type	Associated Area	Well Construction [a]			Historic PSH? [b]	Gauging Frequency	Analytical Suite and Frequency [c]									
			Well Diameter (in)	Screen Interval (ft bgs)	Water Bearing Zone			Purge Parameters	DRO	GRO	VOCs	Metals		Cyanide	Cations/Anions	Nitrate / Nitrite as Nitrogen	Total Dissolved Solids
												As, Ba, Cr, Fe, Pb, Mn, Se	B, Cd, Co, Hg, Ni, U, Va				
MW-21	Monitoring	TMD	4	7.5 to 22	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-25	Monitoring	TMD	2	15.75 to 25.25	Shallow		SA	A	A	-	A	A	-	-	A	A	A
MW-26	Monitoring	TMD	2	15.25 to 24.25	Shallow		SA	A	A	-	A	A	-	-	A	A	A
MW-27	Monitoring	TMD	2	18.25 to 27.75	Shallow		SA	A	A	-	A	A	-	-	A	A	A
MW-46R	Monitoring	TMD	2	3.5 to 18.5	Shallow		SA	SA	SA	-	SA	SA	-	-	SA	SA	SA
MW-68	Monitoring	TMD	2	14.75 to 24.5	Shallow		SA	A	A	-	A	A	-	-	A	A	A
MW-71	Monitoring	TMD	2	9.75 to 19.5	Shallow		SA	A	A	-	A	A	A	A	A	A	A
MW-89	Monitoring	TMD	4	2 to 17	Shallow		SA	A	A	-	A	A	-	-	A	A	A
NP-1	Monitoring	TMD	2	9.5 to 19	Shallow		SA	SA	-	-	SA	-	-	-	A	A	A
NP-2	Monitoring	TMD	2	9.5 to 18.5	Shallow		SA	No samples to be collected									
NP-3	Monitoring	TMD	2	9.5 to 18.5	Shallow		SA	No samples to be collected									
NP-4	Monitoring	TMD	2	24.5 to 33.5	Shallow		SA	No samples to be collected									
NP-6	Monitoring	TMD	2	8.75 to 18.75	Shallow		SA	B	-	-	B	-	-	-	-	-	-
NP-8	Monitoring	TMD	2		Shallow		SA	No samples to be collected									
NP-9	Monitoring	TMD	2		Shallow		SA	No samples to be collected									
UG-1	Monitoring	Upgradient	4	8 to 23	Shallow		A	A	A	A	A	A	A	A	A	A	A
UG-2	Monitoring	Upgradient	4	15 to 30	Shallow		A	A	A	A	A	A	A	A	A	A	A
UG-3R	Monitoring	Upgradient	4	17 to 37	Shallow		A	A	A	A	A	A	A	A	A	A	A
UG-4	Monitoring	Upgradient	2	19.5 to 39.5	Shallow		A	A	A	A	A	A	A	A	A	A	A

Note: Blank cells indicate that information is not available or applicable.

Abbreviations:

A = Annual (March/April event)
B = Biennial (March/April event in odd calendar years)
DRO = Diesal 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
N = North
NA = Not accessible
NCL = North Colony Landfarm
OCD = Oil Conservation District
S = South
SA = Semi-annual (March/April and September/October events)
TEL = Tetra Ethyl Lead Impoundment
TMD = Three Mile Ditch
TPH = Total Petroleum Hydrocarbons
VOCs = Volatile Organic Compounds
Y = Yes

Footnotes:

[a] Available well construction information provided.

[b] PSH was present during previous groundwater monitoring events or a recovery pump is in place. Recovery wells are gauged at least monthly.

[c] Analytical Suite to include the following:

1. Purge parameters pH, temperature, specific conductivity, dissolved oxygen, oxygen-reduction potential, and turbidity will be measured and recorded in the field.
2. DRO by Method 8010Mod.
3. GRO by Method 8010Mod.
4. VOCs by Method 8260, to include methyl tert butyl ether (MTBE) and naphthalene.
5. Total metals by Method 6010/6020 and/or 7470. Specific metals shown in table heading (symbols from periodic chart).
6. Dissolved metals - same list as total metals, but only analyzed during March/April event.
7. Cyanide by Method SM4500.
8. Cations/anions to include Calcium, Potassium, and Sodium by Method 6010 or 6020 and Sulfate, Chloride, and Fluoride by Method 300.
9. Nitrates/Nitrites as Nitrogen by Method 300.
10. 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 0.3 feet thick or greater.*

[d] 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.

[e] Wells will be gauged and/or sampled only if the landowner grants access.

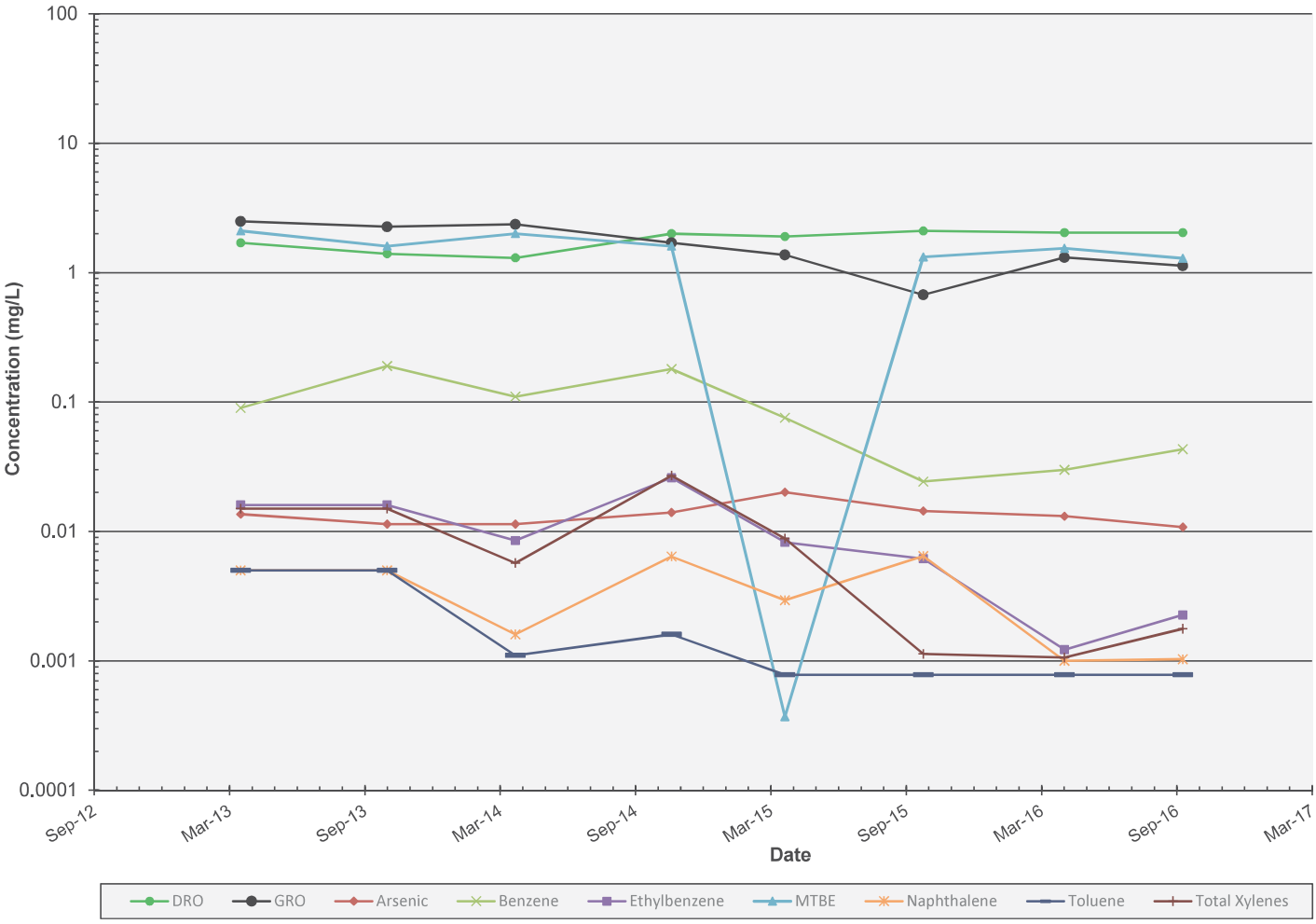
APPENDIX A

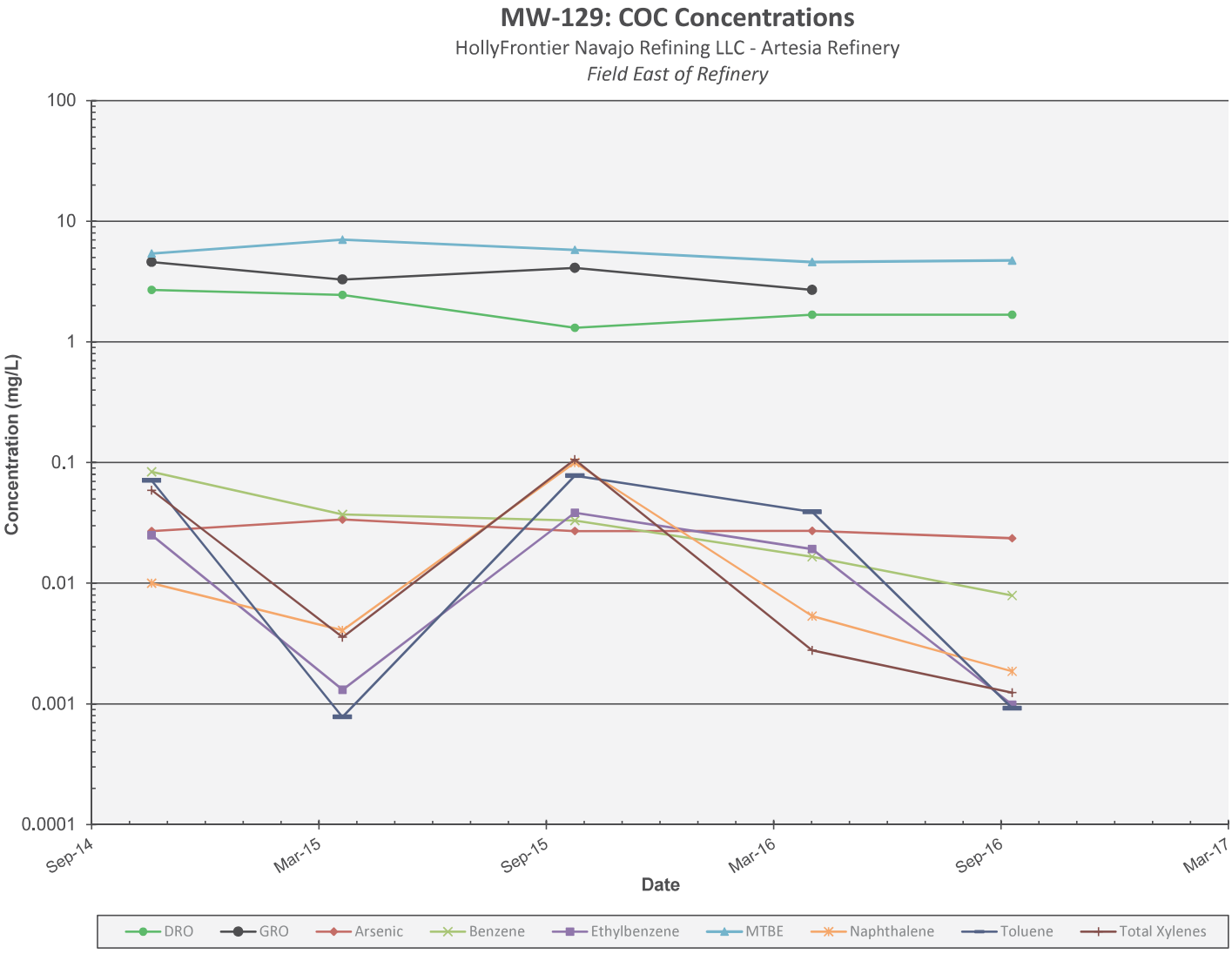
GROUNDWATER CONCENTRATION TIME-SERIES PLOTS OF WELLS PROPOSED FOR SAMPLING FREQUENCY REDUCTION

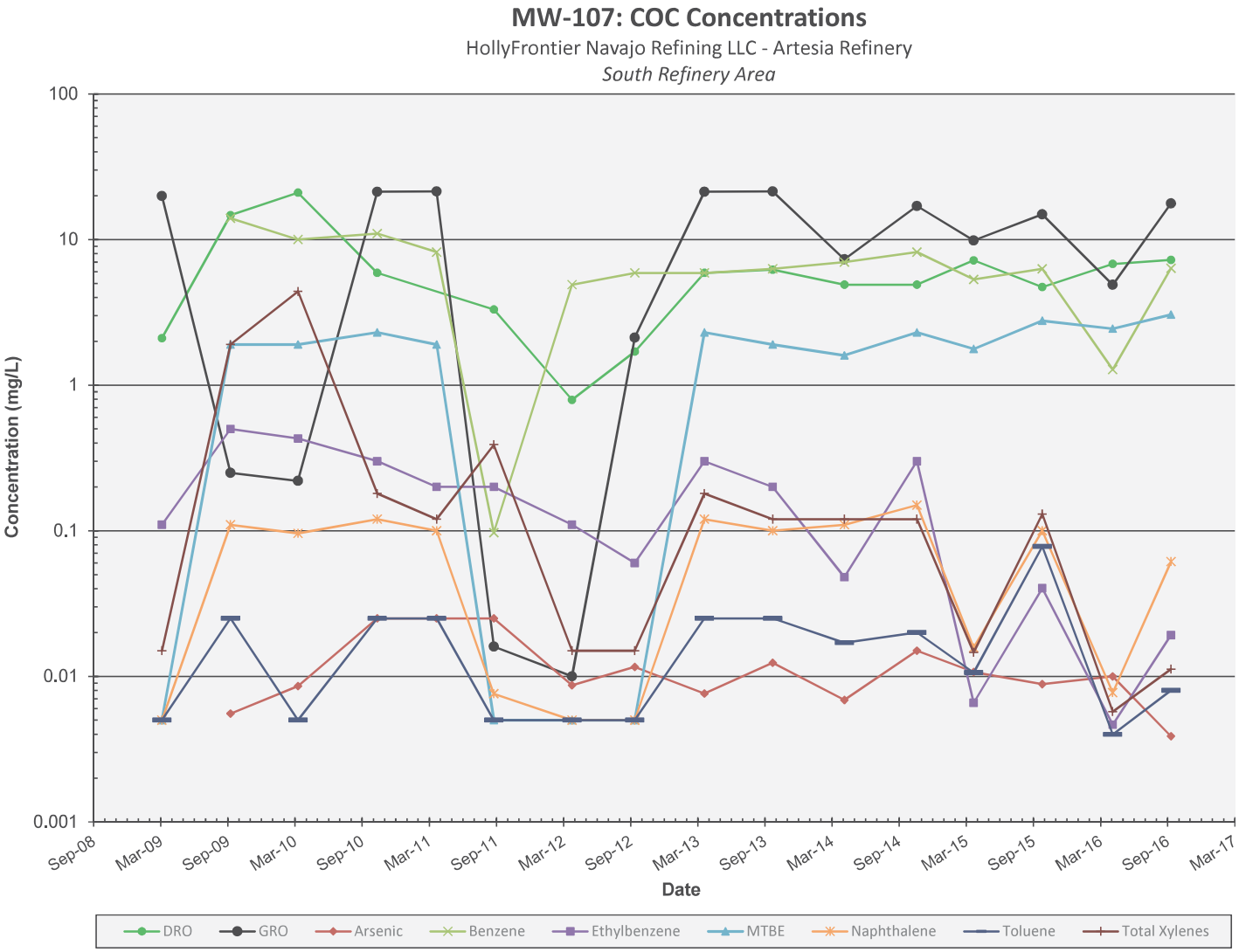
MW-111: COC Concentrations

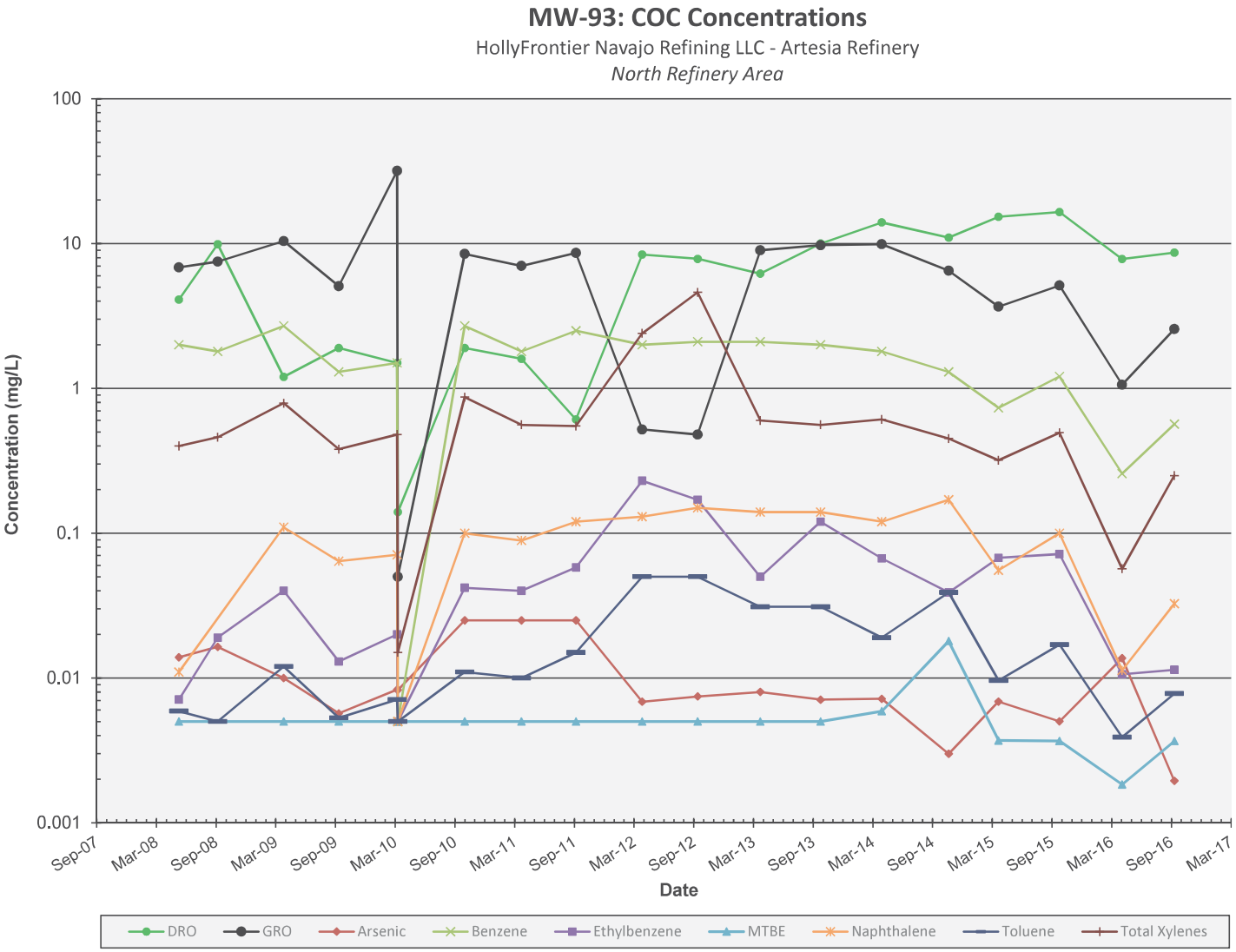
HollyFrontier Navajo Refining LLC - Artesia Refinery

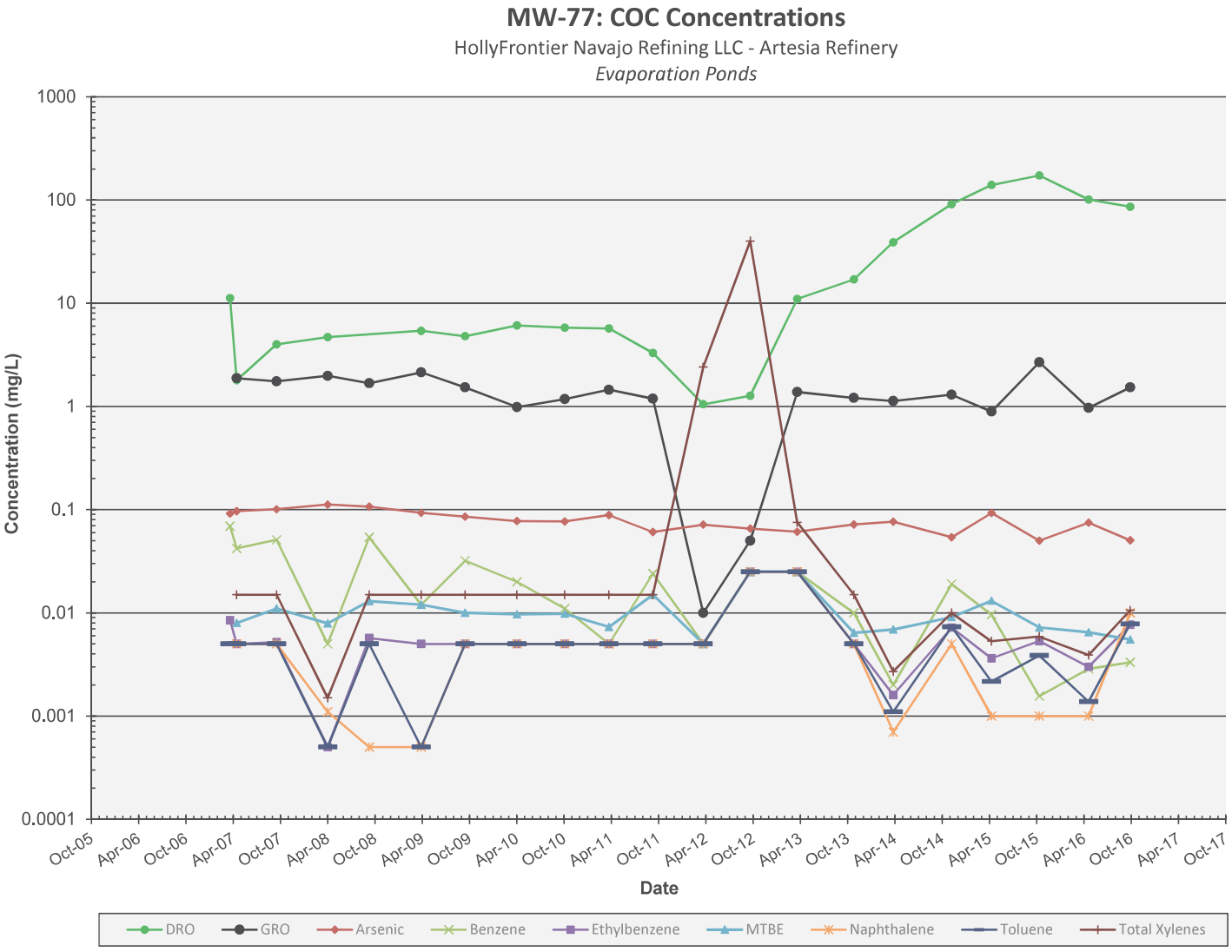
Field East of Refinery

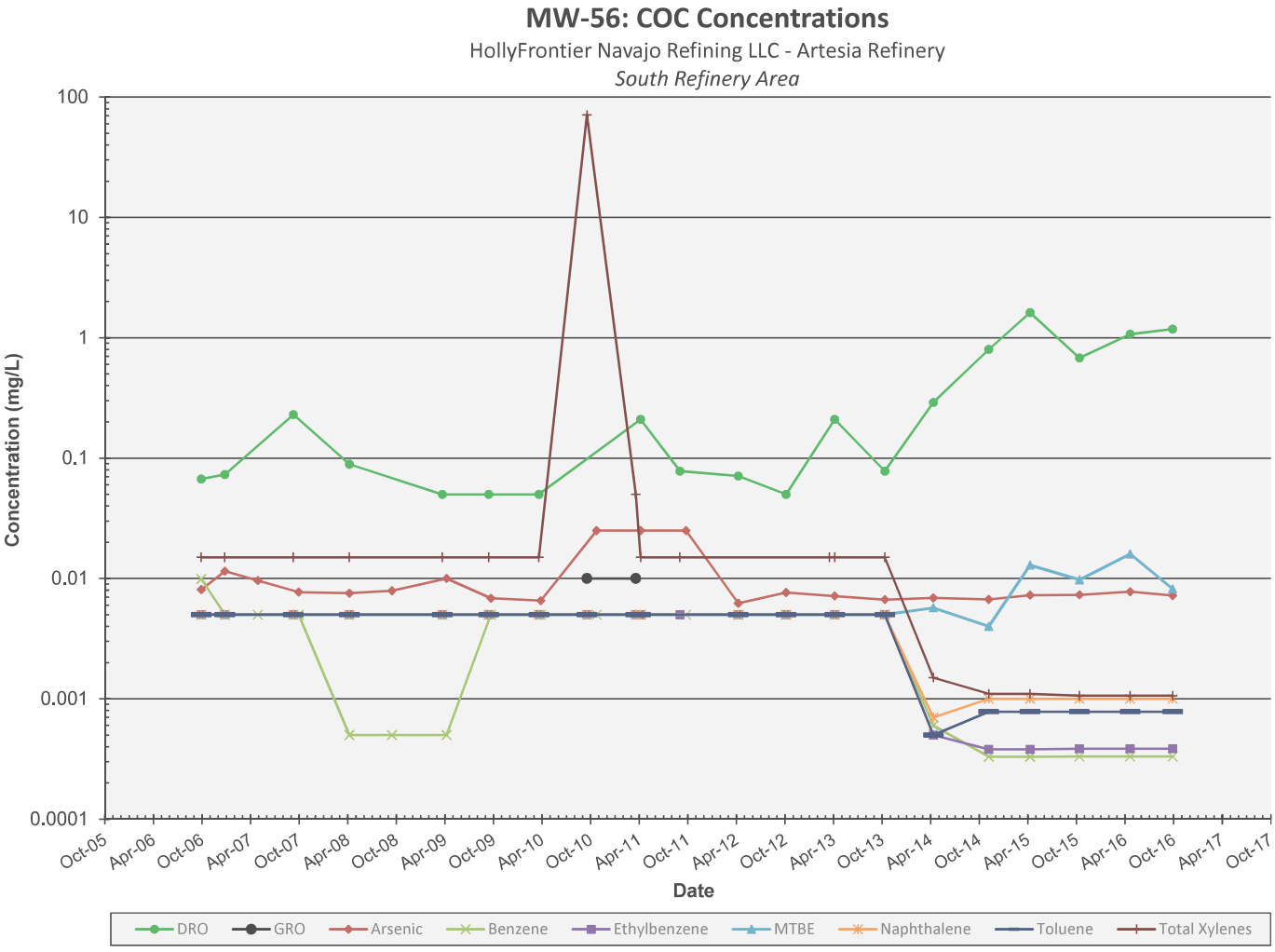



MW-129: COC Concentrations
HollyFrontier Navajo Refining LLC - Artesia Refinery
Field East of Refinery
Concentration (mg/L)
100
10
1
0.1
0.01
0.001
0.0001
Sep-14
Mar-15
Sep-15
Mar-16
Sep-16
Mar-17
Date
DRO
GRO
Arsenic
Benzene
Ethylbenzene
MTBE
Naphthalene
Toluene
Total Xylenes


MW-107: COC Concentrations
HollyFrontier Navajo Refining LLC - Artesia Refinery
South Refinery Area
Concentration (mg/L)
100
10
1
0.1
0.01
0.001
Sep-08
Mar-09
Sep-09
Mar-10
Sep-10
Mar-11
Sep-11
Mar-12
Sep-12
Mar-13
Sep-13
Mar-14
Sep-14
Mar-15
Sep-15
Mar-16
Sep-16
Mar-17
Date
DRO
GRO
Arsenic
Benzene
Ethylbenzene
MTBE
Naphthalene
Toluene
Total Xylenes


MW-93: COC Concentrations
HollyFrontier Navajo Refining LLC - Artesia Refinery
North Refinery Area
Concentration (mg/L)
100
10
1
0.1
0.01
0.001
Sep-07
Mar-08
Sep-08
Mar-09
Sep-09
Mar-10
Sep-10
Mar-11
Sep-11
Mar-12
Sep-12
Mar-13
Sep-13
Mar-14
Sep-14
Mar-15
Sep-15
Mar-16
Sep-16
Mar-17
Date
DRO
GRO
Arsenic
Benzene
Ethylbenzene
MTBE
Naphthalene
Toluene
Total Xylenes


MW-77: COC Concentrations
HollyFrontier Navajo Refining LLC - Artesia Refinery
Evaporation Ponds
Concentration (mg/L)
1000
100
10
1
0.1
0.01
0.001
0.0001
Oct-05
Apr-06
Oct-06
Apr-07
Oct-07
Apr-08
Oct-08
Apr-09
Oct-09
Apr-10
Oct-10
Apr-11
Oct-11
Apr-12
Oct-12
Apr-13
Oct-13
Apr-14
Oct-14
Apr-15
Oct-15
Apr-16
Oct-16
Apr-17
Oct-17
Date
DRO
GRO
Arsenic
Benzene
Ethylbenzene
MTBE
Naphthalene
Toluene
Total Xylenes


MW-56: COC Concentrations
HollyFrontier Navajo Refining LLC - Artesia Refinery
South Refinery Area
Concentration (mg/L)
100
10
1
0.1
0.01
0.001
0.0001
Oct-05
Apr-06
Oct-06
Apr-07
Oct-07
Apr-08
Oct-08
Apr-09
Oct-09
Apr-10
Oct-10
Apr-11
Oct-11
Apr-12
Oct-12
Apr-13
Oct-13
Apr-14
Oct-14
Apr-15
Oct-15
Apr-16
Oct-16
Apr-17
Oct-17
Date
DRO
GRO
Arsenic
Benzene
Ethylbenzene
MTBE
Naphthalene
Toluene
Total Xylenes

State of New Mexico
ENVIRONMENT DEPARTMENT

Hazardous Waste Bureau

2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6313
Phone (505) 476-6000 Fax (505) 476-6030
www.env.nm.gov

SUSANA MARTINEZ
Governor
JOHN A. SANCHEZ
Lieutenant Governor

BUTCH TONGATE
Cabinet Secretary
J. C. BORREGO
Deputy Secretary

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

October 11, 2017

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

RE: APPROVAL WITH MODIFICATIONS
2017 FACILITY WIDE GROUNDWATER
MONITORING WORK PLAN, JUNE 2017
HOLLYFRONTIER NAVAJO REFINING LLC - ARTESIA REFINERY
EPA ID NO. NMD048918817
HWB-NRC-17-005

Dear Mr. Denton:

The New Mexico Environment Department (NMED) has completed its review of HollyFrontier Navajo Refining LLC's, Artesia Refinery's (the Permittee) *2017 Facility Wide Groundwater Monitoring Work Plan* (Work Plan), dated June 2017. NMED hereby issues this Approval with the following modification.

Comment 1

In Section 5.0 (Monitoring Program Scope of Services), page 5-1, the Permittee proposes to reduce the sampling frequency of monitoring wells MW-56, MW-77, MW-93, MW-107, MW-111 and MW-129 from semi-annual to annual. NMED has reviewed the Permittee's request to reduce the sampling frequency from these six wells and hereby approves the proposal for the following monitoring wells: MW-56, MW-77, MW-93, MW-107, and MW-129. The Permittee must continue to sample monitoring well MW-111 semi-annually. Provide replacement pages for the applicable section(s) and table(s) of the Work Plan and ensure future work plans reflect

the approved changes. In addition, NMED notified the Permittee, by e-mailed response, on September 29, 2017 that monitoring and sampling could proceed with the modification to the sampling frequency for the five approved monitoring wells for the current monitoring and sampling event.

The Permittee must address this comment from this Approval with Modifications and provide the applicable replacement pages to NMED by **October 31, 2017**.

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

Sincerely,

for

John E. Kieling
Chief
Hazardous Waste Bureau

cc: D. Cobrain, NMED HWB
K. Van Horn, NMED HWB
L. Tsinnajinnie, NMED HWB
J. Griswold, NMEMNRD OCD
C. Chavez, NMEMNRD OCD
M. Holder, HollyFrontier
R. Combs, HollyFrontier Navajo Refining LLC - Artesia Refinery
L. King, EPA 6PD-N

File: Reading File and NRC 2017
HWB-NRC-17-005

HOLLYFRONTIER

June 30, 2017

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

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

RE: Submittal of the *2017 Facility-Wide Groundwater Monitoring Work Plan* for the HollyFrontier Navajo Refining LLC, Artesia Refinery
RCRA Permit No. NMD048918817
Discharge Permit GW-028

Dear Mr. Kieling and Mr. Chavez:

Enclosed is the annual update to the Facility Wide Groundwater Monitoring Work Plan (FWGMWP) for the Artesia Refinery. 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 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.

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

Sincerely,

Scott M. Denton
Environmental Manager
HollyFrontier Navajo Refining LLC

cc: HFC: R. Combs, A. Sahba
TRC: J. Speer, C. Smith

Location: Env\RCRA\Corrective Actions\Annual GW Report\FWGWMWP\2017

2017 Facility-Wide Groundwater Monitoring Work Plan

NMD048918817 and DP GW-028

HollyFrontier Navajo Refining LLC
Artesia Refinery
Artesia, New Mexico

June 2017

Prepared for:

HOLLYFRONTIER
HollyFrontier Navajo Refining LLC
Artesia, New Mexico

Prepared by:

TRC
TRC Environmental Corporation
Austin, Texas

2017 Facility-Wide Groundwater Monitoring Work Plan

NMD048918817 and DP GW-028

HollyFrontier Navajo Refining LLC
Artesia Refinery
Artesia, New Mexico

Prepared for:

HollyFrontier Navajo Refining LLC
Artesia, New Mexico

Prepared by:

TRC Environmental Corporation
Austin, Texas

TRC Project No. 249545

June 2017

TRC Principal Lead _____
Julie Speer, Project Manager

Certification

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

Scott Denton

Environmental Manager, HollyFrontier Navajo Refining LLC

EXECUTIVE SUMMARY

This *2017 Facility Wide Groundwater Monitoring Work Plan* (2017 FWGMWP) details the proposed groundwater monitoring program to be implemented at the HollyFrontier Navajo Refining LLC (Navajo) Artesia Refinery (Refinery) located at 501 East Main Street in Artesia, New Mexico. The Refinery is subject to (1) a Post-Closure Care Permit (PCC Permit) issued by the New Mexico Environment Department (NMED) in October 2003 and later modified in December 2010; and (2) the renewed Discharge Permit GW-028 issued by New Mexico Energy, Minerals and Natural Resources Department Oil Conservation Division (OCD) on May 25, 2017. Both the PCC Permit and Discharge Permit requires Navajo to conduct facility wide groundwater monitoring to evaluate the presence, nature, and extent of groundwater impacts. This 2017 FWGMWP details all groundwater monitoring activities that will be conducted to satisfy both the NMED PCC Permit and the OCD Discharge Permit upon approval by NMED and OCD.

This 2017 FWGMWP serves as the annual update to the facility wide groundwater monitoring program required by Section 4.7.6.a of the modified PCC Permit. The groundwater monitoring program covers the following Refinery areas:

- The closed Tetra Ethyl Lead (TEL) Impoundment;
- The closed North Colony Landfarm (NCL);
- The inactive Evaporation Ponds (EP);
- Three Mile Ditch (TMD); and
- The vadose zone located beneath the Refinery.

This 2017 FWGMWP details all groundwater monitoring activities that will be conducted to satisfy both the NMED PCC Permit and the OCD Discharge Permit upon approval by NMED and OCD. This 2017 FWGMWP also describes the procedures to be followed during routine groundwater monitoring activities, including well gauging, groundwater sampling, managing investigation-derived waste (IDW), decontamination, analytical requirements, and quality assurance/quality control (QA/QC) requirements.

No substantial changes to the current facility-wide monitoring program have been proposed in this 2017 FWGMWP. The sampling frequency of the following wells are proposed to be reduced from semi-annual to annual: MW-56, MW-77, MW-93, MW-107, MW-111, and MW-129.

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bgs	below ground surface
DO	Dissolved Oxygen
DRO	Diesel Range Organics
EP	Evaporation Ponds
FWGMWP	Facility Wide Groundwater Monitoring Work Plan
GRO	Gasoline Range Organics
HSWA	Hazardous and Solid Waste Amendment
HWB	Hazardous Waste Bureau
IDW	Investigation-Derived Waste
mL	Milliliter
Navajo	HollyFrontier Navajo Refining LLC
NCL	North Colony Landfarm
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
OCD	New Mexico Energy, Minerals and Natural Resources Department Oil Conservation Division
ORP	Oxidation-Reduction Potential
PCC Permit	Post-Closure Care Permit
PIANO	Paraffins, Isoparaffins, Aromatics, Naphthenes, and Olefins
PSH	Phase-Separated Hydrocarbons
QA/QC	Quality Assurance/Quality Control
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigations
RO	Reverse Osmosis
SWMU	Solid Waste Management Units
TDS	Total Dissolved Solids
TEL	Tetra Ethyl Lead
TMD	Three Mile Ditch
TOC	Top of Casing
VOCs	Volatile Organic Compounds
WQCC	Water Quality Control Commission

1.0 INTRODUCTION

This *2017 Facility-Wide Groundwater Monitoring Work Plan* (2017 FWGMWP) details the proposed groundwater monitoring program to be implemented at the HollyFrontier Navajo Refining LLC (Navajo) Artesia Refinery (Refinery) located at 501 East Main Street in Artesia, New Mexico. The location of the Refinery is shown on Figure 1. The Refinery is subject to (1) a Post-Closure Care Permit (PCC Permit) issued by the New Mexico Environment Department (NMED) in October 2003 (NMED 2003) and later modified in December 2010 (NMED 2010); and (2) the renewed Discharge Permit GW-028 issued by New Mexico Energy, Minerals and Natural Resources Department Oil Conservation Division (OCD) on May 25, 2017 (OCD 2017). The PCC Permit authorizes and requires Navajo (the Permittee) to conduct facility-wide groundwater monitoring, with the purpose of evaluating 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 NMAC 20.6.2. The Discharge Permit also requires facility-wide groundwater monitoring to adequately define site conditions and provide necessary data to select and design an effective abatement option.

This 2017 FWGMWP serves as the annual update to the facility-wide groundwater monitoring program required by Section 4.7.6.a of the modified PCC Permit. The previous annual FWGMWP is the *2016 Facility-Wide Groundwater Monitoring Work Plan* which was submitted to NMED and OCD in June 2016 (TRC 2016) and approved on December 7, 2016 (NMED 2016). This 2017 FWGMWP details all groundwater monitoring activities that will be conducted to satisfy both the NMED PCC Permit and the OCD Discharge Permit upon approval by NMED and OCD. This 2017 FWGMWP describes the procedures to be followed during routine groundwater monitoring activities, including well gauging, groundwater sampling, managing investigation-derived waste (IDW), decontamination, analytical requirements, and quality assurance/quality control (QA/QC) requirements. The format of this 2017 FWGMWP follows the general outline specified for an investigation work plan in Appendix E.2 of the PCC Permit, while incorporating the requirements of Section 5 of the Discharge Permit.

The groundwater monitoring program covers the following Refinery areas:

- The closed Tetra Ethyl Lead (TEL) Impoundment;
- The closed North Colony Landfarm (NCL);
- The inactive Evaporation Ponds (EP);
- Three Mile Ditch (TMD); and
- The vadose zone located beneath the Refinery (including the areas referred to as North Refinery, South Refinery, Field East of Refinery, North Reverse Osmosis [RO] Reject

Field, South RO Reject Field, Cross-Gradient of Refinery, and Up-Gradient of Refinery).

The closed TEL Impoundment is an approximately 0.9-acre land treatment unit located along the northern portion of the Refinery to the south and east of Eagle Creek. The closed NCL is an approximately 4.25-acre land treatment unit located near the northwestern corner of the Refinery. The inactive EP area is located approximately three miles east of the active Refinery and immediately south/west of the Pecos River. The locations of these areas and the monitoring wells, recovery wells, and irrigation wells included in the facility-wide groundwater monitoring program are provided on Figure 2.

2.0 SITE BACKGROUND

The Refinery is an active petroleum refinery located at 501 East Main Street in the city of Artesia, Eddy County, New Mexico. The Refinery has been in operation since the 1920's and currently processes crude oil and other feedstocks into asphalt, fuel oil, gasoline, diesel, jet fuel, and liquefied petroleum gas. A site location map is provided as Figure 1. A facility-wide site plan is provided as Figure 2 and shows the locations of wells included in the facility-wide groundwater monitoring program.

The Refinery is regulated under the Resource Conservation and Recovery Act (RCRA) with EPA ID Number NMD 048918817. The NMED issued a Hazardous Waste Facility Permit to Navajo effective August 21, 1989 (NMED 1989), part of which included a Hazardous and Solid Waste Amendment (HSWA) Permit issued by the EPA. The HSWA permit required Navajo to identify all historical and current non-hazardous solid waste management units (SWMUs) and investigate those that had the potential to pose a threat to human health or the environment. RCRA Facility Investigations (RFIs) were conducted at the TMD and EP areas in 1990 (Mariah Associates, Inc. 1990) and from 1991 through 1993 (K.W. Brown Environmental Services 1993). Corrective actions were recommended for soil (K.W. Brown Environmental Services 1996) and groundwater (Foster Wheeler 1997) at the TMD and EP based on the RFI results. RFI activities were conducted at the NCL area from 1994 through 1997 (Covenant Technical Associates, Inc. 1997) and RFI results indicated groundwater impacts associated with historical operations were present at the NCL.

At the request of NMED, Navajo submitted a PCC Permit Application in June 1998 and revisions to the application in 2001 (Navajo 2001). The original intent of this application was to address only closure and post-closure activities at the EPs and TMD, but the application was expanded to include a complete RCRA Permit renewal application. The NMED issued a PCC Permit to Navajo effective October 5, 2003 (NMED 2003). The PCC Permit was modified in December 2010 (NMED 2010). The PCC Permit authorizes and requires the Permittee to monitor the groundwater, maintain all groundwater monitoring wells, and comply with applicable regulations of NMAC 20.4.1.500 during the post-closure period. Specific groundwater monitoring requirements are included in the PCC Permit for the areas of the TMD, NCL, EP, and other areas identified through implementation of the investigations of various SWMUs.

The Refinery applies reject fluids from the RO system to the Refinery North and South RO Reject Fields under Discharge Permit GW-028. The OCD originally issued the Discharge Permit to Navajo on October 21, 1991, and most recently issued a renewal on May 25, 2017 (OCD 2017). The Discharge Permit requires the Permittee to conduct facility-wide groundwater monitoring.

In 2006, Navajo submitted a Groundwater Monitoring Work Plan that combined the requirements of the two permits into a comprehensive facility-wide groundwater monitoring

program (Navajo 2006). This 2017 FWGMWP comprises the annual update of the work plan, as required by Section 4.7.6.a of the PCC Permit.

3.0 SITE CONDITIONS

This section describes the current surface and subsurface conditions at the Refinery.

3.1 Surface Conditions

3.1.1 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 at and surrounding the Refinery is shown on Figure 1. The average elevation of the City of Artesia is 3,380 feet above mean sea level. The plain on which the City of Artesia is located slopes eastward at about 20 feet per mile or 0.378 percent

3.1.2 Surface Water Drainage

Surface drainage in the region is dominated by small ephemeral creeks and arroyos that flow eastward to the Pecos River, located approximately three miles east of the city. The major drainage feature in the immediate area of the Refinery is Eagle Creek (or Eagle Draw), which runs southwest to northeast through the northern process area of the Refinery and then eastward to the Pecos River. Eagle Creek is an ephemeral watercourse that primarily flows only following rain events. Upstream of the Refinery, Eagle Creek functions as a major stormwater conveyance for the city. Eagle Creek also drains outlying areas west of the city and is periodically scoured by intense rain events.

Natural surface drainage at the Refinery is to the north and east. Stormwater within the process areas is captured and routed to the Refinery wastewater treatment system. Stormwater from non-process areas is contained within the Refinery property inside stormwater berms and routed to stormwater retention basins. Stormwater from within the Refinery boundary is not allowed to discharge to Eagle Creek.

The elevation of Eagle Creek 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 Creek was channelized from west of the City of Artesia to the Pecos River to help control and minimize flood events. In the vicinity of the Refinery, the Eagle Creek channel was cemented to provide further protection during flood events. A check dam was also constructed west of the City of Artesia along Eagle Creek. Federal floodplain maps indicate that most of the city and the Refinery have been effectively removed from the 100-year floodplain.

3.1.3 Area Land Uses

The areas north, south and east of the Refinery is sparsely populated and used primarily for agricultural 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 commercial businesses present south of the Refinery along Highway 82, including an oil-field pipe company located at the

southeast corner of the plant. Navajo owns a majority of the land bounded by Highway 82 to the South, East Richey Avenue to the north, Highway 285 to the west, and Bolton Road to the east. A majority of the land located east of the Refinery between Bolton Road and Haldeman Road is cultivated as pecan orchards or used for other agricultural purposes.

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

3.2 Subsurface Conditions

3.2.1 Surficial Soils

Surficial soil at the Refinery is predominantly comprised of approximately 60% Pima series and 40% Karro series. The Pima and Karro series both consist of deep, well drained soils that formed in alluvial settings. They are both calcareous and have slow to medium runoff.

3.2.2 Geology

Artesia is located on the northwest shelf of the Permian Basin. In this region, the deposits comprise of approximately 250 to 300 feet of Quaternary alluvium uncomformably overlying approximately 2,000 feet of Permian clastic and carbonate rocks. These Permian deposits uncomformably overlie Precambrian syenite, gneiss, and diabase crystalline rocks.

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.

3.2.2.2 Permian Artesian Group

The Permian Artesian Group is comprised of the following 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 Seven Rivers Formation is present at an approximate depth of 300 feet in the area between the Pecos River and the Refinery. However, the Seven Rivers Formation thins and pinches to the west and it is not evident based on boring logs that this formation has been encountered beneath the Refinery process areas.

In the area of the Refinery, the Queen and Grayburg Formations have been mapped as a single unit 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 greater than 700 feet thick and composed mainly of limestone and dolomite with irregular and erratic solution cavities ranging up to several feet in diameter. The upper portion of the formation is composed of oolitic dolomite with some anhydrite cement.

3.3 Hydrogeology

The principal aquifers in the Artesia area are within the San Andres Formation and the valley fill alluvium. There are two distinct water-bearing zones within the valley fill alluvium in the vicinity of the Refinery and are referred to as the "shallow saturated zone" and the "valley fill zone". The deeper carbonate aquifer within the San Andres Formation is referred to as the "deep artesian aquifer".

3.3.1 Shallow Saturated Zone

The shallow saturated zone occurs in interbedded sand and gravel channels at 15 to 30 feet below ground surface (bgs). The overlying clays, silts, and caliche undulate at the Refinery, which creates intermittent confined and unconfined groundwater conditions in the shallow saturated zone. Groundwater in this zone is under artesian pressure for some or most of the year, with static water levels measured in groundwater monitoring wells 3 to 5 feet above the shallow saturated zone.

The general direction of flow in this shallow saturated zone is to the east toward the Pecos River. Groundwater flow direction and gradient in the shallow saturated zone have remained generally consistent over time, as documented in previous annual groundwater monitoring reports.

Major sources of water in the shallow saturated zone are likely 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 shallow saturated zone is highly variable in quality, volume, areal extent, and saturated thickness. Concentrations of total dissolved solids (TDS) exceeding 2,000 mg/L and sulfate exceeding 500 mg/L have been recorded northwest (upgradient) of the Refinery.

The shallow saturated zone contains phase-separated hydrocarbon (PSH) and dissolved-phase hydrocarbon constituents, as reported in the *2016 Annual Groundwater Monitoring Report* (TRC 2017). Concentrations of dissolved-phase hydrocarbon constituents in the shallow saturated zone have generally exhibited a stable or decreasing trend over time.

3.3.2 Valley Fill Zone

The valley fill zone underlies the shallow saturated zone and occurs in Quaternary alluvial deposits of sand, silt, clay and gravel. These sediments are about 300 feet thick near the Refinery.

Irrigation and water production wells completed in the valley fill zone are typically screened across one to five water-producing intervals ranging in thickness of 20 to 170 feet, with a majority of the thicknesses being closer to 20 feet. Production intervals are non-continuous, consist principally of sand and gravel, and are separated by less permeable lenses of silt and clay of varying thickness. Based on logs of wells located immediately to the north and east of the Refinery, the thicknesses of silt and clay deposits range from 20 to 160 feet and are interspersed with thin zones of gravels in the upper 100 feet. Wells in the valley fill zone range from 40 to 60 feet bgs and the formation yields water containing TDS ranging from 500 to 1,500 mg/L.

The valley fill zone contains dissolved-phase hydrocarbon constituents, as reported in the *2016 Annual Groundwater Monitoring Report* (TRC 2017). Concentrations of dissolved-phase hydrocarbon constituents in the valley fill zone have generally exhibited a stable or decreasing trend over time.

The valley fill zone and the underlying San Andres aquifer are hydraulically connected in some areas.

3.3.3 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 intervals of variable permeability located in the upper portion of the formation. However, in the Artesia area, the water-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 water-producing interval is estimated to be about 440 feet bgs. 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. TDS in this aquifer ranges from 500 mg/L to more than 5,000 mg/L depending on location. In the Artesia area, water from this aquifer is generally produced from depths ranging from 850 feet to 1,250 feet below ground surface. The aquifer recharges 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 bgs, although extensive rainfall in some years may bring the water levels in some wells close to ground surface.

Available well completion records for irrigation well RA-4798 indicate that it is screened in the deep artesian aquifer from 840 to 850 feet bgs. Historic analytical data from this well does not indicate the presence of hydrocarbon impacts from Refinery operations.

4.0 MODIFICATIONS TO THE GROUNDWATER MONITORING NETWORK

No modifications to the groundwater monitoring network have occurred since submittal of the 2016 FWGMWP. Repairs and/or modifications made to the existing wells are described below.

4.1 New Monitoring Wells

No new monitoring wells have been installed since submittal of the 2016 FWGMWP.

4.2 Well Abandonment

No monitoring wells have been abandoned since submittal of the 2016 FWGMWP.

4.3 Well Repairs and Modifications

The following repairs and/or modifications were made to existing wells since submittal of the 2016 FWGMWP:

- Replaced locking J-plugs and locks on various monitoring wells.
- Installed and maintained PSH-absorbent socks in wells MW-7, MW-64, MW-65, MW-85, MW-86, and KWB-8.
- Redeveloped well NCL-32 to remove silt that had accumulated in the well. The redevelopment was documented in the *2016 Annual Groundwater Monitoring Report* that was submitted to the NMED and OCD in February 2017.

5.0 MONITORING PROGRAM SCOPE OF SERVICES

The proposed groundwater monitoring program will consist of semi-annual gauging of select wells; semi-annual, annual, or biennial groundwater sampling of select wells; and annual reporting. No substantial changes to the previous facility-wide monitoring program have been proposed in this 2017 FWGMWP. The sampling frequency of the following wells have been proposed to be reduced from semi-annual to annual: MW-56, MW-77, MW-93, MW-107, MW-111, and MW-129. The sampling frequency is proposed to be reduced to an annual basis for each well based on the following rationale:

- MW-56 (NCL): stable dissolved-phase COC concentrations over at least the five most recent semi-annual monitoring events and the presence of down-gradient and cross-gradient wells that are sampled on a semi-annual basis.
- MW-77 (EP): stable dissolved-phase COC concentrations over at least the five most recent semi-annual monitoring events and the presence of nearby wells MW-75 and MW-76 that are sampled on a semi-annual basis (i.e., MW-77 is a redundant well).
- MW-93 (North Refinery): stable to decreasing dissolved-phase COC concentrations over at least the five most recent semi-annual monitoring events and the presence of down-gradient wells MW-23, MW-43, MW-62, and MW-137 and cross-gradient wells MW-61, MW-67, and MW-97that are sampled on a semi-annual basis.
- MW-107 (South Refinery): stable to decreasing dissolved-phase COC concentrations over at least the five most recent semi-annual monitoring events and the presence of down-gradient wells MW-127, MW-128, and KWB-10R and cross-gradient wells MW-28, MW-99, and MW-125 that are sampled on a semi-annual basis.
- MW-111 and MW-129 (Field East of Refinery): stable to decreasing dissolved-phase COC concentrations over at least the five most recent semi-annual monitoring events and the presence of down-gradient wells MW-112, MW-131, MW-132, and KWB-6 and cross-gradient wells MW-58, MW-128, KWB-2R, and KWB-5 that are sampled on a semi-annual basis.

The above rationale is supported by the time-series plots provided in Appendix C of the *2016 Annual Groundwater Monitoring Report* and in Appendix A of this 2017 FWGMWP.

5.1 Scheduling and Notification

The schedule of the semi-annual groundwater monitoring events is dependent on the flood irrigation season of the pecan orchard located east of the Refinery, which is typically conducted between April and October. The first semi-annual event will be conducted before the start of the flood irrigation (in March or April of each calendar year) and the second semi-annual event will

be conducted after completion of the flood irrigation season (in October or November of each calendar year). Wells that will be sampled on an annual or biennial basis will be sampled during the March or April monitoring event (i.e., the annual event). Biennial events will be completed during odd-numbered calendar years. The NMED and OCD will be notified of the monitoring schedule prior to each monitoring event. The sampling frequency for each well is provided on Table 1 and Figure 3.

5.2 Gauging Requirements

Synoptic fluid level gauging will be completed semi-annually at all active and accessible monitoring and recovery wells. Wells will be gauged for depth to PSH, if present, depth to water, and total depth. Dedicated tubing will remain in the wells during gauging to minimize disturbance to the water column, if possible. All synoptic well gauging will be completed in as short a time-period as possible, typically within 48 hours. Each monitoring well will also be gauged immediately prior to commencing purging/sampling activities.

5.3 Sampling Requirements

Sampling frequency and target analytes for each well were selected based on historical data, dissolved-phase concentration trends, and well location relative to the Refinery and area boundaries. Select groundwater samples will be analyzed for volatile organic compounds (VOCs), diesel range organics (DRO), gasoline range organics (GRO), total metals, dissolved metals (March or April event only), cations, anions, nitrates/nitrites, cyanide, and/or TDS. Wells that contain PSH at measured thicknesses of 0.03 feet or greater will not be sampled during any event. The required sample analytical parameters and sampling frequency for each well are summarized in Table 1.

6.0 GROUNDWATER MONITORING PROCEDURES

Monitoring activities will consist of the following tasks: field documentation, well inspection, well gauging, groundwater purging and sampling, handling of samples for laboratory analysis, QA/QC sampling, and managing IDW. The procedures that will be used to complete each task are described in detail below.

6.1 Field Documentation

Documentation of field activities associated with groundwater monitoring events will be recorded each day in a bound field logbook and associated field sampling forms. Each page of the logbook and field sampling forms will be signed by the person(s) making entries on that page. The following information will be collected during groundwater sampling activities:

- Sampling and oversight personnel identification
- Instrument calibrations
- Well conditions
- Monitoring well measurements including static water level depth, total well depth, and water column height
- Depth to PSH, if present
- Weather conditions at the time of sample collection and throughout the sampling event
- Well purging procedures including: equipment, purge volume, rate, and elapsed time
- Water quality parameters recorded during purging including appearance, odor, pH, temperature, conductivity, TDS, oxidation-reduction potential (ORP), dissolved oxygen (DO), and turbidity
- Sample collection dates and times
- Reasons for deviating from the sampling and analysis plan (if applicable)

6.2 Well Inspection

During each gauging and sampling event, all monitoring and recovery wells will be inspected for well integrity. The information will be recorded on the groundwater gauging form. Each inspection will include:

- Identification of the well
- Inspection of the well pad for deterioration or damage
- Inspection of the protective casing for deterioration or damage
- Inspection of the well casing for deterioration or damage
- Inspection of the presence or absence and condition of the padlock and expandable well cap

- Measurement of the total depth of the well

6.3 Well Gauging

The depth to PSH, if present, and groundwater will be gauged at each monitoring well prior to sampling. The wells that are to be gauged are presented in Table 1 and well locations are depicted on Figure 2. Prior to gauging, each well cap will be removed to allow groundwater to equilibrate with atmospheric pressure. Fluid level measurements will be collected using an oil/water interface probe to an accuracy of 0.01 feet. Measurements will be made from a marked survey datum at the top of casing (TOC). Data will be recorded on a paper field gauging form. The oil/water interface probe will be decontaminated before use and between wells following the procedures outlined in Section 6.8.

6.3.1 Fluid Level Gauging Procedures

The following procedure will be used to measure the depths to PSH and groundwater:

- The probe will be lowered into the well slowly until the probe alarm sounds or light illuminates, withdraw the tape and lower it again slowly until the alarm is again audible or light again illuminates. Check the depth to fluid on the tape and record the depth to within 0.01 feet. Raise and lower the probe again slowly and repeat measurements for accuracy.
- Well identification, date, time, depth to water, depth to PSH (if applicable), and other pertinent observations will be recorded on the field gauging form.

6.3.2 Total Depth Gauging

Total well depth is measured to detect the amount of silt accumulation in a well. This measurement will be collected during sampling events and well inspections. The following procedures will be followed to determine the total depth of the well:

- The oil/water interface probe will be slowly lowered until the bottom of the well is detected.
- The total well depth will be measured when the tape becomes slack for hard bottoms.
- The point of "pick-up" (where the weight of the probe is felt when reeling up the probe) will be used to determine the total depth in the case of soft sediment bottoms.
- The hardness of the bottom of the well will be documented in the field logbook.

6.4 Groundwater Sampling

Groundwater will be purged and sampled from monitoring and recovery wells using low-flow methods in accordance with the NMED Hazardous Waste Bureau (HWB) Position Paper "Use of Low-Flow and Other Non-Traditional Sampling Techniques for Compliance Groundwater

Monitoring" (NMED 2001). Groundwater will be purged and sampled from irrigation wells using standard procedures described below. Data collected during the purging and sampling of each well will be recorded on a paper groundwater sampling form.

Groundwater will be purged and sampled from monitoring and recovery wells using either a peristaltic pump (for sampling depths of approximately 25 feet bgs or less) or a dedicated, stainless steel submersible pump (for sampling depth greater than 25 feet bgs). The locations of monitoring and recovery wells to be purged and sampled are provided on Figure 3. An oil/water interface probe will be lowered into the monitoring well to record the depth to water.

Groundwater will be purged and sampled from irrigation wells by attaching a decontaminated or dedicated hose barb to the available spigot. The spigot will be located at a point before the water supply is introduced into any storage tanks or treatment units. The groundwater will be purged from the spigot so that any stagnant water from the well casing and surface piping is removed.

A multi-parameter water quality meter with flow-through cell and hand-held turbidity meter will be used during the purging process to monitor for field water quality parameters (pH, temperature, conductivity, TDS, ORP, DO, and turbidity) and demonstrate stabilization. Water quality parameters will be recorded approximately every three minutes during purging. Water quality meters used to measure field parameters will be calibrated each day according to the manufacturer's specifications. The make, model, calibration fluids, and calibration results for the water quality meters will be recorded in the field logbook. The turbidity meter test cell will be triple rinsed with groundwater from the next sample aliquot prior to each reading. The water quality parameters and depth to water (in non-irrigation wells only) will be recorded on the Groundwater Sampling Form. A description of the water quality (e.g., turbidity, sheen, odor) will be recorded during the purging process.

The purging process will be considered complete and groundwater sampling will commence when at least four of the seven water quality parameters achieve stabilization within ten percent for three consecutive readings.

If the well goes dry during purging, a sample will be collected as soon after the water level recovers to a level from which a sample can be collected. The samples will be collected in clean, labeled laboratory-supplied containers prepared with the appropriate amount and type of preservative. The groundwater samples will be submitted for laboratory analysis following the schedule in Table 1.

Samples submitted for dissolved metals analysis will be filtered in the field using a new 0.45-micron filter. Filtering methods will be documented on the groundwater sampling form, field logbook, and chain-of-custody.

6.5 Handling of Samples for Laboratory Analysis

Neoprene or nitrile gloves will be worn during sample collection and while handling sample containers. New disposable gloves will be used to collect each sample. The sample containers will be labeled, secured with bubble wrap, placed in a resealable plastic bag, and immediately placed on ice in a cooler and stored below 4° C. The sample labels will include the Permittee name (Navajo), site name (Artesia Refinery), unique sample identification, sample collection time and date, preservatives, and the name(s) of the sampler(s). The samples will be secured with packing material and kept below 4° C with wet ice in accordance with laboratory cooler shipping guidelines. The cooler will be secured with packing tape, and a signed and dated custody seal will be placed over the cooler lid and secured with tape. The samples and a completed chain-of-custody documentation will be shipped via priority overnight delivery to the analytical laboratory. The chain-of-custody forms are to be maintained as a record of sample collection, transfer, shipment, and receipt by the laboratory. At a minimum, all samples will be submitted to the laboratory within 48 hours after collection. The laboratory will be informed that samples are being submitted for analysis and it will be confirmed that the samples were received the following day. If samples are shipped on Friday for Saturday delivery, the receiving laboratory will be contacted so provisions can be made for laboratory sample receipt.

6.6 Quality Assurance/Quality Control Sampling

Field QA/QC samples for groundwater will be collected as follows:

- Duplicates: Collected at a frequency of ten percent at the same time and from the same location as the original sample.
- Equipment blanks: Collected from non-dedicated, decontaminated equipment at a frequency of five percent by pouring distilled water over the equipment and collecting the sample in the appropriate laboratory containers.
- Trip blanks: One included in each cooler shipped to the laboratory that contains samples for VOC analyses. The trip blank consists of two 40-milliliter (mL) vials of reagent water provided by the laboratory that were stored in the sample cooler at all times.

Laboratory QA/QC samples will be performed according to test methodologies specified for each analytical method. The laboratory QA/QC samples may 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.

6.7 PSH Sample Collection

In the event that PSH is present in any of the monitoring or recovery wells that have not historically contained PSH, samples may be collected when sufficient volume (80 mL) is present for collection and analysis. The desired analyses for evaluation of PSH include paraffins, isoparaffins, aromatics, naphthenes, and olefins (PIANO) as well as specific gravity and simulated distillation. Navajo will notify the NMED within seven calendar days if PSH is present in wells where PSH has not previously be encountered, as required by the PCC Permit.

PSH samples will be collected using a disposable, non-dedicated 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 managed per methods discussed in Section 6.9.

6.8 Decontamination

The interface probe and other non-dedicated equipment coming into contact with groundwater will be decontaminated by the following procedures:

1. Remove PSH, if present, with an absorbent pad.
2. Remove any solids to the degree possible with a brush and tap or distilled water. Wash with a brush, laboratory-grade non-phosphate detergent (e.g., Liquinox, Alconox), and potable tap water. Allow excess soap to drain off the equipment when finished.
3. Double rinse with distilled water.

All decontamination fluids will be managed per methods discussed in Section 6.9.

6.9 Investigation Derived Waste Disposal

The IDW (e.g., purge water, decontamination water) generated during monitoring activities will be disposed of at the collected and disposed of in the Refinery wastewater treatment system, upstream of the oil/water separator. Miscellaneous IDW (e.g., gloves, bailers) in contact with investigative material deemed to have no or de minimus contamination will be disposed of in a general refuse container. Any IDW deemed to have greater than de minimus contamination will be stored in labeled drums and disposed appropriately on a per case basis.

7.0 ANNUAL FACILITY-WIDE GROUNDWATER MONITORING REPORT

Groundwater monitoring from each calendar year will be documented in an *Annual Facility-Wide Groundwater Monitoring Report*, in accordance with both the PCC Permit and the Discharge Permit. The *Annual Facility-Wide Groundwater Monitoring Report* will follow the general report format provided in Appendix E of the PCC Permit and incorporate the requirements of Section 2.E of the Discharge Permit. At a minimum, the *Annual Facility-Wide Groundwater Monitoring Report* will include 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 semi-annual 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 semi-annual monitoring event of the reporting period, including site features and the direction and magnitude of the hydraulic gradient;
- PSH thickness isopleths maps for each semi-annual 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;
- 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 Facility-Wide Groundwater Monitoring Report* will be submitted to the NMED and OCD by February 28 of the calendar year following sample collection.

8.0 Schedule

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

The second semi-annual event will occur no later than 30 days after the conclusion of the pecan orchard flood irrigation season or November 15 each year. Typically, the second semi-annual event will occur in October or November of each calendar year.

The wells that are sampled on an annual basis will be sampled during the first semi-annual event of each calendar year.

The wells that are sampled biennially will be sampled every other year. Biennial sampling at the Refinery began in the first semi-annual event of 2011. As such, these wells will be sampled during the first semi-annual event of each odd numbered year.

Navajo will notify both NMED and OCD prior to the initiation of each semi-annual sampling event.

The *Annual Facility-Wide Groundwater Monitoring Report* will be submitted to NMED and OCD no later than February 28 of the calendar year following sample collection.

9.0 References

Covenant Technical Associates, Inc. 1997. Revised RCRA Facility Investigation Phase II Report North Colony Landfarm. November 1997.

Foster Wheeler 1997. Consolidated RFI/CMS Report for Three-Mile Ditch and Evaporation Ponds. December 1997.

K.W. Brown Environmental Services 1993. RFI Three-Mile Ditch and Evaporation Ponds Phase II Report (Revised). November 1993.

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Mariah Associates, Inc. 1990. RCRA Facility Investigation, Three-Mile Ditch and Evaporation Ponds, Phase I (Revised). October 1990.

NMED 1989. Hazardous Waste Facility Permit Number NMD048918817-1. January 22, 1988, amended by letters dated December 22, 1988, January 24, 1989, and August 18, 1989.

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NMED 2003. Navajo Refining Company Artesia Refinery Post-Closure Care Permit. September 2003.

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NMED 2016. Approval, 2016 Facility Wide Groundwater Monitoring Workplan. December 7, 2016.

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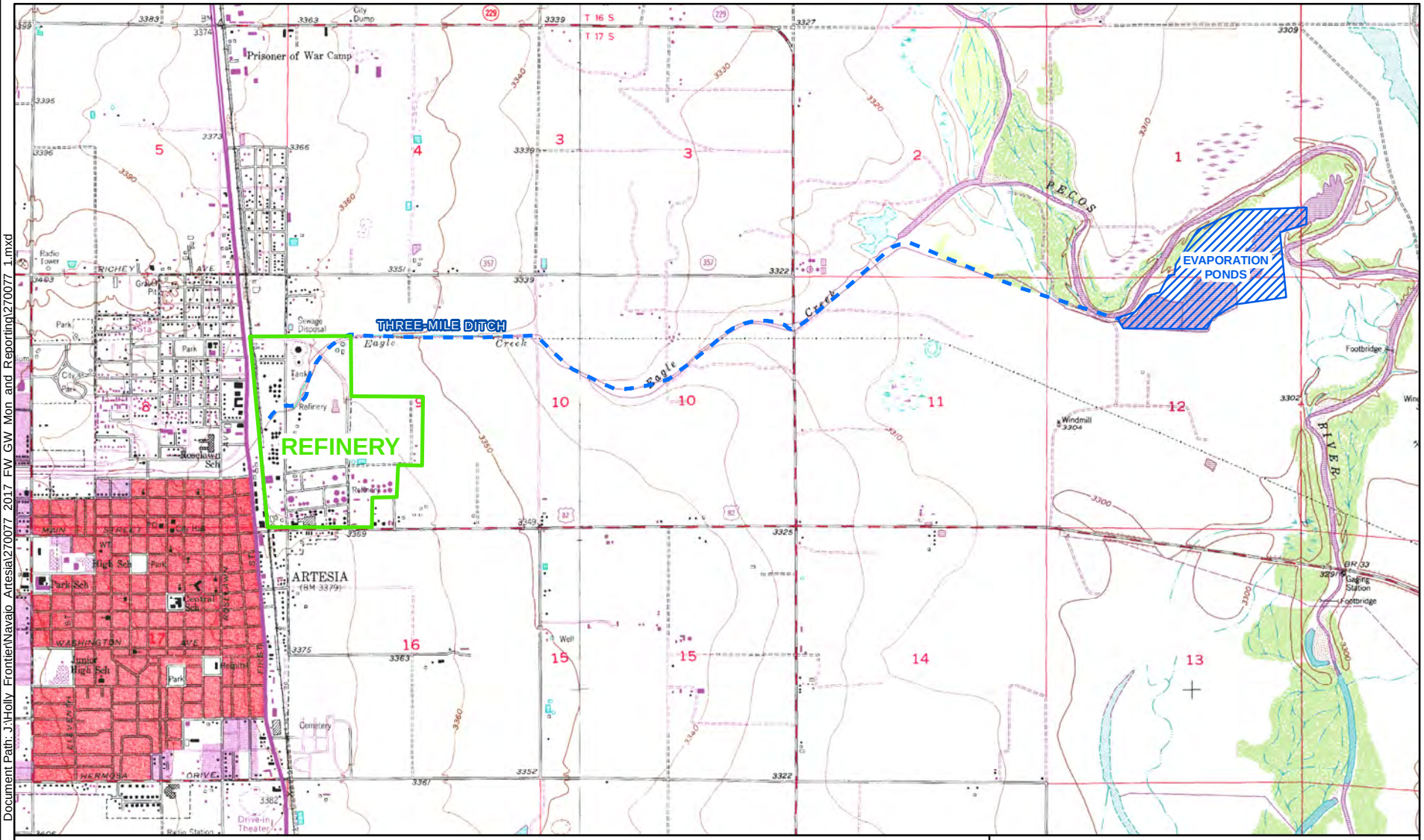
Navajo 2006. Groundwater Monitoring Work Plan for Navajo Refining Company, L.P. Artesia, New Mexico. October 2, 2006.

OCD 2017. HollyFrontier Navajo Refining LLC Artesia Refinery, Renewal of Discharge Permit GW-028. May 25, 2017

TRC 2016. 2016 Facility-Wide Groundwater Monitoring Work Plan. June 29, 2016.

TRC 2017. 2017 Annual Groundwater Monitoring Report. February 2017.

FIGURES



N

0 1,600 3,200
Feet

SOURCE: BASE MAP USGS 7.5 MINUTE SERIES QUADS, ARTESIA AND SPRINGLAKE QUADRANGLES, 1955, PHOTOREVISED 1983.

SITE LOCATION MAP

HOLLYFRONTIER NAVAJO REFINING LLC
ARTESIA REFINERY, EDDY COUNTY, NEW MEXICO

PROJECT NUMBER: 270077	FILE NAME: 270077_1
AUTHOR: MLOVELACE	DATE: 6/8/2017

TRC
505 E. HUNTLAND DR.
SUITE 250
AUSTIN, TX 78752
PH:512-329-6080

FIGURE
1

LEGEND

- IRRIGATION WELL
- MONITORING WELL
- RECOVERY WELL
- REFINERY BOUNDARY

AERIAL IMAGERY SOURCE: GOOGLE AND THEIR DATA PARTNERS 2015

N S E W

0 750 1,500
Feet

1 IN = 750 FT

New Mexico

WELL LOCATION MAP

HOLLYFRONTIER NAVAJO REFINING LLC
ARTESIA REFINERY, EDDY COUNTY, NEW MEXICO

AUTHOR: MLOVELACE | SAVED: 6/8/2017 | MXD: 270077_2

TRC
505 E. HUNTLAND DR.
SUITE 250
AUSTIN, TX 78752
PH:512-329-6080

FIGURE
2

Document Path: J:\Holly_Frontier\Navajo_Artesia\270077_2017_FW_GW_Mon_and_Reporting\270077_2.mxd

LEGEND

- IRRIGATION WELL NOT INCLUDED IN SAMPLING PLAN
- MONITORING WELL NOT INCLUDED IN SAMPLING PLAN
- RECOVERY WELL NOT INCLUDED IN SAMPLING PLAN
- WELL TO BE SAMPLED ON A SEMI-ANNUAL BASIS
- WELL TO BE SAMPLED ON AN ANNUAL BASIS
- WELL TO BE SAMPLED ON A BIENNIAL BASIS
- REFINERY BOUNDARY

AERIAL IMAGERY SOURCE: GOOGLE AND THEIR DATA PARTNERS 2015

N E S W

0 750 1,500
Feet

1 IN = 750 FT

NOTES:
1. SAMPLES WILL BE SUBMITTED FOR LABORATORY ANALYSIS IN ACCORDANCE WITH TABLE 1 OF THIS WORK PLAN.
2. SAMPLE POINTS IN RECOVERY TRENCHES 11, 15, 16, 17, AND 18 ARE RW-11-0, RW-15C, RW-16B, RW-17A, AND RW-18-A, RESPECTIVELY.

New Mexico

FACILITY-WIDE GROUNDWATER SAMPLING PLAN

HOLLYFRONTIER NAVAJO REFINING LLC
ARTESIA REFINERY, EDDY COUNTY, NEW MEXICO

AUTHOR: MLOVELACE | SAVED: 6/8/2017 | MXD: 270077_3

TRC

505 E. HUNTLAND DR.
SUITE 250
AUSTIN, TX 78752
PH:512-329-6080

FIGURE 3

TABLES

Table 1. 2017 Facility-Wide Groundwater Monitoring Program and Schedule

HollyFrontier Navajo Refining LLC - Artesia Refinery, Artesia, New Mexico

Well ID	Well Type	Associated Area	Well Construction [a]			Historic PSH? [b]	Gauging Frequency	Analytical Suite and Frequency [c]									
			Well Diameter (in)	Screen Interval (ft bgs)	Water Bearing Zone			Purge Parameters	DRO	GRO	VOCs	Metals		Cyanide	Cations/Anions	Nitrate / Nitrite as Nitrogen	Total Dissolved Solids
												As, Ba, Cr, Fe, Pb, Mn, Se	B, Cd, Co, Hg, Ni, U, Va				
KWB-13	Monitoring	Crossgradient	2		Shallow		SA	A	A	-	A	A	A	A	A	A	A
MW-136	Monitoring	Crossgradient	2	10 to 25	Shallow		SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
NP-5	Monitoring	Crossgradient	2	10.25 to 20	Shallow		SA	B	B	-	B	B	-	-	B	B	B
MW-1R	Monitoring	EP	2	8 to 23	Shallow		SA	A	A	-	A	A	-	-	A	A	A
MW-2A	Monitoring	EP	2		Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-2B	Monitoring	EP	2	38.5 to 48	Valley Fill		SA	No samples to be collected									
MW-3	Monitoring	EP	2		Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-4A	Monitoring	EP	4		Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-4B	Monitoring	EP	4	60.25 to 70	Valley Fill		SA	B	B	B	B	B	-	-	B	B	B
MW-5A	Monitoring	EP	2		Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-5B	Monitoring	EP	2	41.5 to 50.5	Valley Fill		SA	B	B	B	B	B	-	-	B	B	B
MW-5C	Monitoring	EP	2	59.25 to 68.75	Valley Fill		SA	B	B	B	B	B	-	-	B	B	B
MW-6A	Monitoring	EP	2		Shallow		SA	A	A	A	A	A	-	-	A	A	A
MW-6B	Monitoring	EP	2	39.5 to 49	Valley Fill		SA	B	B	B	B	B	-	-	B	B	B
MW-7A	Monitoring	EP	2		Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-7B	Monitoring	EP	4	39.5 to 49	Valley Fill		SA	B	B	B	B	B	-	-	B	B	B
MW-10	Monitoring	EP	2		Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-11A	Monitoring	EP	4	5.5 to 20	Shallow		SA	A	A	A	A	A	-	-	SA	SA	SA
MW-11B	Monitoring	EP	2	35.5 to 45	Valley Fill		SA	B	B	B	B	B	-	-	B	B	B
MW-12	Monitoring	EP	4	6.5 to 16	Shallow		SA	No samples to be collected									
MW-13	Monitoring	EP	4	9.5 to 19	Shallow		SA	No samples to be collected									
MW-14	Monitoring	EP	4	5.5 to 20	Shallow		SA	No samples to be collected									
MW-15	Monitoring	EP	4	9 to 19	Shallow		SA	A	A	A	A	A	-	-	A	A	A
MW-18A	Monitoring	EP	4	10 to 20	Shallow		SA	SA	SA	-	SA	SA	SA	SA	SA	SA	SA
MW-18B	Monitoring	EP	2	37 to 47	Valley Fill		SA	B	B	B	B	B	-	-	B	B	B
MW-18T	Monitoring	EP	4	37 to 47	Valley Fill		SA	No samples to be collected									
MW-22A	Monitoring	EP	4	5.5 to 20.5	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-22B	Monitoring	EP	2	42.3 to 52	Valley Fill		SA	B	B	B	B	B	-	-	B	B	B
MW-24	Monitoring	EP	6	15 to 20	Shallow		SA	No samples to be collected									
MW-69	Monitoring	EP	2	5 to 20	Shallow		SA	No samples to be collected									
MW-70	Monitoring	EP	4	5 to 20	Shallow		SA	SA	SA	SA	SA	SA	-	-	A	A	A
MW-72	Monitoring	EP	4	2 to 12	Shallow		SA	A	A	A	A	A	-	-	A	A	A
MW-73	Monitoring	EP	4	2 to 17	Shallow		SA	A	A	A	A	A	-	-	A	A	A
MW-74	Monitoring	EP	4	2 to 17	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-75	Monitoring	EP	4	3 to 18	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-76	Monitoring	EP	4	3 to 18	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-77	Monitoring	EP	4	3 to 18	Shallow		SA	A	A	A	A	A	-	-	A	A	A
MW-78	Monitoring	EP	4	2 to 17	Shallow		SA	A	A	A	A	A	-	-	A	A	A
MW-79	Monitoring	EP	4	2 to 17	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-80	Monitoring	EP	4	2 to 17	Shallow		SA	A	A	A	A	A	-	-	A	A	A
MW-81	Monitoring	EP	4	2 to 17	Shallow		SA	A	A	A	A	A	-	-	A	A	A
MW-82	Monitoring	EP	4	2 to 17	Shallow		SA	A	A	A	A	A	-	-	A	A	A
MW-83	Monitoring	EP	4	2 to 17	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-84	Monitoring	EP	4	2 to 17	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-85	Monitoring	EP	4	3 to 18	Shallow	**Y**	SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-86	Monitoring	EP	4	2 to 17	Shallow	**Y**	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
MW-87	Monitoring	EP	4	2 to 17	Shallow		SA	SA	SA	SA	SA	SA	-	-	A	A	A
MW-88	Monitoring	EP	4	3 to 18	Shallow		SA	SA	SA	SA	SA	SA	-	-	A	A	A
MW-120	Monitoring	EP	2	10 to 25	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-121	Monitoring	EP	2	10 to 25	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-122	Monitoring	EP	2	10 to 20	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-123	Monitoring	EP	2	10 to 25	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-124	Monitoring	EP	2	5 to 20	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
OCD-1R	Monitoring	EP	2		Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
OCD-2A	Monitoring	EP	2	8.5 to 23.5	Shallow		SA	SA	SA	SA	SA	SA	-	-	A	A	A
OCD-2B	Monitoring	EP	2	38.5 to 48	Valley Fill		SA	No samples to be collected									
OCD-3	Monitoring	EP	2	6.5 to 21.5	Shallow		SA	SA	SA	SA	SA	SA	-	-	A	A	A
OCD-4	Monitoring	EP	2	6.5 to 21.5	Shallow		SA	SA	SA	SA	SA	SA	-	-	A	A	A
OCD-5	Monitoring	EP	2		Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
OCD-6	Monitoring	EP	2	8 to 23	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
OCD-7AR	Monitoring	EP	4	5.5 to 19.5	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
OCD-7B	Monitoring	EP	2	43.5 to 52.5	Valley Fill		SA	B	B	B	B	B	-	-	B	B	B
OCD-7C	Monitoring	EP	2	60.25 to 69.75	Valley Fill		SA	No samples to be collected									
OCD-8A	Monitoring	EP	2	3 to 18	Shallow		SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
OCD-8B	Monitoring	EP	2	43.5 to 53	Valley Fill		SA	B	B	B	B	B	-	-	B	B	B

Table 1. 2017 Facility-Wide Groundwater Monitoring Program and Schedule

HollyFrontier Navajo Refining LLC - Artesia Refinery, Artesia, New Mexico

Well ID	Well Type	Associated Area	Well Construction [a]			Historic PSH? [b]	Gauging Frequency	Analytical Suite and Frequency [c]									
			Well Diameter (in)	Screen Interval (ft bgs)	Water Bearing Zone			Purge Parameters	DRO	GRO	VOCs	Metals: As, Ba, Cr, Fe, Pb, Mn, Se	Metals: B, Cd, Co, Hg, Ni, U, Va	Cyanide	Cations/Anions	Nitrate / Nitrite as Nitrogen	Total Dissolved Solids
KWB-1A	Monitoring	Field E of Refinery	2	18 to 32	Shallow		SA	SA	SA	-	SA	SA	SA	SA	SA	SA	SA
KWB-1B	Monitoring	Field E of Refinery	4	18 to 32	Shallow		SA	No samples to be collected									
KWB-1C	Monitoring	Field E of Refinery	4	30.5 to 49.5	Valley Fill		SA	B	B	-	B	B	-	-	B	B	B
KWB-2R	Monitoring	Field E of Refinery	2		Shallow	Y	SA	SA	SA	-	SA	SA	-	-	SA	SA	SA
KWB-3AR	Monitoring	Field E of Refinery	2	17 to 33	Shallow		SA [e]	SA [e]	SA [e]	-	SA [e]	SA [e]	SA [e]	SA [e]	SA [e]	SA [e]	SA [e]
KWB-5	Monitoring	Field E of Refinery	2	24.7 to 38.7	Shallow	Y	SA	SA	SA	-	SA	SA	-	-	SA	SA	SA
KWB-6	Monitoring	Field E of Refinery	2	17.5 to 36.5	Shallow		SA	SA	SA	-	SA	SA	-	-	SA	SA	SA
KWB-7	Monitoring	Field E of Refinery	2	18 to 32	Shallow	Y	SA	SA	SA	-	SA	SA	SA	SA	SA	SA	SA
KWB-8	Monitoring	Field E of Refinery	2	15 to 34	Shallow	Y	SA	SA	SA	-	SA	SA	SA	SA	SA	SA	SA
KWB-9	Monitoring	Field E of Refinery	2	20 to 34	Shallow		SA [e]	A [e]	A [e]	-	A [e]	A [e]	A [e]	A [e]	A [e]	A [e]	A [e]
KWB-10R	Monitoring	Field E of Refinery	4	9 to 29	Shallow	Y	SA	SA	SA	-	SA	SA	-	-	SA	SA	SA
KWB-11A	Monitoring	Field E of Refinery	4	30 to 39.5	Shallow		SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
KWB-11B	Monitoring	Field E of Refinery	4	50 to 69.5	Valley Fill		SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
KWB-12A	Monitoring	Field E of Refinery	4	15.5 to 24.5	Shallow		SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
KWB-12B	Monitoring	Field E of Refinery	4	25.5 to 39.5	Valley Fill		SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
KWB-P4	Monitoring	Field E of Refinery	2		Shallow		B	B	B	-	B	-	-	-	-	-	-
MW-57	Monitoring	Field E of Refinery	2	10 to 30	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-58	Monitoring	Field E of Refinery	4	13 to 28	Shallow	Y	SA	SA	SA	-	SA	SA	SA	SA	SA	SA	SA
MW-111	Monitoring	Field E of Refinery	2	25 to 40	Shallow		SA	A	A	A	A	A	-	-	A	A	A
MW-112	Monitoring	Field E of Refinery	2	25 to 35	Shallow	Y	SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-113	Monitoring	Field E of Refinery	2	20 to 35	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-125	Monitoring	Field E of Refinery	2	15 to 25	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-126A	Monitoring	Field E of Refinery	2	19 to 34	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-126B	Monitoring	Field E of Refinery	2	40 to 50	Valley Fill		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-127	Monitoring	Field E of Refinery	2	20 to 50	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-128	Monitoring	Field E of Refinery	2	15 to 35	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-129	Monitoring	Field E of Refinery	2	20 to 50	Shallow	Y	SA	A	A	A	A	A	-	-	A	A	A
MW-131	Monitoring	Field E of Refinery	2	20 to 50	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-132	Monitoring	Field E of Refinery	2	15 to 40	Shallow	Y	SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-133	Monitoring	Field E of Refinery	2	15 to 35	Shallow	Y	SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-134	Monitoring	Field E of Refinery	2	20 to 30	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-135	Monitoring	Field E of Refinery	2	35 to 65	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
RA-1227	Irrigation	Field E of Refinery	10 / 8	194 to 246	Artesian		NA	A [e]	-	-	A [e]	-	-	-	A [e]	A [e]	A [e]
RA-3156	Irrigation	Field E of Refinery	4	182 to ?	Artesian		NA	A	-	-	A	-	-	-	A	A	A
RA-4196	Irrigation	Field E of Refinery	8	280 to 292	Artesian		NA	SA	-	-	SA	-	-	-	SA	SA	SA
RA-4798	Irrigation	Field E of Refinery	7	840 to 850	Artesian		NA	SA	-	-	SA	-	-	-	SA	SA	SA
RW-11 [d]	Recovery	Field E of Refinery	36		Shallow		SA	A	A	-	A	A	-	-	A	A	A
RW-12R	Recovery	Field E of Refinery	12	15 to 35	Shallow	Y	SA	A	A	-	A	A	-	-	A	A	A
RW-13R	Recovery	Field E of Refinery	12	15 to 35	Shallow	Y	SA	A	A	-	A	A	-	-	A	A	A
RW-14R	Recovery	Field E of Refinery	12	15 to 35	Shallow	Y	SA	A	A	-	A	A	-	-	A	A	A
RW-18 [d]	Recovery	Field E of Refinery	36		Shallow		SA	A	-	-	A	A	-	-	A	A	A
RW-20	Recovery	Field E of Refinery	4		Shallow	Y	SA	A	A	-	A	A	-	-	A	A	A
RW-22	Recovery	Field E of Refinery	12	11.5 to 39	Shallow	Y	SA	A	A	-	A	A	-	-	A	A	A
MW-23	Monitoring	N Refinery	6	15 to 20	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-29	Monitoring	N Refinery	2	9.75 to 19.25	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-30	Monitoring	N Refinery	8		Shallow		SA	No samples to be collected									
MW-39	Monitoring	N Refinery	2	14 to 24	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-40	Monitoring	N Refinery	2		Shallow		SA	A	A	A	A	A	-	-	A	A	A
MW-41	Monitoring	N Refinery	2	14 to 19	Shallow		SA	A	A	A	A	A	-	-	A	A	A
MW-42	Monitoring	N Refinery	2		Shallow		SA	A	A	A	A	A	-	-	A	A	A
MW-43	Monitoring	N Refinery	6	15.5 to 20.5	Shallow		SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
MW-59	Monitoring	N Refinery	2	15 to 30	Shallow		SA	A	A	A	A	A	-	-	A	A	A
MW-60	Monitoring	N Refinery	2	15 to 30	Shallow		SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
MW-61	Monitoring	N Refinery	4	14 to 29	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-62	Monitoring	N Refinery	4	14 to 29	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-67	Monitoring	N Refinery	4	12 to 27	Shallow		SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
MW-90	Monitoring	N Refinery	4	5 to 20	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-91	Monitoring	N Refinery	4	7 to 22	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-92	Monitoring	N Refinery	4	5 to 20	Shallow	Y	SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-93	Monitoring	N Refinery	4	5 to 20	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-94	Monitoring	N Refinery	4	5 to 20	Shallow	Y	SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-95	Monitoring	N Refinery	4	7 to 22	Shallow		SA	A	A	A	A	A	-	-	A	A	A
MW-96	Monitoring	N Refinery	4	7 to 22	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-97	Monitoring	N Refinery	4	8 to 23	Shallow	Y	SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-98	Monitoring	N Refinery	4	13 to 23	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA

Table 1. 2017 Facility-Wide Groundwater Monitoring Program and Schedule

HollyFrontier Navajo Refining LLC - Artesia Refinery, Artesia, New Mexico

Well ID	Well Type	Associated Area	Well Construction [a]			Historic PSH? [b]	Gauging Frequency	Analytical Suite and Frequency [c]									
			Well Diameter (in)	Screen Interval (ft bgs)	Water Bearing Zone			Purge Parameters	DRO	GRO	VOCs	Metals		Cyanide	Cations/Anions	Nitrate / Nitrite as Nitrogen	Total Dissolved Solids
												As, Ba, Cr, Fe, Pb, Mn, Se	B, Cd, Co, Hg, Ni, U, Va				
MW-137	Monitoring	N Refinery	2	10 to 30	Shallow		SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
MW-138	Monitoring	N Refinery	2	TBD	Shallow		SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
RW-1R	Recovery	N Refinery	12	15 to 35	Shallow	Y	SA	A	A	A	A	A	-	-	A	A	A
RW-2R	Recovery	N Refinery	12	14.5 to 34.5	Shallow	Y	SA	A	A	A	A	A	-	-	A	A	A
RW-7R	Recovery	N Refinery	12	14.5 to 34.5	Shallow	Y	SA	A	A	A	A	A	-	-	A	A	A
RW-8R	Recovery	N Refinery	12	14.5 to 34.5	Shallow	Y	SA	A	A	-	A	A	-	-	A	A	A
RW-9	Recovery	N Refinery	36		Shallow		SA	A	A	A	A	A	-	-	A	A	A
RW-10	Recovery	N Refinery	36		Shallow		SA	A	A	A	A	A	-	-	A	A	A
RW-16 [d]	Recovery	N Refinery	36		Shallow		SA	A	A	-	A	A	-	-	A	A	A
RW-17 [d]	Recovery	N Refinery	36		Shallow		SA	A	A	A	A	A	-	-	A	A	A
MW-117	Monitoring	N RO Reject Field	2	10 to 25	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-118	Monitoring	N RO Reject Field	2	10 to 25	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-119	Monitoring	N RO Reject Field	2	10 to 25	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-18	Monitoring	NCL	8	15 to 19	Shallow		SA	A	A	-	A	A	A	A	A	A	A
MW-19	Monitoring	NCL	2		Shallow		SA	No samples to be collected									
MW-45	Monitoring	NCL	2	10.5 to 15.5	Shallow		SA	SA	SA	-	SA	SA	SA	SA	SA	SA	SA
MW-53	Monitoring	NCL	2	13.8 to 23.8	Shallow		SA	A	A	-	A	A	-	-	A	A	A
MW-54A	Monitoring	NCL	2	12.7 to 27.7	Shallow		SA	SA	SA	-	SA	SA	-	-	SA	SA	SA
MW-54B	Monitoring	NCL	2	33.8 to 43.8	Valley Fill		SA	B	B	B	B	B	-	-	B	B	B
MW-55	Monitoring	NCL	2	13.7 to 23.7	Shallow		SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
MW-56	Monitoring	NCL	2	13.4 to 23.4	Shallow		SA	A	A	-	A	A	-	-	A	A	A
MW-108	Monitoring	NCL	4	9 to 24	Shallow		SA	SA	SA	-	SA	SA	-	-	SA	SA	SA
NCL-31	Monitoring	NCL	2	13 to 18	Shallow		SA	SA	SA	-	SA	SA	-	-	SA	SA	SA
NCL-32	Monitoring	NCL	2	17 to 22	Shallow		SA	SA	SA	-	SA	SA	-	-	SA	SA	SA
NCL-33	Monitoring	NCL	2	13 to 18	Shallow		SA	SA	SA	-	SA	SA	-	-	SA	SA	SA
NCL-34	Monitoring	NCL	2	16 to 21	Shallow		SA	SA	SA	-	SA	SA	-	-	SA	SA	SA
NCL-44	Monitoring	NCL	2		Shallow		SA	SA	SA	-	SA	SA	-	-	SA	SA	SA
NCL-49	Monitoring	NCL	2	16.8 to 17.8	Shallow		SA	SA	SA	-	SA	SA	-	-	SA	SA	SA
KWB-4	Monitoring	S Refinery	2	20 to 39	Shallow	Y	SA	SA	SA	-	SA	SA	-	-	SA	SA	SA
MW-28	Monitoring	S Refinery	6	25 to 30	Shallow		SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
MW-48	Monitoring	S Refinery	2	19 to 34	Shallow	Y	SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-50	Monitoring	S Refinery	2	12 to 27	Shallow		SA	SA	SA	-	SA	SA	-	-	SA	SA	SA
MW-52	Monitoring	S Refinery	2	19 to 34	Shallow		SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
MW-64	Monitoring	S Refinery	4	15 to 30	Shallow	Y	SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-65	Monitoring	S Refinery	4	14.5 to 29.5	Shallow	Y	SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-66	Monitoring	S Refinery	4	14.6 to 29.6	Shallow		SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
MW-99	Monitoring	S Refinery	4	12 to 27	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-101	Monitoring	S Refinery	4	8 to 23	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-102	Monitoring	S Refinery	4	12 to 27	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-103	Monitoring	S Refinery	4	7 to 22	Shallow		SA	A	A	A	A	A	-	-	A	A	A
MW-104	Monitoring	S Refinery	4	3 to 18	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-105	Monitoring	S Refinery	4	8 to 18	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-106	Monitoring	S Refinery	4	0 to 11	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-107	Monitoring	S Refinery	4	12 to 22	Shallow		SA	A	A	A	A	A	-	-	A	A	A
MW-109	Monitoring	S Refinery	2	15 to 29.5	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-110	Monitoring	S Refinery	2	15 to 29.5	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-130	Monitoring	S Refinery	2	30 to 45	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
RA-313	Irrigation	S Refinery	10	904 to 1157	Artesian		NA	A	-	-	A	-	-	-	A	A	A
RW-4R	Recovery	S Refinery	12	14.5 to 34.5	Shallow	Y	SA	A	A	-	A	A	-	-	A	A	A
RW-5R	Recovery	S Refinery	12	13 to 33	Shallow	Y	SA	A	A	-	A	A	-	-	A	A	A
RW-6R	Recovery	S Refinery	12	14.5 to 34.5	Shallow	Y	SA	A	A	-	A	A	-	-	A	A	A
RW-15 [d]	Recovery	S Refinery	36		Shallow	Y	SA	A	A	-	A	A	-	-	A	A	A
RW-19	Recovery	S Refinery	12	11 to 46	Shallow	Y	SA	A	A	-	A	A	-	-	A	A	A
MW-114	Monitoring	S RO Reject Field	2	20 to 35	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-115	Monitoring	S RO Reject Field	2	10 to 25	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-116	Monitoring	S RO Reject Field	2	10 to 25	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-49	Monitoring	TEL	2	19 to 34	Shallow		SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
TEL-1	Monitoring	TEL	2	13 to 23	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
TEL-2	Monitoring	TEL	2	13 to 23	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
TEL-3	Monitoring	TEL	2	13 to 23	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
TEL-4	Monitoring	TEL	2	13 to 23	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-8	Monitoring	TMD	2		Shallow		SA	A	A	A	A	A	-	-	A	A	A
MW-9	Monitoring	TMD	2		Shallow		SA	No samples to be collected									
MW-16	Monitoring	TMD	4	8.5 to 19	Shallow		SA	A	A	-	A	A	-	-	A	A	A
MW-20	Monitoring	TMD	4	9.5 to 23.5	Shallow		SA	A	A	-	A	A	-	-	A	A	A

Table 1. 2017 Facility-Wide Groundwater Monitoring Program and Schedule

HollyFrontier Navajo Refining LLC - Artesia Refinery, Artesia, New Mexico

Well ID	Well Type	Associated Area	Well Construction [a]			Historic PSH? [b]	Gauging Frequency	Analytical Suite and Frequency [c]									
			Well Diameter (in)	Screen Interval (ft bgs)	Water Bearing Zone			Purge Parameters	DRO	GRO	VOCs	Metals: As, Ba, Cr, Fe, Pb, Mn, Se	Metals: B, Cd, Co, Hg, Ni, U, Va	Cyanide	Cations/Anions	Nitrate / Nitrite as Nitrogen	Total Dissolved Solids
MW-21	Monitoring	TMD	4	7.5 to 22	Shallow		SA	SA	SA	SA	SA	SA	-	-	SA	SA	SA
MW-25	Monitoring	TMD	2	15.75 to 25.25	Shallow		SA	A	A	-	A	A	-	-	A	A	A
MW-26	Monitoring	TMD	2	15.25 to 24.25	Shallow		SA	A	A	-	A	A	-	-	A	A	A
MW-27	Monitoring	TMD	2	18.25 to 27.75	Shallow		SA	A	A	-	A	A	-	-	A	A	A
MW-46R	Monitoring	TMD	2	3.5 to 18.5	Shallow		SA	SA	SA	-	SA	SA	-	-	SA	SA	SA
MW-68	Monitoring	TMD	2	14.75 to 24.5	Shallow		SA	A	A	-	A	A	-	-	A	A	A
MW-71	Monitoring	TMD	2	9.75 to 19.5	Shallow		SA	A	A	-	A	A	A	A	A	A	A
MW-89	Monitoring	TMD	4	2 to 17	Shallow		SA	A	A	-	A	A	-	-	A	A	A
NP-1	Monitoring	TMD	2	9.5 to 19	Shallow		SA	SA	-	-	SA	-	-	-	A	A	A
NP-2	Monitoring	TMD	2	9.5 to 18.5	Shallow		SA	No samples to be collected									
NP-3	Monitoring	TMD	2	9.5 to 18.5	Shallow		SA	No samples to be collected									
NP-4	Monitoring	TMD	2	24.5 to 33.5	Shallow		SA	No samples to be collected									
NP-6	Monitoring	TMD	2	8.75 to 18.75	Shallow		SA	B	-	-	B	-	-	-	-	-	-
NP-8	Monitoring	TMD	2		Shallow		SA	No samples to be collected									
NP-9	Monitoring	TMD	2		Shallow		SA	No samples to be collected									
UG-1	Monitoring	Upgradient	4	8 to 23	Shallow		A	A	A	A	A	A	A	A	A	A	A
UG-2	Monitoring	Upgradient	4	15 to 30	Shallow		A	A	A	A	A	A	A	A	A	A	A
UG-3R	Monitoring	Upgradient	4	17 to 37	Shallow		A	A	A	A	A	A	A	A	A	A	A
UG-4	Monitoring	Upgradient	2	19.5 to 39.5	Shallow		A	A	A	A	A	A	A	A	A	A	A

Note: Blank cells indicate that information is not available or applicable.

Abbreviations:

A = Annual (March/April event)
B = Biennial (March/April event in odd calendar years)
DRO = Diesal 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
N = North
NA = Not accessible
NCL = North Colony Landfarm
OCD = Oil Conservation District
S = South
SA = Semi-annual (March/April and September/October events)
TEL = Tetra Ethyl Lead Impoundment
TMD = Three Mile Ditch
TPH = Total Petroleum Hydrocarbons
VOCs = Volatile Organic Compounds
Y = Yes

Footnotes:

[a] Available well construction information provided.

[b] PSH was present during previous groundwater monitoring events or a recovery pump is in place. Recovery wells are gauged at least monthly.

[c] Analytical Suite to include the following:

1. Purge parameters pH, temperature, specific conductivity, dissolved oxygen, oxygen-reduction potential, and turbidity will be measured and recorded in the field.
2. DRO by Method 8010Mod.
3. GRO by Method 8010Mod.
4. VOCs by Method 8260, to include methyl tert butyl ether (MTBE) and naphthalene.
5. Total metals by Method 6010/6020 and/or 7470. Specific metals shown in table heading (symbols from periodic chart).
6. Dissolved metals - same list as total metals, but only analyzed during March/April event.
7. Cyanide by Method SM4500.
8. Cations/anions to include Calcium, Potassium, and Sodium by Method 6010 or 6020 and Sulfate, Chloride, and Fluoride by Method 300.
9. Nitrates/Nitrites as Nitrogen by Method 300.
10. 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 0.3 feet thick or greater.*

[d] 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.

[e] Wells will be gauged and/or sampled only if the landowner grants access.

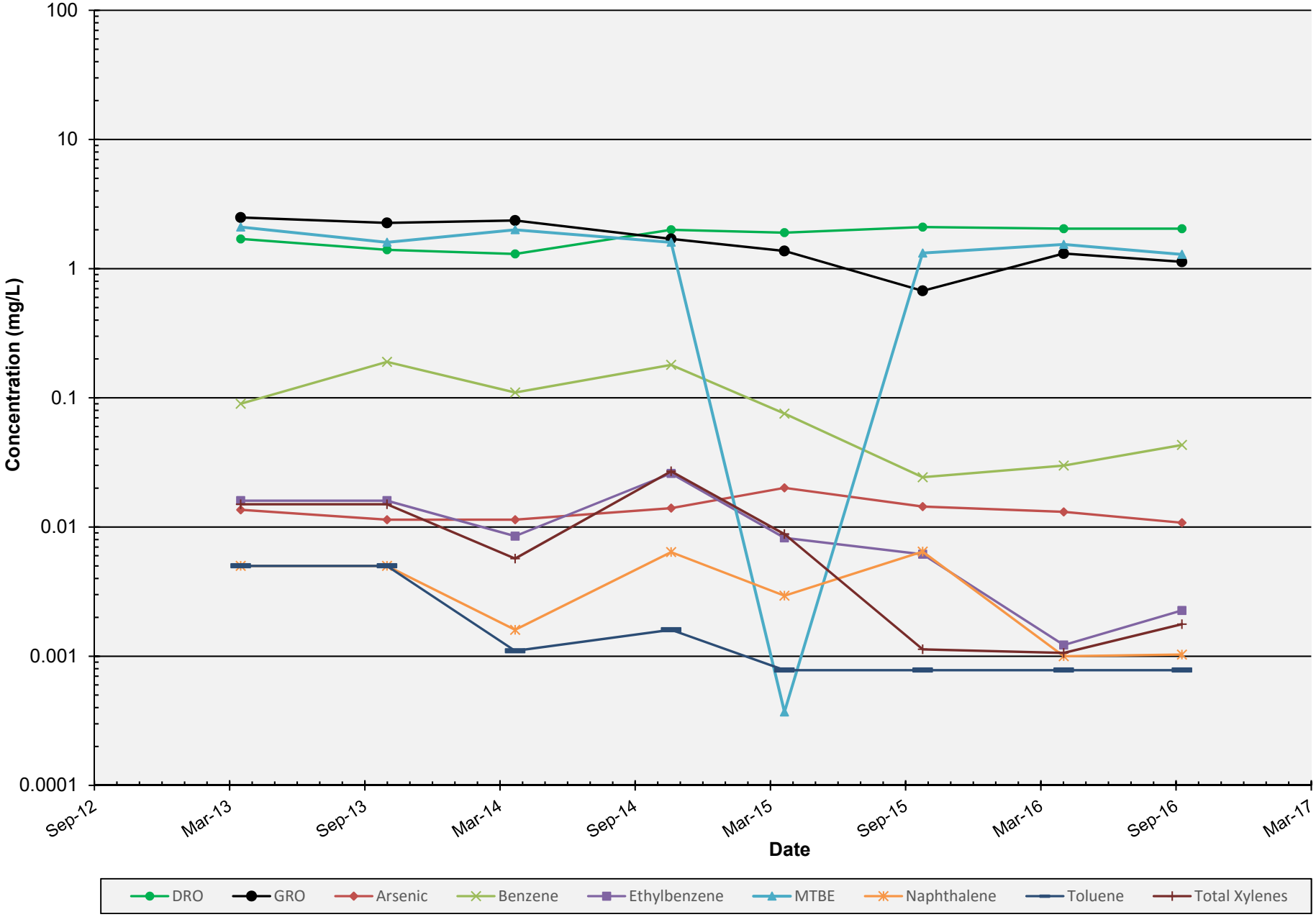
APPENDIX A

GROUNDWATER CONCENTRATION TIME-SERIES PLOTS OF WELLS PROPOSED FOR SAMPLING FREQUENCY REDUCTION

MW-111: COC Concentrations

HollyFrontier Navajo Refining LLC - Artesia Refinery

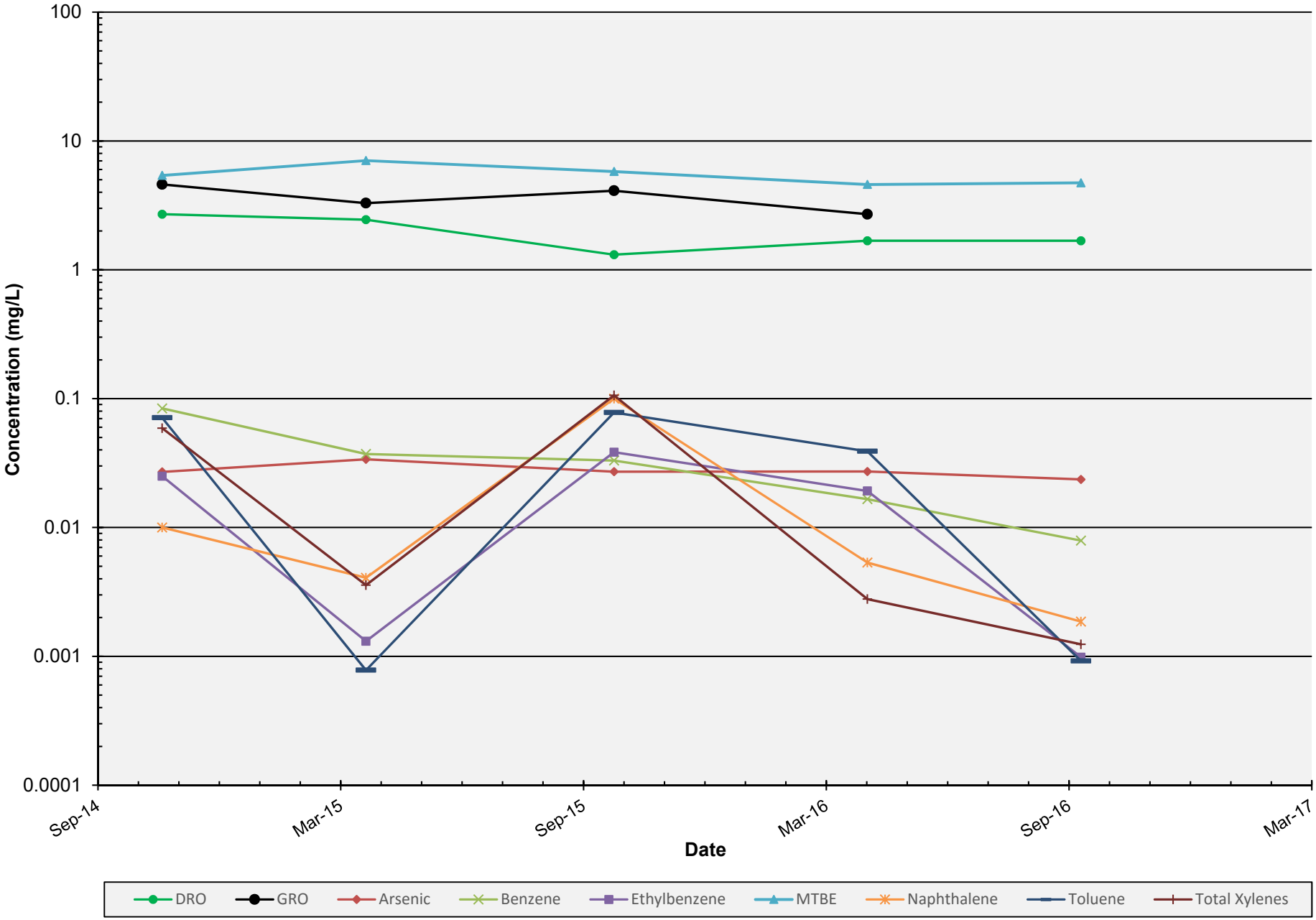
Field East of Refinery



MW-129: COC Concentrations

HollyFrontier Navajo Refining LLC - Artesia Refinery

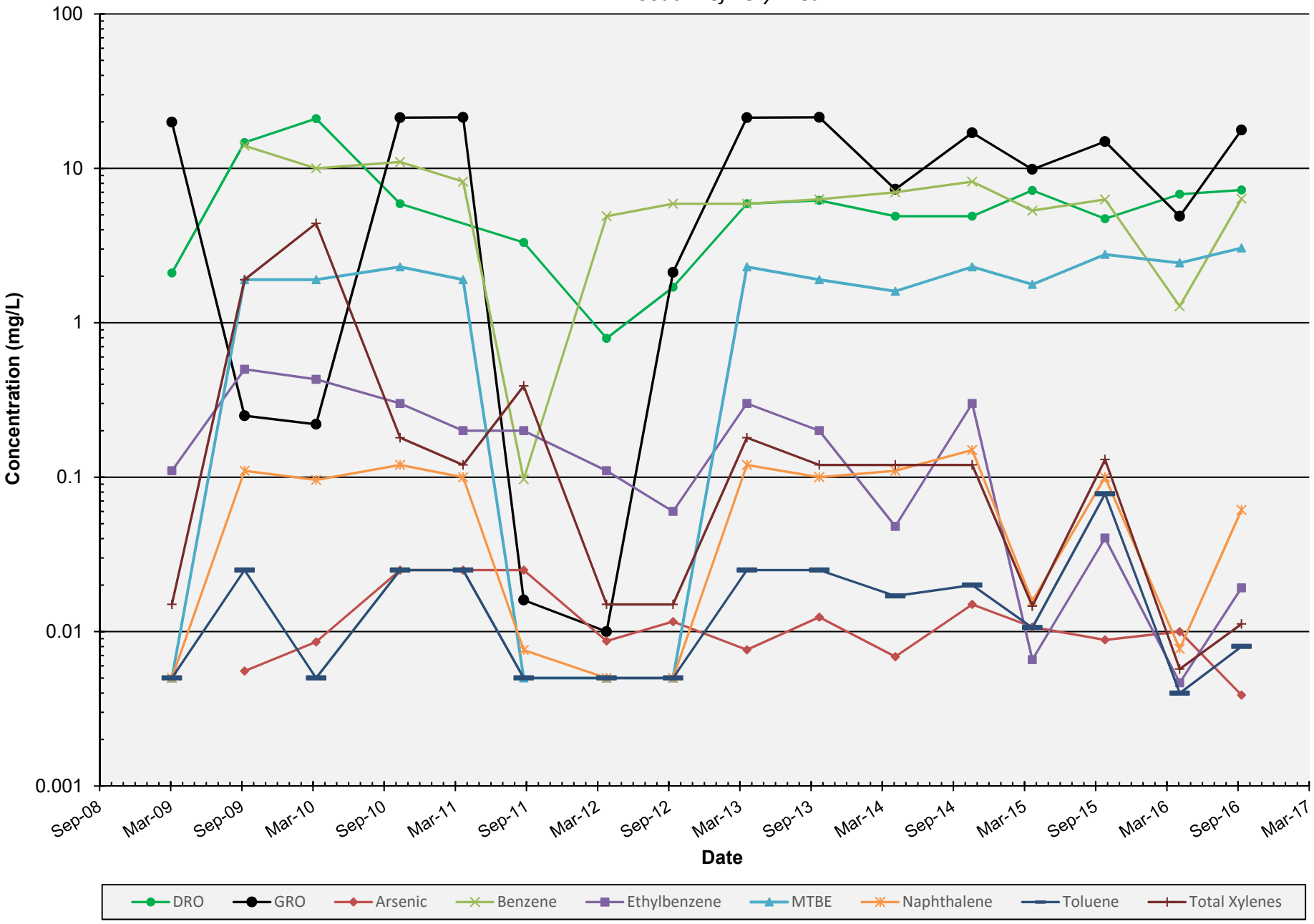
Field East of Refinery



MW-107: COC Concentrations

HollyFrontier Navajo Refining LLC - Artesia Refinery

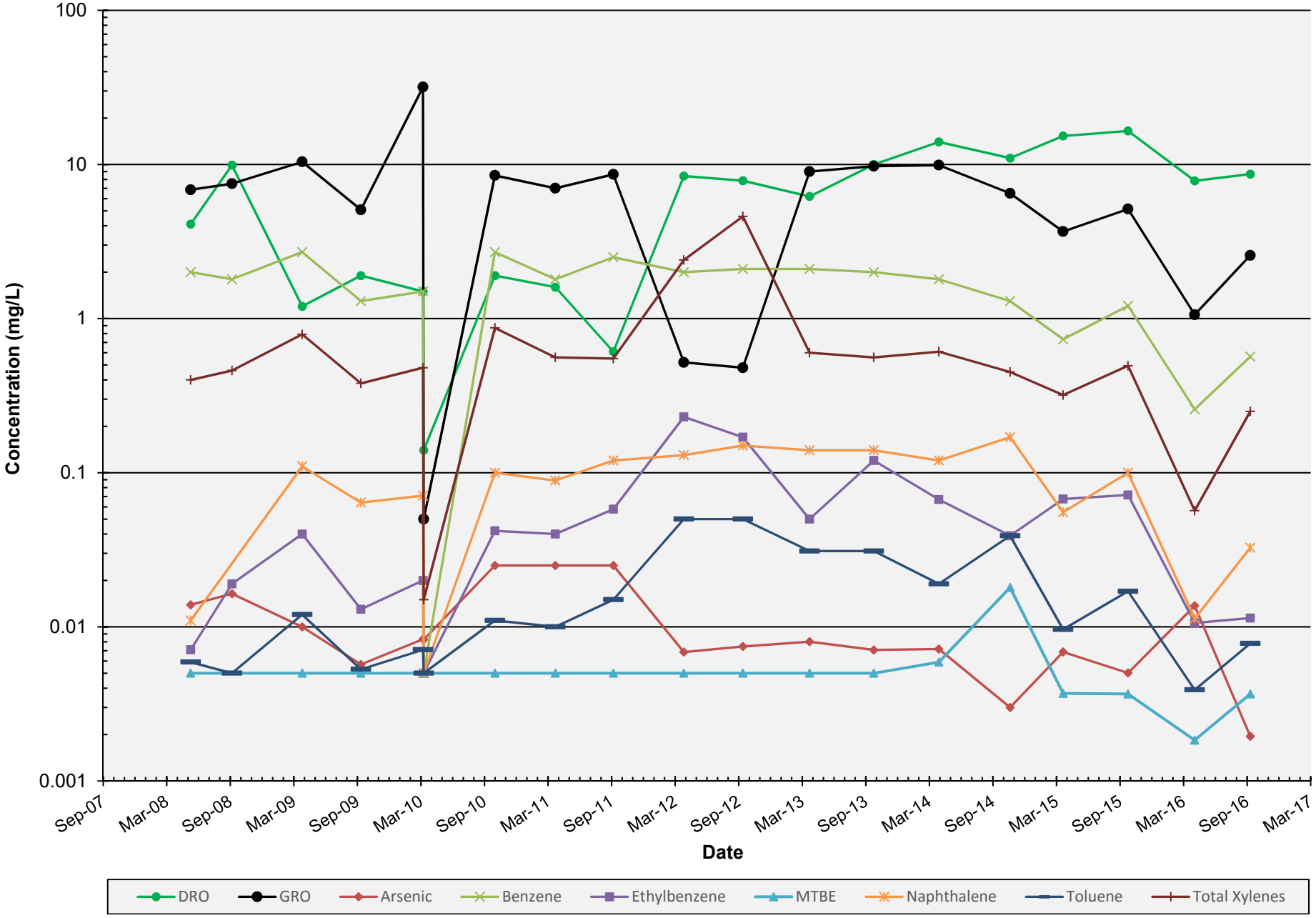
South Refinery Area



MW-93: COC Concentrations

HollyFrontier Navajo Refining LLC - Artesia Refinery

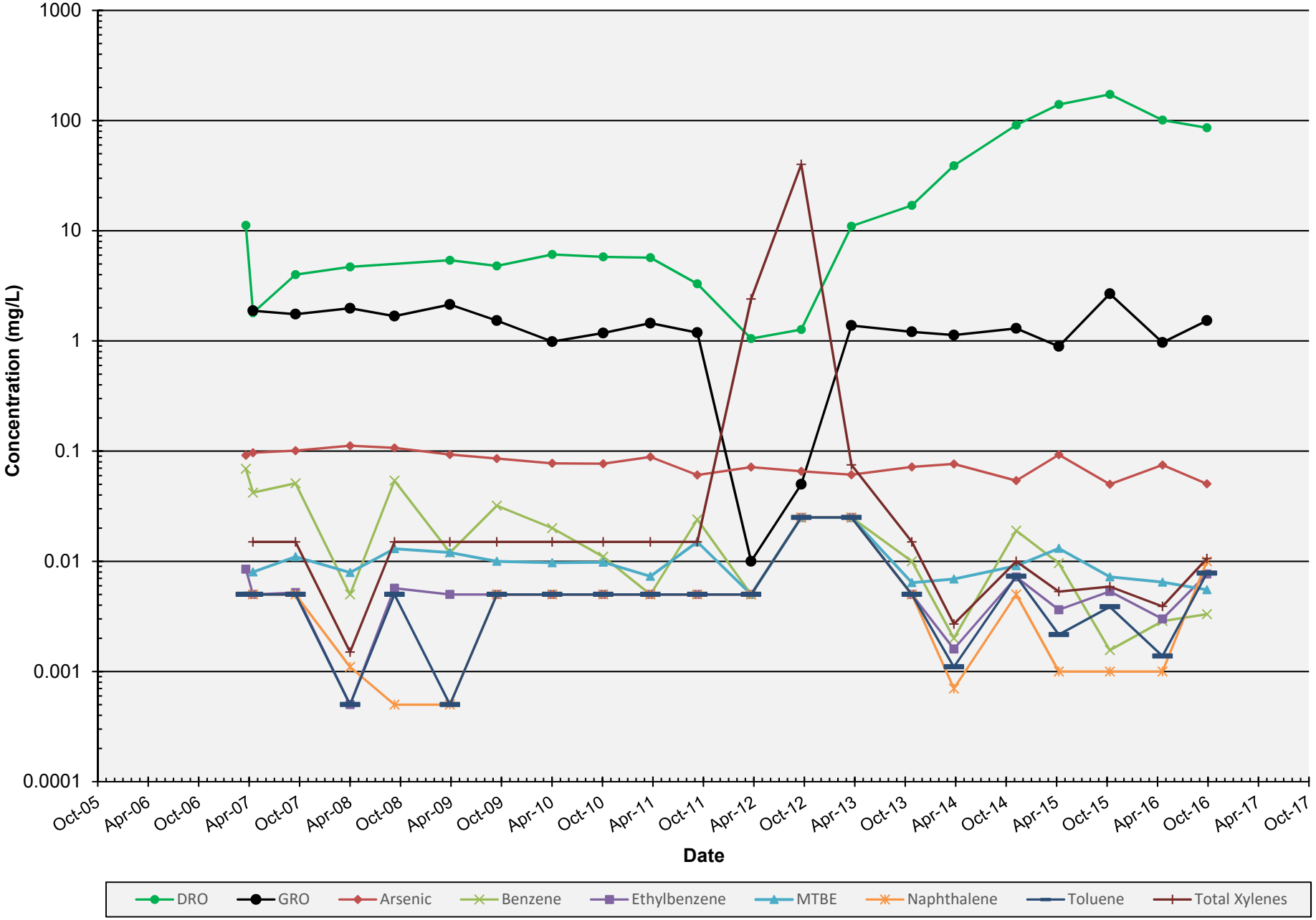
North Refinery Area



MW-77: COC Concentrations

HollyFrontier Navajo Refining LLC - Artesia Refinery

Evaporation Ponds



MW-56: COC Concentrations

HollyFrontier Navajo Refining LLC - Artesia Refinery

South Refinery Area