GW - 28

REPORTS

YEAR(S):

1995

1 of 2

VOLUME I
RCRA FACILITY INVESTIGATION
THREE-MILE DITCH & EVAPORATION PONDS
PHASE III REPORT
NAVAJO REFINERY
ARTESIA, NEW MEXICO

Topical Report RSI-0611

prepared for

Navajo Refining Company
501 East Main Street
Artesia, New Mexico 88210

April 1995

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April 28, 1995

Mr. Rich Mayer, Environmental Engineer
RCRA Permits Branch
U.S. Environmental Protection Agency
1445 Ross Ave., Suite 1200
Dallas, TX 75202-2733

Re: Transmittal of RFI Phase III Report, Three-Mile Ditch and Evaporation Ponds, Navajo Refinery, Artesia, New Mexico, April 1995

Dear Mr. Mayer:

Enclosed please find the RFI Phase III Report for the above facility. This report details and reports the results of field investigation activities that commenced in November, 1994 and were completed in February. It includes measurement of water levels, monitor well sampling, installation of new wells and piezometers, sampling of ditch sediments, and Pecos River surface water and sediment sampling. The investigation is the culmination of a series of EPA-required RFI studies that began in 1990, and the findings of the previous studies and referenced and included in the document where appropriate.

The results of this investigation substantiated and reinforced the results and conclusions presented in the 1993 RFI Phase II study. Waste material in the buried Three-Mile Ditch shows little or no risk to groundwater, now or in the future, although some sediments previously dredged from the ditch and remaining at the surface may need to be addressed. Chemical data generated from the new deep monitor wells at the ponds does not show the presence of organic target compounds. Although arsenic is pervasive in turbid samples from shallow wells, an elevated level of arsenic only slightly above the health-based standard was detected in one deep well.

Of greater importance, the pond monitor wells show improving water quality in the shallow alluvial system. Benzene was detected in just one well (vs. five in 1993) at a level slightly under three-times the EPA health based limit. Water chemistry in wells adjacent to the now-dry evaporation ponds shows ongoing replacement of pond water with native water. The mechanism that allows natural remediation to occur is the positive upward groundwater gradient which has been documented during these studies as occurring in the vicinity of the ponds. This mechanism will continue and likely accelerate once fluids are removed from the other ponds and the system reaches natural hydrologic equilibrium.

Although groundwater impacted by some pond constituents is improving, the native shallow groundwater remains naturally salty (approaching or in excess of 10,000 mg/L) and is unusable for drinking or agriculture. The nearby Pecos River remains severely salt-impacted from other sources and unusable for domestic use. As demonstrated by the recently submitted Corrective Measures Study for Evaporation Pond 1, the area around the outside of the ponds also continues to be subject to frequent flooding. This combination of factors will prevent use of the area for human habitation and restrict groundwater withdrawal for any purpose. Therefore, use of human health-based standards to evaluate any remaining groundwater pollutants upon pond closure is inappropriate.

Based on the results of this study and the earlier Phase II investigation, further investigatory action beyond limited monitoring of groundwater to demonstrate water quality improvement as ponds are removed from service is unwarranted.

If you have any questions, please do not hesitate to contact me at (505) 748-3311.

Sincerely,

Matthew P. Clifton
Senior Vice-President

encl.

RCRA FACILITY INVESTIGATION
THREE-MILE DITCH & EVAPORATION PONDS

PHASE III REPORT

NAVAJO REFINERY
ARTESIA, NEW MEXICO

April 30, 1995

prepared for:

Navajo Refining Company
501 East Main Street
P. O. Drawer 159
Artesia, New Mexico 88210

presented by:

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CERTIFICATION STATEMENT

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with 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 be 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.

(Signature)

Matthew P. Clifton
Senior Vice-President
(Printed Name and Title)

April 28, 1995
(Date)

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1.0 EXECUTIVE SUMMARY

A Phase III Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) was conducted at two solid waste management units (SWMUs) at the Navajo Refinery (EPA ID No. NMD 048918817) located in Artesia, New Mexico. The purpose of this follow-up investigation was to verify and expand upon certain findings and conclusions presented in the Phase II revised report, submitted to the U.S. Environmental Protection Agency (EPA) in November 1993 and to better define the source characteristics and the nature and extent of any contamination from the SWMUs. The two SWMUs are Three-Mile Ditch (TMD), an unlined wastewater conveyance channel that was operated for approximately 50 years, and a partially active evaporation pond system that covers approximately 115 acres.

The Phase III investigation was intended to:

- provide a more detailed representation of groundwater flow along various sections of TMD;
- characterize above-grade deposits of dredged waste materials deposited adjacent to the ditch in several areas;
- further search for any evidence of shallow groundwater contamination due to past use of the wastewater ditch;
- conduct follow-up groundwater sampling from the existing monitoring well network at the evaporation ponds;
- further delineate the vertical extent of groundwater contamination in the immediate vicinity of the ponds; and
- perform environmental evaluation of surface water and sediments in the Pecos River in the area of the ponds.

The Phase III investigation included groundwater sampling and chemical analyses of 37 monitor wells and the windmill in the vicinity of the evaporation ponds, 15 wells along TMD, and water from the evaporation ponds and the Pecos River. Three deep monitor wells were installed in the vicinity of the ponds, and five shallow wells and three piezometers were installed adjacent to TMD.

A summary of the key findings of this investigation are as follows:

Three-Mile Ditch — Surface Sediments

- Surface sediments were removed from the base of the ditch when in active use and placed adjacent to the ditch. Most sediments accumulated in areas where flow was slow due to a flat topographic gradient. Some sediments remain on the surface in shallow piles. Two areas identified in this study are located immediately east of Bolton Road and east of the Artesia Wastewater Treatment Plant.

- Metals analyses performed on six samples for arsenic, chromium, lead, nickel and zinc show elevated levels of all five constituents. Lead, especially, exceeded risk-based concentration limits derived for similar materials in Pond 1. Samples from the Bolton Road interval were observed to contain the highest concentrations. Navajo and EPA need to discuss options for evaluation of these materials to establish information on potential exposure to environmental receptors and mitigation alternatives.

Three-Mile Ditch — Unit Soils and Groundwater

- The information generated during the Phase III study, plus review of data produced during the Phase II investigation, continue to support the conclusion of the Phase II study that unit soils associated with TMD do not pose a present or future significant threat to human health or the environment. This suggests that remaining residual organic constituents contained within the unit soils present only minimal likelihood for significant contamination of shallow groundwater (i.e., above conservatively-calculated, health-based levels). Likewise, analyses for metals support earlier conclusions that evidence does not exist to indicate that any residual metal constituents present within the unit soils are migrating or have the potential to migrate from the unit.

- Organic volatile and semivolatile constituents were not reported at low detection levels in groundwater in new or existing monitor wells installed along the ditch.

- Exceedances of chromium and nickel in groundwater samples from several older stainless steel wells continue to be detected; the Phase II report determined the likely source of contamination is the corrosion of the stainless-steel casing of these wells. A slightly elevated level of lead continues to be detected in MW-45; this well is located adjacent to refinery operations areas known to have had underground releases from product storage tanks and lines.

- Groundwater flow direction was mapped and shows water movement from Eagle Creek into the near-surface saturated zone (NSSZ) along the section of the creek from the refinery to just east of Bolton Road. East of MW-29, the direction of movement is generally parallel to the ditch eastward to the vicinity of the river. When surface water is present in Eagle Creek, groundwater recharges to the NSSZ, at least in the section from the refinery to the vicinity of Bolton Road, as evidenced by the direction of mapped groundwater contours. Additional evidence of a surface water/groundwater connection was the observation during the Phase II investigation of pooled water supporting aquatic life forms.

- The NSSZ in the vicinity of TMD is too discontinuous to provide a potentially usable water source, and the quality of the groundwater is poor due to excessive concentrations of total dissolved solids (TDS). The average TDS of the 15 monitor wells installed along TMD is in excess of 6,000 mg/L. The quality of the shallow water approaching the evaporation ponds is also very poor because of excessively high salt concentrations in alluvial groundwater near the river.

- The Phase II comparison of the water chemistry of shallow groundwater in the area was revised and updated using the new wells installed for this study. The results of the current review support the earlier conclusion that there is no evidence to indicate that the shallow water was from an effluent source. These comparisons offer support to the results of the organic and metal analyses which show any current groundwater impacts of past ditch use are at most minimal.

Evaporation Ponds — Groundwater

- The results of the Phase III investigation at the evaporation ponds substantiated and reinforced the conclusions of the Phase II study. Since that study, a second evaporation pond has been deactivated, and sampling of downgradient monitor wells reflects improvement in alluvial water quality and overall reduction in hazardous constituents. Also, water-level measurements continue to demonstrate upward movement of generally-better quality water from lower zones.

- Benzene was confirmed in only one well (MW-4A), with an average concentration of approximately 0.014 mg/L. In 1993, benzene was found in five wells where the maximum concentration was 0.021 mg/L. Benzene was the only volatile constituent detected in groundwater in the vicinity of the ponds that exceeded health-based drinking water standards. Ethylbenzene, toluene, and xylenes were confirmed in four wells (down from five in 1993); the maximum concentration for any volatile organic compound was 0.032 mg/L of total xylene. Semivolatile PAH compounds were not found in the groundwater at detection levels as low as 0.01 mg/L.

- Except for arsenic, the metals chromium, lead, and nickel exceeded respective EPA health-based standards only in the older wells having stainless steel casing, in wells with high sample turbidity, or a combination of these. Filtering and/or resampling these wells after purging at very low flow rates eliminated exceedances and, in most cases, detections for these three metals.

- Arsenic concentrations were confirmed to exceed the EPA health-based standard at 11 monitor wells, but only four of the wells exceeded the New Mexico groundwater standard. The maximum exceedance was slightly greater than four times the EPA standard of 0.05 mg/L. Arsenic problems during sampling included high turbidity samples obtained from new wells and the movement into suspension of clay particles containing arsenic during purging and bailing. Resampling of several new and existing wells after purging with a low-flow peristaltic pump resulted in markedly lower total arsenic values.

- Three monitor wells installed to depths of approximately 70 feet during the Phase III investigation did not detect target organic constituents. Arsenic, initially detected at significantly elevated concentrations, was either absent or near the EPA health-based standard after resampling using a low-flow pump for well purging.

- Existing and new monitor wells continue to document the very poor quality of shallow groundwater at locations close to the river and away from the direct influence of the pond. Some of the dissolved salt concentrations in the groundwater at river locations unimpacted by the ponds were in excess of 10,000 mg/L. Analyses by the United States Geological Survey (USGS) show river water during certain months of the year approaches these concentrations.

- Eleven sets of shallow and deep pairs of groundwater monitoring wells have been installed in the vicinity of the evaporation ponds. Comparison of groundwater elevations in shallow monitor wells with elevations in monitor wells screened at lower depths in the valley fill alluvium continues to demonstrate the existence of an upward vertical gradient in the vicinity of the evaporation ponds. Results of four sets of measurements beginning in 1993 show the magnitude of the gradient to be generally consistent. The presence of an upward vertical gradient greatly reduces the potential for any shallow groundwater contaminants to migrate to deeper zones of higher quality groundwater.

- Although extensive groundwater contour maps in the vicinity of the pond were not prepared during the Phase III investigation, review of the paired monitor well data does not show any obvious changes from 1993 levels. Groundwater mapping during that study showed horizontal movement of groundwater to a discharge area south and east of the ponds in the vicinity of U.S. Highway 82. The area is identified on local topographic maps and was verified as being a marshy area heavily populated with salt cedar, which is considered nuisance vegetation.

- The area in the vicinity of the ponds serves as a regional groundwater discharge location. Naturally occurring salts in water discharged from depth to the surface are concentrated as a result of direct surface evaporation and high transpiration by salt-tolerant plants growing in this and other marshy areas adjacent to the Pecos River. Water not evaporated or consumed by vegetation is discharged into the Pecos River during times of low flow.

- Sampling of the Pecos River at two locations during the Phase III investigation did not detect elevated levels of constituents attributable to Navajo Refinery practices. The historically poor quality of river water has been documented by state and federal agencies. Likewise, sediment sampling from the Pecos River at four locations during the Phase III study did not detect any volatile or semivolatile organics, although a slightly elevated level of arsenic was found at a location about 4,800 feet downstream from the ponds.

- Using field-derived information on the local geology, hydraulic conductivity, and horizontal and vertical gradients, a groundwater flow model was developed during the Phase II study to replicate the horizontal and vertical groundwater movement in the study area. Based on review of the potentiometric gradient information generated during the Phase III investigation, upward flow gradients continue to be observed at the magnitudes previously measured. Therefore, the modeling assumptions and calculations performed for the Phase II study remain valid.

- The Phase II and Phase III investigations compared the chemistry of the inorganic constituents of the pond wastewater, of groundwater in the pond monitor wells, and of groundwater in the valley fill alluvium. The review determined that the groundwater in the shallow monitor wells immediately adjacent to the pond and in some deeper monitor wells on the south side of the pond had characteristics indicating partial mixing of the groundwater with pond water.

- Phase III water chemistry sampling results show improvement in water quality (defined as replacement of sodium chloride water with water having calcium-magnesium sulfate properties) in shallow and deep wells downgradient from the now-inactive ponds. The improvement in water quality observed in the current investigation supports the Phase II observations that the downward vertical groundwater gradient underlying the ponds is in effect only to a limited depth and is now diminishing due to removal of overlying hydraulic rock. Thereafter, up welling of deep alluvial groundwater redirects the downward-moving contaminated groundwater upwards to the shallow groundwater zone.

- The water of the Pecos River and the shallow groundwater in the vicinity of the ponds are naturally high in TDS. The salty content of the river water makes it unusable for domestic uses, and the salty nature of the shallow groundwater renders it unusable for domestic, agricultural, or industrial purposes.

The results of groundwater sampling and analysis in the vicinity of the evaporation ponds indicate that the deeper groundwater in the river alluvium of the valley fill aquifer has not been excessively impacted by refinery activity. The southeasterly flow direction of water in the alluvium moves contaminants previously released from the ponds to the southeast, away from the better quality groundwater to the west. The prevailing upward vertical flow minimizes the downward migration of any possible contamination to the deeper portion of the valley fill aquifer, and provides a natural remediation mechanism as demonstrated by improvement in water quality in monitor wells adjacent to the inactive ponds.

Because of the lack of potential environmental receptors for groundwater downgradient of the ponds, the restriction of any contamination from the ponds to the uppermost portion of the river alluvium, the naturally salty groundwater in shallow river alluvium, and elimination of volatile and semivolatile organics in the wastewater stream, the evaporation ponds do not currently pose a significant environmental risk to the area and are not likely to become such in the future.

The various RFI investigations at TMD and the ponds have adequately characterized the nature and extent of contamination and releases from the SWMUs. With the exception of the dredged sediments along portions of TMD, the relatively low levels of organic and inorganic constituents beneath and in proximity to the SWMUs pose little threat to human health and the environment, as defined by federal and state criteria. With respect to the sediments at the surface, some additional work is necessary to determine the potential exposure to environmental receptors via surface pathways, and to evaluate action options. Otherwise, no further investigations are necessary beyond limited routine monitoring of water levels and selected constituents in the vicinity of the ponds to verify conditions and to monitor water quality, including the progress of natural remediation at the inactive pond units.

2.0 INTRODUCTION

Navajo Refining Company (Navajo), located in Artesia, New Mexico, owns and operates a wastewater evaporation pond system located adjacent to the Pecos River approximately three miles east of its refinery plant. The system consists of three interconnected ponds (Ponds 3, 5, and 6) that receive approximately 650,000 gallons of wastewater per day from the refinery wastewater treatment plant via a 20,000-linear-foot enclosed pipeline. Besides those ponds currently in service, the system formerly included two other impoundments (Ponds 1 and 2), which were removed from service in 1987 and 1994, respectively.

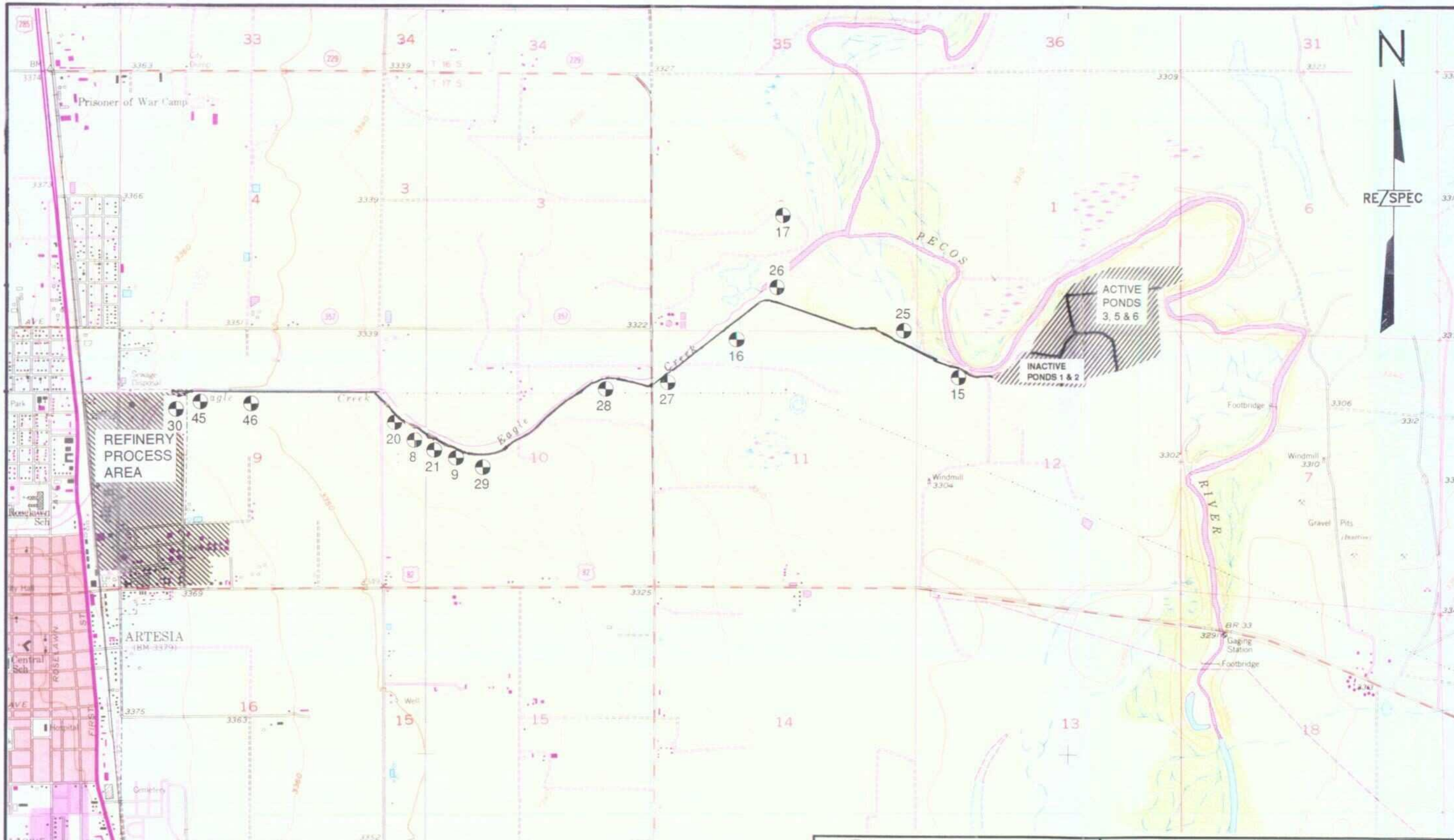
Refinery wastewater was conveyed to the pond system via an unlined earthen ditch known as TMD until 1987, when a subsurface high-density polyethylene pipe replaced TMD. At that time, Pond 1, which directly received the wastewater conveyed by the ditch, was also removed from service. Figure 2-1 shows the inactive ditch and current evaporation pond system.

Several reports generated since the beginning of the RCRA Corrective Action Program at the refinery serve as background documents to this Phase III effort, including:

- RFI Phase I Report, Sections 5.0 through 7.0 (final submittal) — December 1990
- RFI Phase I Report (2nd submittal) — October 1990
- RFI Phase II Work Plan (2nd submittal) — December 1990
- RFI Phase II Work Plan (final submittal) — May 1991
- RFI Phase II Workplan (revised) — June 1992
- RFI Phase II Report (1st submittal) — April 1993
- RFI Phase II Report (2nd submittal) — November 1993
- RFI Phase III Workplan — July 1994
- Evaporation Pond 1 Corrective Measures Study Workplan (1st submittal) — August 1994
- Evaporation Pond 1 Corrective Measures Study Workplan (2nd submittal) — December 1994

Under the auspices of the preceding RFI Phase I and Phase II investigations, the subject units have been extensively characterized in terms of their environmental setting and source characterization. Therefore, information generated from the previous investigations is not necessarily fully reiterated in this report. Detailed information concerning the environmental setting (site climate, topography and surface water, soils, geology, hydrogeology, and potential receptors) and source characterization are contained in the above-referenced Three-Mile Ditch and Evaporation Ponds RFI Phase II Report. Additional detailed information and discussion regarding potential environmental receptors in the vicinity of the evaporation ponds may also be found in the Pond 1 Corrective Measures Study Workplan (2nd submittal).

Figure 2-1. Location Map, Three-Mile Ditch and Evaporation Ponds, Navajo Refinery, RFI Investigations



EXPLANATION

MONITOR WELL LOCATIONS
THREE-MILE DITCH, RFI PHASE III, 1995

2000 0 2000 6000 FEET

NOTE: MAP COMPILED FROM USGS ARTESIA AND SPRING LAKE 7.5 MINUTE QUADRANGLE (1973). MONITOR WELLS ADJACENT TO EVAPORATION PONDS NOT SHOWN.

RE/SPEC

prepared for

Navajo

LOCATION MAP, THREE-MILE DITCH AND EVAPORATION PONDS, NAVAJO REFINERY, RFI INVESTIGATIONS

PROJECT: 318/3	
LOCATION: ARTESIA, NEW MEXICO	
APPR:	DATE: 4-28-95
DRAWN BY: DB	SCALE:
DATE:	FIGURE: 2-1

2.1 Scope and Goals of the RFI Phase III

This document presents the activities and findings of an RFI Phase III investigation for TMD and evaporation ponds. The RFI Phase III was conducted according to the July 31, 1994, Phase III workplan approved by EPA Region 6 in September 1994.

The Phase III investigation workplan was intended to meet the following investigative requirements stipulated by Region 6:

- Obtain a more detailed representation of groundwater flow along various sections of TMD;
- search for any further evidence that might indicate that shallow groundwater adjacent to the ditch is being impacted by subsurface contaminants underlying the ditch;
- Conduct follow-up sampling and evaluation of groundwater from the existing monitoring-well network at the evaporation ponds;
- Further delineate the vertical extent of groundwater contamination in the immediate vicinity of the ponds;
- Characterize above-grade deposits of dredged waste materials deposited parallel to the ditch along several ditch segments; and
- Perform environmental evaluation of surface water and sediments in the Pecos River adjacent to and in the vicinity of the ponds.

2.2 Organization of the RFI Report

This Phase III report is organized into seven sections and supporting appendices. Section 3.0 describes the Phase III soils and groundwater investigations along TMD, while Sections 4.0 and 5.0 present the details of Phase III investigation activities and findings associated with the evaporation ponds and the Pecos River, respectively. Phase III investigation findings and conclusions are presented in Section 6.0. References cited in the report are provided in Section 7.0. Appendix A presents selected analytical laboratory data extracted from the prior TMD/evaporation ponds RFI Phase I and Phase II investigation. Boring logs for Phase III monitoring well and piezometer boring locations are presented in Appendix B, and aquifer test data and graphs generated during Phase III for newly installed monitoring wells are given in Appendix C. Analytical laboratory reports for all environmental samples generated during the Phase III investigation are presented in Appendix D, and analytical laboratory reports generated by split sampling activities conducted by EPA representatives during the Phase III are shown in Appendix E.

3.0 RFI PHASE III INVESTIGATION - THREE-MILE DITCH

The following sections describe Phase III investigative procedures and results for TMD. Soil sample collection locations, procedures, and analytical results are presented in Section 3.1. Descriptions of groundwater monitoring well and piezometer installation, groundwater measurements, sample collection, and analytical results are presented in Section 3.2.

3.1 Soils Investigation

At some areas along TMD, waste materials accumulated in the ditch bed were dredged from the base of the unit and deposited atop the ditch bank. Such residual dredged materials remain in place along two separate segments of the TMD that extend over a total distance of approximately one mile. As part of the Phase III investigation, six soil samples were collected at various locations along these two ditch sections. Figure 3-1 depicts the two ditch intervals at which residual deposits of dredged materials are located and the specific locations at which soil samples were collected.

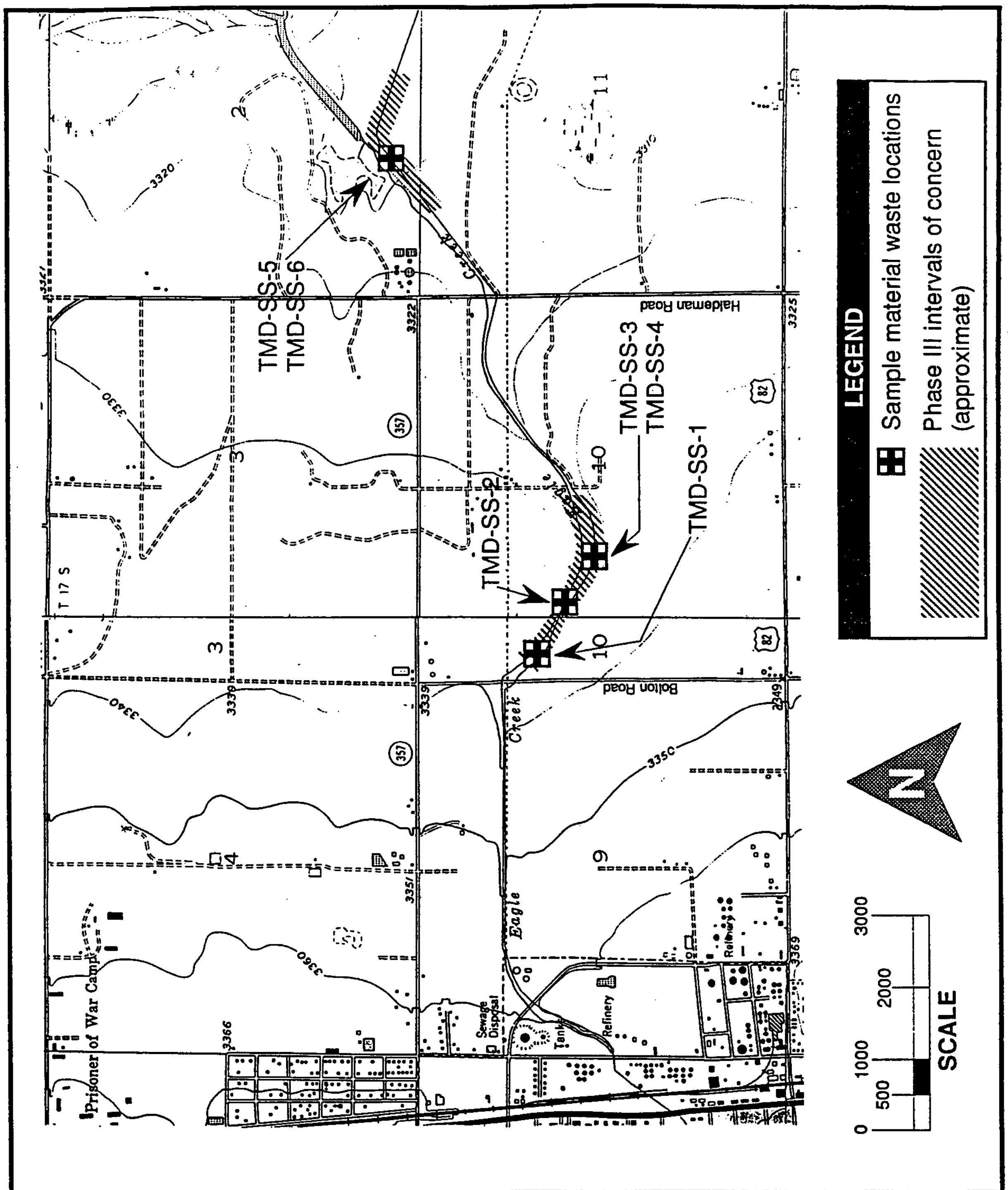
3.1.1 Soil Sampling Procedures

The soil samples were obtained as simple grab samples placed in appropriate sample containers. Samples were obtained using either a decontaminated hand shovel or, in loose soils, by hand using new latex gloves. Sample intervals extended from the soil surface to approximately three inches below grade. The onsite EPA representative was consulted in the selection of general sample locations representative of typical conditions along the targeted intervals, and specific sample locations were selected either randomly (three samples) or as biased samples on the basis of visual appearance (three samples).

3.1.2 Soil Sample Laboratory Analyses

The Phase III soil samples collected from the TMD were analyzed for the following parameters/constituents:

- pH;
- electrical conductivity (EC);
- oil and grease;
- arsenic, chromium, lead, nickel, and zinc; and
- semivolatile organics (EPA Method 8270 polynuclear aromatics).



RE/SPEC

General location of residual dredged waste materials, Three-Mile Ditch, RFI Phase III, April 1995

prepared for:

PROJECT: 318/3	
LOCATION: ARTESIA, NEW MEXICO	
APPR:	DATE: 4-28-95
DRAWN BY: DB	SCALE:
DATE:	FIGURE: 3-1

3.1.3 Analytical Results

Analytical results of the Phase III investigation are presented in Appendix D and summarized in Table 3-1. Soil pH and EC parameters were within the normal range for soils in this area. Oil and grease content ranged from 0.3 to 11 percent. None of the targeted semivolatile organic constituents were detected in the TMD soil samples. However, because detection levels for semivolatile constituents were significantly elevated due to heavy matrix interference, the possibility that some semivolatile constituents may be present at concentrations below the reported detection limits cannot be ruled out.

The TMD Phase III soil samples were analyzed for five metal constituents, including nickel, zinc, chromium, arsenic and lead. The results are presented below with discussion presented in Section 3.1.4:

- Nickel concentrations for the six soil samples ranged from 15 to 37 mg/Kg (see Table 3-1). These concentration values are generally within, or only slightly above, the range of background concentrations for nickel found in native soils in this region. Therefore, the current Phase III data provides further confirmation to the existing body of Phase I and Phase II soil data for the interconnected TMD and Pond 1 systems indicating that nickel was not a major constituent of the historical refinery wastewater stream.

- Similarly, the soil data for zinc and chromium are also similar to that obtained from the preceding Phase I and Phase II investigations. While soil concentrations in the TMD and Pond 1 soils tend to be significantly elevated for these constituents relative to background levels (as discussed in Section 3.1.4), the observed concentrations are not indicative of a potential threat to human health or the environment.

- Arsenic concentrations reported for the TMD Phase III soil samples are also within the range of concentration values previously obtained for soils from the TMD and Pond 1. One elevated concentration begins to approach levels of human health concern, which is discussed in the following section.

- Lead concentrations for the Phase III soil samples yielded the highest soil lead concentration obtained over the course of the RFI (Table 3-1). The highest concentrations of metal constituents of concern were all obtained along the same ditch interval at locations TMD-SS-1 through TMD-SS-4 (Figure 3-1). Sample TMD-SS2 yielded a reported concentration value of 11,600 mg/Kg of lead. Soil samples TMD-SS-1 through SS-4 all exhibited total lead concentration values in excess of 500 mg/Kg. In contrast, the two soil samples obtained at the second, downgradient interval of concern (TMD-SS-5 and SS-6) yielded metal concentration data which were generally lower than that obtained for the samples obtained at the upgradient interval.

Table 3-1. Summary of Three-Mile Ditch RFI Phase III Soil Sample Analytical Results

PARAMETER	SAMPLE LOCATION					
	TMD-SS-1	TMD-SS-2	TMD-SS-3	TMD-SS-4	TMD-SS-5	TMD-SS-6
pH	7.8	7.7	7.4	7.5	7.8	7.7
EC (mmhos/cm)	7.6	5.5	3.8	3.8	8.6	8.9
Oil & Grease (%)	0.3	1.9	11	3.7	2.5	1.9
Semi-volatiles (mg/Kg)[1]	< 1.8	< 30	< 30	< 40	< 60	< 36
Metals (mg/Kg)						
As	26.7	11.8	85.2	23.8	21.9	14.8
Cr	249	305	639	1,016	226	156
Pb	530	11,600	1,670	906	205	191
Ni	21	20	37	20	15	18
Zn	199	203	434	320	155	144

Notes: [1]All semivolatile constituents evaluated were less than the reported detection limits.

3.1.4 Soil Investigation Discussion

Residual surface deposits of waste materials dredged from TMD exist adjacent to the bank of the former unit at two discrete linear intervals. The presence of these materials is indicated both by visual observation and analytical results that reveal oil and grease residues and elevated metal concentrations.

For the most part, analytical data generated by the six Phase III soil samples is comparable to preceding Phase I and II soil data generated for TMD and the linearly contiguous Pond 1. Metals data from TMD dredged-waste materials may be directly compared to the risk-based pollutant limits derived for metals in Pond 1. These were presented in Table 3-1 of the revised "Evaporation Pond I Corrective Measures Study Workplan" submitted to EPA in December 1994 and are summarized in Table 3-2 below.

Table 3-2. Summary of Limiting Pathways and Derived Concentration-Based Limits for Pond 1 Soil Metal Concentrations

Constituent	Range/Average for Pond 1 Soils (mg/Kg)	Primary Limiting Exposure Pathway	Derived Concentration Limit
Arsenic	1.6 - 39.9/23.5	Sludge to child via oral ingestion	41 mg/Kg
Chromium	32 - 1,011/386	Phytotoxicity	1,500 mg/Kg
Lead	9 - 389/112	Sludge to child via oral ingestion	300 mg/Kg
Nickel	12 - 37/22.5	Phytotoxicity	210 mg/Kg
Zinc	40 - 434/198	Phytotoxicity	1,400 mg/Kg

No evidence obtained from any of the RFI soils investigations conducted at this unit indicate that nickel is a legitimate constituent of concern. The current data provides further confirmation to the existing body of Phase I and Phase II soil data, which indicates that nickel was not a major constituent of the historical refinery wastewater stream. Therefore, sufficient information has been compiled to confidently conclude that nickel can be excluded from any further environmental investigation or monitoring associated with both TMD and the associated evaporation ponds system.

While zinc concentrations in unit soils are elevated relative to background levels, the reported concentrations are consistently lower than any level which might constitute a potential threat to human health or the environment under any circumstances. Consequently, sufficient information is also available to conclude that zinc can be excluded from any further environmental investigation or monitoring associated with TMD and the evaporation ponds system.

The cumulative results of the RFI program show that soil chromium concentrations are also significantly elevated above background levels. However, the levels of chrome are less than the threshold level presented in Table 3-2. The secondary limiting exposure pathway and associated risk-based limit for chrome is sludge to groundwater to human via drinking water at 6,000 mg/Kg.

While one of the Phase III arsenic soil samples for TMD-SS-3 yielded a concentration value that might be construed to pose environmental risk under a land-use scenario that assumes a high level of human exposure, insufficient data is available to determine if such conditions are widely prevalent in surface soils along the ditch intervals of concern. Further, due to the remoteness and inaccessibility of the site, no imminent threat to human health is indicated on the basis of human exposure to arsenic-containing waste residuals currently present along the subject ditch segments.

TMD Phase III soil data for lead provides the greatest indication of potential environmental concern. All samples obtained from the most upgradient ditch interval evaluated during this investigation (encompassing soil sample locations TMD-SS-1 through SS-4 over a distance of approximately one-half mile) yielded lead concentrations in excess of normal health-based levels. Although insufficient data is currently available to arrive at a definitive determination, site topography and existing environmental conditions suggest that lead-bearing materials suspended in the wastewater stream may have been preferentially deposited along this section of the unit.

In the ditch interval extending from the refinery boundary to just west of Bolton Road, a distance of approximately 3,800 feet, surface elevation decreases approximately 22 feet, which amounts to a grade of 0.6 percent. However, in the immediately following interval extending from just west of Bolton Road to the culvert that crosses Eagle Draw, about midway between Bolton and Haldeman Roads, the ground slope diminishes to about 0.38 percent, or an 11-foot drop over 2,900 feet.

Thus, the section of TMD at which Phase III soil samples TMD-SS-1 through SS-4 were obtained likely represent an interval in which suspended waste materials were afforded an initial opportunity to settle out of the waste stream. This would have resulted in more intense dredging activities to maintain the ditch gradient in this area and higher concentrations of metals.

A second Phase III ditch interval of concern, which also possesses surface accumulations of residual dredge spoils, begins approximately 1800 feet east of Haldeman Road in the vicinity of MW-16 and extends for approximately 1000 feet. Soil samples TMD-SS-5 and SS-6, which were collected within this ditch interval, exhibited metal concentration levels that were for the most part the lowest reported among those soil samples obtained during the Phase III investigation. This observation is in apparent agreement with the premise that the highest incidence of metals deposition occurred in the upgradient ditch interval at which Phase III soil samples TMD-SS-1 through SS-4 were obtained.

Because of potential exposure to environmental receptors, Navajo and EPA need to discuss options to evaluate such lead exposure and to establish mitigation alternatives.

3.2 TMD Groundwater

The objectives of the Phase III groundwater investigation program at TMD were to verify previous information generated during earlier studies regarding the absence of significant groundwater contamination and to provide better data on groundwater movement in the NSSZ in the immediate proximity of the ditch.

Specific activities performed in the vicinity of TMD during the Phase III investigation included:

- Measurement of water levels in all available monitor wells and piezometers;
- Collection of samples from existing TMD monitor wells;
- Installation of five monitor wells to determine if groundwater contamination has occurred in areas of the ditch where deep soil contamination and/or intersection of the water table has been documented;

- Installation of three piezometers to further define groundwater flow geometry in the vicinity of the ditch; and
- Collection of samples from new monitor wells.

This section describes the procedures followed during the groundwater portion of this investigation. Included are descriptions of drilling and well installation, hydrogeologic characterization, and sample collection. These are followed by a presentation of the results and subsequent discussion.

3.2.1 Drilling Procedures

The drilling procedures observed during the Phase III investigation were designed to produce:

- data of a consistently high quality and tailored to the needs and goals of the project;
- samples representative of the media under investigation;
- samples identified, preserved, and transported in a manner that ensured that they remained intact and produced legally valid data; and
- data compatible in both type and quality to those produced by previous investigations.

All drilling, well installation, well development, groundwater sampling, and other related field activities conformed to state and EPA requirements for RCRA investigations.

To meet the previously stated objectives, the drilling program was performed by qualified personnel following recognized protocols, with all steps, measurements, and anomalies permanently recorded in the field logbooks.

3.2.1.1 Drilling Methods

The installation of five monitor wells and three piezometers along TMD during Phase III field investigations occurred during January 1995 and was performed by Precision Engineering, Drillers, and Engineers of Las Cruces, New Mexico. A CME 75 hollow-stem dry auger rig, mounted on a truck, was used to drill each well. Tools and augers were cleaned prior to use on each well or piezometer using a high-pressure hot-water cleaner mounted on an auxiliary trailer. Each well and piezometer boring was advanced using 4.25-inch I.D. hollow-stem augers with a cutting head on the lead auger. For the optimum recovery of undisturbed cores, a CME five-foot recovery split barrel was placed within the augers and the core barrel cutting shoe rode six inches ahead of the auger head. After each five-foot interval was advanced, the barrel was retrieved and opened for the geologist to visually classify the subsurface soils. The boring was continued in this manner until the first water-saturated zone was found. Typically, coring would continue another five to 10 feet below that depth to ensure that the installation would be a producing well. The 4.25-inch augers were then removed from the boring. For both wells and piezometers, two-inch I.D. PVC casing was installed, in accordance with the approved RFI workplan.

All soils removed from a boring were placed on plastic sheeting for later collection and disposal by Navajo Refinery personnel.

3.2.1.2 Borehole Logs

Core samples and lithologic descriptions acquired during the drilling of both monitor wells and soil borings were recorded on a standard borehole log. The following information was entered in the log or attached to it:

- project name and number;
- borehole location and number;
- initials of geologist who logged the borehole;
- date;
- drilling company and method of drilling;
- special problems encountered and their resolution;
- distinct boundaries between soil types and/or lithologies and depths of occurrence;
- depth of first occurrence of groundwater; and
- description of each soil sample taken, according to the methodology in ASTM D2488-84 "Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)," which includes the following:
  — soil type;
  — grain size;
  — color;
  — plasticity of fines (non-plastic, low, medium, high);
  — odor, if organic or unusual;
  — moisture;
  — other observations such as presence of roots or rootholes; mica, gypsum, caliche, or other secondary precipitates; or surface coatings on coarse-grained particles; and
  — sample depths and sample numbers.

3.2.2 Well/Piezometer Installation and Development

The monitor wells were designed to

- allow sufficient groundwater flow for well sampling;
- minimize the passage of formation materials (turbidity); and
- provide sufficient structural integrity to prevent the collapse of the intake structure.

Piezometers were designed to provide for measurement of groundwater levels in the first saturated zone. They were completed using the same methods as the monitor wells, but were developed only to the extent necessary for measuring water levels.

After drilling, the well casing, screen, filter pack, bentonite seal, and grout were placed within the borehole, and the wellhead was completed with a cement seal and locking surface casing.

The monitor wells were completed with two-inch I.D. schedule 40 PVC casing with 0.01-inch machine-slotted screen. The casing sections used are flush-threaded with screw joints. Well logs for the monitor wells and piezometers are shown in Appendix B.

The screened interval ranged from 10 to 15 feet and intercepts the water table (allowing for seasonal fluctuations). The endings, casings, and screens were stored in factory-applied plastic wrapping until actual installation to prevent the introduction of any contamination.

A sand pack consisting of CSSI 16/40 silica sand was installed within the auger-string to ensure the maintenance of the annular integrity. Sand was placed from the base of the boring to two feet above the top of the screen.

The field geologist recorded the depth intervals in which sand was packed, the amount of sand used, and any problems that arose.

A bentonite seal with a minimum thickness of two feet was placed in the annular space above the sand pack. Bentonite pellets were emplaced in the hole, hydrated with fresh water, and allowed to set up for at least 30 minutes prior to grouting. The geologist recorded the start and stop times of the bentonite seal emplacement, the interval of the seal, the amount of bentonite that was used, and any problems that arose. The geologist also recorded the type of bentonite and the supplier.

All monitor wells and piezometers were grouted from the top of the bentonite seal to within three feet of the ground surface using a tremie pipe. The grout mixture placed above the bentonite was composed of a 10:1 ratio of Portland cement to bentonite powder (by weight) and contained only enough water for a pumpable mix. The grout was allowed to set up for 24 hours before surface completion in order to avoid problems related to settlement.

Measurements of various well/piezometer dimensions were completed for each installation unless the depth of the borehole made measuring the total length of the screens and casings on the ground surface impractical. Measurements consisted of the distances from the top of the casing to the:

- top of the bentonite seal;
- top of the sand pack;
- top of the screen; and
- bottom of the borehole.

The monitor wells and piezometers were completed at the surface with the casing extending approximately 3 feet above grade where possible. The steel protective cover with locking cap placed over the casing riser extends approximately two feet below grade. The well head is surrounded by a cement pad (four feet by four feet by four feet) that slopes away from the center. Each well/piezometer is clearly identified with a permanent identification marking on the inside of the protective cover.

The elevation and location of all monitor wells and piezometers was surveyed in February 1995 by John D. Jaquess & Associates, New Mexico license 6290. The elevations of the natural ground surface, the top of the PVC well casing, and the top of the locking cap of the steel protective casing were determined to be 0.01 feet, based on a previously established benchmark. The location of each well was determined to be 0.01 feet, relative to a previously established refinery control benchmark. The new wells were plotted on the 1:3,600 (1 inch = 300 feet) base map previously prepared for the RFI Phase II report from aerial photographs of the Navajo Refinery and the USGS Artesia 7.5-minute quadrangle topographic map.

Drilling details and lithologic descriptions from the soil boring log, well/piezometer construction, sample collection, and other pertinent information are presented on a well completion form for each monitor well and piezometer installed at the Navajo Refinery. These forms include:

- project name and number;
- borehole or well/piezometer identification number;
- initials of the geologist(s) who logged the borehole;
- date drilled;
- driller's license number and company;
- materials used for casing, sand pack, borehole seals, grout, and surface completion;
- final construction specifications, including total depth of the borehole, depth of the screened interval, depths to the top of the sand pack, bentonite seal, and grout;
- elevation of the top of the casing, the top of the protective cover, and ground surface;
- any special problems encountered during installation and their resolution;
- pertinent depth-to-water measurements to date;
- complete lithologic description of geologic materials found; and
- visual observations of contamination, including the presence of discolored geologic materials and odors.

Well development is the process by which the aquifer's hydraulic conductivity is restored by removing mobile particulates from within and adjacent to newly installed wells. Well development substantially minimizes the amount of fine materials that may accumulate in the well between sampling events, thus reducing the amount of purging needed to obtain a clear sample.

A Grunfos Redi-Flo two percent, two-inch electric submersible pump was used to develop each well. Surging was accomplished by lifting and dropping the pump through the column of water in the well. The entire screened interval was surged in five-foot sections using approximately 10 to 20 iterations per section. If the discharge rate of the well remained low, the development process was repeated.

Electrical conductivity, pH, and temperature were monitored throughout the development process. Completion of the development process was defined as the stabilization (i.e., less than 10 percent variability between readings) of these parameters and the removal of at least three well volumes. A single well volume is considered to be the volume of water in the well casing.

All fluids produced during development were collected in drums provided by the refinery for disposal in the refinery wastewater treatment system.

All well-development equipment was decontaminated prior to use at each monitor well and piezometer to prevent the possibility of cross-contamination. Decontamination consisted of washing the equipment in Liquinox™ detergent and then rinsing with bottled deionized or drinking-quality water.

3.2.3 Groundwater Measurements, Sample Collection, and Quality Control

Groundwater sampling at TMD was performed in a two-step process. Existing wells were first sampled in November 1994. The second step involved sampling the newly installed monitor wells and resampling selected previously existing wells for verification in the event of anomalous results.

The following sections describe well purging, sample collection, and equipment decontamination procedures for collecting groundwater samples from the monitor wells at the Navajo Refinery. Prior to purging or sampling, the groundwater elevation was measured and recorded at each monitor well using the protocol set described below.

In this investigation, groundwater elevation was measured at each monitor well and piezometer prior to each sampling event using an electronic depth-to-water meter. The depth-to-water meter is accurate to 0.01 feet. The measurements were taken from a clearly marked reference point on the top of the well casing and recorded in the field logbook. The elevation of the reference point was established through surveying as described in Section 3.2.2, "Well/Piezometer Installation and Development". The depth-to-water meter was decontaminated prior to use at each well.

3.2.3.1 Well Purging

Each well was purged prior to the collection of groundwater samples to ensure that the samples were representative of groundwater conditions. A minimum of three well volumes was removed using a submersible pump or a disposable bailer. A well volume is defined as the volume of water in the well casing. Wells completed during this project produced sufficient water such that the well was not pumped dry before three well volumes were removed.

The turbidity, electrical conductivity, pH, and temperature of the groundwater were monitored during purging until their values stabilized. Turbidity was visually monitored, whereas the other parameters were monitored with an electronic field conductivity meter, pH strip paper, and a field temperature thermometer. Based on past experience at the site, electrical conductivity is the most sensitive field parameter and varies widely from site to site and during well development. Therefore, it was the only parameter requiring precision measurements.

If the turbidity of a well was not sufficiently clear for sampling, a "slug" was then used to surge the well. Typically, the volume of water displaced by the submersible pump served as the slug.

All readings were immediately recorded in the field logbook. An initial reading was taken five to 10 seconds after pumping had begun or after one gallon had been removed with a bailer. Subsequent readings were taken on an interval that allowed for at least five additional measurements to be taken during purging. Purging continued until the measured parameters had stabilized and at least three well volumes had been removed. If the field measurements had not stabilized after three well volumes had been removed, purging continued until they stabilized. The electrical conductivity meter was calibrated prior to purging to correct for any instrument drift.

All fluids produced while purging were collected in drums provided by the refinery for disposal in the refinery wastewater treatment system.

3.2.3.2 Sample Collection

A groundwater sample was taken only after purging was complete and the depth-to-water level had recovered to within 90 percent of the pre-purged level. A disposable bailer and dedicated nylon twine were used to collect groundwater samples. Latex gloves were worn at all times during sample collection to ensure the safety of personnel and to prevent cross-contamination between wells. Plastic sheeting was placed around the wellhead to ensure that the bailer line did not touch the ground while the bailer was raised and lowered.

The sample was poured from the bailer directly into the appropriate sample container to which any necessary preservatives had been previously added. The sample bottles were filled in the order of volatiles, semivolatiles, metals, and general water chemistry. Special care was taken when filling the bottles for volatile organics analysis. These bottles were filled very slowly to prevent any loss of volatile organics. If appropriate, the sample was then immediately placed in an insulated container containing ice. Samples for dissolved metals were filtered in the field using a peristaltic pump and an in-line, high-capacity 0.45-micron filter. Each sample was collected directly from the bailer using 0.25-inch flexible tubing. Bailers and the in-line filters were used only once and discarded for disposal with other refinery solid waste.

The sampler initialed each sample label, including the time of sampling, for each well. The 40-ml samples for volatile organics analysis were wrapped in bubble wrap and taped. The samples were packed in the insulated containers to ensure that they remained cool and would not be subject to breakage. All sample labels and lids on the sample containers for semivolatiles, metals, and general water chemistry were securely taped prior to shipping. Fresh ice was placed in plastic freezer bags immediately prior to shipment. Ice was double-bagged to reduce leakage during melting. The completed chain-of-custody form was sealed inside a plastic bag and placed inside each insulated container prior to shipment. The insulated containers were then taped closed for shipment to the laboratory. To prevent tampering, clear packing tape served as custody seals and was placed over the container lid and signed by the sampler.

All QC samples -- including trip blanks, field blanks, and duplicates -- were added to the insulated container at the time of sampling. Precautions were taken to ensure that sample integrity was maintained during transport to the analytical laboratory.

3.2.3.3 Equipment Decontamination

All groundwater purging and sampling equipment was decontaminated prior to use at each monitor well and piezometer to prevent the possibility of cross-contamination. Interior submersible pump decontamination was performed at the conclusion of each day. The discharge hose and flow meter were decontaminated with Liquinox™ detergent followed by a clean-water rinse after purging each well. Dedicated filters for dissolved metals were used on the peristaltic pump and the tubing was flushed with Liquinox™ detergent followed by a clean-water rinse.

The standard decontamination procedure consisted of scrubbing the equipment in Liquinox™ detergent and water and then rinsing with bottled deionized or drinking-quality water. No non-aqueous phase liquids were encountered, and the use of special procedures (modified to include non-phosphate detergent and a final hexane rinse) for high organic concentrations were not necessary. All decontamination solutions were discharged into drums for disposal to the refinery wastewater treatment system. Dedicated equipment at a well did not require decontamination after use. Any disposable materials that may have been contaminated were collected and placed in appropriate containers for proper disposal.

3.2.3.4 Quality Control Sample Collection

QC samples included duplicates, equipment blanks, and trip blanks. One duplicate sample was collected for approximately every 12 groundwater sites sampled. Duplicate samples were assigned sequential numbers different from the original sample, and the collection site and time were recorded in the field logbook. An equipment field blank was collected for every nine sites sampled. Sample and duplicate bottles for each analysis were filled simultaneously from the same bailer(s) to minimize inducing error into the result. An equipment blank was collected for equipment not dedicated to a well. For heavy metals, a blank was taken for dissolved metals by running reagent-grade distilled water through the peristaltic pump with a clean filter installed. Duplicates and field blanks were submitted to the laboratory as blind QC samples.

A trip blank for volatiles accompanied each insulated cooler used for storing samples throughout the sampling effort. These blanks were prepared in the laboratory and placed in the insulated containers with the empty sample bottles prior to shipping them to the site. The blanks remained in the insulated containers until they were returned to the laboratory with the samples for analysis.

3.2.4 Results

From the RFI Phase III and earlier studies, a total of 15 monitor wells are available to monitor groundwater quality adjacent to TMD, from the northeast corner of the refinery to the entrance of the now-inactive Evaporation Pond 1 (Figure 2-1). Data from these wells provides a snapshot of the geology and water quality adjacent to the entire length of the ditch and the parallel portion of Eagle Creek. Groundwater elevation data from these wells and eight piezometers east of the process area of the refinery provides detailed information on groundwater movement downgradient from the refinery.

3.2.4.1 Drilling Program Results

Review of the boring logs (Appendix B) from the five monitor wells and three piezometers installed adjacent to TMD during the Phase III investigation support the stratigraphic relationships found during the Phase II study. MW-25, approximately 850 feet west of the Pecos River, has fine grained clay and silt sediments typical of a meandering river depositional environment. Upgradient 2,900 feet and adjacent to Eagle Creek, sediments at MW-26 are much more diverse consisting of silts, sands, and clays with some caliche gravel. The pattern found at this well continues upstream for the other borings. Although the upstream borings contain sediments having a mixture of sizes, the main constituent of these materials is silty clay. In these wells and piezometers, saturated zones were most clearly encountered and delineated when the borings encountered zones of caliche gravel. In wells MW-27, 28, and 29, auger cuttings produced well-rounded carbonate gravels up to 2 inches in diameter.

Because the near subsurface is dominated by fine grained silts and clays except where carbonate gravels are encountered, the boring logs generally do not provide good information on the depth to water upon completion of the well. For example, in the above three wells, saturation was first reported at depths of 15, 18, and 17 feet, respectively, while final depths to water were 10.7, 14.5, and 8.5 feet below the ground surface, respectively. Such disparity between the initial and final depths to water leads to a conclusion that water in the upper-most zone is partially confined, thereby producing water levels at elevations above where water was first encountered. The semi-artesian conditions observed in these wells were also observed in some wells drilled earlier along TMD. For example, MW-16 first encountered water at 12 feet, and the final depth to water was 8.3 feet.

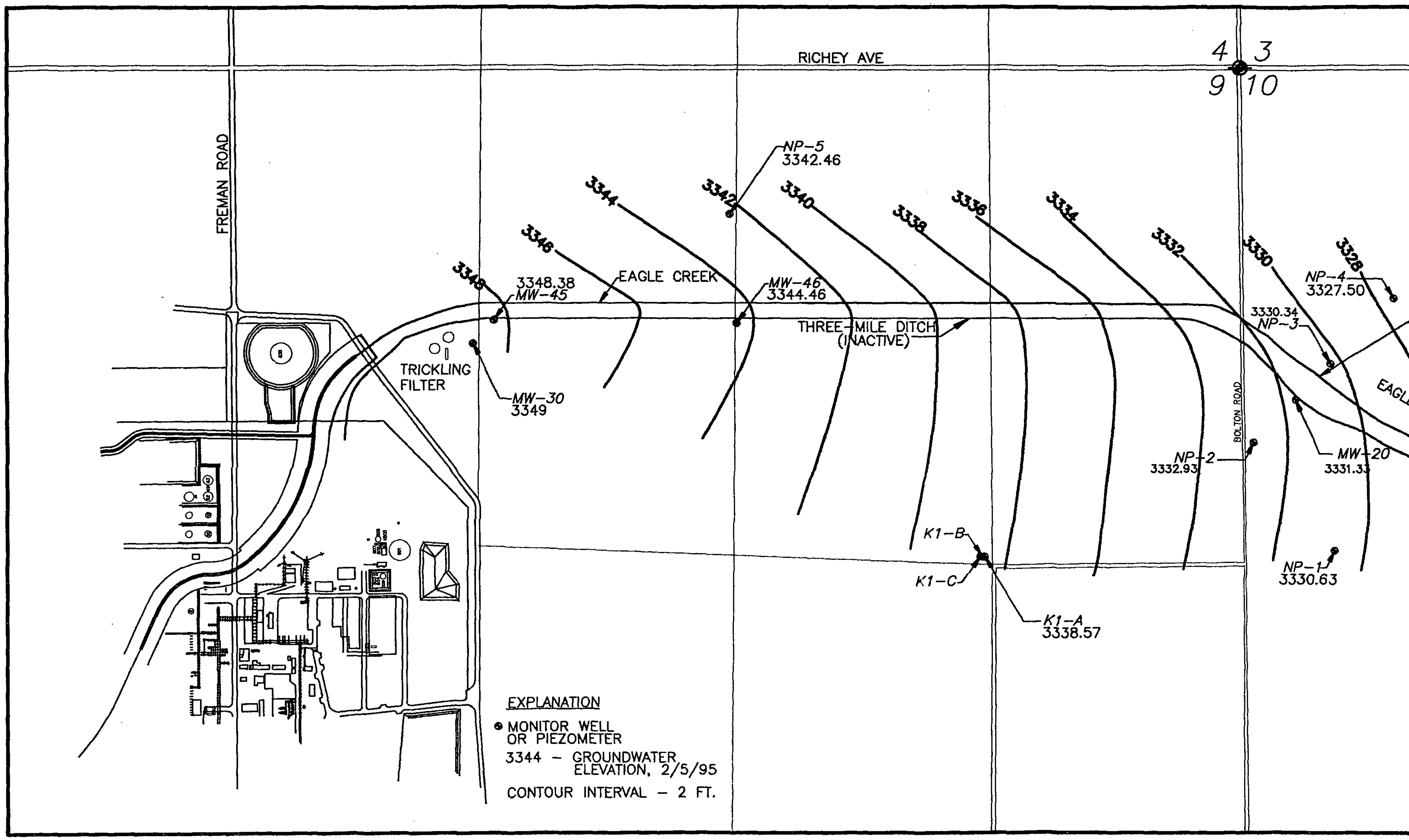
3.2.4.2 Groundwater Movement

Depth-to-water measurements were made on February 5, 1995, in 23 of the monitor wells and piezometers adjacent to TMD and in one monitor well (K-1A) installed during a separate groundwater investigation. Additionally, an existing unnamed well, installed prior to 1987, was found to be suitable for water-level measurements and was labeled and surveyed as NP-8. Water-level elevations were calculated by subtracting these readings from the surveyed elevations for the top of the well casings (Table 3-3). The water-level elevations were plotted on the 1:3,600 (1 inch = 300 feet) TMD base map in the area from the refinery to just east of Bolton Road, and on a 1:7,200 (1 inch = 600 feet) map for the area from the refinery to the ponds. Water-level contour lines were drawn at 2-foot elevation intervals in the mapped area. The resulting contour maps (Figures 3-2 and 3-3) show generally eastward flow along the entire length of the ditch.

Table 3-3. Water Level Elevations At Monitor Wells And Piezometers Along Three-Mile Ditch, February 5, 1995.

Well #	Top of Inner Casing (feet)	Depth to Water (feet)	Water Level Elevation (feet)
MW-1	3311.56	10.46	3301.10
MW-6A	3310.67	11.75	3298.92
MW-8	3335.26	8.43	3326.83
MW-9	3335.05	8.95	3326.10
MW-15	3310.93	11.07	3299.86
MW-16	3315.47	6.62	3308.85
MW-17	3320.38	18.61	3301.77
MW-20	3340.00	8.67	3331.33
MW-21	3336.18	9.74	3326.44
MW-25	3310.32	12.70	3297.62
MW-26	3314.30	11.58	3302.73
MW-27	3320.13	12.62	3307.51
MW-28	3327.24	16.69	3310.55
MW-29	3334.29	11.19	3323.10
MW-45	3356.32	7.94	3348.38
MW-46	3354.33	9.88	3344.46
NP-1	3341.49	10.87	3330.63
NP-2	3341.89	8.96	3332.93
NP-3	3342.05	11.71	3330.34
NP-4	3344.84	17.34	3327.50
NP-5	3353.41	10.95	3342.46
NP-6	3336.96	10.06	3326.90
NP-7	3328.86	24.61	3304.26
NP-8	3312.51	11.68	3300.83
KWB-1A	3350.87	12.36	3338.51

Sources: Survey Information: Jaquess Engineering, Roswell, 1992, 1993, 1995; Water level measurements: RE/SPEC, February 5, 1995



RE/SPEC RESEARCH SPECIALISTS	GROUNDWATER POTENTIOMETRIC MAP, THREE-MILE DITCH, FEBRUARY 1995, REFINERY TO BOLTON ROAD, RFI PHASE III
	PROJECT: 318/3.4(NAVWEST)
prepared for Navajo	DRAWN BY: W & C — DATE: 04/95
	CHECKED BY: DGB — SCALE: AS SHOWN
	JOB NO.: 318 — FIGURE: 3-2

Figure 3-3. Groundwater Potentiometric Map, Three-Mile Ditch, February 1995, Refinery to Pecos River, RFI Phase III


N
RE/SPEC
RICHEY AVE.
FREEMAN ROAD
BOLTON ROAD
HALDEMAN ROAD
EAGLE CREEK
THREE-MILE DITCH (INACTIVE)
PECOS RIVER
ARTESIA WWTP
TRICKLING FILTER
WINDMILL
NE CORNER SECTION 11 T. 17 S, R 26 E
BM R-26-R ELEV.=3308.20
GRAPHIC SCALE
(IN FEET)
600 0 300 600 1200 1800 2400 3000
EXPLANATION
MONITOR WELL OR PIEZOMETER
DITCH SURFACE SOIL SAMPLE
PECOS RIVER, RIVER WATER OR SEDIMENT SAMPLE
3304 – GROUNDWATER ELEVATION, 2/5/95
DASHED WHERE APPROXIMATE
CONTOUR INTERVAL 2 FT.
RE/SPEC
RESEARCH SPECIALISTS
prepared for:
Navajo
GROUNDWATER POTENTIOMETRIC MAP, THREE-MILE DITCH, FEBRUARY 1995, REFINERY TO PECOS RIVER, RFI PHASE III.
PROJECT: 318/3.4 (NAVMID)
DRAWN BY: W & C
DATE: APRIL 1995
CHECKED BY: DGB
SCALE: AS SHOWN
JOB NO.: 318
FIGURE: 3-3

In the vicinity of MW-45 and MW-46, a pronounced recharge effect can be observed which is defined by the contours bending at angle with the vertex of the angle pointing downstream (Figure 3-2). Since groundwater moves at right angles to the hydraulic gradient as represented by the contour lines, the map can be interpreted as showing recharge to the groundwater system from Eagle Creek. At most times of the year, the recharge water is predominantly reserve osmosis reject (ROR) water from the refinery's fresh water treatment system. The ROR discharge, which has received state agency approval, occurs directly upstream from MW-45 and has an elevated total dissolved solids (TDS) comparable to the quality of the water naturally occurring in the NSSZ.

From east of Bolton Road in the vicinity of MW-29 to the Pecos River, the contours are generally perpendicular to Eagle Creek, indicating northeasterly flow toward the Pecos River, but also indicating southeasterly and southerly flow in the vicinity of the river and ponds (Figure 3-3).

The drawing of the contours was complicated in the area of Haldeman Road and the Artesia Wastewater Treatment Plant (MW-16, 27, and 28 as well as NP-7) by unexplained anomalies in water levels in some of these wells. For example, MW-16, located 1800 feet downstream from MW-27, has a water-level elevation 1.3 feet higher than MW-27. Also, NP-7, located 700 feet upstream from MW-27 on the north side of Eagle Creek at Haldeman Road, has a water level 3.3 feet lower than MW-27 and 6.3 feet lower than MW-28. Because of these significant anomalies, the wells were re-surveyed, which resulted in only minor changes in the elevations. However, MW-16 is located directly across Eagle Creek from a treated sewage wastewater holding lagoon. Although originally lined with bentonite when constructed approximately 10 years ago, on-site monitor wells reflect fluctuations in pond levels. Because of the proximity to the holding lagoon, there is a strong likelihood that MW-16 is similarly affected by changes in water levels. Water-bearing zones in NP-7 were first encountered at depths greater than 10 feet below water zones in MW-27 or MW-28. Because of this, there is a possibility that the NSSZ seen in upstream wells is missing at this location. Neither MW-16 nor NP-7 water-level elevations were used in preparing the contour map for this report.

The hydraulic gradient as measured from the map was approximately 0.004 foot/foot along the ditch from MW-45 to MW-21. From MW-21 to MW-28, the gradient steepens to approximately 0.006 foot/foot. At MW-28, the gradient again flattens with an approximate slope of 0.002 foot/foot from MW-28 along the ditch to MW-26. Elevation from wells NP-7 and MW-16 were not included in this calculation as described above.

The gradient from MW-45 east to MW-21 is slightly flatter than calculated in 1993, while the relatively short section from MW-21 to MW-28 remains steep. The slightly flatter gradient could be result of the recharge, which would tend to raise and equalize water levels all along the section of the creek where the surface water is present. The steeper gradient downstream could reflect changes in the subsurface material with the coarser gravels, while still present, less frequent or below the bottom of the creek so that direct recharge is not possible. For example, the gravels in MW-21 were encountered at 7.5 feet, which is about the same elevation as the creek bottom, while in MW-28 they were detected at 17 feet.

Below MW-28 to the vicinity of the river, contour spacing changes with wider spacing, indicating a flatter gradient once again. In this area, both the topographic and hydrologic gradients are flatter. In addition to mimicking the topographic surface gradient, the groundwater contours may be flatter due to recharge effects from the Artesia wastewater plant. In the vicinity of the junction between Eagle Creek and the river, the contours are approximated due to the lack of hydrologic control. In this area, it is likely that changes in groundwater flow direction occur during the year due to changes in river water level elevation from irrigation releases or runoff events in response to severe precipitation.

3.2.4.3 Groundwater Quality

Results of the RFI Phase III groundwater sampling of the ditch monitoring wells are presented in this section, with the data included in Appendix D. Relevant results from prior sampling events and from the Phase I and Phase II studies are included in Appendix A. Results from MW-15 and MW-1, which are located in the vicinity of the evaporation ponds, are included in the data presentations for both TMD and the evaporation ponds.

Field parameters of pH, conductivity, and temperature were measured at each monitor well sampled. As described in the protocol in Section 3.2.3, sampling was performed after these field parameters had stabilized during pumping. The final readings taken for samples from the monitor wells along TMD are shown in Table 3-4.

3.2.4.3.1 Organic Constituents

Based on the results of the Phase II investigation, which did not detect chlorinated or exotic compounds in monitor wells, samples taken from the existing and new wells installed along TMD were analyzed for a lessor number of volatile and semi-volatiole organic compounds. Volatile compound analysis was limited to benzene, toluene, ethylbenzene, and total xylenes (BTEX) as well as methyl ethyl ketone (2-butanone) and carbon disulfide. Semi-volatile analyses were limited to 16 polynuclear aromatic compounds commonly found in oily wastes. The results of the analyses and detection limits are shown in Table 3-5.

Table 3-4. Groundwater Indicator Measurements at the Time of Field Sampling, Three-Mile Ditch, Navajo Refinery, RFI Phase III

Well sample identification	Laboratory number	Date sampled	Time sampled	pH	Conductivity (µmhos/cm at 25°C)	Temperature (°C)
MW-20	0694G02058	11/03/94	0955	7	9,600	NM
MW-8	0694G02055	11/04/94	1104	7	6,300	NM
MW-21	0694G02057	11/04/94	1138	7	6,300	NM
MW-9	0694G02056	11/04/94	1228	NM	6,550	NM
MW-16	0694G02079	11/05/94	0915	NM	5,300	NM
MW-1	0694G02080	11/05/94	1035	7.5	16,500	NM
MW-15	0694G02111	11/09/94	0856	6.5	4,100	17
MW-46	0694G02159	11/11/94	0810	7	4,600	17
MW-45	0694G02160	11/11/94	0856	7	7,400	18
MW-30	0694G02161	11/11/94	1038	7	7,000	16.8
MW-29	0695G00137	01/12/95	1030	6.5	6,100	17.7
MW-15	0695G00138	01/12/95	1445	6.5	3,100	18.9
MW-28	0695G00139	01/15/95	0950	7	4,400	17.9
MW-27	0695G00149	01/15/95	1045	7	3,100	18.4
MW-26	0695G00150	01/15/95	1205	7	8,200	17.9
MW-25	0695G00189	01/18/95	0850	7	17,000	15.8
MW-28	0695G00602	02/23/95	1655	6.5	4,600	NM
MW-15	0695G00607	02/24/95	1600	7	3,300	NM

Notes:
pH measured using paper pH strips
NM - not measured

Table 3-5. Summary of TMD RFI Phase III Groundwater Volatile/Semivolatile Sample Analyses

		Volatile Organics (mg/L)						Semi-volatile Organics[a]
Sample ID	Date	Benzene	Toluene	Ethyl-benzene	Xylenes (total)	Methyl ethyl ketone	Carbon Disulfide	
MW-1	5-Nov-94	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.010
MW-8	4-Nov-94	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.010
MW-9	4-Nov-94	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.010
MW-15	9-Nov-94	0.015	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.010
MW-15[b]	12-Jan-95	0.013	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	NS
MW-15[c]	24-Feb-95	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	NS
MW-16	5-Nov-94	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.010
MW-20	4-Nov-94	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.010
MW-21	4-Nov-94	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.010
MW-25	18-Jan-95	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.010
MW-25 dup[d]	18-Jan-95	< 0.001	< 0.001	< 0.001	< 0.002	< 0.005	< 0.005	< 0.0032
MW-26	15-Jan-95	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.010
MW-27	15-Jan-95	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.010
MW-28	15-Jan-95	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.010
MW-29	12-Jan-95	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.010
MW-30	11-Nov-94	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.020
MW-45	11-Nov-94	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.020
MW-46	11-Nov-94	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.010

Notes: All analyses by Inter-Mountain Laboratories, College Station, Texas, unless otherwise noted

[a] All semivolatile constituents that were evaluated were less than the reported detection limits presented in the table.

[b] Re-sample obtained during second phase of RFI Phase III field work.

[c] Sample obtained during follow-up sampling subsequent to formal RFI Phase III field work.

[d] Sample analyzed by Assaigai Analytical Laboratories, Albuquerque, NM.

Federal Secondary MCL Standards (mg/L): benzene, .005; ethylbenzene, .7; toluene, 1; xylenes, 10.

New Mexico WQCC Groundwater Standards (mg/L): benzene, .01; ethylbenzene, .75; toluene, .75; xylenes, .62.

Analyses for the above target compounds detected organics in just one well, MW-15, which is located immediately upgradient from the entrance to inactive Pond 1. In this well, benzene was detected at a level of 0.015 mg/L in the sampling on November 9, 1994, and again at 0.013 mg/L when resampled on January 12, 1995. However, the split sample taken on November 9 by PRC, EPA's on-site contractor, and a subsequent resampling by Navajo on February 24, 1995, did not detect benzene at the practical quantitation limit (PQL) of 0.005 mg/L. The November 9 and January 14 detections of benzene by Inter-Mountain Laboratories of College Station, Texas, were not accompanied by the detection of other common BTEX constituents. Because benzene commonly is detected together with the other BTEX compounds in waste petroleum constituents, or, alternatively, has been removed while the others remain, its presence by itself is suspect. The absence of benzene or any BTEX constituent in the PRC split sample and February Navajo resampling lead to the conclusion that its detection was a false positive by the laboratory and the compound is not present in the groundwater at that location.

The results of the PRC split sample analyses for TMD monitor wells do not show any volatile or semivolatile organic constituents except for various phthalate compounds in the some semivolatile samples. Based on previous work and published literature, phthalates in this environment are considered laboratory artifacts and not a constituent of the groundwater.

3.2.4.3.2 Metals

Metals analyses for total and dissolved arsenic, chromium, lead, and nickel are presented in Table 3-6 together with EPA and New Mexico water-quality standards. The EPA maximum contaminant level (MCL) for lead is an action level requiring treatment at the tap if exceeded in drinking water. In New Mexico, nickel is an irrigation standard, not a human health standard. Because New Mexico groundwater protection regulations require that measurements be made on a dissolved (vs. total) sample, all samples were filtered in the field using a 0.45-micron dedicated filter, as described in Section 3.2.3.2, "Sample Collection."

The results for TMD groundwater sampling show an exceedance of the federal or state standards for total arsenic in MW-9 (0.068 mg/L) and in one sample from MW-28 (0.120 mg/L). Dissolved arsenic from both wells was not detected at the PQL of 0.005 mg/L. The sample from MW-9 was increased over the value found during the Phase II sampling, but a similar increase was noted in total chromium. As documented in that study, the stainless steel casing has significantly deteriorated over time, leading to the displacement of very turbid water during the purging process. MW-28 was a new well completed in January which was sampled three days after initial development. Total metals results for all four metal constituents were elevated in this well, although dissolved metals were not detected at the respective detection levels. MW-28 was resampled five weeks later and purged using a low-flow peristaltic pump to minimize introduction of turbidity. Tubing used in the purging was set to remove water in the well from within two feet of the static water level, which is the zone sampled using a bailer. Total metals analysis of this sample did not result in any detections.

Table 3-6. Results of groundwater metals analyses, Three-Mile Ditch, Navajo Refinery, RFI Phase III, 1995.

Sample ID	Date Sampled	Total Dissolved Solids (180°C)	Total Arsenic (mg/L)	Total Chromium (mg/L)	Total Lead (mg/L)	Total Nickel (mg/L)	Dissolved Arsenic (mg/L)	Dissolved Chromium (mg/L)	Dissolved Lead (mg/L)	Dissolved Nickel (mg/L)
MW-1	05-Nov-94	10,200	0.013	**0.184**	<0.01	0.08	<0.005	<0.02	<0.1	<0.05
MW-8	04-Nov-94	5,730	0.029	**8.320**	<0.01	**1.45**	<0.005	**0.060**	<0.01	**0.50**
MW-9	04-Nov-94	6,160	**0.068**	**24.520**	<0.01	**4.96**	<0.005	0.030	<0.01	**4.11**
MW-15	09-Nov-94	3,660	0.028	<0.02	<0.01	0.02	0.008	<0.02	<0.01	0.02
MW-16	05-Nov-94	4,080	<0.005	<0.02	<0.01	0.02	<0.005	<0.02	<0.01	0.02
MW-20	04-Nov-94	8,630	0.008	<0.005	<0.01	0.03	0.007	0.020	<0.01	<0.01
MW-21	04-Nov-94	5,690	0.007	<0.005	<0.01	0.04	<0.005	<0.02	<0.01	<0.01
MW-25	18-Jan-95	11,600	<0.005	0.020	<0.01	<0.05	<0.005	0.006	<0.01	<0.05
MW-26	15-Jan-95	7,830	0.013	0.024	<0.01	<0.05	<0.005	<0.005	<0.01	<0.05
MW-26 (Lab Dup.)	15-Jan-95	7,830	0.014	0.021	<0.01	<0.05	<0.005	<0.005	<0.01	<0.05
MW-27	15-Jan-95	2,650	0.006	0.017	<0.01	<0.05	<0.005	<0.005	<0.01	<0.05
MW-28	15-Jan-95	3,930	**0.120**	**0.278**	**0.07**	**0.11**	<0.005	<0.005	<0.01	<0.05
MW-28	23-Feb-95	--	<0.005	<0.005	<0.01	<0.05	--	--	--	--
MW-29	12-Jan-95	5,650	0.008	0.025	<0.01	<0.05	<0.005	<0.005	<0.01	<0.05
MW-30	11-Nov-94	4,890	0.020	<0.005	<0.01	0.02	0.018	<0.02	<0.01	0.02
MW-45	11-Nov-94	6,590	0.022	0.035	**0.10**	<0.01	<0.005	<0.02	<0.01	<0.01
MW-45 (Field Dup. 4)	11-Nov-94	--	0.018	0.040	**0.07**	<0.01	<0.005	<0.02	<0.01	0.02
MW-45 (L Dp.of FD 4)	11-Nov-94	--	0.018	0.040	**0.08**	<0.01	<0.005	<0.02	<0.01	0.01
MW-46	11-Nov-94	3,880	<0.005	<0.005	0.01	<0.01	<0.005	<0.02	<0.01	<0.01
MW-46 (Lab Dup.)	11-Nov-94	3,920	<0.005	<0.005	0.01	<0.01	<0.005	<0.02	<0.01	<0.01

Notes: Water Quality Standards (mg/L):
EPA MCL: As, 0.05; Cr, 0.1; Pb, Action level=0.015; Ni, 0.1
NM WQCC Groundwater: As, 0.10; Cr, 0.05; Pb, 0.05; Ni, 0.2
Bold: Excedance of listed standard

Lead was not detected in any of the wells along TMD except in MW-28 (0.07 mg/L), as discussed above, and in MW-45. In MW-45, total lead at an average of 0.08 mg/L for three analyses (sample, field duplicate, and laboratory duplicate) was slightly elevated above the Phase II value of 0.05 mg/L. Again, no lead was detected in the dissolved samples. The total lead concentration observed in MW-45 is approximately 23 times less than the value of 1.83 mg/L reported from the Phase I investigation.

As observed in the Phase II investigation, both chromium and nickel are elevated in several of the wells along TMD, with chromium levels in three wells ranging from 0.184 to 24.52 mg/L, and nickel levels significantly elevated in two of the wells. The three wells with elevated levels of chromium or nickel were constructed of stainless-steel casing, and the high values for the two metals are related to degradation of the well casing material in the saline environment rather than actual groundwater concentrations of chromium and nickel. PVC-cased wells installed intermediate between two of these wells during the Phase II study had uniformly low values of both constituents.

3.2.4.3.3 Water Chemistry

The laboratory analytical data for the inorganic water quality constituents and indicator constituents for groundwater in the vicinity of TMD are shown in Table 3-7. In addition to the major constituents, the minor constituent fluoride, measured and calculated values of TDS, cation-anion totals, and percent difference are shown in the table. The latter three values provide a rapid check of the completeness and accuracy of the water analysis. For good-quality, low-TDS water, a percent difference of one to two percent is easily obtained. For wastewater and high-TDS water that can cause analytical instrument interference, a five percent difference may be acceptable.

Although discussion and interpretation of these results are presented in Section 3.2.5.2.3, the water quality of the NSSZ along TMD exceeded federal and state secondary standards for chloride, fluoride, sulfate, and TDS at all locations sampled except chloride at MW-27. Secondary drinking water standards are applied for constituents that generally impart aesthetic impacts such as taste or odor or increase salt concentrations in the water. They also may cause minor stomach irritation (sulfates), mottling of teeth (fluorides), or staining of clothes and fixtures (iron and manganese).

TDS, especially, is a good indicator of potability for humans and animals. TDS for the November 1994 and January 1995 sampling events ranged from 3,880 to 8,630 mg/L in the upper portion of TMD (MW-30 to MW-29) and from 2,650 to 11,600 mg/L in the lower portion (MW-28 to MW-15). The average TDS of upper and lower sections was 5,903 and 6,280 mg/L, respectively. The overall average for all ditch wells was 6,080 mg/L. A follow-up sample collected at MW-15 in February 1995 measured 2,200 mg/L TDS.

Table 3-7. Results of Water Chemistry Analyses, Three-Mile Ditch, Navajo Refinery, RFI Phase III, 1995.

Sample ID	MW-1	MW-8	MW-9	MW-15	MW-15	MW-15 (Lab Dup.)	MW-16	MW-20	MW-21	MW-25
Date Sampled	05-Nov-94	04-Nov-94	04-Nov-94	09-Nov-94	24-Feb-95	24-Feb-95	05-Nov-94	04-Nov-94	04-Nov-94	18-Jan-95
Lab pH (SU)	7.7	7.2	6.8	7.5	7.6	7.6	7.4	7.4	7.3	7.0
Lab EC (umhos/cm)	14,500	5,880	6,380	4,860	2,880	2,880	4,600	8,220	5,800	17,100
Total Dissolved Solids (180°C)	10,200	5,730	6,160	3,660	2,200	2,200	4,080	8,630	5,690	11,600
Calcium (mg/L)	862	556	637	372	263	262	570	499	589	664
Magnesium (mg/L)	459	480	488	113	79	77	238	932	480	436
Potassium (mg/L)	8	3	5	8	4	4	14	2	2	7
Sodium (mg/L)	2,130	358	416	519	332	329	424	456	321	2,560
Bicarbonate (mg/L)	472	400	293	175	124	125	379	451	368	202
Carbonate (mg/L)	0	0	0	0	0	0	0	0	0	0
Chloride (mg/L)	3,590	524	621	743	443	451	704	628	466	4,010
Sulfate (mg/L)	2,800	3,020	3,250	1,470	943	917	1,920	4,800	2,990	2,670
Fluoride (mg/L)	1.2	2.2	2.0	1.2	1.1	1.1	2.3	3.2	2.1	1.1
Cations (meq/L)	173.42	82.89	90.16	50.65	34.17	33.82	66.83	121.48	82.92	180.51
Anions (meq/L)	167.46	84.28	89.94	54.37	34.17	33.86	66.03	125.11	81.35	172.05
Balance (% Diff.)	1.75	-0.83	0.12	-3.54	0.00	-0.06	0.60	-1.47	0.96	2.40

See final page of table for applicable federal and state standards.

Table 3-7. Results of Water Chemistry Analyses, Three-Mile Ditch, Navajo Refinery, RFI Phase III, 1995. (continued)

Sample ID	MW-26	MW-26 (Lab Dup.)	MW-27	MW-28	MW-29	MW-30	MW-45	MW-46	MW-46 (Lab Dup.)
Date Sampled	15-Jan-95	15-Jan-95	15-Jan-95	15-Jan-95	12-Jan-95	11-Nov-94	11-Nov-94	11-Nov-94	11-Nov-94
Lab pH (SU)	7.8	7.8	7.3	7.8	7.4	7.7	6.9	7.1	7.1
Lab EC (umhos/cm)	8,900	8,900	3,250	4,660	6,410	6,080	7,450	4,410	4,410
Total Dissolved Solids (180°C)	7,830	7,830	2,650	3,930	5,650	4,890	6,590	3,880	3,920
Calcium (mg/L)	488	494	470	512	537	467	865	641	652
Magnesium (mg/L)	661	666	95	245	438	285	447	247	252
Potassium (mg/L)	7	7	10	6	5	3	14	14	14
Sodium (mg/L)	804	812	194	319	477	568	463	205	206
Bicarbonate (mg/L)	317	317	258	313	373	450	303	401	400
Carbonate (mg/L)	0	0	0	0	0	0	0	0	0
Chloride (mg/L)	1,020	1,020	179	328	484	756	939	369	371
Sulfate (mg/L)	3,740	3,740	1,460	2,180	3,000	2,090	3,110	2,020	2,010
Fluoride (mg/L)	2.3	2.3	1.2	1.9	1.8	1.5	2.1	2.4	2.4
Cations (meq/L)	113.90	114.96	39.97	59.73	83.73	71.55	100.45	61.60	62.59
Anions (meq/L)	111.65	111.75	39.70	59.75	82.12	72.26	96.21	59.10	58.92
Balance (% Diff.)	1.00	1.42	0.34	0.00	0.97	-0.49	2.16	2.07	3.02

See final page of table for applicable federal and state standards.

Table 3-7. Results of Water Chemistry Analyses, Three-Mile Ditch, Navajo Refinery, RFI Phase III, 1995. (concluded)

Sample ID	Pecos River	Pecos River	Effluent, 02-93	Effluent (NMOCD)
Date Sampled	11-Nov-94	1-Mar-91	11-Feb-93	26-Jul-89
Lab pH (SU)	7.9	8.3	8.3	- -
Lab EC (umhos/cm)	6,630	10,500	9,300	- -
Total Dissolved Solids (180°C)	4,580	6,620(s)	7,348	2,915(s)
Calcium (mg/L)	555	470	21	95
Magnesium (mg/L)	178	240	55	71
Potassium (mg/L)	6	12	22	9
Sodium (mg/L)	696	1,600	1,290	656
Bicarbonate (mg/L)	191	176	1,011	788
Carbonate (mg/L)	0	0	0	0
Chloride (mg/L)	1,300	2,300	1,920	577
Sulfate (mg/L)	1,510	1,900	1,034	860
Fluoride (mg/L)	0.7	1.5	151	- -
Cations (meq/L)	73	- -	62	- -
Anions (meq/L)	71	- -	92	- -
Balance (% Diff.)	1	- -	-19	- -

Federal Secondary MCL Standards (mg/L): TDS, 500; chloride, 250; sulfate, 250; fluoride, 2.
New Mexico WQCC Groundwater Standards (mg/L): TDS, 1,000; chloride, 250; sulfate, 600; fluoride, 1.6.
Federal MCL for fluoride: 4 mg/L.

3.2.5 Discussion

3.2.5.1 Groundwater Occurrence and Movement

Shallow groundwater occurs at depths between four and 22 feet below the land surface along TMD's length. The near-surface geology determined from this and the earlier drilling program consists of sands and sandy fines near the river (MW-15), grading to silty clays and clays at MW-25, approximately 1,250 feet upgradient. Beginning at MW-26 and continuing upgradient, gravels were encountered at depths ranging from 12 feet (MW-21) to 26 feet (NP-7). The diversity of depths at which gravels and water were encountered, together with the anomalous water levels found in NP-7, bolster the conclusion in the Phase II report that the NSSZ is generally discontinuous in the area of the ditch.

A series of piezometers and monitor wells have been installed along and adjacent to TMD to determine groundwater flow direction and quality. Information collected from the new and existing wells piezometers shows that current groundwater movement essentially is parallel to the ditch and Eagle Creek except in the reach between MW-45 and Bolton Road. In that section, recent discharge of ROR water has modified the groundwater flow pattern from what was observed in 1993. Currently, groundwater contours indicate movement of the discharge water into the NSSZ along that section of Eagle Creek, although that may change during portions of the year when water is used for on-site crop irrigation. In the vicinity of the Artesia Wastewater Treatment Plant, discharge by the city to a treated wastewater holding lagoon has an apparent impact on water levels in MW-16.

Closer to the river, current data show the groundwater gradient to be much flatter and generally ill-defined. Groundwater levels are impacted by changes in river water-level elevations due to seasonal changes governed by irrigation requirements and in response to occasional precipitation-triggered runoff events. The seasonal fluctuations likely prevent a permanent groundwater flow pattern from developing in the shallow groundwater nearest the river. Without a defined flow pattern, water in this zone may become stagnant with salts tending to accumulate through lack of a flushing action. The removal of copious quantities of water by salt cedar further aggravates the situation because moisture transpires from the subsurface while the salts remain behind.

As documented in the Phase II report, the nearest active domestic water wells are north of Eagle Creek at a minimum distance of about one-quarter mile. These water wells are all located west of Haldeman Road. No water wells in the vicinity of the ditch are located east of Haldeman Road. The proximity of the wastewater plant, apparent groundwater impacts from the wastewater holding lagoon, and the rapidly decreasing quality of the groundwater approaching the river along Eagle Creek will preclude establishment of shallow domestic water wells in that area.

3.2.5.2 Groundwater Quality

3.2.5.2.1 Volatile and Semivolatile Organic Compounds

Analyses of groundwater from existing and newly installed monitor wells did not detect volatile or semivolatile organic compounds except for a low concentration of benzene (0.015 mg/L) in MW-15 during the primary sampling event and one follow-up event. However, this compound was not detected in the PRC split sample, nor in a third sampling of the well. Also, the compound was not detected during sampling for the Phase II study. Based on the absence of the other BTEX constituents that are commonly found in other petroleum-impacted monitor wells in the vicinity of the evaporation pond, and the lack of confirmation in both the split sample and a follow-up sample, it is concluded that the detection in MW-15 is a false positive by the analytical laboratory.

3.2.5.2.2 Selected Metals

The earlier investigations found significant levels of metals in monitor wells MW-8 and MW-9, located between TMD and Eagle Creek east of Bolton Road. This area was the focus of intense study during the Phase II investigation. Results of the Phase II confirmed high chromium and nickel concentrations, but further investigation and detailed constituent analysis of groundwater and of the stainless-steel well determined that the most probably source of these elevated metals was corrosion residuals resulting from decomposition of the stainless steel screen and/or casing. The Phase III results supported this conclusion with total chromium concentrations of 8.3 and 24.5 mg/L for MW-8 and MW-9, respectively, but filtered samples dropped below the federal maximum contaminant limit (MCL) for chromium. MW-21, cased with PVC and located between these wells, does not contain elevated levels of metals..

The level of total chromium in MW-1 was significantly reduced from the Phase II investigation. The reduction from 3.65 mg/L in 1992 to 0.184 mg/L in 1994 is likely related to reduced turbidity in the collected sample. Filtered samples from both samplings did not detect chromium at the detection level of 0.02 mg/L.

Monitor well 45 had a slightly elevated level of total lead (0.08 mg/L) relative to the state groundwater standard of 0.05 mg/L. Dissolved lead was not detected at 0.01 mg/L. This well is completed in a concrete pad that is flush with the ground surface. A metal locking cover does not provide a complete seal as evidenced by a multitude of spider webs that were required to be cleared before purging. The well is adjacent to a field that is sometimes cultivated, and it is likely that dust and other particulates enter the well during the frequent windy periods.

Newly constructed MW-28 had MCL exceedances for all four metals. This well was sampled in January, 1995, three days after well development, and purged using the high-capacity pump used in the development. A second sample was obtained five weeks later using a low-capacity peristaltic pump to purge the well with the purged water withdrawn from near the water level surface at about the elevation water would enter a bailer. The results of this sampling did not detect any metal constituents at their levels of detection. It is likely that purging using the larger pump caused fines not removed during initial well development to move into the well and be caught by the bailer. This effect was also seen in several wells in the vicinity of the evaporation ponds as discussed in 4.5.2.2.

3.2.5.2.3 Water Chemistry

Spatial water chemistry relationships between monitor wells and temporal changes in a well between sampling events can provide information on changes in groundwater quality due to either natural causes or man-caused impacts. Examination of the water chemistry of the groundwater in the vicinity of the ditch and interpretation of the relationships among and between samples can provide support for a hypothesis that the mixing of groundwater has or has not occurred for a specific sample. For example, among three samples, one of which is an effluent known to have a high sodium concentration, and a second background sample, detection of a high sodium concentration in the third sample relative to the second sample could lead to the conclusion that the third sample was impacted by the high sodium source. However, such a determination depends not only on the direction of groundwater flow, but on the total salt concentration of the sample and the relative concentrations of the individual constituents.

In the Phase II report, the Piper trilinear diagram was used to illustrate relationships between water quality from differing sources. This diagram provides information on the major ionic components of a water sample and directly compares component composition with those of other samples. Because complete water chemistry data were collected during the investigation, the Piper method was used, together with the volatiles and metals analyses, to demonstrate the lack of contamination between effluent carried in TMD and shallow and deep groundwater in the immediate vicinity of the ditch (Section 9.1.3, RFI Phase II Report).

The Piper diagram has three fields, two triangular-shaped and one diamond-shaped, for plotting sample constituent concentrations and for observing similarities or differences between samples. The left and right triangles show the cation and anion composition of the sample, respectively, whereas the center diagram is the projection of the major cation-anion groups. Although sample points may have a similar cation or anion composition in one of the two triangles (as determined by position relative to the vertices), it is necessary for the points to be located in the same relative position in all three plots for the samples to be considered from the same source. Possible sample mixing is evidenced by the placement of a point on a straight line between two other points in each of the three fields. However, mixing is physically possible only when groundwater movement is in a direction that will allow such mixing.

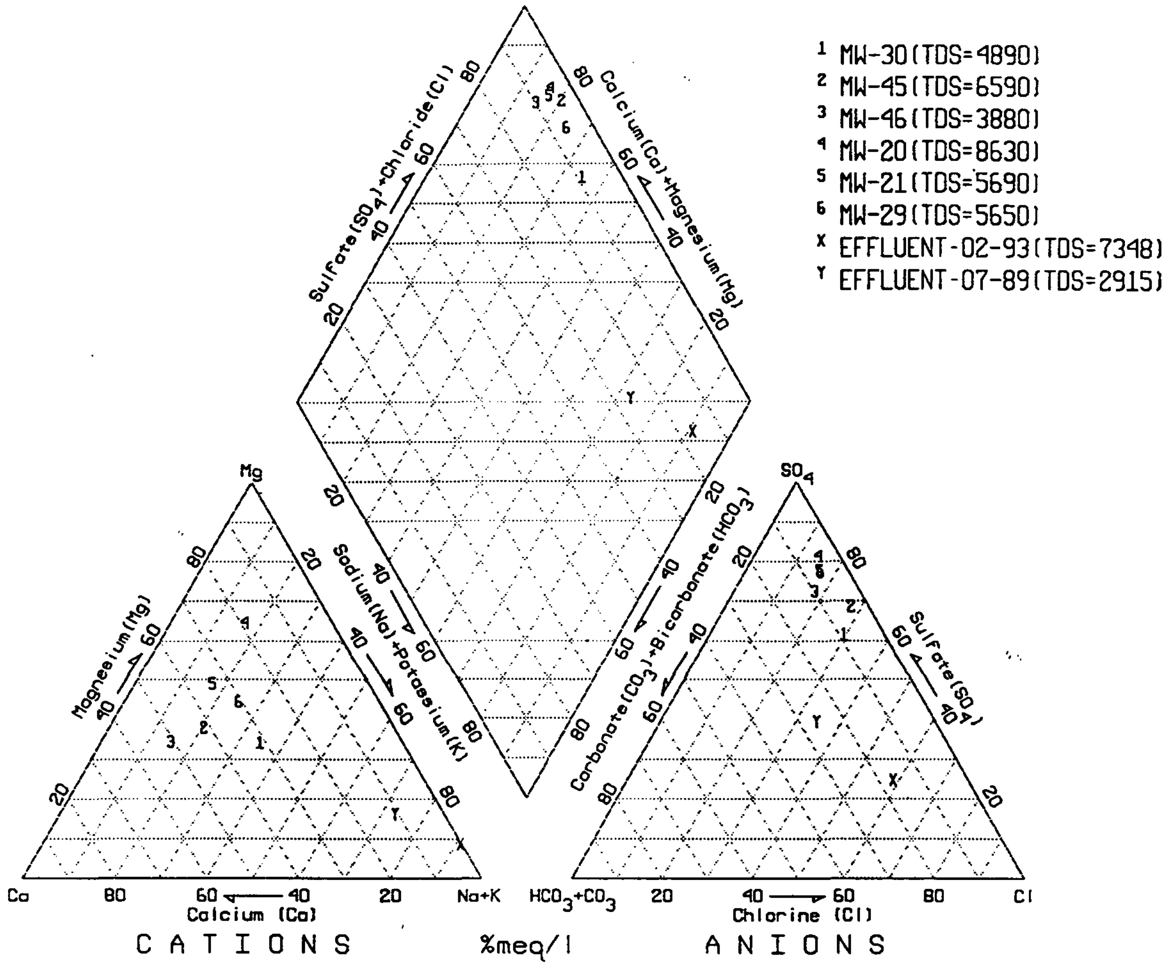
Data from the current sampling effort for TMD are presented in two Piper diagrams. Figure 3-4 presents water quality data from the refinery (MW-30) to the area just east of Bolton Road (MW-29). Water concentrations from MW-8 and MW-9 are not shown because they are almost identical to that of MW-21 and overlay that point in the diagram. For comparison, 1994 data from the Pecos River and two effluent samples are included. The 1993 effluent sample was obtained during the Phase II investigation, and the 1989 effluent analysis is from a sampling of the outfall to the ponds by the New Mexico Oil Conservation Division. It is a reasonable assumption that water chemistry composition of pre-1989 effluent was similar to the composition range shown here because the major reduction in water use and changes in the non-organic composition of the wastewater only recently occurred. Prior to 1993, most treatment was related to organics reduction.

With the exception of MW-30, the water quality of all monitor wells along this reach of TMD, including new MW-29, plot separately from the effluent samples. The ditch monitor well samples have sodium concentrations of less than 25 percent and plot along the left axis of the cation triangle. Sulfate concentrations of these wells are greater than 70 percent and plot in the upper right of the anion plot. All ditch wells plot in the top corner of the center diamond plot.

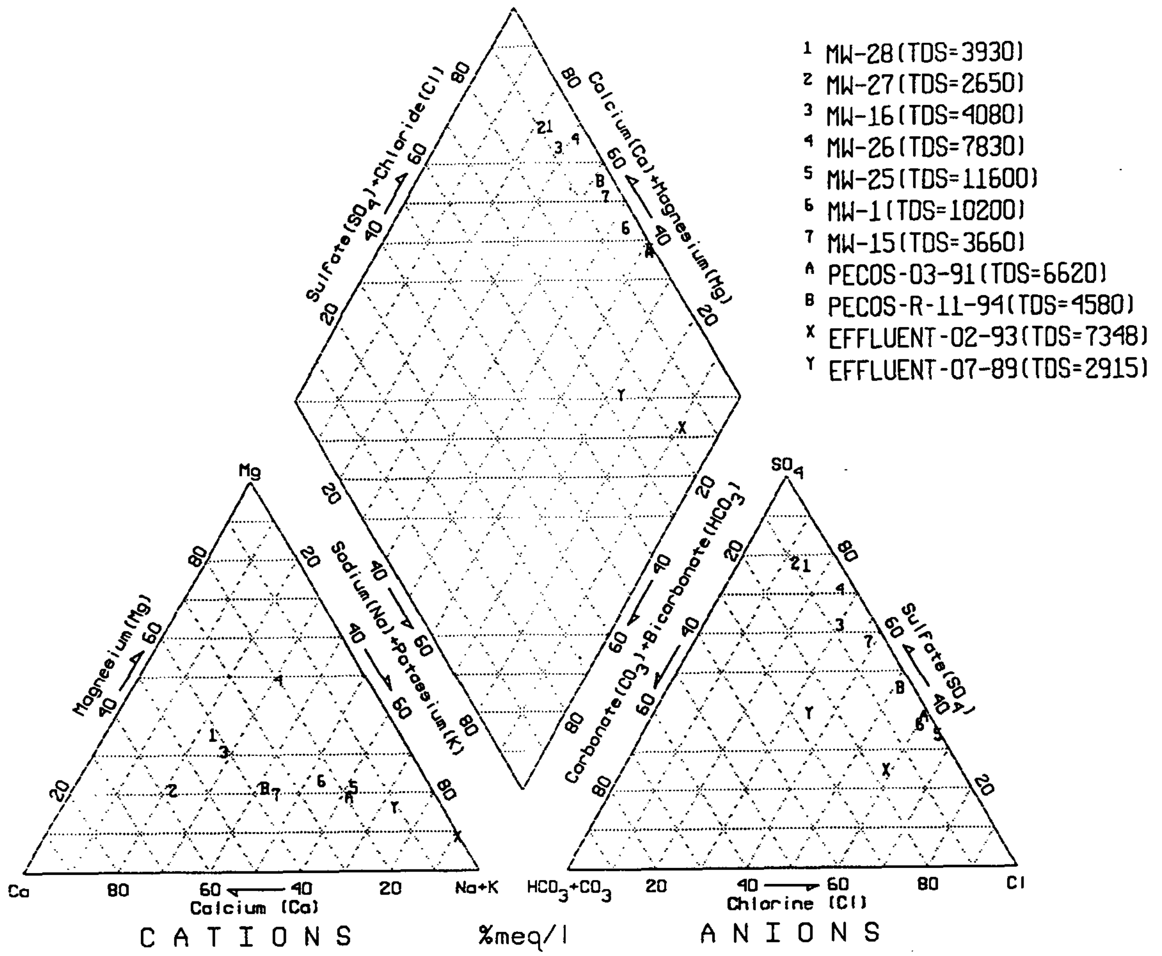
MW-30, located on the refinery property near the trickle filter, has slightly more sodium chloride than do the ditch monitor wells. Whether the slight increase of sodium chloride relative to the other samples and the effluent has any significance is unknown. However, MW-30 had no detectable organic constituents and arsenic and nickel metals were only slightly elevated above detected levels.

The two effluent samples have high sodium values and plot in the lower right of the cation triangle. In the anion triangle, the effluent samples are toward the chloride end. In the center diamond, the effluent samples are isolated from the six ditch samples.

In Figure 3-5, the seven TMD monitor wells in the lower ditch area are plotted together with the analyses of Pecos River and effluent samples. The four wells immediately adjacent to Eagle Creek (MW-16, MW-26 to MW-28) have characteristically different water than the three monitor wells near the river; and the river wells have different characteristics than the effluent. The Eagle Creek wells show sodium concentrations between 20 and 30 percent and chloride concentrations less than 40 percent. Calcium and magnesium are the predominant cations, and sulfate concentrations are greater than 60 percent. MW-16 has the highest percentage chloride concentration, but concentrations again drop slightly downstream. Because sodium concentrations remain low in that sample, water quality may have been impacted by water from the city wastewater treatment plant. MW-15 has concentrations similar to the Pecos River. Because the TDS value is lower than the typical Pecos River sample, it is likely that river recharge to the well most commonly occurs during times of better quality flow during high river level conditions.



RE/SPEC	Trilinear mixing diagram, MW-30 to MW-29, Upper Three-Mile Ditch, RFI Phase III, April 1995	
prepared for: Navajo	PROJECT: 318/3	
	LOCATION: ARTESIA, NEW MEXICO	
	APPR:	DATE: 4-28-95
	DRAWN BY: DB	SCALE:
	DATE:	FIGURE: 3-4



RE/SPEC	Trilinear mixing diagram, MW-28 to MW-15, Lower Three-Mile Ditch, RFI Phase III, April 1995	
prepared for:	PROJECT: 318/3	
	LOCATION: ARTESIA, NEW MEXICO	
	APPR:	DATE: 4-28-95
	DRAWN BY: DB	SCALE:
	DATE:	FIGURE: 3-5

The Piper water quality diagrams graphically demonstrate that the effluent sources have had no obvious impact on the water chemistry of groundwater adjacent to the ditch. The effluent sources plot separately from the monitor wells and river water on both diagrams. The diagrams and results of the organic and metal analyses presented previously continue to support the conclusion of the Phase II study that show that any current groundwater impacts of past ditch use are at most minimal.

The shallow groundwater in the vicinity of the ditch, as shown in Table 3-7, has high, naturally-occurring TDS concentrations that make it unusable except for occasional stock use. Not withstanding the lack of current use, there is no evidence to support widespread contamination of the groundwater as a result of past ditch use and no evidence that existing sediments are contributing or will contribute to groundwater degradation in the ditch area.

4.0 RFI PHASE III INVESTIGATION - EVAPORATION PONDS GROUNDWATER

The objectives of the additional groundwater sampling and investigation program at the evaporation ponds were:

- To verify and update groundwater conditions and water quality information generated during earlier investigations, and
- To drill two new groundwater monitor wells to determine hydraulic conditions and groundwater quality at depths up to 70 ft. in the vicinity of the ponds.

A third monitor well was installed downgradient from inactive Pond 1 as required by the Corrective Measures Study workplan for that unit. Because that workplan has been submitted to EPA, the results of the investigation at the third deep well are included in this report.

The groundwater investigation in the vicinity of the ponds included the following specific activities:

- Measurement of water levels in shallow and deep paired monitor wells and piezometers;
- Sampling of selected shallow and deep monitor wells to update and verify constituent concentrations found in the Phase II study;
- Sampling of the pond windmill;
- Installation of three deep monitor wells to delineate vertical extent of contamination at depths greater than 50 feet, if any, and to provide hydrogeologic baseline information on deeper water zones;
- Performance of borehole aquifer tests to determine *in situ* hydraulic conductivity; and
- Collection of water quality samples from new monitor wells

This section describes the groundwater study procedures followed during the Phase III investigation of this unit. Included are descriptions of drilling and well installation, hydrogeologic characterization, and sample collection. These are followed by presentation of the results and the section concludes with a discussion of the investigation results.

4.1 Drilling Procedures

The procedures followed for drilling and sampling monitor wells and borings at the evaporation ponds are similar to those described in Section 3.2.1, "Drilling Procedures," for the investigation at TMD. Some modifications to those procedures were necessary for drilling deep monitor wells; these are described in the following section on monitor well installation.

4.2 Monitor Well Installation and Development

To characterize the deeper groundwater zone, three additional monitor wells were completed in the valley fill alluvium in the vicinity of the evaporation ponds. The wells were drilled by Precision Engineering using a CME 75 Hi-Torque hollow-stem dry auger rig mounted on a four-wheel-drive truck.

These wells, identified with the suffix letter C (e.g., MW-5C), are surface-cased to isolate the deeper groundwater from the surficial zone within the aquifer. Two wells, MW-5C and OCD-7C, are located on Navajo property at sites where both shallow and intermediate depth wells were previously drilled. MW-4C was installed as a requirement of the CMS workplan; it is located south of inactive Pond 1 on adjacent land (known as the Holt property) where a shallow well (MW-4) was previously installed. The shallow well was redesignated MW-4A upon drilling of the deep well. Because "B" suffix wells are of intermediate depth (35-50 feet), this deep well was designated MW-4C.

Installation of the deep wells required different techniques to address the difficulties in boring and sampling in the saturated heaving sands at depths of 50 to 70 feet in the valley fill alluvium. MW-4C was logged throughout its total length, but core barrel sampling was replaced with split-spoon at 52 feet when sands pushing into the augers became unmanageable. Because of the heaving sands and since intermediate wells at MW-5C and OCD-7C were previously installed and logged during the Phase II investigation, the deep borings at these locations were advanced without lithologic sampling until below the base of the surface casing when split-spoon sampling was performed.

Once surface casing depth was achieved, the 4.25-inch I.D. augers were replaced with 8.25-inch I.D. augers with a wooden knockout plug inserted in the lead auger to keep sand from pushing into the auger annulus. The larger augers were used to overdrill the boring and were advanced to five to 10 feet beyond total depth of the surface casing to provide space for the heaving sands when the augers were removed. The augers remained in the hole while 10-inch O.D. schedule 40 PVC casing was assembled. The augers were then removed and the surface casing pushed into the boring. The 20-foot sections of PVC casing were connected using stainless-steel screws while a section was suspended in the hole. The rig kelley was used to press the PVC casing the last few feet to total depth. A seal was installed between the PVC casing and the boring wall by using a tremie pipe to pump a slurry of cement and five percent bentonite into the annulus. The tremie pipe was placed a few feet above the bottom of the casing to avoid pumping grout into the zone to be screened.

The grout was allowed to cure for at least 24 hours before the rig was set back over the hole. The 4.25-inch augers were rigged with a wooden knockout plug and quickly advanced to the total depth of the boring. The wood plug was then knocked out by lowering the drill rod through the auger casing. Spilt-spoon sampling to final total depth performed immediately ahead of auger advancement. A screened section of two-inch diameter PVC casing was emplaced through the surface casing and set at total depth. Silica sand was placed in the annulus between the auger and the two-inch PVC casing to form a sand pack, and the auger was pulled slowly from the hole to ensure proper placement of the sand pack. The problems with heaving sands ended once the lead auger was pulled into the 10-inch surface casing, and the remainder of the auger sections could be pulled quickly. The sand pack was extended for a few feet into the surface casing, and then a bentonite seal was placed using dry-pellets. After a short hydration period, concrete was pumped into the annulus between the surface casing and the 2-inch well casing to provide an anchor and seal. Surface completion for the deep wells was the same as previously described in Section 3.2.2, "Well Installation and Development."

4.3 Groundwater Measurements, Sample Collection, and Quality Control

Groundwater measurements, sample collection, and quality control at the evaporation ponds were performed using procedures identical to those used for collection of data at TMD. An additional procedure was the conducting of a "slug" test at the three new deep wells to collect aquifer permeability data. An attempt was made to conduct a test at existing well MW-4A, but equipment was not able to move past down-hole joints connecting sections of the steel casing.

A slug test is a procedure utilizing a tool of known volume (a "slug") that is inserted into and removed from the well while measurements are made of the time response for water to return to the original static water level. Since dimensions of the slug and wellbore are known, the time required for the water level to stabilize is proportional to the formation hydraulic conductivity. Because these wells were completed in relatively permeable formations, the time for the wells to recover was on the order of a few minutes and required use of a data recorder to provide usable measurements for the conductivity calculations. The advantage of a slug test is that water which may be possibly contaminated is not removed from the well and a power source is not needed to pump the water; its drawback is that conductivity is measured only a short distance in the formation from the well.

The "slug" used in this procedure was a section of one-inch PVC pipe with an outside diameter of 1-5/16 inch (0.11 foot) and a length of 6.25 feet. It was filled with clean pea gravel for weight, sealed at the top and bottom with 1-5/8-inch OD caps, and secured with small stainless steel screws. An eye hook was attached to the top cap and clean rope attached for lowering into the wells. The total volume displaced by the slug was 0.45 gallons.

Data collection equipment included a battery-powered In-Situ 1000C data logger and an In-Situ 10 PSI pressure transducer. The transducer was placed downhole at a depth lower than the base of the slug. The test was conducted by starting the data logger and quickly lowering the slug into the well. The water level stabilized within ten minutes and data collection concluded. The data logger was reset and a second test was started by quickly removing the slug. Wells MW-4C, MW-5C and OCD-7C were tested using this method. The results of the test are presented and discussed in Section 4.4.2.2.

4.4 Results

4.4.1 Results of the Drilling Program

The drilling program results supported the lithologic results obtained during the Phase II study. This study found the near-surface geology to be predominantly fine- to medium-grain and well-graded sands exhibiting increasing grain sizes with depth and interbedded with thin clayey zones in the upper 15 to 20 feet of the vertical section. Boring logs for the three deep wells included with Appendix B.

At MW-4C and 5C, finer grained silts, sands and clays are present in top 15 feet. Below that depth, coarser sands and gravels were found down to total depth of 72 feet with the exception of several thin (1 to 2.5 inches) clay and clayey gravel zones near total depth. At OCD-7B, drilled during the Phase II investigation, the sediments were sandy from 18 to 51 feet where a two-foot clay zone was encountered from 51 to 53 feet. Lithologic sampling for OCD-7C was performed after setting of surface casing. Split-spoon sampling at OCD-7C began at 65 feet because overdrilling necessary to allow surface casing placement had disturbed zones from 55 to 65 feet. From 65 to 67 feet, the split spoon recovered fine grained sands and sandy gravels. At 70 to 72 feet, a dark greenish gray mottled clay was encountered.

There was no indication of free-product petroleum hydrocarbons in the sediments. At MW-4C, dark gray and black zones with strong hydrocarbon-type odors were present from 25 to 45 feet. However, when placed in clear water, the sediments did not impart a rainbow sheen to the water and the sediments did not leave a greasy residue on the protective gloves worn during sampling. At total depth in all three wells, there was a general absence of hydrocarbon-type odors in the sediments. A very slight odor was noted in some basal sediments from MW-4C and MW-5C. Sediments at 72 feet from OCD-7C had a septic odor.

Soil samples from various depths in MW-4C were analyzed for petroleum volatiles and semi-volatiles, and arsenic, chromium, lead and nickel metals (Table 4-1). No volatiles or semivolatiles were detected at 0.005 or 0.5 mg/Kg, respectively. Metal detections ranged from 1.5 to 7.9 mg/Kg for arsenic, four to 16 mg/Kg for chromium, two to seven mg/Kg for lead, and <5 to 10 mg/Kg for nickel. The maximum concentration for each of these metals is within the background concentration range for these metals. Notwithstanding soil discoloration and odor, the sample results do not indicate the presence of subsurface soil contamination by organics or metals.

Table 4-1. Results of Soil Sampling at MW-4C

Sample ID and Depth	Volatiles[1] (mg/Kg)	Semivol[2] (mg/Kg)	Arsenic[3] (mg/Kg)	Chromium[3] (mg/Kg)	Lead[3] (mg/Kg)	Nickel[3] (mg/Kg)
MW-4C (9-10 ft.)	<0.005	<0.5	NS	NS	NS	NS
MW-4C (14-15 ft.)	<0.005	<0.5	2.6	9	4	8
MW-4C (29-30 ft.)	<0.005	<0.5	7.9	10	7	9
MW-4C (32-33 ft.)	<0.005	<0.5	4.5	9	5	7
MW-4C (33 ft.)	<0.005	<0.5	NS	NS	NS	NS
MW-4C (42 ft.)	<0.005	<0.5	1.5	4	2	<5
MW-4C (56 ft.)	<0.005	<0.5	1.8	16	7	5
MW-4C (58-60 ft.)	<0.005	<0.5	1.6	7	3	10

Notes:

[1] Volatiles analyzed were benzene, ethylbenzene, toluene, total xylenes, methyl ethyl ketone and carbon disulfide.

[2] Semi volatiles analyzed were 12 polycyclic aromatic hydrocarbons.

[3] NS - Not Sampled

4.4.2 Groundwater Movement

The RFI Phase II investigation showed the general direction of flow from the area of the ponds is south to southeasterly with groundwater generally discharging in the low-lying area and salt cedar thickets in the vicinity of the U.S. Highway 82 bridge. At those locations and times of the year when the elevation of the groundwater is higher than the elevation of the river, groundwater in sediments immediately adjacent to the river migrates in the direction of the river. Based on the naturally high TDS of unimpacted shallow groundwater in some of the monitor wells in that area (e.g., MW-18A and MW-19, and MW-23 north of the ponds) it is likely that much of the groundwater discharges via surface evapotranspiration leaving behind high concentrations of salt.

A detailed discussion on groundwater flow direction in the vicinity of the evaporation ponds was presented in the Phase II report. Because groundwater flow direction had been defined in the earlier report, depth-to-water was measured only in wells where groundwater samples were obtained and in wells used for determination of vertical flow gradients.

4.4.2.1 Vertical Flow Gradients

Depth-to-water measurements in the eleven paired monitor wells were made from November 5 to 10, 1994 and again on February 5, 1995. Between the two sets of measurements, an additional three monitor wells were drilled to provide water level and water quality measurements of the deep alluvial zone to approximately 70 feet. Newly installed and existing paired wells were surveyed in February 1995 to determine new casing elevations and confirm previously surveyed readings.

The Phase II and III installation of a total of eleven sets of nested monitor wells enabled determination of the existence of positive or negative vertical gradients at a particular well location. Water-level elevations were first calculated by subtracting the depth-to-water readings from the surveyed top-of-casing elevations. Differences in vertical potentiometric levels are determined by comparing water-level elevations in the shallow "A" wells and the deeper "B" and "C" wells.

Four sets of water level elevation readings in the nested monitor wells have been made since February 1993. The water level elevations and results of the comparison of the elevations in the adjacent wells are shown in Table 4-2. A positive difference indicates upward vertical movement in the aquifer in the immediate vicinity of the well. Upward vertical movement is seen at eight of the eleven well locations. Well locations indicating downward groundwater movement are at MW-2, OCD-2, and OCD-7. All three locations are directly adjacent to active sections of the evaporation ponds and intercept the groundwater mound created by the pond.

The direction and magnitude of the well readings are generally consistent over time. A discrepancy was seen in the data from OCD-2 for February 1993 and at OCD-8 for February 1995. The apparent discrepancies are most likely caused by an error in one of the depth-to-water readings for these wells on those dates. The other readings show little difference between measurement dates.

4.4.2.2 Aquifer Test Data Analysis

A series of tests were conducted on February 4, 1995, to determine the *in situ* hydraulic conductivity of the aquifer opposite the three newly drilled deep wells in the vicinity of the Navajo Refinery evaporation ponds. The wells, MW-4C, MW-5C, and OCD-7C, were tested using a procedure known as a "slug test" where a tool of known volume was quickly inserted in the well and the subsequent displacement and time for recovery of water levels were registered on a data recorder. The equipment and methodology used in conducting the test was described in Section 4.3. This section describes the procedures used in analyzing the data and compares the results to earlier hydraulic conductivity testing performed in the vicinity of the evaporation ponds.

Table 4-2. Well and Water-Level Elevations at Monitor Wells Near Navajo Evaporation Ponds, 1993-1995

Well I.D.	Top of Casing Elevation (ft.)	2/09/93 D-T-W (ft.)	2/09/93 Water Level Elevation (ft.)	11/13/93 D-T-W (ft.)	11/13/93 Water Level Elevation (ft.)	11//94 D-T-W (ft.)	11/94 Water Level Elevation (ft.)	02//95 D-T-W (ft.)	02/95 Water Level Elevation (ft.)
MW-2A	3309.80	8.32	3301.48	10.01	3299.79	9.59	3300.21	9.35	3300.45
MW-2B	3309.29	9.36	3299.93	10.94	3298.35	10.57	3298.72	10.09	3299.20
Difference:			**-1.55**		**-1.44**		**-1.49**		**-1.25**
MW-4A	3309.57	- -	- -	- -	- -	- -	- -	11.27	3298.30
MW-4C	3309.09	- -	- -	- -	- -	- -	- -	10.50	3298.59
Difference:									**0.29**
MW-5A	3305.87	7.64	3298.23	8.45	3297.42	8.90	3296.97	8.46	3297.41
MW-5B	3305.94	7.22	3298.72	8.06	3297.88	8.49	3297.45	8.04	3297.90
Difference:			**0.49**		**0.46**		**0.48**		**0.49**
MW-5A	3305.87	- -	- -	- -	- -	- -	- -	8.46	3297.41
MW-5C	3306.23	- -	- -	- -	- -	- -	- -	8.19	3298.04
Difference:									**0.63**
MW-6A	3310.67	11.01	3299.66	12.56	3298.11	12.19	3298.48	11.75	3298.92
MW-6B	3310.59	10.86	3299.73	12.41	3298.18	12.05	3298.54	11.59	3299.00
Difference:			**0.07**		**0.07**		**0.06**		**0.08**
MW-7A	3304.73	6.52	3298.21	7.22	3297.51	7.64	3297.09	7.20	3297.53
MW-7B	3306.30	7.72	3298.58	8.41	3297.89	8.85	3297.45	8.42	3297.88
Difference:			**0.37**		**0.38**		**0.36**		**0.35**

Notes: DTW - Depth to Water
Difference: Value shown is "B" elevation minus "A" elevation; positve number is upward gradient, negative is downward gradient.

Table 4-2. Well and Water-Level Elevations at Monitor Wells Near Navajo Evaporation Ponds, 1993-1995 (concluded)

Well I.D.	Top of Casing Elevation (ft.)	2/09/93 D-T-W (ft.)	2/09/93 Water Level Elevation (ft.)	11/13/93 D-T-W (ft.)	11/13/93 Water Level Elevation (ft.)	11//94 D-T-W (ft.)	11/94 Water Level Elevation (ft.)	02//95 D-T-W (ft.)	02/95 Water Level Elevation (ft.)
MW-11A	3307.46	8.81	3298.65	9.07	3298.39	9.29	3298.17	9.00	3298.47
MW-11B	3307.55	8.76	3298.79	9.04	3298.51	9.22	3298.33	8.93	3298.63
Difference:			**0.14**		**0.12**		**0.16**		**0.16**
MW-18A	3305.36	9.53	3295.83	10.68	3294.68	10.35	3295.01	9.81	3295.55
MW-18B	3305.58	9.46	3296.12	10.62	3294.96	10.29	3295.29	9.71	3295.87
Difference:			**0.29**		**0.28**		**0.28**		**0.32**
MW-22A	3304.30	6.75	3297.55	7.65	3296.65	8.06	3296.24	7.52	3296.78
MW-22B	3304.46	6.61	3297.85	7.51	3296.95	7.91	3296.55	7.37	3297.09
Difference:			**0.30**		**0.30**		**0.31**		**0.31**
OCD-2A	3310.99	11.23	3299.76	12.26	3298.73	11.77	3299.22	11.53	3299.46
OCD-2B	3309.90	10.07	3299.83	11.51	3298.39	11.13	3298.77	10.70	3299.20
Difference:			**0.07**		**-0.34**		**-0.45**		**-0.26**
OCD-7AR	3307.05	7.89	3299.16	8.33	3298.72	8.69	3298.36	8.46	3298.59
OCD-7B	3307.15	8.21	3298.94	8.80	3298.35	9.10	3298.05	8.72	3298.43
Difference:			**-0.22**		**-0.37**		**-0.31**		**-0.16**
OCD-7AR	3307.05	- -	- -	- -	- -	- -	- -	8.46	3298.59
OCD-7C	3306.92	- -	- -	- -	- -	- -	- -	8.58	3298.34
Difference:									**-0.25**
OCD-8A	3306.66	8.33	3298.33	8.93	3297.73	9.32	3297.34	9.17	3297.49
OCD-8B	3306.08	7.66	3298.42	8.32	3297.76	8.69	3297.39	8.27	3297.81
Difference:			**0.09**		**0.03**		**0.05**		**0.32**

Notes: DTW - Depth to Water
Difference: Value shown is "B" elevation minus "A" elevation; positve number is upward gradient, negative is downward gradient.

Depending on aquifer properties, slug test results are evaluated using one of two procedures. Water in confined (artesian) aquifers is analyzed using a procedure developed by H. Cooper and others in 1967 (Cooper, et al, 1967). Although possessing upward vertical gradients, alluvial groundwater in the vicinity of the evaporation ponds was observed to be shallow, at depths generally less than ten feet, and unconfined. Procedures were developed by H. Bouwer and R.C. Rice (Bouwer and Rice, 1976; Bouwer, 1989) for analysis of slug test data from unconfined aquifers. Because of its simplicity, the Bouwer and Rice slug test method is a frequently used tool in groundwater studies and its use was appropriate for evaluation of information collected during the current investigation.

The Bouwer and Rice equation and test parameters used in calculating the hydraulic conductivities are presented in Appendix C. Appendix C also includes graphs of the test data. Displacement and time data collected during the two tests conducted at each well are graphically displayed on a semi-logarithmic plot with displacement plotted on the vertical logarithmic axis and time plotted on the horizontal axis. For the straight line portion of each graph, two points are chosen for inclusion in the equation and resultant hydraulic conductivity (K) calculated. The resultant values are shown on each graphical plot and summarized in Table 4-3 below.

Table 4-3. Results of Slug-Test Evaluation, Evaporation Pond Area, RFI Phase III, 1995

Well	Screened Interval (ft)	Test	Hydraulic Conductivity (ft/min)	Hydraulic Conductivity (ft/day)	Transmissivity[a] (ft^2/day)	Seepage Velocity (ft/yr)
MW-4C	9.5	Slug-in	0.00187	2.69	25.6	4.9
MW-4C	9.5	Slug-out	0.00186	2.68	25.4	4.9
MW-5C	9.5	Slug-in	0.00867	12.5	118.6	22.8
MW-5C	9.5	Slug-out	0.00925	13.3	126.3	24.3
OCD-7C	9.5	Slug-in	0.00806	11.6	110.3	21.2
OCD-7C	9.5	Slug-out	0.00882	12.7	120.7	23.2

Notes:

[a] Transmissivity shown is the product of hydraulic conductivity and screened aquifer interval

The slug test equations require use of aquifer thickness as a parameter for calculation of hydraulic conductivity. The depth to the base of the alluvial system in the vicinity of the ponds has not been determined, and an arbitrary depth of 100 feet was selected for use in the calculations. This depth was used in calculating hydraulic conductivities in the Phase I investigation which makes the results of these tests directly comparable with the earlier findings. A sensitivity analysis that compared use of thicknesses of 100 and 200 feet in the calculation showed only a slight decrease in values of hydraulic conductivity when using a thickness of 200 feet. On the other hand, equating the saturated thickness of water in the wells (approximately 64 feet) with aquifer thickness increased hydraulic conductivities approximately 20 percent. Because hydraulic conductivity values between wells in alluvial environments commonly differ by one order of magnitude or more, an exact aquifer thickness is not necessary to evaluate the results. Therefore, use of the thickness value of 100 feet selected for the earlier tests was continued in these calculations.

The seepage velocity of the groundwater system can be determined from the hydraulic conductivity, hydraulic gradient, and effective porosity of the aquifer. The hydraulic gradient is typically measured from a groundwater contour map or a potentiometric surface map. The groundwater-flow gradient of 0.001 foot/foot calculated in the Phase II investigation for the area south of the evaporation ponds was used in the calculation of seepage velocity. The effective porosity can be estimated from the intrinsic porosity of the aquifer. Although the intrinsic porosity is the actual pore volume of the aquifer matrix, it is usually not representative of the actual porosity that governs the flow of water through the matrix because of the influence of isolated pore spaces, grain angularity, and other factors. The effective porosity of the aquifer is a corrected porosity that more closely represents true flow conditions. Effective porosity can be several orders of magnitude lower than the intrinsic porosity in consolidated aquifers, but the effective porosity of an unconfined alluvial aquifer is typically 10 to 100 percent of the intrinsic porosity (Fetter, 1988), which is usually 25 percent to 30 percent in alluvial sediments. In the absence of site-specific porosity data, the effective porosity was assumed to be 20 percent, which is representative of porosities found in this lithologic environment. Thus, the seepage velocity of the groundwater system south of the evaporation ponds was calculated using an effective porosity of 20 percent according to the following equation:

$$v = Ki/n_e$$

where:

K = hydraulic conductivity (ft/yr),
v = seepage velocity (ft/yr),
i = hydraulic gradient (ft/ft), and
n_e = effective porosity (unitless)

To compare the slug test results from the current investigation with those of earlier studies, hydraulic conductivity and transmissivity were converted to units of feet per day and square feet per day, respectively. The results of the tests are of the same magnitude as the results of earlier slug tests shown in Table 4-4. The deeper wells generally have higher hydraulic conductivities than those found in the shallow wells, but values from both sets of tests were within approximately one order of magnitude. Since hydraulic conductivities in alluvial environments can commonly deviate over several orders of magnitude, the slug test results show a generally homogeneous aquifer setting.

Because a slug test is conducted using only a small volume of water and the resultant impacts on the aquifer last for only a short period of time, the information obtained using a slug test is limited to the immediate vicinity of the borehole. Aquifer pumping tests conducted for 24 hours or longer and using one or more observation wells are commonly utilized to obtain a data that is more regional in nature. Several such tests were conducted in the past in the vicinity of the ponds and the results were discussed in the Phase II report.

Table 4-4. Summary of Previous Evaporation Pond Aquifer Test Data

Well	Screened interval (ft)	Test Number or Description	Test Conducted by[a]	Hydraulic conductivity (ft/day)	Transmissivity[b] (ft^2/day)	Seepage velocity (ft/yr)
MW-4	10	1, Slug	Mariah	10.08	100.8	18.4
MW-4	10	2, Slug	Mariah	7.25	72.5	13.3
MW-6A	10	1, Slug	Mariah	26.87	268.7	49.2
MW-6A	10	2, Slug	Mariah	3.97	39.7	7.27
MW-7A	10	1, Slug	Mariah	2.67	26.7	4.89
MW-7A	10	2, Slug	Mariah	1.09	10.9	2.00
MW-18B (pumped well)	9.5	Pumping	KWBES	2.29	21.7	4.18
MW-18B (pumped well)	9.5	Recovery	KWBES	0.70	6.7	1.29
MW-18T (observation well)	9.5	Pumping	KWBES	27.67	263.4	50.6
MW-18T (observation well)	9.5	Recovery	KWBES	29.95	284.0	54.7
OCD-3	18.5	1, Slug	Mariah	1.98	36.6	3.63
OCD-3	18.5	2, Slug	Mariah	2.30	42.5	4.19
EPA-1	10	1, Slug	Mariah	2.63	26.3	4.83
EPA-1	10	2, Slug	Mariah	1.98	19.8	3.63
Temp. well (vicinity Pond 1)	25	- -	Geoscience	33.42	834.2	60.9

Notes:

[a] Tests conducted by Mariah Associates, K.W. Brown Environmental Services, Geoscience Consultants

[b] Calculated from the test data as the product of hydraulic conductivity and the length of the screened interval except for MW-18 and Geoscience tests.

The aquifer tests using observation wells resulted in seepage velocities which are from two to three times to an order of magnitude greater than seepage velocities determined using the slug test method. Given the limitations of the slug test methodology discussed above, these differences are not considered significant in evaluating the overall ability of the aquifer to transmit water. The Phase II study showed that the seepage velocities determined using the aquifer test results matched well with the available field information. This included data generated by that investigation, such as the subsurface soil gas survey, and earlier groundwater studies. The current results continue to show that the new deep wells generally exhibit good hydraulic conductivity which, together with the upward vertical gradients, will assist in natural groundwater quality improvement as the ponds are closed and preexisting groundwater conditions are reestablished.

4.4.3 Groundwater Quality

Results of the RFI Phase III groundwater sampling of the monitor wells and a windmill used for stock watering are presented in this section, with the data included in Appendix D. Pecos River water quality data is tabulated in Section 5. Field parameters of pH, conductivity, and temperature were measured at each monitor well sampled. As described in the protocol in Section 3.2.3.2, "Sample Collection," sampling was performed after these field parameters had stabilized during pumping. Final readings taken for samples from the monitor wells are shown in Table 4-5.

4.4.3.1 Results of Organics Analyses

Table 4-6 is a summary table showing sampling results for volatile and semi-volatile organic compounds in monitor wells in the vicinity of the ponds. Sampling of the existing and new monitor wells installed in the vicinity of the evaporation ponds for volatile organic compounds detected target compounds in several wells south (downgradient) of inactive Ponds 1 and 2. Volatiles were detected and confirmed during one or more Phase III samplings in wells MW-3, 4A, 5A, and 6A. All detected compounds in the pond wells are at concentrations less than 0.032 mg/L. As will be discussed in Section 4.5, the shallow groundwater in the vicinity of the ponds is naturally unsuitable for human consumption, but drinking-water standards for the detected compounds are presented in the table for comparison purposes where they have been established.

Benzene at concentrations between 0.009 and 0.015 mg/L was detected during one or more Phase III samplings in wells MW-4A, MW-4C, MW-5C, and MW-15. Detections in MW-4C and MW-5C were not confirmed in split-samples by EPA's contractor PRC, nor in resampling by Navajo. Also, in the vicinity of the ponds, benzene was detected but not confirmed in sampling of TMD well MW-15 as discussed in Section 3.2.4.2. The MCL for benzene set by the EPA under the Safe Drinking Water Act is 0.005 mg/L. In New Mexico, the state Water Quality Control Commission (WQCC) health standard for benzene in groundwater is 0.010 mg/L.

Ethylbenzene was detected in wells MW-4A and MW-6A at concentrations between 0.006 and 0.016 mg/L. The MCL for ethylbenzene is 0.700 mg/L, whereas the WQCC health standard for ethylbenzene in groundwater is 0.750 mg/L. EPA has proposed an MCL of 0.030 mg/L as a recommended aesthetic standard.

Toluene was found at low levels just above the detection level of 0.005 mg/L in MW-4A and MW-5C. The detection in MW-5C was not confirmed by additional sampling nor in the EPA-PRC split sample. The MCL for toluene is 1.0 mg/L, whereas the New Mexico health standard in groundwater is 0.750 mg/L. The proposed EPA secondary, aesthetic standard for toluene is 0.040 mg/L.

Table 4-5. Groundwater Indicator Measurements at the Time of Field Sampling, Evaporation Pond Area, Navajo Refinery, RFI Phase III

Well sample identification	Laboratory number	Date sampled	Time sampled	pH	Conductivity (µmhos/cm at 25°C)	Temperature (°C)
MW-2A	0694G02081	11/05/94	1218	7.5	13,000	NM
MW-2B	0694G02083	11/05/94	1245	7	3,950	NM
OCD-1	0694G02074	11/05/94	1350	7.5	15,000	NM
OCD-2B	0694G02075	11/05/94	1512	7	15,000	NM
OCD-2A	0694G02077	11/05/94	1733	7.5	17,000	NM
OCD-3	0694G02076	11/05/94	1625	7	20,500	NM
OCD-4	0694G02086	11/06/94	0825	7.5	20,500	NM
OCD-5	0694G02087	11/06/94	0920	7.5	20,000	NM
OCD-6	0694G02088	11/06/94	1005	7.5	15,000	NM
MW-11B	0694G02089	11/06/94	1055	6.7	23,000	NM
MW-11A	0694G02090	11/06/94	1120	7	32,000	NM
OCD-8B	0694G02091	11/06/94	1225	6.7	8,450	NM
OCD-8A	0694G02092	11/06/94	1240	7.5	11,400	NM
MW-7A	0694G02099	11/06/94	1540	7	15,000	NM
MW-7B	0694G02100	11/06/94	1555	7	7,650	NM
OCD-7B	0694G02103	11/06/94	1515	7.5	7,000	19
OCD-7AR	0694G02104	11/06/94	1645	7	13,000	18
MW-5B	0694G02094	11/08/94	0920	7	9,950	15.8
MW-5A	0694G02095	11/08/94	1010	7.5	19,500	18
MW-3	0694G02096	11/08/94	1145	7.5	6,150	NM
MW-6B	0694G02107	11/08/94	1555	6.5	5,050	17.3
MW-6A	0694G02110	11/08/94	1635	7	5,300	19.5
Pond Windmill	0694G02112	11/09/94	0954	6.5	6,600	NM
MW-10	0694G02113	11/09/94	1047	6	6,150	16
MW-22B	0694G02128	11/09/94	1351	6.5	6,300	16
MW-22A	0694G02129	11/09/94	1422	6.5	7,100	17.5
MW-18B	0694G02130	11/09/94	1635	6	5,300	16
MW-18A	0694G02131	11/09/94	1650	NM	26,000	17.5
MW-19	0694G02153	11/10/94	1014	7	7,000	17
MW-23	0694G02154	11/10/94	1135	7	20,000	15.5
MW-14	0694G02155	11/10/94	1322	7	19,000	17
MW-4A	0694G02156	11/10/94	1552	7	7,900	NM

Notes:
pH measured using paper pH strips
NM - not measured

Table 4-5. Groundwater Indicator Measurements at the Time of Field Sampling, Evaporation Pond Area, Navajo Refinery, RFI Phase III (concluded)

Well sample identification	Laboratory number	Date sampled	Time sampled	pH	Conductivity (µmhos/cm at 25°C)	Temperature (°C)
MW-6A	0695G00139	01/14/95	1630	6.5	4,600	18.9
MW-6B	0695G00151	01/15/95	1420	7	4,400	19.3
MW-5B	0695G00152	01/15/95	1500	7	9,200	17.9
MW-7B	0695G00153	01/15/95	1720	7	7,600	18.8
MW-4C	0695G00191	01/20/95	1330	7.5	6,100	18.0
MW-5C	0695G00193	01/20/95	1605	7.5	4,300	11.0
OCD-7C	0695G00198	01/20/95	1010	7	7,600	18.8
OCD-7C	0695G00603	02/24/95	1255	7.5	11,500	NM
OCD-7AR	0695G00604	02/24/95	1315	7.5	10,400	NM
MW-5C	0695G00605	02/24/95	1435	7	4,200	NM
MW-5A	0695G00606	02/24/95	1505	7	18,500	NM
MW-4C	0695G00608	02/24/95	1710	7	5,000	NM
MW-4A	0695G00609	02/24/95	1740	7	7,350	NM

Notes:
pH measured using paper pH strips
NM - nNot measured

Table 4-6. Summary of Navajo Evaporation Ponds groundwater volatile/semivolatile sample analyses, RFI Phase III, 1995

		Volatile Organics (mg/l)						
Sample ID	Date	Benzene	Toluene	Ethyl-benzene	Xylenes (total)	Methyl ethyl ketone	Carbon Disulfide	Semi-volatile Organics [a]
MW-1	5-Nov-94	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.010
MW-2A	5-Nov-94	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.010
MW-2B	5-Nov-94	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.010
MW-2B (dup)	5-Nov-94	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.010
MW-3	8-Nov-94	<0.005	<0.005	<0.005	0.006	<0.005	<0.005	<0.40
MW-4A	10-Nov-94	0.013	0.006	0.015	0.028	<0.005	<0.005	<0.010
MW-4A (dup)	10-Nov-94	0.014	0.006	0.016	0.032	<0.005	<0.005	<0.010
MW-4C [c]	20-Jan-95	0.013	<0.005	<0.005	0.006	<0.005	<0.005	<0.020
MW-4C [b]	20-Jan-95	0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.020
MW-4C [e]	24-Feb-95	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NA
MW-5A	8-Nov-94	<0.005	<0.005	<0.005	0.021	<0.005	<0.005	<0.020
MW-5A (dup)	8-Nov-94	<0.005	<0.005	<0.005	0.020	<0.005	<0.005	<0.40
MW-5B	8-Nov-94	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.010
MW-5B [d]	15-Jan-95	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NA
MW-5C [c]	20-Jan-95	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NA
MW-5C [b]	20-Jan-95	0.009	0.005	<0.005	<0.005	<0.005	<0.005	<0.010
MW-5C [e]	24-Feb-95	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NA
MW-6A	8-Nov-94	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.010
MW-6A [d]	14-Jan-95	<0.005	<0.005	0.006	0.01	<0.005	<0.005	<0.010
MW-6B	8-Nov-94	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.010
MW-6B [d]	15-Jan-95	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	<0.010
MW-7A	6-Nov-94	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.010
MW-7B	6-Nov-94	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.010
MW-10	9-Nov-94	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.10
MW-11A	6-Nov-94	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.010
MW-11B	6-Nov-94	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.010
MW-14	10-Nov-94	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.040
MW-15	9-Nov-94	0.015	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.010
MW-15 [d]	12-Jan-95	0.013	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	NA
MW-15 [e]	24-Feb-95	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	NA
MW-18A	9-Nov-94	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.010
MW-18B	9-Nov-94	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.010
MW-19	10-Nov-94	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.020
MW-22A	9-Nov-94	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.050
MW-22B	9-Nov-94	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.050
MW-23	10-Nov-94	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.010

Notes:

[a] All semivolatile constituents less than the reported detection limits presented in the table.
[b] Sample obtained by standard bailing method.
[c] Sample obtained through submersible pump as described in text.
[d] Re-sample obtained during second phase of RFI Phase III field work.
[e] Sample obtained during follow-up sampling subsequent to formal RFI Phase III field work.
Federal Secondary MCL Standards (mg/L): benzene, .005; ethylbenzene, .7; toluene, 1; xylenes, 10.
New Mexico WQCC Groundwater Standards (mg/L): benzene, .01; ethylbenzene, .75; toluene, .75; xylenes, .62.

Table 4-6. Summary of Navajo Evaporation Ponds groundwater volatile/semivolatile sample analyses, RFI Phase III, 1995 (concluded)

		Volatile Organics (mg/l)						
Sample ID	Date	Benzene	Toluene	Ethyl-benzene	Xylenes (total)	Methyl ethyl ketone	Carbon Disulfide	Semi-volatile Organics [a]
OCD-1	5-Nov-94	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.010
OCD-2A	5-Nov-94	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.010
OCD-2B	5-Nov-94	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.010
OCD-3	5-Nov-94	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.010
OCD-4	6-Nov-94	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.010
OCD-5	6-Nov-94	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.010
OCD-6	6-Nov-94	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.010
OCD-7A	7-Nov-94	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.010
OCD-7B	7-Nov-94	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.010
OCD-7C [c]	21-Jan-95	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	NA
OCD-7C [b]	21-Jan-95	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.010
OCD-7C dup [b]	21-Jan-95	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.010
OCD-7C dup [f]	21-Jan-95	< 0.001	< 0.001	< 0.001	< 0.002	< 0.005	< 0.005	< 0.003
OCD-8A	6-Nov-94	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.010
OCD-8B	6-Nov-94	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.010
Pond Windmill	9-Nov-95	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.010
Pond Windmill [e]	20-Jan-95	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	NA
Pond 3	6-Nov-94	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	NA

Notes:

[a] All semivolatile constituents evaluated were less than the reported detection limits presented in the table.
[b] Sample obtained by standard bailing method.
[c] Sample obtained through submersible pump as described in text.
[d] Re-sample obtained during second phase of RFI Phase III field work.
[e] Sample obtained during follow-up sampling subsequent to formal RFI Phase III field work.
[f] Sample analyzed by Assagai Laboratories, Albuquerque.
Federal Secondary MCL Standards (mg/L): benzene, .005; ethylbenzene, .7; toluene, 1; xylenes, 10.
New Mexico WQCC Groundwater Standards (mg/L): benzene, .01; ethylbenzene, .75; toluene, .75; xylenes, .62.

Xylenes were detected during one or more Phase III samplings at MW-3, MW-4A, MW-4C, MW-5A, and MW-6A at concentrations between 0.006 and 0.032 mg/L. Again, the MW-4C detection was not confirmed. The drinking-water MCL for total xylenes is 10 mg/L, with a proposed MCL of 0.020 mg/L as a recommended aesthetic standard. In New Mexico, the WQCC health standard for total xylenes in groundwater is 0.62 mg/L.

Methyl ethyl ketone and carbon disulfide were not detected during this sampling. In the Phase II study, these two compounds were found only in MW-6B.

No semivolatile constituent detections were found in the Phase III samples above detection levels which were generally 0.010 mg/L. At some sample locations, dilution of the sample was necessary to allow enough to be available for internal QC testing. The sample analyses were limited only to polycyclic aromatic hydrocarbons, but results from samples split with PRC showed phthalates in several PRC samples. As discussed in previous study report, phthalates are common laboratory contaminants and unlikely to be found in groundwater.

The pond windmill is close to the inactive evaporation pond inlet and south of TMD. However, it did not show evidence of volatile or semivolatile organic contamination in two samplings in November and January. Although south of the ponds, the windmill is located off-gradient from all but the uppermost end of Pond 1.

4.4.3.2 Results of Metals Analyses

A total of 54 samples were collected for metals analysis from 37 groundwater locations, two pond samples, and two surface water sources in the vicinity of the evaporation ponds. Two samples were also obtained from the active ponds. The difference between the number of samples and locations represents samples that were field or laboratory duplicates or locations that were resampled. Metals analyses for total and dissolved arsenic, chromium, lead, and nickel are presented in Table 4-7 together with EPA drinking water and New Mexico groundwater quality standards. The EPA MCL for lead is an action level requiring treatment at the tap if exceeded in drinking water. In New Mexico nickel is an irrigation standard, not a human-health standard. The other standards shown are human-health standards in water. Because New Mexico groundwater protection regulations require measurements be made on a dissolved (vs. total) sample basis, most samples were filtered in the field using a 0.45-micron dedicated filter, as described in 3.2.3.2, "Sample Collection." Metals samples not filtered included surface water samples from the evaporation ponds, groundwater from "pump" samples at wells MW-4C, MW-5C, and OCD-7C, and follow-up samples collected at monitor wells for verification purposes.

Table 4-7. Results of Groundwater Metals Analyses, Evaporation Pond Area, Navajo Refinery, RFI Phase III, 1995

Sample ID	Date Sampled	Total Dissolved Solids (mg/L @ 180°C)	Total Arsenic (mg/L)	Total Chromium (mg/L)	Total Lead (mg/L)	Total Nickel (mg/L)	Dissolved Arsenic (mg/L)	Dissolved Chromium (mg/L)	Dissolved Lead (mg/L)	Dissolved Nickel (mg/L)
MW-1	05-Nov-94	10,200	0.013	**0.184**	<0.01	0.08	<0.005	<0.02	<0.1	<0.05
MW-2A	05-Nov-94	7,620	**0.156**	0.020	<0.01	0.03	**0.208**	<0.02	<0.1	0.02
MW-2A (Lab Dup.)	05-Nov-94	7,670	**0.158**	0.030	<0.01	0.03	**0.259**	<0.02	<0.1	0.03
MW-2B	05-Nov-94	2,490	<0.005	<0.02	<0.01	<0.01	<0.005	<0.02	<0.01	<0.01
MW-2B (Fld Dup. 1)	05-Nov-94	2,610	<0.005	<0.02	<0.01	<0.01	<0.005	<0.02	<0.01	<0.01
MW-3	08-Nov-94	5,970	0.045	0.040	<0.01	0.04	0.029	0.020	**0.11**	<0.05
MW-4A	10-Nov-94	5,410	**0.156**	0.090	**0.07**	**0.13**	0.076	<0.02	<0.1	<0.05
MW-4A (Fld Dup. 3)	10-Nov-94	5,600	**0.143**	0.063	**0.06**	0.07	0.083	<0.02	<0.01	<0.01
MW-4A	24-Feb-95	--	**0.051**	<0.005	<0.01	<0.05				
MW-4C BAIL	20-Jan-95	3,830	**0.070**	0.019	<0.01	<0.05	0.063	0.011	<0.01	<0.05
MW-4C PUMP	20-Jan-95	3,840	**0.067**	0.009	<0.01	<0.05				
MW-4C	24-Feb-95	--	**0.061**	<0.005	<0.01	<0.05				
MW-5A	08-Nov-94	14,600	**0.127**	0.084	**0.02**	**0.15**	**0.132**	<0.02	<0.1	0.05
MW-5A (Fld Dup. 2)	08-Nov-94	14,700	**0.129**	0.056	0.01	**0.11**	**0.122**	<0.02	<0.01	0.04
MW-5A	24-Feb-95	--	**0.092**	<0.005	<0.01	<0.05				
MW-5B	08-Nov-94	6,570	**0.213**	<0.02	<0.01	<0.01	**0.178**	<0.02	<0.01	<0.01
MW-5C BAIL	20-Jan-95	3,750	**0.204**	**0.526**	**0.28**	**0.35**	0.013	<0.005	<0.01	<0.05
MW-5C PUMP	20-Jan-95	3,430	0.022	0.031	<0.01	<0.05				
MW-5C	24-Feb-95	--	0.008	<0.005	<0.01	<0.05				
MW-6A	08-Nov-94	3,650	**0.085**	0.062	**0.02**	0.07	0.017	<0.02	<0.01	0.01
MW-6B	08-Nov-94	3,190	0.011	<0.02	<0.01	<0.01	0.006	<0.02	<0.01	<0.01
MW 7A	06-Nov-94	10,200	**0.097**	0.040	**0.02**	0.03	0.039	<0.02	<0.01	<0.01
MW 7B	06-Nov-94	5,600	0.011	<0.02	<0.01	<0.01	0.007	<0.02	<0.01	<0.01
MW-10	09-Nov-94	4,420	0.035	**0.107**	**0.09**	**0.18**	0.006	<0.02	<0.01	<0.01

Notes on final page of table

Table 4-7. Results of Groundwater Metals Analyses, Evaporation Pond Area, Navajo Refinery, RFI Phase III, 1995 (continued)

Sample ID	Date Sampled	Total Dissolved Solids (mg/L @ 180°C)	Total Arsenic (mg/L)	Total Chromium (mg/L)	Total Lead (mg/L)	Total Nickel (mg/L)	Dissolved Arsenic (mg/L)	Dissolved Chromium (mg/L)	Dissolved Lead (mg/L)	Dissolved Nickel (mg/L)
MW-11A	06-Nov-94	19,200	0.013	<0.02	<0.01	<0.01	<0.005	<0.02	<0.01	<0.01
MW-11A (Lab Dup.)	06-Nov-94	19,200	0.012	<0.02	<0.01	<0.01	<0.005	<0.02	<0.01	<0.01
MW-11B	06-Nov-94	13,600	0.013	<0.02	<0.01	<0.01	<0.005	<0.02	<0.01	<0.01
MW-14	10-Nov-94	12,600	**0.087**	<0.005	<0.01	<0.01	0.040	<0.02	<0.01	<0.01
MW-15	09-Nov-94	3,660	0.028	<0.02	<0.01	0.02	0.008	<0.02	<0.01	0.02
MW-18A	09-Nov-94	17,700	<0.005	<0.005	<0.01	<0.01	<0.005	<0.02	<0.01	<0.01
MW-18B	09-Nov-94	3,670	<0.005	<0.005	<0.01	<0.01	<0.005	<0.02	<0.01	<0.01
MW-19	10-Nov-94	5,360	0.015	<0.005	<0.01	<0.01	<0.005	<0.02	<0.01	<0.01
MW-22A	09-Nov-94	4,740	**0.075**	<0.005	<0.01	<0.01	0.021	<0.02	<0.01	<0.01
MW-22B	09-Nov-94	4,480	<0.005	<0.005	<0.01	<0.01	<0.005	<0.02	<0.01	<0.01
MW-23	10-Nov-94	15,600	0.034	<0.005	<0.01	<0.01	0.015	<0.02	<0.01	<0.01
Pond Windmill	09-Nov-94	4,260	0.017	<0.02	**0.02**	<0.01	<0.005	<0.02	<0.01	<0.01
Pond Windmill	20-Jan-95	4,450	<0.005	<0.02	<0.01	0.06				
Pnd.Wind. (Lab Dup.)	20-Jan-95	4,500	<0.005	<0.02	<0.01	<0.05				
POND 3	06-Nov-94	8,220	**0.497**	<0.02	<0.01	0.03				
POND 5	06-Nov-94	4,630	**0.298**	<0.02	<0.01	<0.01				

Notes on final page of table

Table 4-7. Results of Groundwater Metals Analyses, Evaporation Pond Area, Navajo Refinery, RFI Phase III, 1995 (concluded)

Sample ID	Date Sampled	Total Dissolved Solids (mg/L @ 180°C)	Total Arsenic (mg/L)	Total Chromium (mg/L)	Total Lead (mg/L)	Total Nickel (mg/L)	Dissolved Arsenic (mg/L)	Dissolved Chromium (mg/L)	Dissolved Lead (mg/L)	Dissolved Nickel (mg/L)
OCD-1	05-Nov-94	8,970	**0.103**	0.024	**0.02**	0.07	0.072	<0.02	<0.01	0.04
OCD-2A	05-Nov-94	11,000	0.048	0.077	**0.03**	0.08	0.041	<0.02	<0.1	<0.01
OCD-2B	05-Nov-94	4,070	0.006	<0.02	<0.01	<0.01	<0.005	<0.02	<0.01	<0.01
OCD-3	05-Nov-94	12,200	0.028	0.043	**0.02**	0.04	<0.005	<0.02	<0.01	<0.01
OCD-4	06-Nov-94	12,400	0.024	0.028	**0.02**	<0.01	0.005	<0.02	<0.1	<0.01
OCD-5	06-Nov-94	12,100	0.041	0.030	**0.02**	0.02	0.008	<0.02	<0.01	<0.01
OCD-6	06-Nov-94	9,500	0.039	0.040	**0.03**	0.04	0.053	<0.02	<0.1	0.01
OCD-7AR	07-Nov-94	8,320	**0.149**	<0.02	<0.01	0.03	**0.150**	<0.02	<0.01	0.02
OCD-7AR (Lab Dup.)	07-Nov-94	8,340	**0.164**	<0.02	<0.01	0.04	**0.159**	<0.02	<0.01	0.02
OCD-7AR	24-Feb-95	8,590	0.030	0.007	<0.01	<0.05				
OCD-7B	07-Nov-94	5,190	<0.005	<0.02	<0.01	<0.01	<0.005	<0.02	<0.1	<0.01
OCD-7C BAIL	21-Jan-95	5,280	**0.111**	**0.598**	**0.33**	**0.53**	0.015	0.005	<0.01	<0.05
OCD-7C PUMP	21-Jan-95	8,730	0.011	0.018	<0.01	<0.05				
OCD-7C	24-Feb-95	8,680	0.011	<0.005	<0.01	<0.05				
OCD-8A	06-Nov-94	9,560	0.022	**0.058**	**0.02**	**0.11**	0.019	<0.02	<0.1	<0.05
OCD-8B	06-Nov-94	5,550	<0.005	<0.02	<0.01	<0.01	<0.005	<0.02	<0.01	<0.01

Notes:

Water Quality Standards (mg/L):

EPA MCL: As, 0.05; Cr, 0.1; Pb, Action level=0.015; Ni, 0.1

NM WQCC Groundwater: As, 0.10; Cr, 0.05; Pb, 0.05; Ni, 0.2

Arsenic analyses by SW-846 Method 7061, except MW-2A by method 6010A

Bold: Exceedance of listed standard

The analyses for total arsenic samples collected in the evaporation pond area showed exceedances of the EPA MCL of 0.05 mg/L for total arsenic at 13 of 37 groundwater sample locations. However, for wells where multiple samples were collected not all samples exceeded the federal MCL. The New Mexico groundwater standard of 0.10 mg/L is exceeded at four locations (MW-2A, 5A, 5B, and OCD-7AR) in the dissolved samples. Figure 4-1 is a map showing values of total and dissolved arsenic in the evaporation pond area. The value shown for total arsenic is the most recent verification or follow-up sample presented in Table 4-7. Analyses for dissolved arsenic generally showed reductions in the metal from the non-filtered sample. However, the degree of change from the total arsenic value ranged from non-detection to values greater than the total arsenic value. The wide range of values is believed due to two factors: dissolved arsenic actually in solution (e.g., at monitor wells MW-2A and 5A as well as OCD-7AR), and turbid samples containing arsenic that moves into solution when the sample is digested (e.g., MW-4A and 5C as well as OCD-7C). Some results may be a combination of these postulated effects.

Further discussion of arsenic results is presented in Section 4.5.2.2.

Total chromium exceeded the EPA MCL of 0.1 mg/L in four wells. Two of these were new deep wells (MW-5C and OCD-7C) where turbidity was still a problem due to incomplete development before sampling. Of the other two wells, MW-1 was documented to have a deteriorated casing which can impart chromium particles to a sample bailer under turbid conditions. The other well, MW-10, did not exhibit elevated levels of chromium in the Phase II study. However, because of the distance from the ponds and the fact that both chromium and nickel were found to be elevated during this sampling, it is possible that the detections are from the well casing. However, since downhole well construction details are unknown, this cannot be verified. Dissolved chromium and nickel were not detected in this well. Dissolved chromium did not exceed the NM WQCC standard of 0.05 mg/L in any of the wells sampled.

Total lead exceeded the EPA action level 0.015 mg/L at several wells in the vicinity of the pond. The most significant exceedances were at new wells MW-5C and OCD-7C, where sample turbidity was high. One sample from the pond windmill had a slightly elevated value of 0.02 mg/L, but analysis of the PRC split-sample did not detect lead at 0.01 mg/L. A sample from MW-3 had a dissolved lead value of 0.11 mg/L, but this is believed to be a reporting error based on the total lead value of <0.01 mg/L. Other values of dissolved lead were less than the detection level.

MCL exceedances for total nickel were observed in samples collected at wells MW-4A, MW-5A, MW-5C, MW-10, OCD-7C, and OCD-8A. Significant levels of nickel were found only in new wells MW-5C and OCD-7C, which were observed to have high levels of turbidity. Dissolved nickel concentrations did not exceed federal MCL or NM groundwater standards.

Laboratory analytical results for total metals in the evaporation pond samples did not detect any metals exceeding federal or state standards except for arsenic. Arsenic in Ponds 3 and 5 was detected at 0.497 mg/L and 0.298 mg/L, respectively. Both values exceed federal and state water standards and are likely contributing to elevated arsenic values in monitor wells completed in the shallow groundwater around the periphery of the ponds.

Figure 4-1. Arsenic Concentration Map, Evaporation Ponds, RFI Phase III, 1995

4.4.3.3 Water Chemistry Results

The laboratory analytical data for the inorganic water quality constituents and indicator constituents for groundwater in the vicinity of the evaporation pond are shown in Table 4-8. In addition to the major constituents, the minor constituent fluoride, measured TDS, cation-anion totals, and percent difference are shown. The latter three values provide a rapid check of completeness and accuracy of the water analysis. For good-quality, low-TDS water, a percent difference of one to two percent is easily obtained. For wastewater and high-TDS water that can cause analytical instrument interference, a five percent difference is acceptable. Although discussion and interpretation of these results are presented in Section 4.5.2.3 , the water quality of the alluvial zone exceeded federal and state secondary (aesthetic) standards for chloride, sulfate, and TDS at all locations sampled. The EPA MCL for fluoride of four mg/L was exceeded at wells MW-2A, MW-7A, OCD-1, and OCD-7AR. An additional six wells had concentrations above the aesthetic concentration of two mg/L, but less than the MCL.

4.5 Discussion

4.5.1 Groundwater Occurrence and Movement

4.5.1.1 Groundwater Hydrogeology

Extensive discussion of the geology and hydrologic characteristics of the shallow alluvial materials in the vicinity of the ponds was provided in the Phase II report. The most notable feature of the sediments to a depth of approximately 70 feet is the coarse-grained nature of the material with fine- to medium-grained sands being predominant with some gravel zones. Thin interbedded clay zones are present in the upper 20 feet and thicker zones up to two feet were occasionally observed. However, most clay zones are several inches to about six inches thick and appear to be discontinuous. The general uniformity of the sediments allows fairly complete mixing of groundwater in the upper subsurface and also facilitates the transport of constituents.

The drilling of shallow and deep paired wells allowed measurement of vertical gradients. Four separate sets of measurements continue to demonstrate that upward movement of water occurs in the vicinity of the ponds except directly adjacent to the active ponds where groundwater mounding counteracts upward flow. The magnitudes of the gradient values have been consistent over the past two years. If regional water withdrawals for irrigation have an impact on the gradients, values measured in early November, shortly after conclusion of the growing season in October, should be lower than February values. Examination of the data for wells away from the ponds shows no obvious seasonal variations.

Table 4-8. Results of Inorganic Water Quality Analyses, Evaporation Pond Area, Navajo Refinery, RFI Phase III, 1995

Sample ID	MW-1	MW-2A	MW-2A (Lab Dup.)	MW-2B	MW-2B (Field Dup.1)	MW-3	MW-4	MW-4 (Field Dup.3)	MW-4C (Bail)	MW-4C (Pump)
Date Sampled	05-Nov-94	05-Nov-94	05-Nov-94	05-Nov-94	05-Nov-94	08-Nov-94	10-Nov-94	10-Nov-94	20-Jan-95	20-Jan-95
Lab pH (SU)	7.7	7.1	7.1	7.5	7.4	7.1	7.4	7.1	7.3	7.8
Lab EC (umhos/cm)	14,500	10,600	10,600	3,310	3,330	7,500	7,480	7,690	5,510	5,420
TDS (180°C)	10,200	7,620	7,670	2,490	2,610	5,970	5,410	5,600	3,830	3,840
Calcium (mg/L)	862	542	541	379	359	608	495	502	351	336
Magnesium (mg/L)	459	91	90	133	120	204	139	156	150	153
Potassium (mg/L)	8	10	10	4	3	7	3	5	2	2
Sodium (mg/L)	2,130	2,100	2,110	295	280	983	1,230	1,240	626	622
Bicarbonate (mg/L)	472	701	706	199	198	357	311	605	278	276
Carbonate (mg/L)	0	0	0	0	0	0	0	0	0	0
Chloride (mg/L)	3,590	1,910	1,910	868	738	1,120	1,310	1,390	784	777
Sulfate (mg/L)	2,800	2,610	2,570	746	746	2,290	2,370	1,900	1,370	1,320
Fluoride (mg/L)	1.2	14.3	14.3	1.1	1.0	2.6	1.9	1.7	1.2	1.1
Cations (meq/L)	173.42	126.27	126.23	42.78	40.05	90.06	89.76	91.99	57.13	56.48
Anions (meq/L)	167.46	119.53	118.83	43.28	39.59	85.16	91.21	88.58	55.18	53.90
Balance (% Diff.)	1.75	2.74	3.02	-0.58	0.58	2.80	-0.80	1.89	1.74	2.34

Note: See last page of table for applicable federal and state standards.

Table 4-8. Results of Inorganic Water Quality Analyses, Evaporation Pond Area, Navajo Refinery, RFI Phase III, 1995 (continued)

Sample ID	MW-5A	MW-5A (Field Dup.2)	MW-5B	MW-5C (Bail)	MW-5C (Pump)	MW-6A	MW-6B	MW 7A	MW 7B	MW-7B	MW-10
Date Sampled	08-Nov-94	08-Nov-94	08-Nov-94	20-Jan-95	20-Jan-95	08-Nov-94	08-Nov-94	06-Nov-94	06-Nov-94	15-Jan-95	09-Nov-94
Lab pH (SU)	7.0	7.3	7.3	7.4	7.4	7.5	7.8	7.7	7.6	7.4	7.6
Lab EC (umhos/cm)	17,500	17,100	8,750	4,820	4,570	4,720	4,390	12,900	7,190	9,110	5,960
TDS (180°C)	14,600	14,700	6,570	3,750	3,430	3,650	3,190	10,200	5,600	6,620	4,420
Calcium (mg/L)	536	567	543	503	480	390	362	409	512	543	395
Magnesium (mg/L)	587	546	168	126	126	94	81	336	190	238	83
Potassium (mg/L)	8	3	7	6	4	2	6	7	8	8	4
Sodium (mg/L)	3,370	3,120	1,020	428	388	512	520	2,520	895	1,200	937
Bicarbonate (mg/L)	475	473	371	212	224	175	32	349	255	287	279
Carbonate (mg/L)	0	0	0	0	0	0	0	0	0	0	0
Chloride (mg/L)	3,320	3,310	1,720	515	540	727	803	2,450	1,230	1,460	993
Sulfate (mg/L)	5,350	5,400	1,170	1,660	1,450	1,400	1,180	3,380	2,160	2,550	1,570
Fluoride (mg/L)	2.9	2.4	1.4	1.2	1.0	2.2	0.6	7.1	1.1	1.3	1.0
Cations (meq/L)	221.80	208.98	85.64	54.24	51.30	49.52	47.51	157.89	80.31	98.99	67.39
Anions (meq/L)	212.88	213.62	79.02	52.62	49.12	52.61	47.70	145.15	83.89	98.89	65.30
Balance (% Diff.)	2.05	-1.10	4.02	1.52	2.17	-3.03	-0.20	4.20	-2.18	0.05	1.58

Note: See last page of table for applicable federal and state standards.

Table 4-8. Results of Inorganic Water Quality Analyses, Evaporation Pond Area, Navajo Refinery, RFI Phase III, 1995 (continued)

Sample ID	MW-11A	MW-11A (Lab Dup.)	MW-11B	MW-14	MW-15	MW-15	MW-15 (Lab Dup.)	MW-18A	MW-18B	MW-19	MW-22A
Date Sampled	06-Nov-94	06-Nov-94	06-Nov-94	10-Nov-94	09-Nov-94	24-Feb-95	24-Feb-95	09-Nov-94	09-Nov-94	10-Nov-94	09-Nov-94
Lab pH (SU)	7.1	7.1	7.2	7.2	7.5	7.6	7.6	7.3	7.2	7.5	7.6
Lab EC (umhos/cm)	27,800	27,800	19,600	16,800	4,860	2,880	2,880	23,000	4,680	6,990	6,760
TDS (180°C)	19,200	19,200	13,600	12,600	3,660	2,200	2,200	17,700	3,670	5,360	4,740
Calcium (mg/L)	1,065	1,106	842	733	372	263	262	731	576	720	374
Magnesium (mg/L)	442	441	187	469	113	79	77	956	163	216	99
Potassium (mg/L)	23	24	38	10	8	4	4	51	4	11	6
Sodium (mg/L)	4,920	4,800	3,640	2,960	519	332	329	3,980	326	661	1,170
Bicarbonate (mg/L)	407	409	134	1,344	175	124	125	400	185	255	201
Carbonate (mg/L)	0	0	0	0	0	0	0	0	0	0	0
Chloride (mg/L)	9,260	9,030	5,890	3,680	743	443	451	5,790	635	1,170	1,170
Sulfate (mg/L)	1,770	1,760	1,840	3,760	1,470	943	917	4,880	1,590	2,020	1,660
Fluoride (mg/L)	0.8	0.8	0.8	0.8	1.2	1.1	1.1	2.3	1.0	0.9	1.1
Cations (meq/L)	303.94	301.02	216.80	204.15	50.65	34.17	33.82	289.45	56.45	82.74	77.98
Anions (meq/L)	304.72	297.85	206.57	204.14	54.37	34.17	33.86	271.29	54.12	79.19	70.85
Balance (% Diff.)	-0.13	0.53	2.42	0.00	-3.54	0.00	-0.06	3.24	2.11	2.19	4.79

Note: See last page of table for applicable federal and state standards.

Table 4-8. Results of Inorganic Water Quality Analyses, Evaporation Pond Area, Navajo Refinery, RFI Phase III, 1995 (continued)

Sample ID	MW-22B	MW-23		OCD-1	OCD-2A	OCD-2B	OCD-3	OCD-4	OCD-5	OCD-6	OCD-7A
Date Sampled	09-Nov-94	10-Nov-94		05-Nov-94	05-Nov-94	05-Nov-94	05-Nov-94	06-Nov-94	06-Nov-94	06-Nov-94	07-Nov-94
Lab pH (SU)	7.6	7.1		7.2	7.1	7.6	7.2	7.2	7.4	7.7	7.2
Lab EC (umhos/cm)	6,040	21,500		11,700	14,400	5,190	17,500	18,000	16,800	12,800	10,800
TDS (180°C)	4,480	15,600		8,970	11,000	4,070	12,200	12,400	12,100	9,500	8,320
Calcium (mg/L)	409	1,033		601	581	692	1,025	795	744	527	575
Magnesium (mg/L)	145	504		142	238	46	274	248	230	164	173
Potassium (mg/L)	35	15		7	11	12	27	62	36	13	8
Sodium (mg/L)	875	3,800		2,170	2,830	480	2,750	3,270	3,040	2,590	1,960
Bicarbonate (mg/L)	199	695		756	615	46	300	234	287	754	642
Carbonate (mg/L)	0	0		0	0	0	0	0	0	0	0
Chloride (mg/L)	910	5,560		2,200	2,800	828	5,680	4,820	4,520	2,210	2,000
Sulfate (mg/L)	1,820	3,800		2,940	3,510	1,630	2,000	2,690	2,620	3,510	2,920
Fluoride (mg/L)	0.8	0.8		6.0	1.2	0.4	0.8	1.0	1.0	3.7	5.1
Cations (meq/L)	71.30	258.87		136.37	171.87	59.51	193.96	203.82	189.34	152.96	128.26
Anions (meq/L)	66.86	247.30		135.68	162.31	58.08	206.73	195.77	186.81	147.83	127.66
Balance (% Diff.)	3.21	2.29		0.25	2.86	1.22	-3.19	2.01	0.67	1.71	0.23

Note: See last page of table for applicable federal and state standards.

Table 4-8. Results of Inorganic Water Quality Analyses, Evaporation Pond Area, Navajo Refinery, RFI Phase III, 1995 (continued)

Sample ID	OCD-7A (Lab Dup.)	OCD-7A	OCD-7B	OCD-7C	OCD-7C (Bail)	OCD-7C (Pump)	OCD-8A	OCD-8B		Pond Windmill	Pond Windmill
Date Sampled	07-Nov-94	24-Feb-95	07-Nov-94	24-Feb-95	21-Jan-95	21-Jan-95	06-Nov-94	06-Nov-94		09-Nov-94	20-Jan-95
Lab pH (SU)	7.2	7.3	7.6	7.0	7.3	7.1	7.4	7.6		7.6	7.6
Lab EC (umhos/cm)	10,800	10,100	6,880	10,400	7,140	12,100	12,200	7,460		5,870	6,610
TDS (180°C)	8,340	8,590	5,190	8,680	5,280	8,730	9,560	5,550		4,260	4,450
Calcium (mg/L)	575	571	715	650	620	643	634	822		330	298
Magnesium (mg/L)	173	225	105	217	134	216	345	190		165	173
Potassium (mg/L)	7	3	13	11	14	11	9	6		3	4
Sodium (mg/L)	1,970	1,850	824	1,880	789	1,900	2,140	588		697	841
Bicarbonate (mg/L)	641	706	118	525	320	456	497	164		176	144
Carbonate (mg/L)	0	0	0	0	0	0	0	0		0	0
Chloride (mg/L)	2,020	1,930	1,120	2,250	1,000	2,160	2,340	1,740		1,130	1,070
Sulfate (mg/L)	2,920	2,950	2,060	3,110	2,040	2,860	3,480	1,780		1,440	1,550
Fluoride (mg/L)	4.9	1.1	1.2	1.2	1.7	1.0	2.7	0.8		0.9	1.0
Cations (meq/L)	128.64	127.44	80.49	132.35	76.65	132.97	153.36	82.39		60.46	65.79
Anions (meq/L)	128.39	127.47	76.52	136.71	76.03	127.93	146.46	88.81		64.67	64.75
Balance (% Diff.)	0.10	-0.01	2.53	-1.62	0.41	1.93	2.30	-3.75		-3.36	0.80

Note: See last page of table for applicable federal and state standards.

Table 4-8. Results of Inorganic Water Quality Analyses, Evaporation Pond Area, Navajo Refinery, RFI Phase III, 1995 (concluded)

Sample ID	Pnd.Wind (Lab Dup.)		Pond 3	Pond 5		NPR-RW-1	NPR-RW-2
Date Sampled	20-Jan-95		06-Nov-94	06-Nov-94		11-Nov-94	11-Nov-94
Lab pH (SU)	7.6		7.2	7.1		7.9	7.8
Lab EC (umhos/cm)	6,610		12,600	8,030		6,630	6,680
TDS (180°C)	4,500		8,220	4,630		4,580	4,610
Calcium (mg/L)	301		38	33		555	547
Magnesium (mg/L)	175		86	61		178	164
Potassium (mg/L)	6		86	51		6	7
Sodium (mg/L)	847		2,670	1,260		696	696
Bicarbonate (mg/L)	143		251	315		191	188
Carbonate (mg/L)	0		0	0		0	0
Chloride (mg/L)	1,120		2,300	1,370		1,300	1,280
Sulfate (mg/L)	1,570		2,720	958		1,510	1,460
Fluoride (mg/L)	1.0		158.4	126.8		0.7	0.7
Cations (meq/L)	66.40		127.19	62.92		72.76	71.24
Anions (meq/L)	66.61		125.45	63.78		71.24	69.49
Balance (% Diff.)	-0.16		0.69	-0.68		1.06	1.24

Notes:
Federal Secondary MCL Standards (mg/L): TDS, 500; chloride, 250; sulfate, 250; fluoride, 2.
New Mexico WQCC Groundwater Standards (mg/L): TDS, 1,000; chloride, 250; sulfate, 600; fluoride, 1.6.
Federal MCL for fluoride: 4 mg/L.

The upward gradient observed during the Phase II and III studies is regional in nature. Upward discharge of water from the shallow aquifer along the Pecos River from the vicinity of Acme (north of Roswell) to about one mile south of the Highway 82 bridge has been documented by the USGS and the New Mexico State Engineer Office (Welder, 1983).

Groundwater mapping performed for the Phase II study showed groundwater flow to be generally southeasterly in the area south of Ponds 1 and 2, which until 1987 received effluent having minimal wastewater treatment. The discharge area for seepage water from these ponds is the vicinity of U.S. Highway 82 and the Pecos River, in an area populated with salt cedar, a phreatophyte that consumes large amounts of water in the summer months. Heavily vegetated areas of salt cedar in the vicinity of the highway extend at least several miles to the south. As water is consumed by the plant, the dissolved salts remain behind and contribute to the poor water quality of shallow groundwater and cause localized areas of salt-impacted soils. The negative impact of phreatophytes on groundwater in this reach of the Pecos River has been studied by both state and federal investigators (Mower et al., 1964). Water not consumed by vegetation has concentrated levels of natural salts. Water within several feet of the surface evaporates, leaving elevated salts in soils, or discharges into the Pecos River during low flow thus exacerbating river salt impacts.

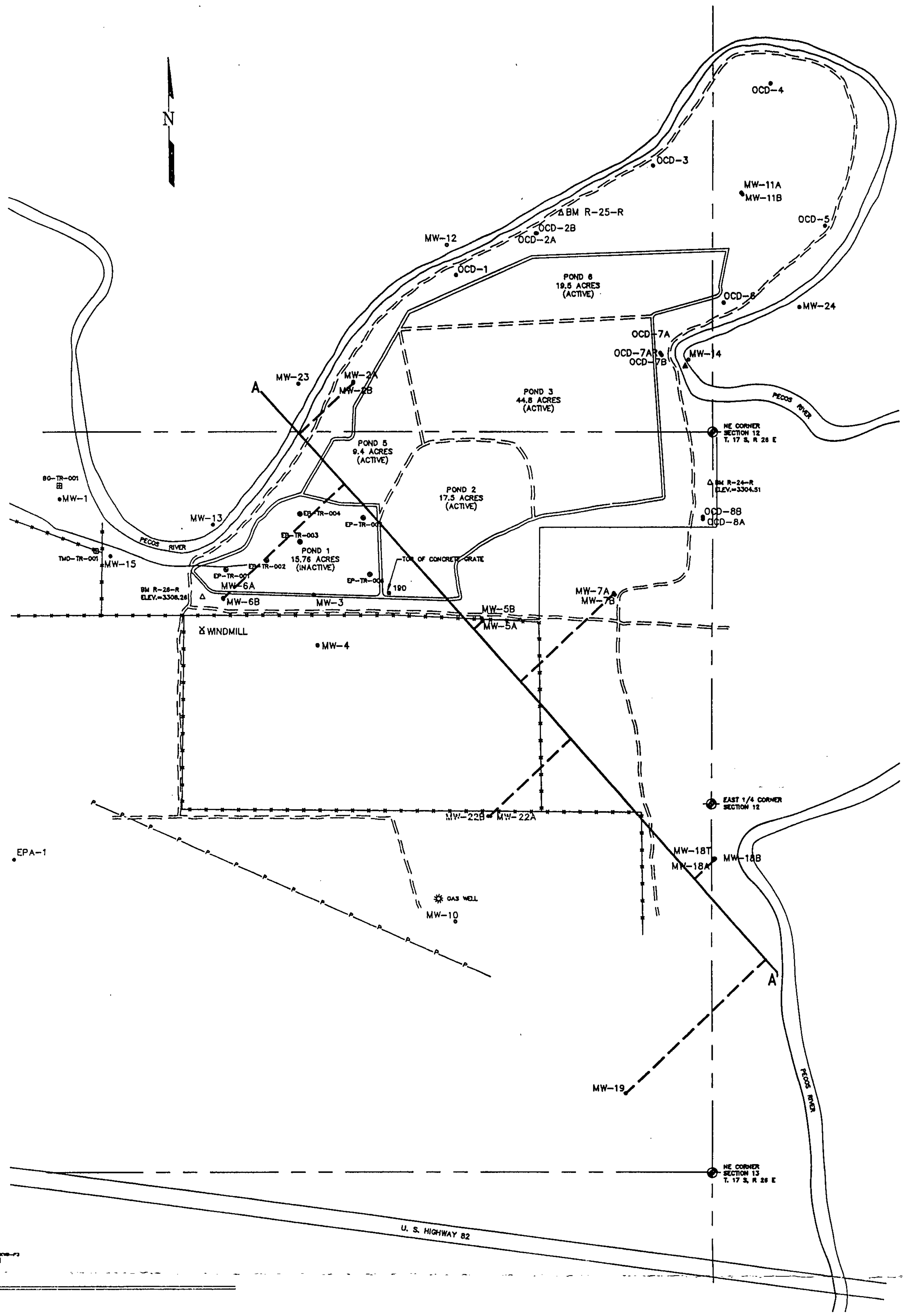
4.5.1.2 Groundwater Modeling

Groundwater modeling of the flow system in the vicinity of the river was performed during the Phase II investigation to provide mathematical and visual interpretation of the hydraulic effects occurring as a result of the interaction of the ponds and the natural system. Sufficient information was available on vertical and horizontal gradients and hydraulic conductivities to allow use of a relatively simple and accepted groundwater model.

Because the hydrologic data measured during the current Phase III study has not significantly changed and supports information collected in the earlier investigation, no additional groundwater modeling was performed for this study. However, because current data support the earlier results, the model is briefly discussed in this report. Figures 4-2 and 4-3 show the location of the wells used in the model and the resultant particle flow lines. The latter figure illustrates a situation in which there is downward flow from the pond superimposed on a flow that is generally moving vertically upward. Thus, the flow is initially downward directly beneath the pond, and rises laterally in the downgradient direction. There is a surface upon which particles move neither upward or downward. Here, motion is lateral and follows the regional gradient away from the influence of the pond. Thus, a particle moves off the vertically static surface to a region in which flow is again upward.

From Figure 4-3, it is clear why, under the given conditions, lower zones remain uncontaminated despite local downward movement in upper zones significantly influenced by the ponds. For example, the lower zone in the vicinity of MW-2 remains largely uncontaminated because of the confined effect of the vertical and horizontal gradients and conductivity. The particle flow map also shows how flow will influence the movement of particles upward toward a discharge area southeast of the ponds.

Figure 4-2. Cross Section Location for Vertical Groundwater Flow Model, Evaporation Pond Area, RFI Phase II, 1993



EXPLANATION:

MW-10 MONITOR WELL

PIEZOMETER

800 0 800 2400 FEET

NOTE: MAP COMPILED FROM NAVAJO REFINERY AND USGS SPRING LAKE 7.5 MINUTE QUADRANGLE. WELL LOCATIONS AND ELEVATIONS FROM NAVAJO REFINERY CONTROL. WELL LOCATIONS SURVEYED 2/93, JAQUESS & ASSOCIATES.

LOCATION T 17 S, R 26 E, NMPM, EDDY COUNTY, NM

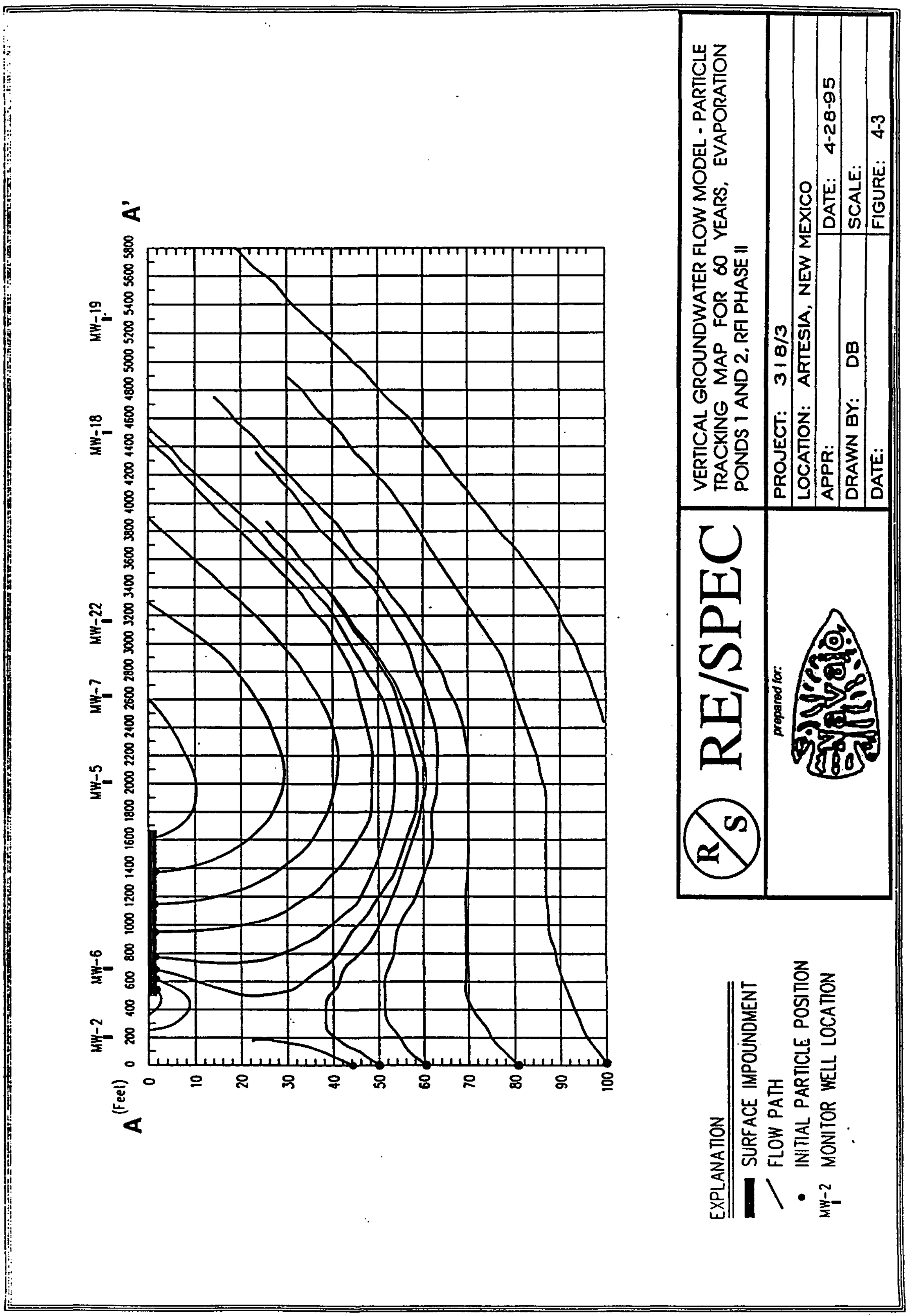
RE/SPEC

prepared for:

Navajo

CROSS SECTION LOCATION FOR VERTICAL GROUNDWATER FLOW MODEL, EVAPORATION POND AREA, RFI PHASE II

PROJECT: 318/3	
LOCATION: ARTESIA, NEW MEXICO	
APPR:	DATE: 4-28-95
DRAWN BY: DB	SCALE:
DATE:	FIGURE: 4-2


VERTICAL GROUNDWATER FLOW MODEL - PARTICLE TRACKING MAP FOR 60 YEARS, EVAPORATION PONDS 1 AND 2, RFI PHASE II
PROJECT: 318/3
LOCATION: ARTESIA, NEW MEXICO
APPR:
DATE: 4-28-95
DRAWN BY: DB
SCALE:
DATE:
FIGURE: 4-3
RE/SPEC
prepared for:
EXPLANATION
SURFACE IMPOUNDMENT
FLOW PATH
INITIAL PARTICLE POSITION
MONITOR WELL LOCATION
MW-2
A
A'
(Feet)
MW-6
MW-5
MW-7
MW-22
MW-18
MW-19
0
10
20
30
40
50
60
70
80
90
100
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
3200
3400
3600
3800
4000
4200
4400
4600
4800
5000
5200
5400
5600
5800

The groundwater modeling results provide a graphical picture of the interaction of groundwater moving upward from the valley fill aquifer with water seepage from the evaporation pond. Although some zones appear to undergo little mixing, movement of water into and out of the cross section can not be seen because the model is two dimensional. Slight variations in actual vertical or horizontal gradients or hydraulic conductivity will cause particle movement to deviate from the paths shown. However the overall effect will cause groundwater to move upward toward the discharge zone, where it will be consumed through evaporation and transpiration.

With use of the map and available geologic, hydrologic, and chemical data, predictions regarding locations of future impact of the seepage water can be offered. For example, the model shows that not all flow paths have reached the surface discharge area even after 60 years. During the remaining time necessary for a particle to reach the surface, the model can show locations of intermediate zones subject to degradation as the contaminant front passes through the area. Therefore, the first detection of constituents in a monitor well should not immediately be a cause for concern if the location of the well is in the predicted path of the mobile contaminants. Such detection should be looked upon as verification of the utility of the program and its ability to accurately represent subsurface flow.

The results of these measurements, together with aquifer testing, contour mapping and the groundwater modeling performed in the Phase II study, provide sufficient scientific evidence to demonstrate that the hydrologic system in the vicinity of the evaporation ponds is discharging groundwater upward. That work also showed that groundwater in the general vicinity of Ponds 1 and 2 moves in a southeasterly direction toward the Pecos River crossing at U.S. Highway 82 and areas heavily vegetated with salt cedar located immediately adjacent to the highway.

4.5.2 Groundwater Quality

4.5.2.1 Organic Compounds

The results of testing for volatile organic compounds in the area of the evaporation ponds showed marked improvement from the sampling analyses conducted during RFI Phase II study. Table 4-9 compares the type and number of organic constituents detected in this investigation with those found during the 1993 Phase II investigation. Also, Table 4-9 includes results of split sampling by PRC.

The number of confirmed benzene detections are lower than reported during the 1993 Phase II study. In the current study, only MW-4A was confirmed to contain benzene and it exists at a lower concentration than found in earlier samplings. In the 1993 study, water samples from four additional wells (MW-3, MW-5A, MW-6B, and OCD-7B) had detectable levels of benzene.

Table 4-9 Comparision of Volatile Organic Compound Detections, 1992-1995, Evaporation Pond Area, Navajo Refining Company, RFI Phase III, 1995

Sample ID	Date Sampled	Benzene (mg/L)	Ethyl-benzene (mg/L)	Toluene (mg/L)	Total Xylenes (mg/L)	MEK (mg/L)	Carbon Disulfide (mg/L)
Evap. Pond. 3	11/06/94 (11/20/92)	ND (0.043)	ND (0.016)	ND (0.061)	ND (0.045)	ND (<0.010)	ND (0.032)
MW-3	11/08/94 (11/12/92)	ND (0.017)	ND (0.016)	ND (0.021)	0.006 (0.025)	ND (<0.010)	ND (ND)
MW-3 PRC	11/08/94	ND	0.004	0.004	0.006	<0.010	ND
MW-4A	11/10/94 (11/12/92)	0.013 (0.021)	0.015 (0.019)	0.006 (0.009)	0.028 (0.032)	ND (<0.010)	ND (ND)
MW-4A Field Dup.	11/10/94	0.014	0.016	0.006	0.032	ND	ND
MW-4A PRC	11/10/94	0.015	0.017	0.0067	0.028	<0.010	ND
MW-4C Bail	01/20/95	0.010	ND	ND	ND	ND	ND
MW-4C Pump	01/20/95	0.013	ND	ND	0.006	ND	ND
MW-4C PRC	01/20/95	ND	ND	ND	ND	<0.010	ND
MW-4C Resample	02/24/95	ND	ND	ND	ND	ND	ND
MW-5A	11/08/94 (11/11/92)	ND (0.013)	ND (0.006)	ND (0.028)	0.021 (0.008)	ND (<0.010)	ND (ND)
MW-5A Field Dup.	11/08/94	ND	ND	ND	0.020	ND	ND
MW-5A PRC	11/08/94	ND	ND	ND	0.010	<0.010	ND
MW-5C Bail	01/20/95	0.009	ND	0.005	ND	ND	ND
MW-5C Pump	01/20/95	ND	ND	ND	ND	ND	ND
MW-5C PRC	01/20/95	ND	ND	ND	ND	<0.010	ND
MW-5C Resample	02/24/95	ND	ND	ND	ND	ND	ND

Notes:
ND: Not detected at a minimum detection level of 0.005 mg/L.
EPA MCL: Benzene, 0.005 mg/L; ethylbenzene, 0.70 mg/L; toluene, 1.0 mg/L; xylenes, 10.0 mg/L.
NM WQCC: Benzene, 0.010 mg/L; ethylbenzene, 0.75 mg/L; toluene, 0.75 mg/L; xylenes, 0.62 mg/L.

Table 4-9 Comparision of Volatile Organic Compound Detections, 1992-1995, Evaporation Pond Area, Navajo Refining Company, RFI Phase III, 1995 (concluded)

Sample ID	Date Sampled	Benzene (mg/L)	Ethyl-benzene (mg/L)	Toluene (mg/L)	Total Xylenes (mg/L)	MEK (mg/L)	Carbon Disulfide (mg/L)
MW-6A	11/08/94 (11/12/92)	<0.025 (ND)	<0.025 (0.007)	<0.025 (0.006)	<0.025 (0.014)	<0.025 (<0.010)	<0.025 (ND)
MW-6A Resample	01/14/95	ND	0.006	ND	0.010	ND	ND
MW-6B	11/08/94 (01/30/93)	<0.025 (0.009)	<0.025 (ND)	<0.025 (0.006)	<0.025 (ND)	<0.025 (0.048)	<0.025 (0.117)
MW-6B PRC	11/08/94	ND	ND	ND	ND	<0.010	ND
MW-6B Resample	01/15/95	ND	ND	ND	ND	ND	ND
OCD-7B	11/07/94 (01/30/93)	ND (0.009)	ND (ND)	ND (ND)	ND (ND)	ND (<0.010)	ND (ND)
OCD-7B PRC	11/07/94	ND	ND	ND	ND	<0.010	ND

Notes:
ND: Not detected at a minimum detection level of 0.005 mg/L.
EPA MCL: Benzene, 0.005 mg/L; ethylbenzene, 0.70 mg/L; toluene, 1.0 mg/L; xylenes, 10.0 mg/L.
NM WQCC: Benzene, 0.010 mg/L; ethylbenzene, 0.75 mg/L; toluene, 0.75 mg/L; xylenes, 0.62 mg/L.

The 1993 investigation detected ethylbenzene in four wells (MW-3, MW-4A, MW-5A, and MW-6A), at levels between 0.006 and 0.019 mg/L, versus two wells this year. In 1993, toluene was present in MW-3, MW-4A, MW-5A, MW-6A, and MW-6B; the current study detected and confirmed toluene only in MW-4A. Xylene was detected in wells MW-3, MW-4A, MW-5A, and MW-6A during both Phase II and Phase III samplings but levels are lower in three of the four wells. Unlike the Phase II study, methyl ethyl ketone and carbon disulfide were not detected in MW-6B. In both studies, only benzene exceed current federal or state standards. As in 1993, the extensive testing conducted for semivolatile organic compounds in groundwater in the area of the evaporation ponds did not result in any semivolatile constituent detections.

4.5.2.2 Selected Metals

Several problems, separately or together, caused elevated concentrations of lead, chromium, and/or nickel in several of the wells sampled. This was especially true for new wells drilled and developed only several days before first being sampled, and for the older stainless steel wells. In some of newer wells, fine grained particles continued to produce light brown opaque water even though other water quality parameters, especially conductivity, had long since stabilized. It was not uncommon to pump over 100 gallons of water from the new wells to storage barrels in an attempt to remove turbidity. The older stainless steel wells also were difficult to purge. The submersible pump used in purging the more recent two-inch well installations could not be inserted inside the casing of the older wells. Use of a bailer was difficult due to frequent hang-up on the casing joints. Considerable fine material was dislodged from the casing walls and the shallow wells also were silty near the bottom.

These problems were most prevalent in stainless steel wells MW-1, MW-4A, MW-5A, and MW-6A, and to a lessor extent in the other steel wells. MW-10, whose construction details are unknown, had elevated chromium and nickel concentrations that mimicked the steel wells, but an elevated lead concentration could lead to an interpretation of turbidity in the sample. Water from new wells MW-5C and OCD-7C was clearly turbid and appeared dark brown in the bailer after purging. Because of time constraints, these new wells were sampled almost immediately after development and, based on observed turbidity, apparently needed additional development work. In an attempt to get a less turbid sample, a second sample for metals was collected through the submersible pump used for purging at MW-4C, MW-5C, and OCD-7C. Bailed samples at these wells were also field filtered which eliminated most detections except for arsenic.

Several wells experienced changes in chromium, lead, and nickel concentrations from sampling results reported in the Phase II report. PVC-cased well OCD-3, which had a total chromium concentration of 0.19 mg/L in the 1993 sampling, currently has a concentration of 0.043. In 1993, total lead was found in OCD-3 at a concentration of 0.06 mg/L. Current sampling detected lead at 0.02 mg/L. Turbidity and/or high TDS concentrations may elevate levels of these metal constituents in OCD-3; current TDS for this well is 12,200 mg/L. As mentioned above, MW-10 had elevated levels of several constituents, including nickel. The concentration result for total nickel doubled from that reported in the 1993 investigation. However, nickel was not detected in the filtered sample leading to the supposition that elevated levels are due to turbidity.

Because of changes from the earlier study, this well should be included in any resampling performed at the unit.

Based on elevated concentration levels of chromium, lead, and nickel found in several of the new wells in the November, 1994 and January 1995 testing, an additional sampling event was performed in February. Using a peristaltic pump, the three new deep wells and three older ones at each location were purged at low flow rates of approximately one liter per minute with the intake hose set at approximately two to three feet beneath the water level surface. Although slow in removing large volumes of water, wells purged using this method did not exhibit significant turbidity.

The resampling resulted in significant improvement in the water quality of each well for these three metal constituents. Total chromium, lead, and nickel were not reported detected in the six wells except for a value of 0.007 mg/L chromium in OCD-7AR, which is just slightly above the 0.005 mg/L detection level. Based on these results, all future purging for RCRA samplings should be performed using a low flow pump prior to sampling.

As noted in the results, sampling from wells purged at low flow rates, and field filtering did not prevent arsenic concentrations at some wells from exceeding the federal MCL of 0.05 mg/L. However, some wells had dramatic reductions in concentrations after purging at low flow rates. For example, concentration was reduced to one-third of the original concentration in MW-4A (0.156 to 0.051 mg/L), to one-fifth in OCD-7AR (0.149 to 0.030 mg/L), and to less than 10 percent of original levels in MW-5C (0.204 to 0.008 mg/L) and OCD-7C(0.111 to 0.011 mg/L). The other two wells had only slight reductions in arsenic; the value for MW-4C (0.061 mg/L) was approximately the same concentration as found in the original filtered and unfiltered bailed samples.

As previously mentioned, the wide range of arsenic values is believed due to two factors: dissolved arsenic actually in solution (e.g., at monitor wells MW-2A, MW-5A, and OCD-7A), and turbid samples containing arsenic that moves into solution when the sample is digested (e.g., MW-4A, MW-5C, and OCD-7C). Some results may be a combination of these postulated effects.

The minimal effect of filtration on some samples of arsenic can be interpreted as meaning that arsenic is present in colloidal form. Common dimensions for colloids are 0.001 to 0.200 microns; substances of that size will pass through the 0.45 micron filter used to collect a dissolved sample. Arsenic sulfide is one such example of a colloid. The charge on the sulfur ion in As_2S_3 is negative, indicating sulfur is a reduced species. Likewise, the chemical environment in the immediate vicinity of the ponds also is expected to be reduced because of the presence of organics in the subsurface. In such surroundings, the charge on a sulfur ion would likely be negative (-2) versus the positive charge (+6) commonly found in an oxidizing environment. Although arsenic speciation in the groundwater is unknown; it could very likely be colloidal in nature given the circumstances postulated above.

Table 4-10 is a compilation and comparison of all arsenic sample results collected from wells in the vicinity of ponds during the Phase II and III investigations. Arsenic problems due to turbidity mask actual groundwater concentrations and make comparison of concentration changes from 1993 to 1995 difficult. However, measurable and significant concentration increases are suspected in MW-2A, MW-5A, MW-5B, MW-6A, MW-7A, MW-10, MW-14, MW-15, MW-22A, MW-23, and OCD-5. Lowered values are observed in MW-3, MW-4A, MW-6B, MW-7B, OCD-2A, and OCD-7AR. Three of these latter wells are in close proximity to inactive Pond 1, indicating possible improved water quality as a result of pond closure.

As discussed elsewhere, groundwater in the immediate area of the ponds is essentially unusable owing to the high natural concentration of salts. Although there is some limited use of poor-quality water for livestock on the west side of the ponds, which is upgradient from the site, the combination of a groundwater discharge area and high natural concentrations of salts eliminate the possibility of the high arsenic levels impacting usable ground water supplies and potential receptors.

4.5.2.3 Water Chemistry

Inorganic water chemistry data were collected during the Phase II study to provide information regarding the impact of the pond chemistry on the local hydrologic environment. The installation of the deeper monitor wells allowed comparison of the deeper groundwater with that at shallow depths.

Analysis of Phase II groundwater samples from the monitor wells in the vicinity of the ponds indicated that the groundwater at some locations had been impacted by seepage discharge from the ponds. This information was reviewed and updated using data collected during the Phase III study to perform trend analysis and to evaluate whether inactivation of Pond 1 in 1987, and Pond 2 early in 1994, have resulted in measurable improvement in groundwater quality. Water quality is considered to have improved if high sodium chloride water present in the ponds is being replaced with water having calcium-magnesium sulfate properties more common to unimpacted alluvial sediments. The use of water chemistry techniques, in addition to evaluation of changes in organic and metal constituents, can be used to provide evidence supporting the concept of natural remediation of pollutants at the units.

Because complete information on the major water constituents was collected at the time of sampling for target compounds, an analysis of the types of water present could be performed that would be useful in interpretation of hydrologic conditions at the site. The Piper trilinear diagram (Hem, 1989) was the method of analysis chosen to represent the various types of water likely to be present in the area. A description of method and its use was provided in the discussion of water chemistry at TMD (Section 3.2.5.2.3) and will not be reviewed here.

Table 4-10. Comparison of Total Arsenic Values, 1993-1995, Evaporation Pond Area, Navajo Refinery, RFI Phase III, 1995

Well ID	Sample ID	Date	Total Dissolved Solids (mg/L @180°C)	As Mean Value[1] (mg/L)	PRC As Value[2] (mg/L)	Sample ID	Date	Total Dissolved Solids (mg/L @180°C)	Total Arsenic[1] (mg/L)	PRC As Value[2] (mg/L)
MW-1	MW-01-01	10-Nov-92	11,200	0.022	0.008[J]	MW-1	05-Nov-94	10,200	0.013	
MW-2A	MW-02A	10-Nov-92	11,300	**0.102**	**0.212[J]**	MW-2A	05-Nov-94	7,620	**0.156**	
MW-2A			8,430			MW-2A (Lab Dup)	05-Nov-94	7,670	**0.158**	
MW-2B	MW-02B	16-Dec-92	2,500	<0.005	< 0.003	MW-2B	05-Nov-94	2,490	<0.005	
MW-2B	MW-02B (L. Dp.)	16-Dec-92	2,540	<0.005		MW-2B (Field Dup. 1)	05-Nov-94	2,610	<0.005	
MW-3	MW-03	12-Nov-92	5,310	**0.087**		MW-3	08-Nov-94	5,970	0.045	**0.090**
MW-3						MW-3 (PRC Dup)	08-Nov-94			**0.100**
MW-4A	MW-04	12-Nov-92	5,360	**0.096**	**0.213[J]**	MW-4A	10-Nov-94	5,410	**0.156**	**0.241**
MW-4A	MW-04 (L. Dup.)	12-Nov-92	5,360	**0.085**		MW-4A (Field Dup. 3)	10-Nov-94	5,600	**0.143**	
MW-4A						MW-4A	24-Feb-95		**0.051**	
MW-4C						MW-4C Bail	20-Jan-95	3,830	**0.070**	**0.140**
MW-4C						MW-4C Bail (PRC D.)	20-Jan-95			**0.135**
MW-4C						MW-4C Pump	20-Jan-95	3,840	**0.067**	
MW-4C						MW-4C	24-Feb-95		**0.061**	
MW-5A	MW-05A	11-Nov-92	24,300	**0.082**		MW-5A	08-Nov-94	14,600	**0.127**	**0.075**
MW-5A	MW-05A (Fld D.)	11-Nov-92	24,400	**0.077**		MW-5A (Field Dup. 2)	08-Nov-94	14,700	**0.129**	
MW-5A						MW-5A	24-Feb-95		**0.092**	
MW-5B	MW-05B	22-Jan-93	7,350	**0.141**	**0.200**	MW-5B	08-Nov-94	6,570	**0.213**	**0.290**
MW-5C						MW-5C Bail	20-Jan-95	3,750	**0.204**	**0.090**
MW-5C						MW-5C Pump	20-Jan-95	3,430	0.022	
MW-5C						MW-5C	24-Feb-95		0.008	
MW-6A	MW-06A	12-Nov-92	3,540	**0.065**		MW-6A	08-Nov-94	3,650	**0.085**	
MW-6B	MW-06B	30-Jan-93	3,800	0.021		MW-6B	08-Nov-94	3,190	0.011	0.011
MW-7A	MW-07A	11-Nov-92	11,500	0.038	**0.143[J]**	MW 7A	06-Nov-94	10,200	**0.097**	
MW-7B	MW-07B	21-Jan-93	9,220	0.014	0.017	MW 7B	06-Nov-94	5,600	0.011	

Notes:
1 Navajo samples for arsenic analyzed using EPA SW-846 method 7061; 1993 mean value is average of original and verification value(s), when performed
2 PRC samples for arsenic analyzed using EPA SW-846 method 7060
J Estimated value
Bold: Exceedance of EPA MCL of 0.05 mg/L.

Table 4-10. Comparison of Total Arsenic Values, 1993-1995, Evaporation Pond Area, Navajo Refinery, RFI Phase III, 1995 (continued)

Well ID	Sample ID	Date	Total Dissolved Solids (mg/L @180°C)	As Mean Value[1] (mg/L)	PRC As Value[2] (mg/L)	Sample ID	Date	Total Dissolved Solids (mg/L @180°C)	Total Arsenic[1] (mg/L)	PRC As Value[2] (mg/L)
MW-10	MW-10	18-Nov-92	4,400	0.011		MW-10	09-Nov-94	4,420	0.035	0.048
MW-11A	MW-11A	12-Dec-92	16,100	<0.005		MW-11A	06-Nov-94	19,200	0.013	
MW-11A						MW-11A (Lab Dup.)	06-Nov-94	19,200	0.012	
MW-11B	MW-11B	23-Jan-93	14,000	<0.005		MW-11B	06-Nov-94	13,600	0.013	
MW-14	MW-14	17-Dec-92	8,230	0.012		MW-14	10-Nov-94	12,600	**0.087**	**0.212**
MW-14	MW-14 (Fld D.)	17-Dec-92	7,890	0.010						
MW-15	MW-15	20-Jan-93	2,790	0.008	<0.003	MW-15	09-Nov-94	3,660	0.028	0.034
MW-18A	MW-18A	25-Jan-93	12,600	<0.005		MW-18A	09-Nov-94	17,700	<0.005	
MW-18B	MW-18B	11-Mar-93	3,710	<0.005		MW-18B	09-Nov-94	3,670	<0.005	
MW-18B	MW-18B (L.Dup.)	11-Mar-93	3,710	<0.005						
MW-19	MW-19	26-Jan-93	5,720	<0.005		MW-19	10-Nov-94	5,360	0.015	0.023
MW-22A	MW-22A	29-Jan-93	4,410	0.013		MW-22A	09-Nov-94	4,740	**0.075**	**0.102**
MW-22A	MW-22A (Fld D.)	29-Jan-93	4,400	0.014						
MW-22B	MW-22B	29-Jan-93	4,700	0.008		MW-22B	09-Nov-94	4,480	<0.005	
MW-22B	MW-22B (L Dup.)	29-Jan-93	4,720	0.008						
MW-23	MW-23	28-Jan-93	11,700	0.008		MW-23	10-Nov-94	15,600	0.034	**0.060**
MW-23	MW-23 (L Dup.)	28-Jan-93	11,700	0.007						
Windmill	Pond Windmill	17-Dec-92	4,740	<0.005		Pond Windmill	09-Nov-94	4,260	0.017	0.007
						Pond Windmill	20-Jan-95	4,450	<0.005	<0.005
						Pond Wind. (L. Dup.)	20-Jan-95	4,500	<0.005	
Pond	Pond 3 at OCD 7	16-Nov-92	7,080	**0.167**		Evaporation Pond 3	6-Nov-94	8,220	**0.497**	
						Evaporation Pond 5	6-Nov-94	4,630	**0.298**	

Notes:
1 Navajo samples for arsenic analyzed using EPA SW-846 method 7061; 1993 mean value is average of original and verification value(s), when performed
2 PRC samples for arsenic analyzed using EPA SW-846 method 7060
J Estimated value
Bold: Exceedance of EPA MCL of 0.05 mg/L.

Table 4-10. Comparison of Total Arsenic Values, 1993-1995, Evaporation Pond Area, Navajo Refinery, RFI Phase III, 1995 (concluded)

Well ID	Sample ID	Date	Total Dissolved Solids (mg/L @180°C)	As Mean Value[1] (mg/L)	PRC As Value[2] (mg/L)	Sample ID	Date	Total Dissolved Solids (mg/L @180°C)	Total Arsenic[1] (mg/L)	PRC As Value[2] (mg/L)
OCD-1	OCD-1	13-Nov-92	10,300	**0.106**	**0.235J**	OCD-1	05-Nov-94	8,970	**0.103**	
OCD-2A	OCD-2A	15-Nov-92	11,800	**0.076**		OCD-2A	05-Nov-94	11,000	0.048	
OCD-2A	OCD-2A (L. Dp.)	15-Nov-92	11,700	**0.069**						
OCD-2B	OCD-2B	21-Jan-93	11,600	0.006	0.029	OCD-2B	05-Nov-94	4,070	0.006	
OCD-3	OCD-3	16-Nov-92	11,600	0.022		OCD-3	05-Nov-94	12,200	0.028	
OCD-4	OCD-4-1	16-Nov-92	13,100	0.016		OCD-4	06-Nov-94	12,400	0.024	
OCD-5	OCD-5	16-Nov-92	12,400	0.008		OCD-5	06-Nov-94	12,100	0.041	
OCD-5	OCD-5 (Fld. D.)	16-Nov-92	12,400	0.009						
OCD-5	OCD-5(LD.of FD)	16-Nov-92	12,400	0.008						
OCD-6	OCD-6-1	16-Nov-92	10,900	0.042		OCD-6	06-Nov-94	9,500	0.039	
OCD-7AR	OCD-7AR	19-Jan-93	8,350	**0.175**		OCD-7AR	07-Nov-94	8,320	**0.149**	**0.280**
OCD-7AR						OCD-7AR (Lab Dup.)	07-Nov-94	8,340	**0.164**	
OCD-7AR						OCD-7AR	24-Feb-95	8,590	0.030	
OCD-7B	OCD-7B	30-Jan-93	5,060	<0.005		OCD-7B	07-Nov-94	5,190	<0.005	0.018
OCD-7C						OCD-7C Bail	21-Jan-95	5,280	**0.111**	**0.100**
OCD-7C						OCD-7C Bail[3]	21-Jan-95	5,620	<0.20	
OCD-7C						OCD-7C Pump	21-Jan-95	8,730	0.011	
OCD-7C						OCD-7C	24-Feb-95	8,680	0.011	
OCD-8A	OCD-8A	17-Nov-92	9,670	0.035		OCD-8A	06-Nov-94	9,560	0.022	
OCD-8B	OCD-8B	23-Jan-93	5,400	<0.005		OCD-8B	06-Nov-94	5,550	<0.005	
OCD-8B	OCD-8B (Fld Dp.)	23-Jan-93	5,270	<0.005						

Notes:
1 Navajo samples for arsenic analyzed using EPA SW-846 method 7061; 1993 mean value is average of original and verification value(s), when performed
2 PRC samples for arsenic analyzed using EPA SW-846 method 7060
3 Sample split with Assaigai Analytical Laboratories, Albuquerque
J Estimated value
Bold: Exceedance of EPA MCL of 0.05 mg/L.

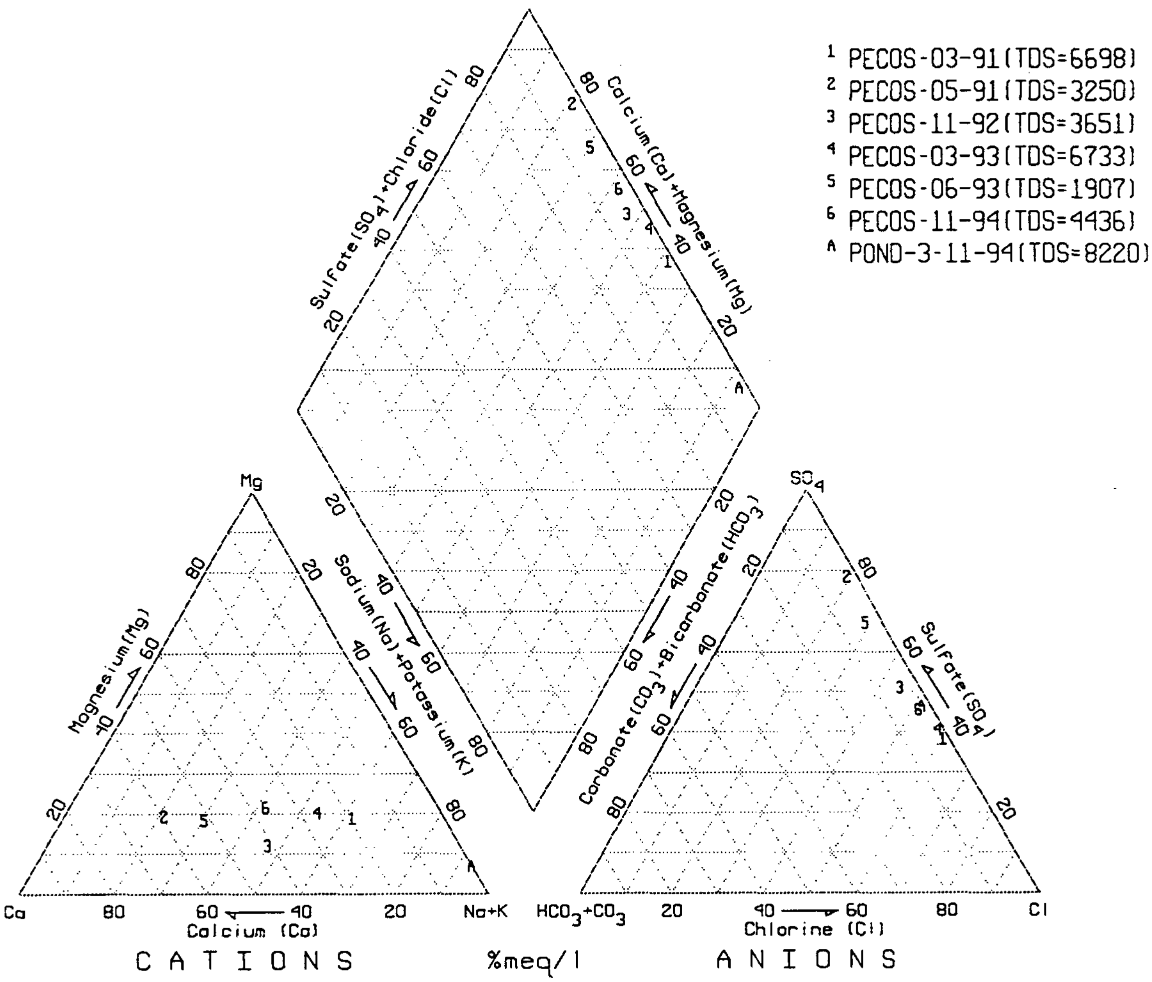
Several sources of water with apparent differences in composition were compared to establish their attributes so that interpretations could be performed. These included monitor wells installed during the Phase II investigation and earlier evaporation pond studies, the Pecos River, a windmill in operation immediately southwest of the ditch entrance to Pond 1, and the effluent currently present in the active pond. Because numerous individual samples were available for comparison, differing combinations of sources were plotted on the diagrams for clarity of interpretation. Of the multitude of combinations available, 13 -- representing the Pecos River water, background water, and the shallow-deep monitor well pairs -- were chosen for presentation and inclusion in this report. For each of the 13 diagrams (Figures 4-4 through 4-16), a summary description and interpretation of the most important water chemistry characteristics are provided in the following narrative:

- The quality of the Pecos River varies greatly during a typical year (Figure 4-4). In March 1991, the composition was greater than 60 percent sodium chloride with a TDS concentration of 6,698 mg/L. By contrast, two months later, in likely response to upstream flow releases for irrigation, the composition was 80 percent calcium-magnesium sulfate with a TDS of 3,250 mg/L. River water on the date of sampling for the current study was intermediate to the above concentrations.

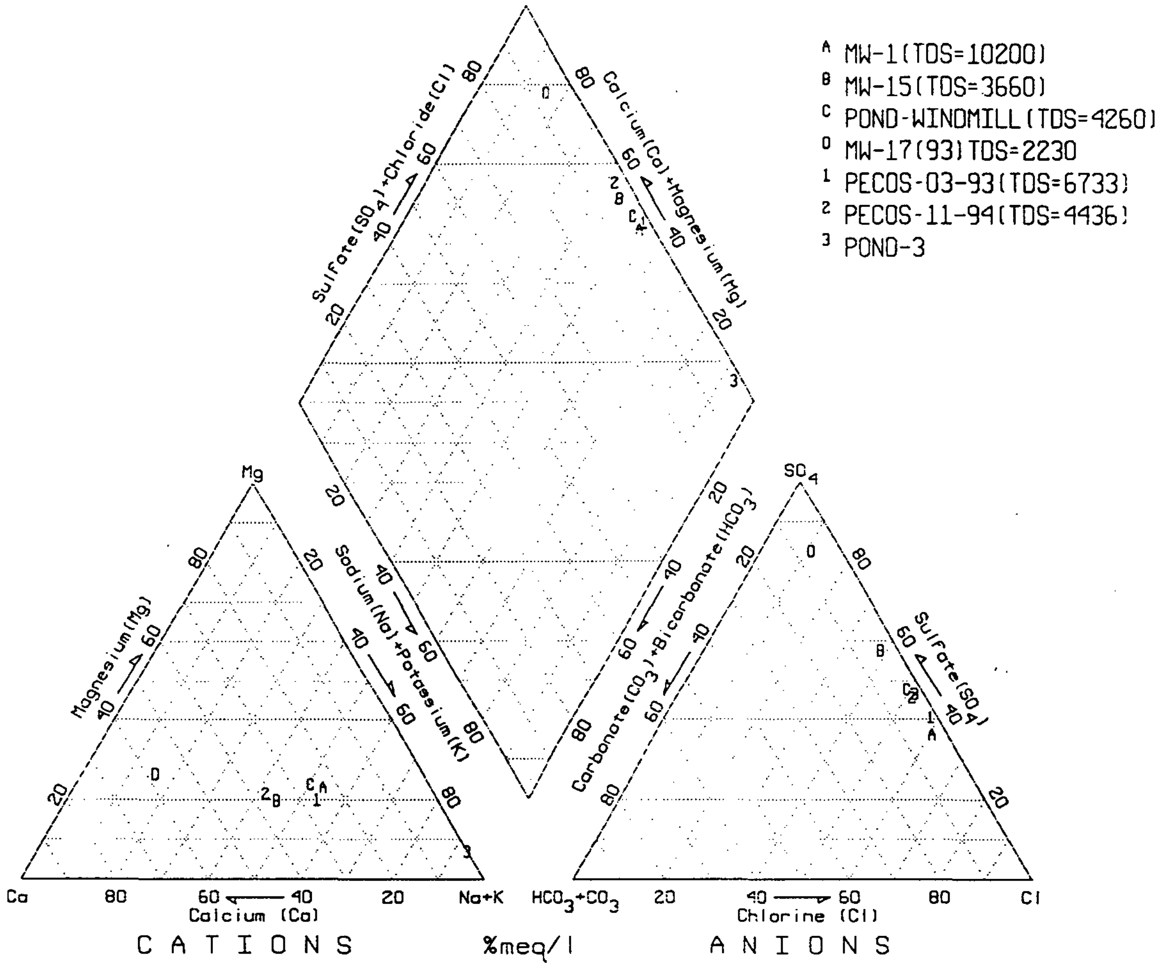
- The concentration of the background groundwater in the vicinity of the ponds is similarly variable and distinctly different from the water in the active pond. The unimpacted water in the shallow subsurface has a composition ranging from that of the Pecos River in March 1993 (Figure 4-5) to a better quality, calcium sulfate water type in the alluvium at MW-17 farther west of the river channel. TDS concentrations range from greater than 10,000 mg/L for water with a composition similar to river water to 2,230 mg/L for water in sediment on the periphery of the floodplain alluvium.

- MW-1, MW-15, and the windmill adjacent to Evaporation Pond 1 do not appear to be impacted by the currently inactive pond and do not show clear evidence of having been impacted by salt in the past (Figure 4-5). TDS concentrations at MW-1, MW-15, and the windmill are 10,200, 3,660, and 4,260 mg/L, respectively. These are not markedly different from concentrations found in 1993.

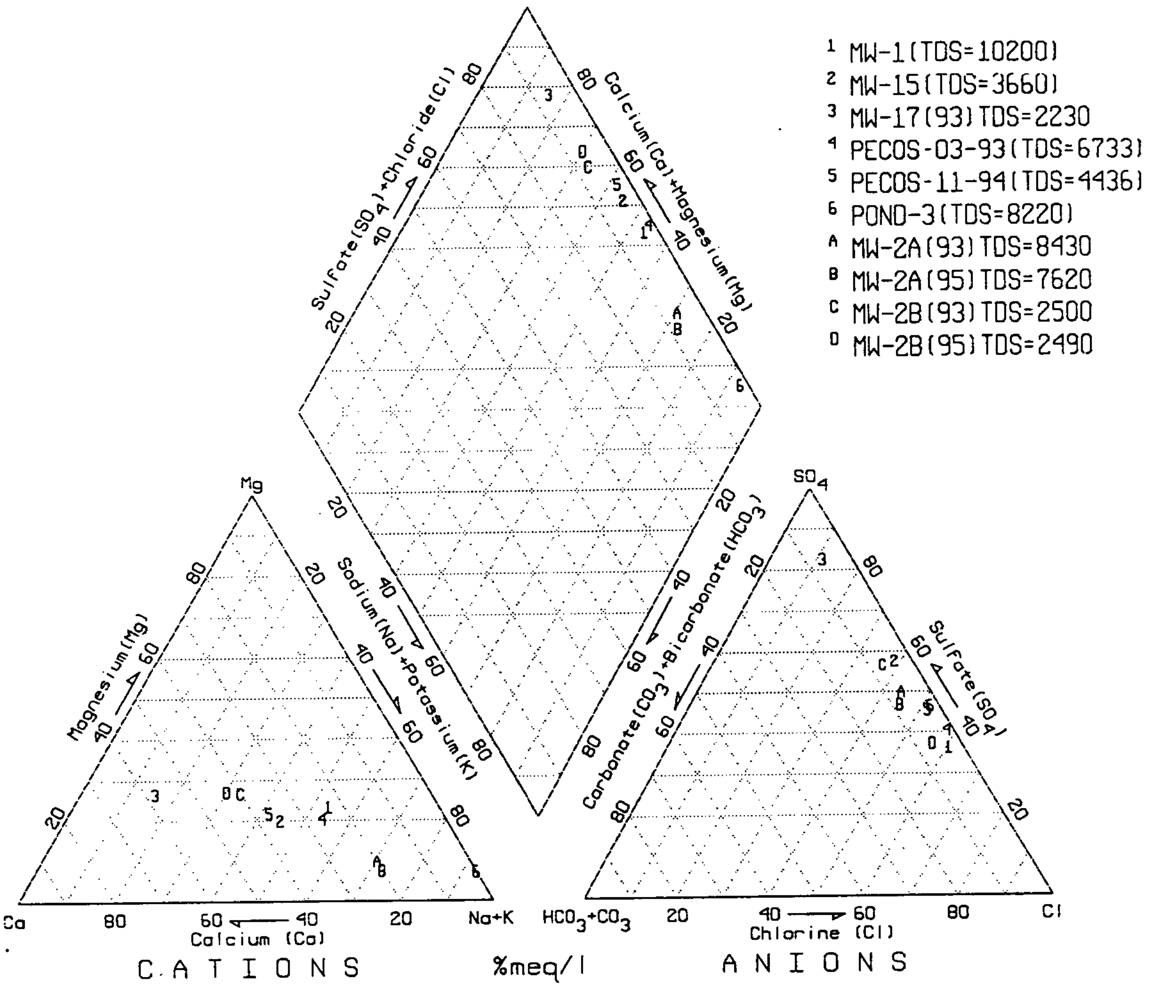
- The location of shallow well MW-2A on the diagram, with respect to the evaporation pond, indicates salt impact from the pond (Figure 4-6). However, deeper well MW-2B shows no evidence of salt impact, which is supported by the metal chemical analyses and a lack of notable organic constituents. Although the measured vertical gradient is downward, the lack of observed salt and major organic impacts provides credence to the groundwater flow model (Figure 4-3). Few changes from 1993 are apparent. MW-2B has slightly more chloride, but TDS and other constituents remain approximately equivalent.



RE/SPEC	Trilinear mixing diagram, Pecos River, RFI Phase III, April 1995	
prepared for: Navajo	PROJECT: 318/3	
	LOCATION: ARTESIA, NEW MEXICO	
	APPR:	DATE: 4-28-95
	DRAWN BY: DB	SCALE:
	DATE:	FIGURE: 4-4



RE/SPEC	Trilinear mixing diagram, pond windmill, background wells, Pecos River, RFI Phase III, April 1995
prepared for: Navajo	PROJECT: 318/3
	LOCATION: ARTESIA, NEW MEXICO
	APPR: / DATE: 4-28-95
	DRAWN BY: DB / SCALE:
	DATE: / FIGURE: 4-5



RE/SPEC

Trilinear mixing diagram, MW-2A, -2B, background wells, Pecos River, RFI Phase III, April 1995

prepared for:

PROJECT: 318/3	
LOCATION: ARTESIA, NEW MEXICO	
APPR:	DATE: 4-28-95
DRAWN BY: DB	SCALE:
DATE:	FIGURE: 4-6

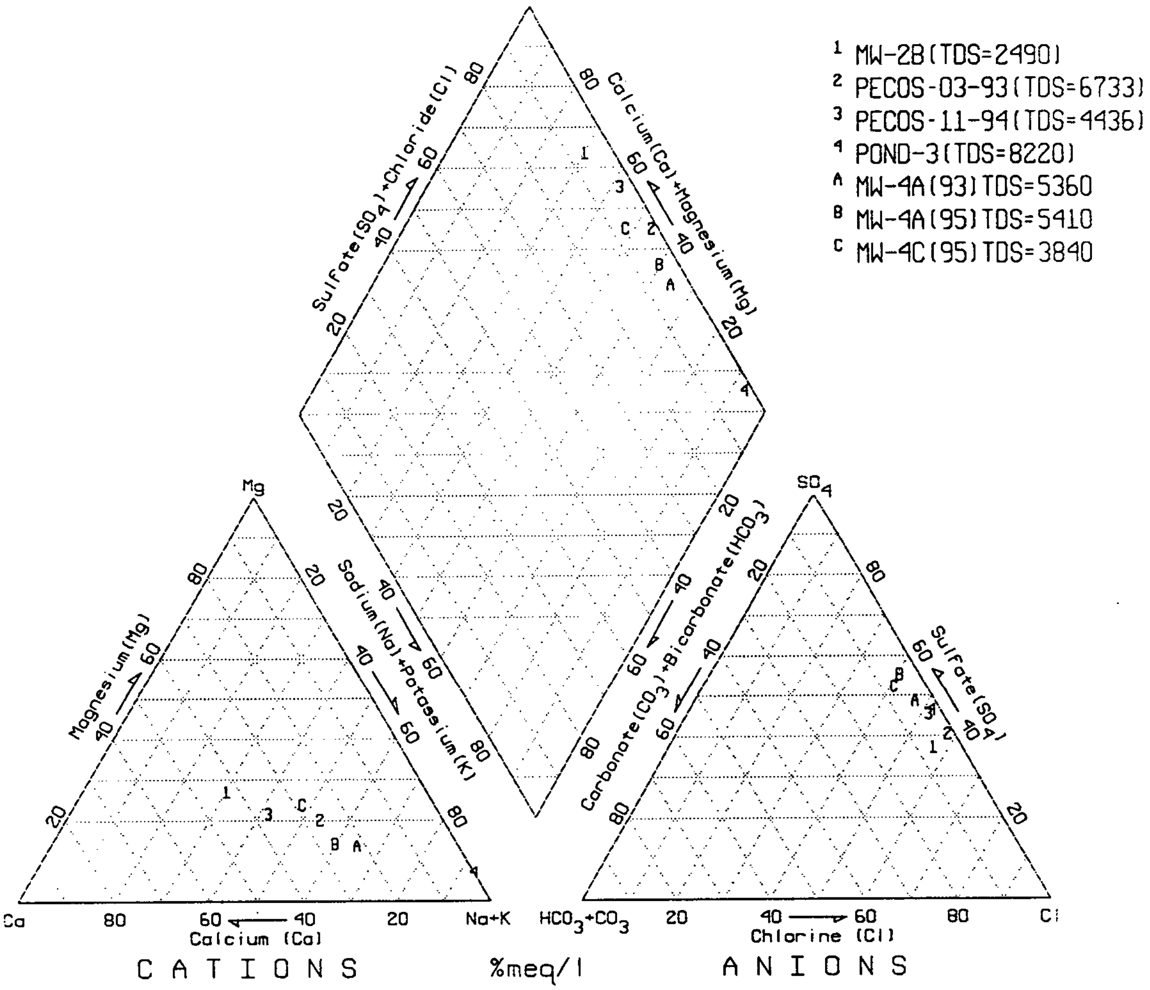
- A deep well was drilled at MW-4C for the Phase III investigation. Water at that well is intermediate between water quality in MW-4A and MW-2B upgradient from the ponds (Figure 4-7). Although TDS in MW-4A has remained about the same, a slight improvement in water quality is evidenced by decrease of both sodium and chloride concentrations. As discussed previously, the concentrations of BTEX constituents also have improved over 1993.

- As noted in the Phase II report, both the shallow and deep wells at MW-5 showed evidence of pond impacts. The 1995 results show little improvement in the type of water in MW-5A although TDS is now about one-half of 1993 (Figure 4-8). The deeper well MW-5B has improved slightly with lower TDS and sodium concentrations. However, chloride remains high and overall quality characteristics appear close to March 1993 Pecos River water. New deep well MW-5C has water relatively low in sodium and chloride. The ponds do not appear to have impacted water in MW-5C; this result is supported by the lack of volatiles or metals seen in the analyses.

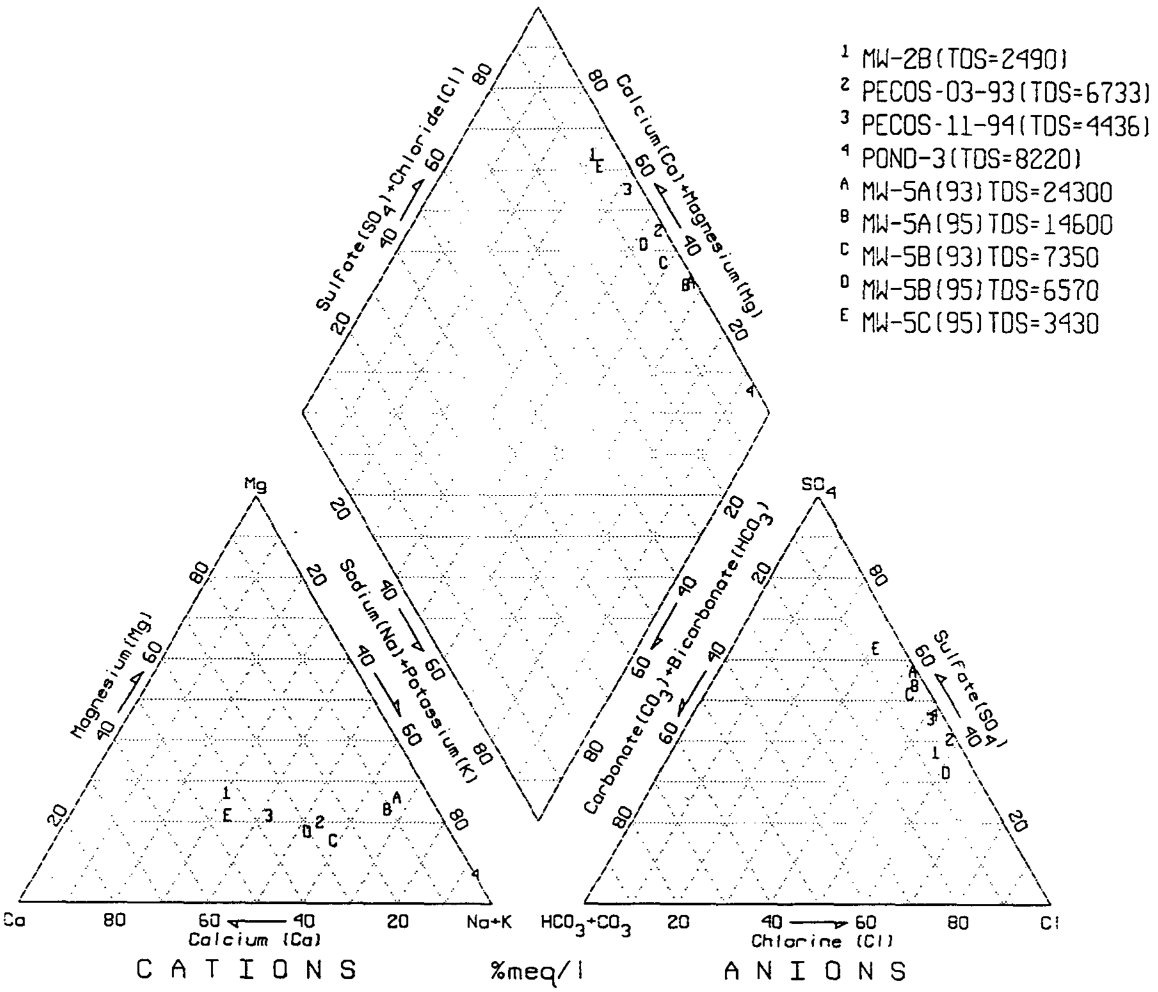
- The water quality of shallow well MW-6A, located immediately adjacent to the entrance to inactive Pond 1, has improved slightly since 1993 (Figure 4-9). When first installed, water from MW-6B had an elevated pH approaching 12 and lacked magnesium which could indicate that some cement grout invaded the screened interval. Sampling this year indicates that water quality is close to that of MW-6A and river water. Low concentrations of several volatiles detected in 1993 were absent in the current sampling. The arsenic concentration has increased since 1993, but the water in this older steel well is very turbid. In 1993, it was hypothesized that water in the impacted zone of MW-6A may be undergoing replacement with better quality groundwater. Changes in water chemistry seen in this well from 1993 to present support that concept.

- Both MW-7A and MW-7B appeared salt impacted in 1993 (Figure 4-10). The 1995 samplings show no change in quality in MW-7A. However, the quality of MW-7B has markedly improved in the past year with respect to both sodium and TDS. Whether this can all be attributed to closure of upgradient Pond 2 is uncertain since arsenic concentrations are already low in this well.

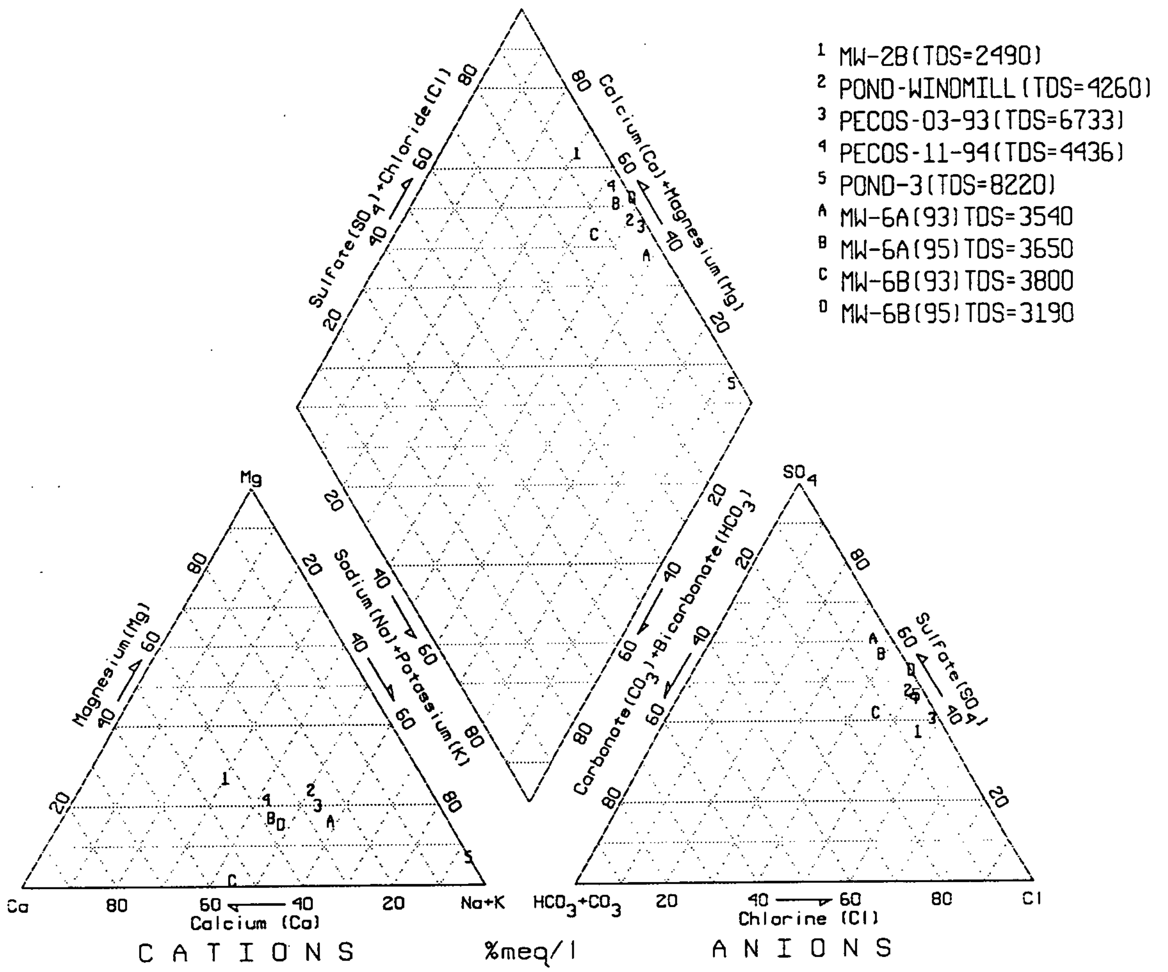
- Owing to their location on the center diamond plot, both MW-11A and MW-11B would appear to be impacted by the pond (Figure 4-11). However, only low detections of contaminants such as arsenic were seen. Additionally, the section of Pond 2 closest to the wells only was completed in 1987. The composition of the shallow and deep water is primarily chloride with relative proportions greater than the existing concentrations of the effluent water. Therefore, the pond is not the likely source of major water in these two wells. Chloride concentrations have increased in both wells since 1993 and arsenic, undetected in 1993, is now at 0.013 mg/L in both wells. Since this section of pond is newer, it is possible that seepage water from the pond is re-dissolving and moving previously deposited soil salinity in the direction of the monitor wells.



RE/SPEC	Trilinear mixing diagram, MW-4A, -4C, Pecos River, evaporation pond, RFI Phase III, April 1995	
prepared for:	PROJECT: 318/3	
	LOCATION: ARTESIA, NEW MEXICO	
	APPR:	DATE: 4-28-95
	DRAWN BY: DB	SCALE:
	DATE:	FIGURE: 4-7



RE/SPEC	Trilinear mixing diagram, MW-5A, -5B, -5C, Pecos River, evaporation pond, RFI Phase III, April 1995
prepared for: Navajo	PROJECT: 318/3
	LOCATION: ARTESIA, NEW MEXICO
	APPR: / DATE: 4-28-95
	DRAWN BY: DB / SCALE:
	DATE: / FIGURE: 4-8

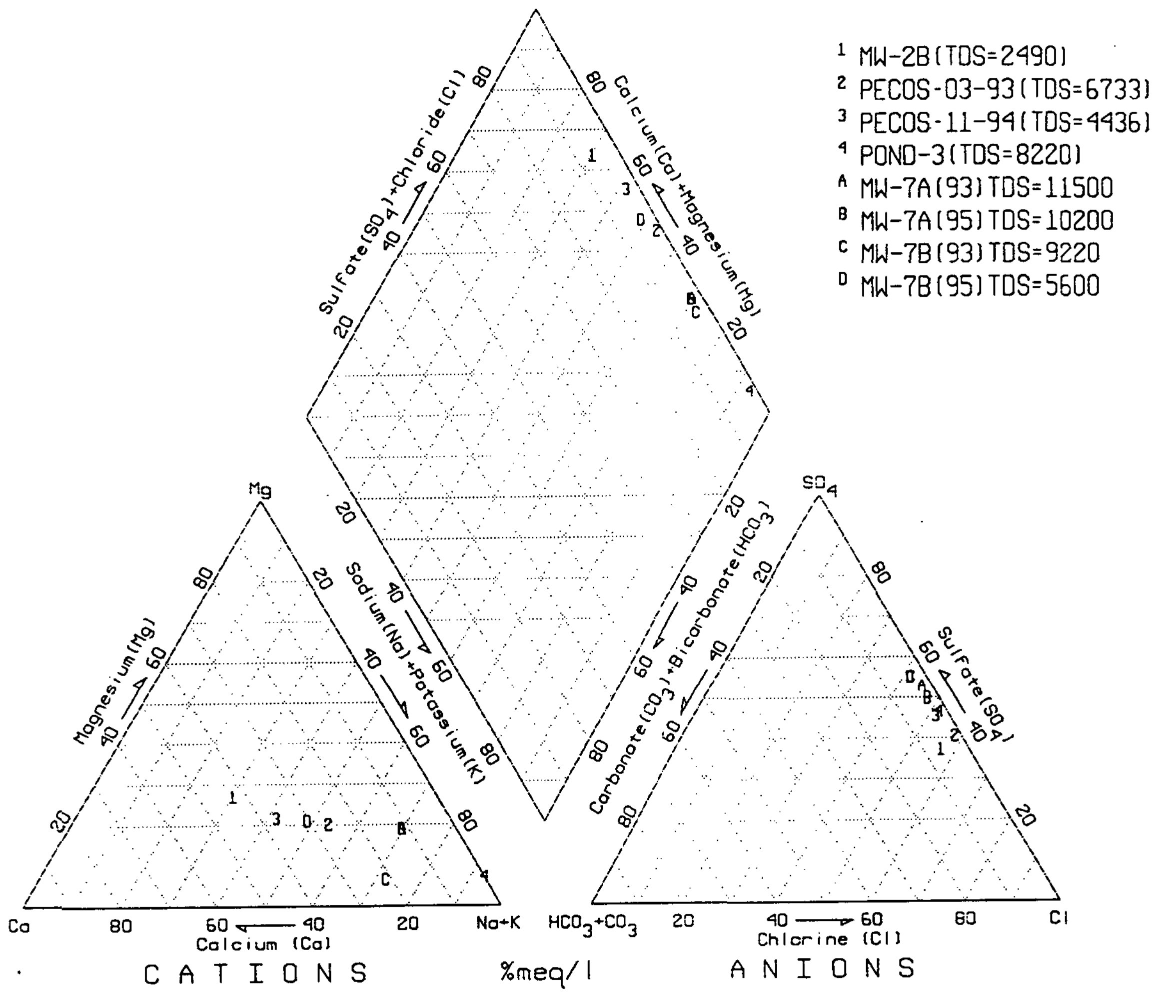


RE/SPEC

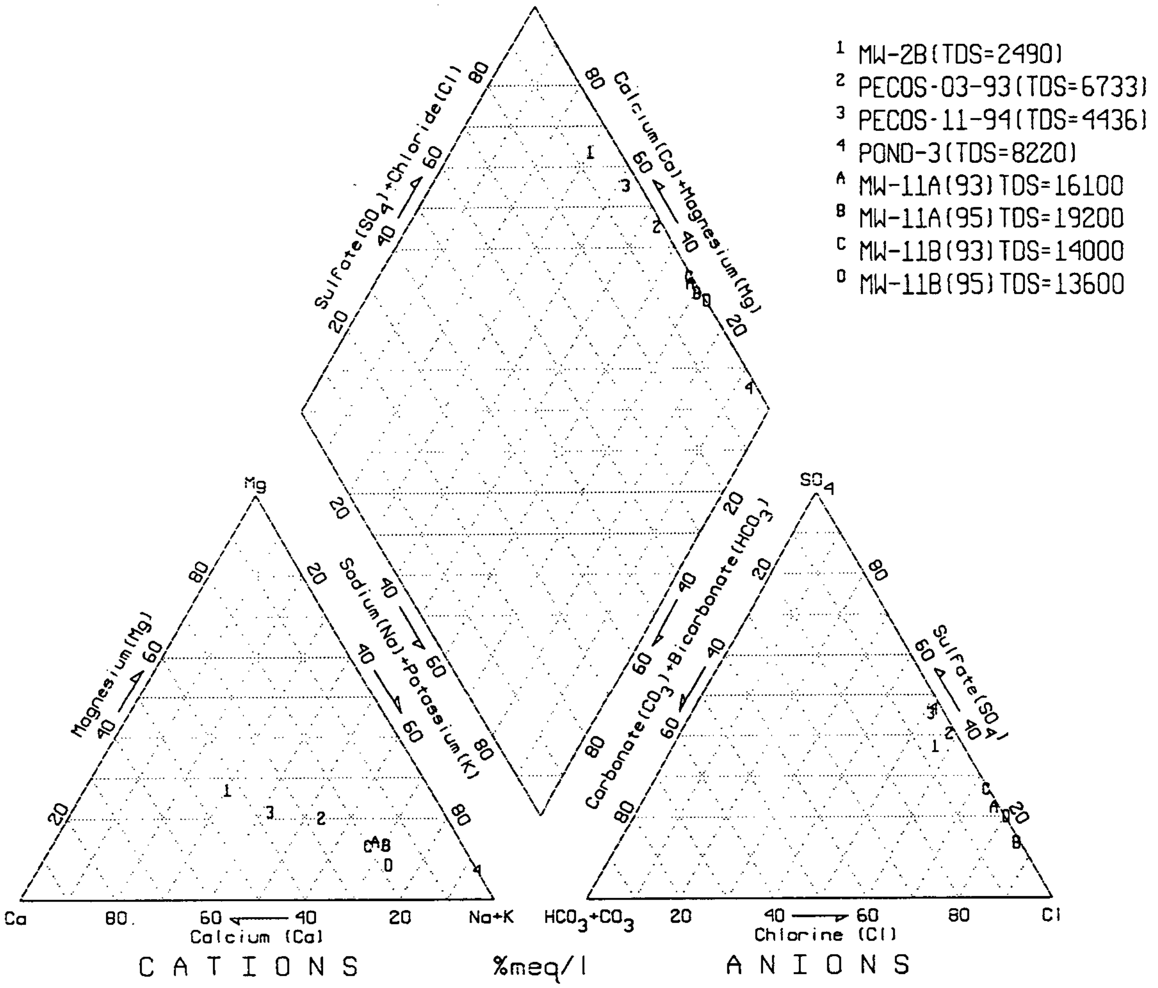
Trilinear mixing diagram, MW-6A, -6B, Pecos River, evaporation pond, RFI Phase III, April 1995

prepared for: Navajo

PROJECT: 318/3	
LOCATION: ARTESIA, NEW MEXICO	
APPR:	DATE: 4-28-95
DRAWN BY: DB	SCALE:
DATE:	FIGURE: 4-9



RE/SPEC	Trilinear mixing diagram, MW-7A, -7B, Pecos River, evaporation pond, RFI Phase III, April 1995	
prepared for: Navajo	PROJECT: 318/3	
	LOCATION: ARTESIA, NEW MEXICO	
	APPR:	DATE: 4-28-95
	DRAWN BY: DB	SCALE:
	DATE:	FIGURE: 4-10

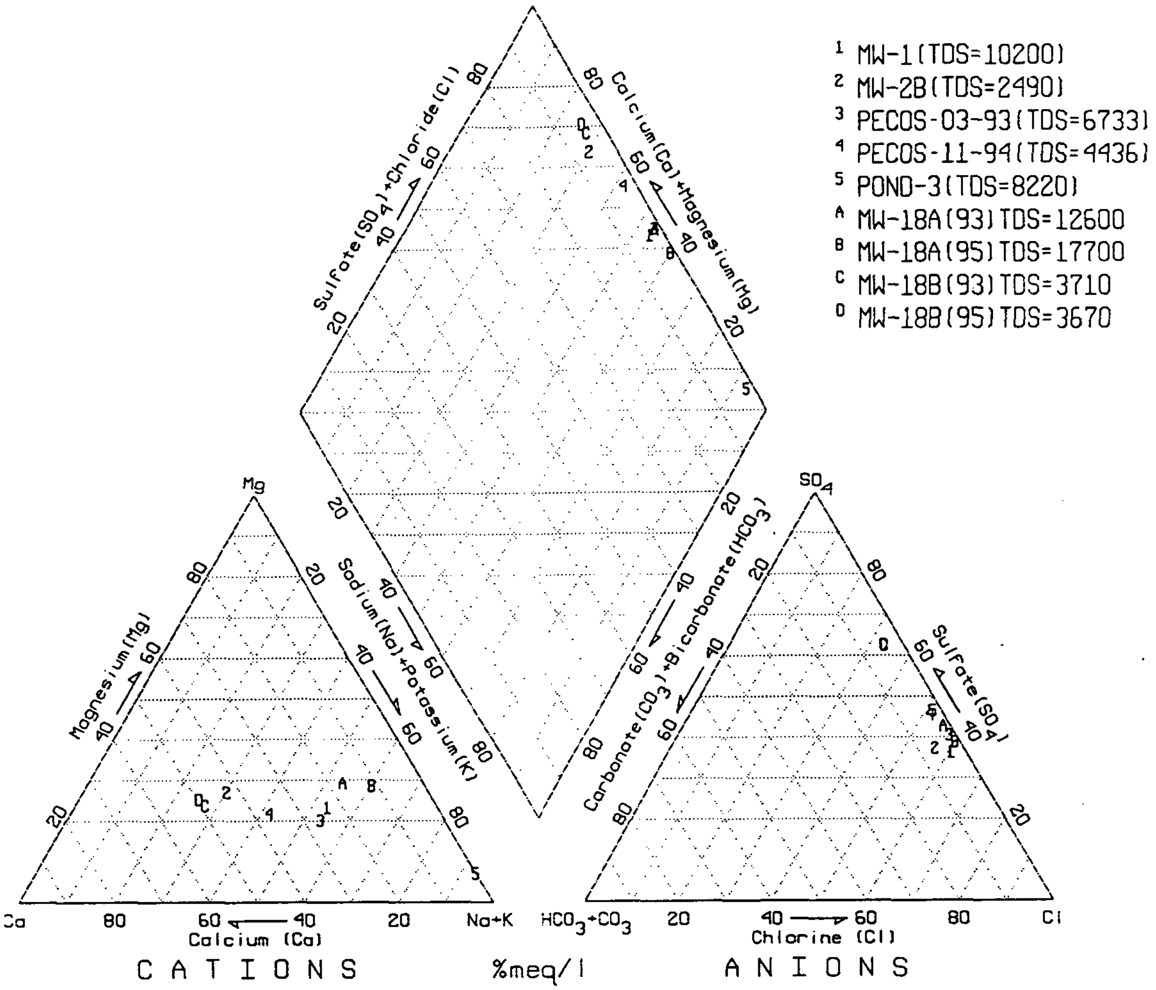


RE/SPEC	Trilinear mixing diagram, MW-11A, -11B, Pecos River, evaporation pond, RFI Phase III, April 1995
prepared for: Navajo	PROJECT: 318/3
	LOCATION: ARTESIA, NEW MEXICO
	APPR: DATE: 4-28-95
	DRAWN BY: DB SCALE:
	DATE: FIGURE: 4-11

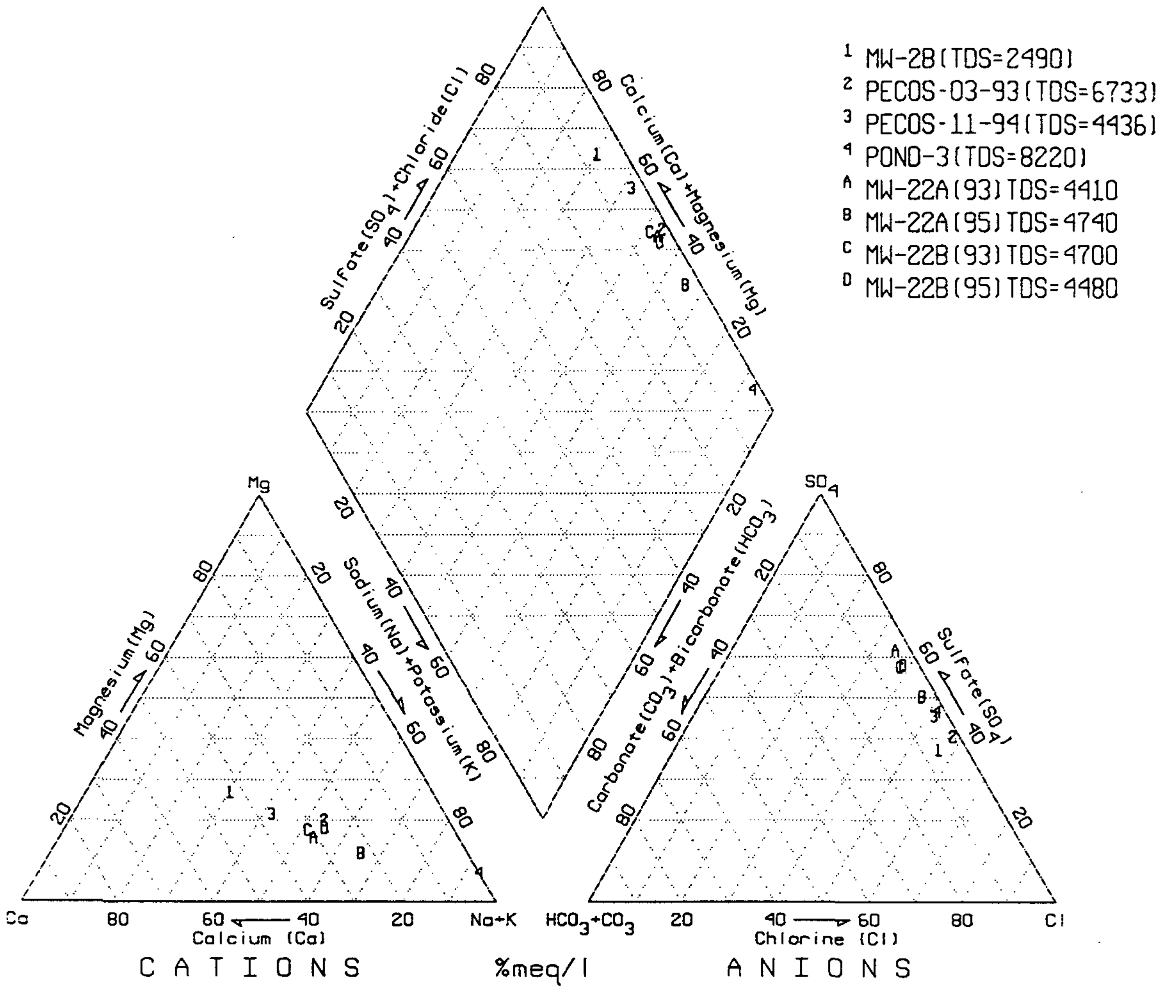
- MW-18 wells are located within about 100 feet of the river. The composition of the water in MW-18A (Figure 4-12) is approximately the same as the river water shown on Figure 4-4 and it is also similar to the water of MW-1, also located near the river. MW-18B water composition is similar to that of MW-2B. However, MW-18A and MW-18B are in the groundwater particle flow path as shown on Figure 4-3. Although downgradient from the pond, the predicted salt impact in MW-18A may not be severe because of the distance from the source and the attenuation of constituents that will occur through groundwater mixing. The particle flow model predicts little or no groundwater impact at MW-18B. Changes since 1993 include an increase in TDS at MW-18A from 12,600 to 17,770 mg/L that are likely unrelated to pond quality changes. Concentrations and proportions of constituents in MW-18B are about identical to 1993.

- MW-22A and MW-22B (Figure 4-13) are directly downgradient from Pond 1 and in the zone of possible impacts as delineated by the Phase II subsurface gas survey and the groundwater flow model (Figure 4-3). Water in MW-22A appears to have poorer quality than in 1993. In addition to an increase in sodium and chloride, arsenic is about six times higher than in 1993. Water in MW-22B remains essentially unchanged with arsenic undetected. Although arsenic is now seen in the well, it is unknown whether the source is high turbidity water, or possibly an early indicator of other contaminants since the well is in the predicted path of the mobile contaminants.

- OCD-2A is salt impacted, but OCD-2B is not (Figure 4-14). Although the vertical gradient at this location is downward, the composition of the deep water appears to be similar to that of MW-2B and MW-18B. The well pair is located beside the river on the northeast side of Pond 2 and in the vicinity of the MW-11 pair. This section of the pond has been in use only since 1987. The percentage sodium concentration in OCD-2A is higher then in 1993 indicating additional evaporation pond impacts which can be interpreted as a decrease in water quality in that well. Although deep groundwater appears to have improved since 1993, it may be that water in the deep monitor well was impacted during drilling, and mixing of the shallow and deep zones occurred. The improvement in quality may come from lateral replacement of water since measurements indicate an upward vertical gradient is not always present at this well pair.



RE/SPEC	Trilinear mixing diagram, MW-18A, -18B, background wells, Pecos River, evaporation pond, RFI Phase III, April 1995	
prepared for:	PROJECT: 318/3	
	LOCATION: ARTESIA, NEW MEXICO	
	APPR:	DATE: 4-28-95
	DRAWN BY: DB	SCALE:
	DATE:	FIGURE: 4-12

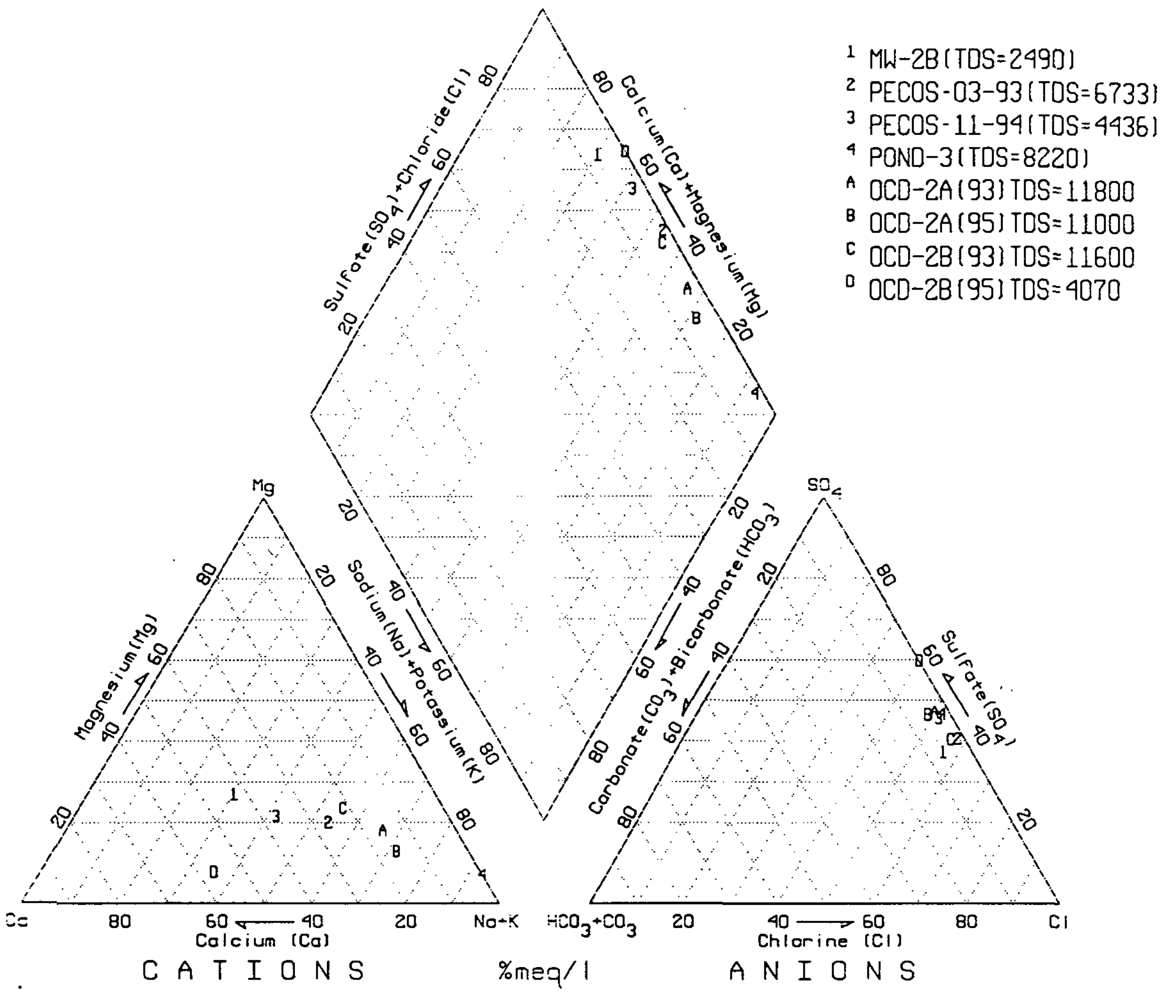


RE/SPEC

Trilinear mixing diagram, MW-22A, -22B, Pecos River, evaporation pond, RFI Phase III, April 1995

prepared for: Navajo

PROJECT: 318/3	
LOCATION: ARTESIA, NEW MEXICO	
APPR:	DATE: 4-28-95
DRAWN BY: DB	SCALE:
DATE:	FIGURE: 4-13

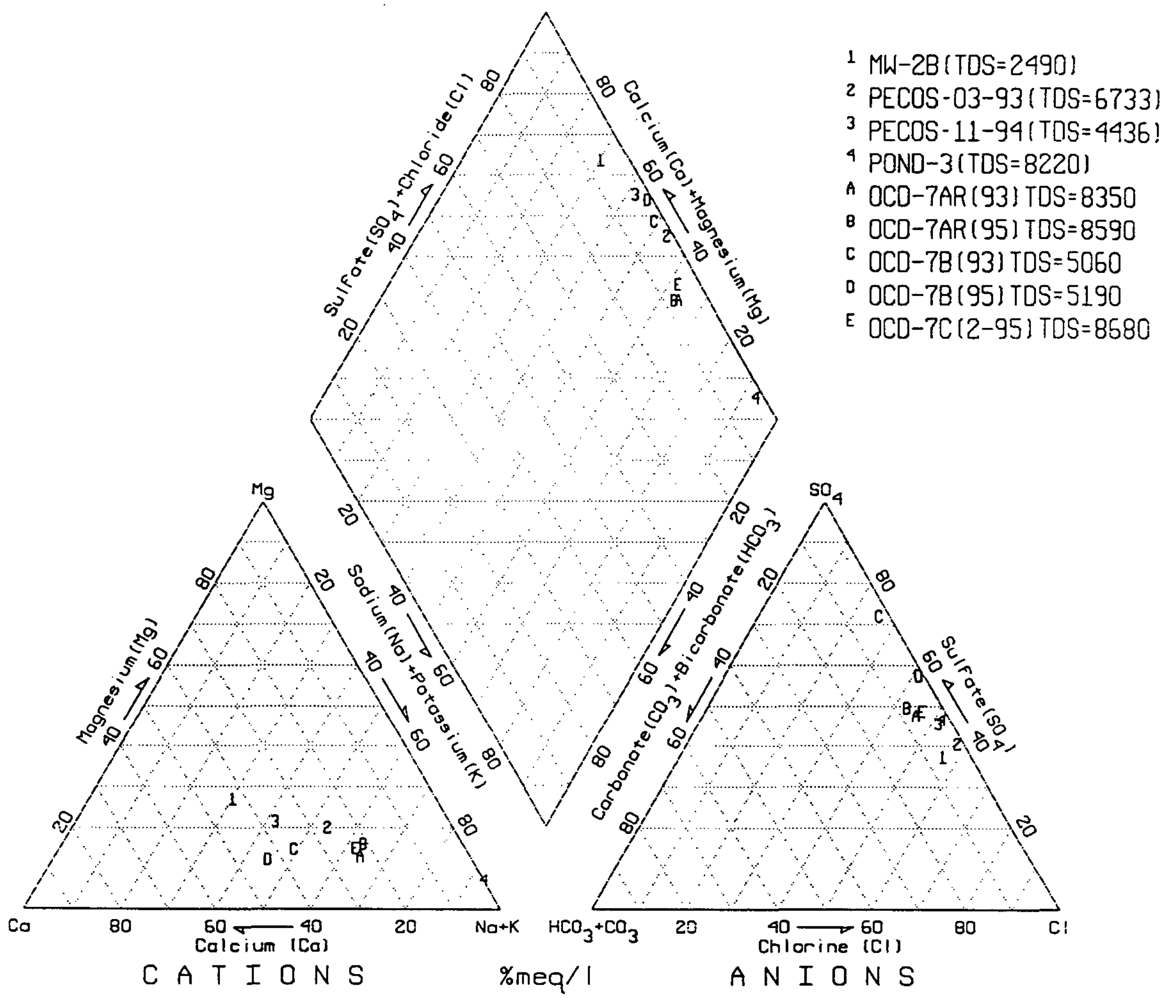


RE/SPEC	Trilinear mixing diagram, OCD-2A, -2B, Pecos River, evaporation pond, RFI Phase III, April 1995	
prepared for:	PROJECT: 318/3	
	LOCATION: ARTESIA, NEW MEXICO	
	APPR:	DATE: 4-28-95
	DRAWN BY: DB	SCALE:
	DATE:	FIGURE: 4-14

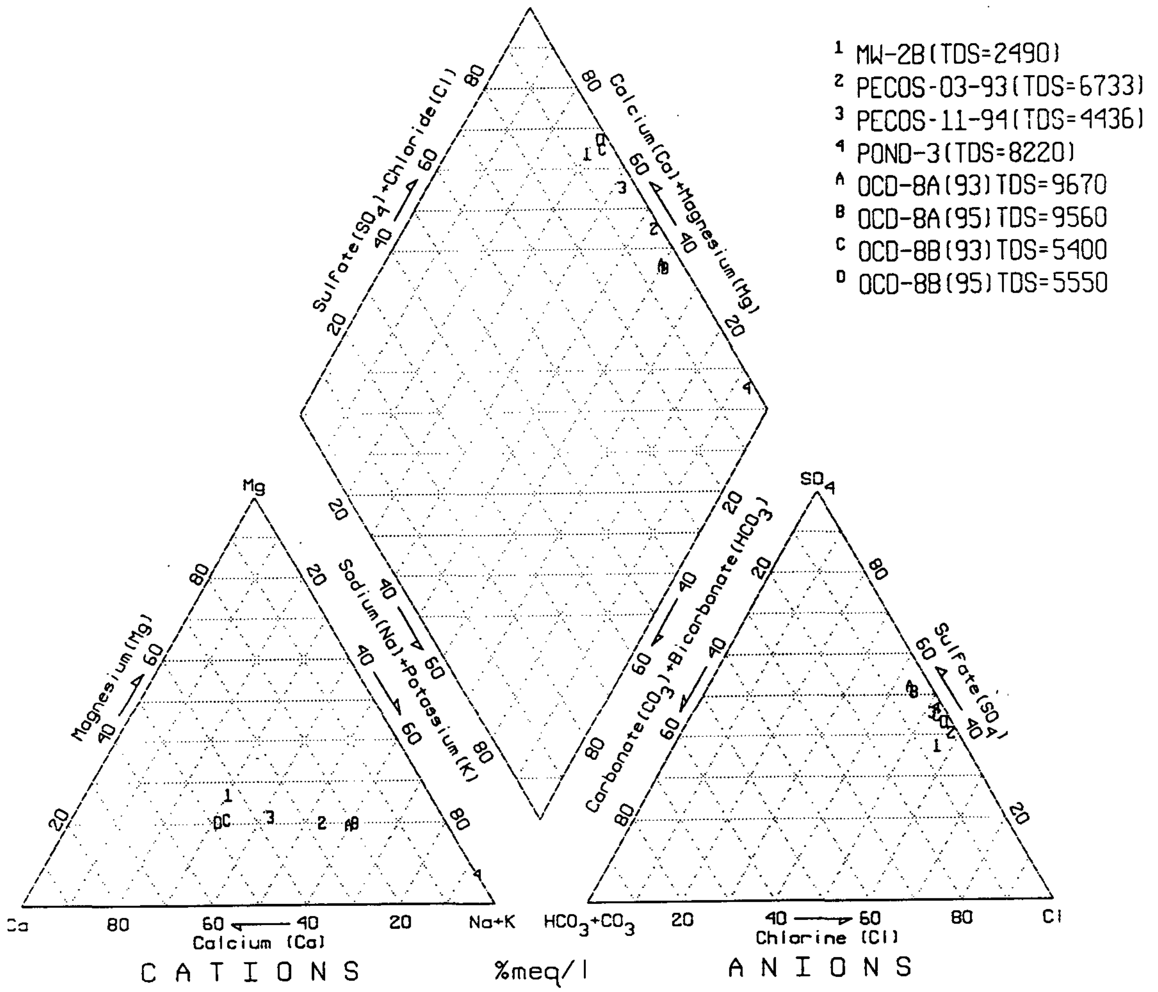
- OCD-7AR and OCD-7B are located within 50 feet of Pond 3 with OCD-7AR showing continued impact by pond salts during the 1993-1995 period (Figure 4-15). Water in OCD-7B has remained approximately the same composition although the chloride composition has increased. Water in new well OCD-7C is almost identical in composition to water in OCD-7AR, even though arsenic levels differ significantly. Because of the chemistry similarities, water from the OCD-7AR zone likely was transported downwards during drilling and associated well development. Based on the lack of arsenic seen in intermediate well OCD-7B, it can be predicted that OCD-7C will stabilize unless artificially created vertical pathways remain available for direct fluid transport.

- OCD-8A appears slightly impacted by the pond, but OCD-8B does not (Figure 4-16). Although downgradient from the pond, no sign of any arsenic or other metal impact is seen in OCD-8B. The deep water has the characteristics seen in MW-2B and MW-18B. No significant changes in water quality were observed between 1993 and 1995.

The preceding information on water characteristics was derived from examination of the trilinear diagrams and used to verify the reasonableness of the groundwater flow model and examine changes in the water quality composition of the groundwater. Because the mathematical flow model is used to duplicate existing flow conditions, interpretation of the geochemical characteristics of the groundwater provides information that supports the predictions made by the model. Together they provide strong evidence that the impacts of past and continued use of the ponds will be limited to the area of the ponds and to the area of poor-quality groundwater that exists near the surface and downgradient of the site.



RE/SPEC	Trilinear mixing diagram, OCD-7A, -7B, -7C Pecos River, evaporation pond, RFI Phase III, April 1995	
prepared for: Navajo	PROJECT: 318/3	
	LOCATION: ARTESIA, NEW MEXICO	
	APPR:	DATE: 4-28-95
	DRAWN BY: DB	SCALE:
	DATE:	FIGURE: 4-15



RE/SPEC

Trilinear mixing diagram, OCD-8A, -8B, Pecos River, evaporation pond, RFI Phase III, April 1995

prepared for: Navajo

PROJECT: 318/3	
LOCATION: ARTESIA, NEW MEXICO	
APPR:	DATE: 4-28-95
DRAWN BY: DB	SCALE:
DATE:	FIGURE: 4-16

5.0 RFI PHASE III INVESTIGATION - PECOS RIVER

The following sections describe RFI Phase III investigation activities conducted on the Pecos River in the vicinity of the evaporation ponds. Investigative activities along the river included sampling and characterization of river bed sediments and surface waters. Phase III activities associated with the sediments investigation are described in Section 5.1, and the surface water investigation is presented in Section 5.2.

5.1 Pecos River Sediment Investigation

The following sections describe activities and results associated with the investigation of river bed sediments in the Pecos River in the vicinity of the evaporation ponds.

5.1.1 Sediment Sampling Procedures

The four sample locations at which river sediments were obtained at the Pecos River are presented in Figure 5-1. The sample locations included: an upstream (background) location approximately 1,000 feet downstream from the confluence of the Pecos River and Eagle Creek (NPR-SD-1); two locations situated at points where the river is in close proximity to the unit (NPR-SD-2 and 3); and a downstream location (NPR-SD-4) located approximately 4,800 feet downstream from the most downgradient point where the east side of the unit is directly adjacent to the river (Figure 5-1). Locations NPR-SD-2 and 3 are located near monitoring well series OCD-2 and OCD-7, respectively. NPR-SD-4 is situated at a point close to where a petroleum/natural gas pipeline crosses the river.

Samples were obtained using an approximately five-foot section of four-inch PVC casing pushed into the river bed. One end of the casing was threaded so that a PVC cap could be secured to seal that end. In order to minimize the amount of river water collected above the sediment sample, the casing was forced through the water column into the upper sediment layer with the cap attached. The cap was then unscrewed and the casing driven into the sediment layer to a depth approximately eight to 12 inches below sediment surface. The PVC cap was then replaced atop the casing and the casing withdrawn from the base of the river bed. To extract the sediment sample, the casing was inclined at an angle slightly above horizontal, the cap removed, and excess water permitted to drain out the casing bottom. Finally, recovered sediment material was transferred directly from the casing into appropriate sample containers.

5.1.2 Sediment Sample Analyses

The Phase III Pecos River sediment samples were analyzed for the following parameters/constituents:

- pH;
- volatile organics (EPA Method 8240 - BTEX, methyl ethyl ketone and carbon disulfide);
- semivolatile organics (EPA Method 8270 - polycyclic aromatics); and
- total arsenic, chromium, lead and nickel.

5.1.3 Analytical Results

Results of the Phase III sediment sample laboratory analyses are presented in Table 5-1 and Appendix D. Sediment pH values (approximately 8.2 standard units) were consistent among all. None of the targeted volatile or semivolatile organic constituents were detected in the river sediment samples. Reported total metal concentrations for chromium, lead, and nickel in sediment samples obtained adjacent and downgradient to the unit were consistent with the sediment concentrations for those constituents reported for the upgradient sample. For three of the four sediment samples, reported arsenic concentrations in sediment were all below the 0.5 mg/Kg detection limit (Appendix D). However, for the most downgradient sediment sample location (NPR-SD-4), arsenic was reported above the detection limit at a concentration of 5.6 mg/Kg.

Table 5-1. Summary of Pecos River RFI Phase III Sediment Sample Analytical Results

	Sample Location				**Background BG-TR-001**	
Parameter	**NPR-SD-1**	**NPR-SD-2**	**NPR-SD-3**	**NPR-SD-4**	5 ft.	8 ft.
pH	8.2	8.3	8.3	8.2	--	--
Volatiles mg/Kg[1]	< 0.006	< 0.006	< 0.006	< 0.006	--	--
Semi-volatiles (mg/Kg)[1]	< 0.4	< 0.4	< 0.4	< 0.4	--	--
Metals (mg/Kg)						
As	< 0.5	< 0.5	< 0.5	5.6	1.3	2.1
Cr	6	7	6	6	10	13
Pb	4	4	2	4	6	7
Ni	6	7	5	5	1	12

Notes: [1] All organic constituents that were evaluated were less than the reported detection limits presented in Table 5-1.

5.1.4 Phase III Sediment Investigation Discussion

For the most part, the results of the Phase III sediment investigation yielded no indication that sediments in the Pecos River have been impacted by the Navajo pond system. The significance, if any, of the reported arsenic detection event at NPR-SD-4 and its absence elsewhere is unknown. Since the sample location was downgradient of the unit, an anthropogenic source for the reported arsenic detection event is possible, although it is noted that elevated arsenic levels were not observed either in sample NPR-SD-2 or 3, which were collected at close proximity to the ponds.

However, alternative explanations to account for the data point must also be considered. Sediment sample NPR-SD-4 was obtained close to the location where several buried petroleum pipelines cross the river and there may be residual disturbance impacts. Further, at the time of sampling, this location also exhibited significant impact resulting from the movement of livestock passing to, from, and within the river. The river bank was severely eroded, the river bed significantly wider, and water depth significantly less than that encountered at the other Phase III sediment sample locations. Thus, it is possible that sample NPR-SD-4 was not representative of typical sediment conditions along that reach of the river. Alternately, since only a single sample was obtained in this general area, the possibility that the reported concentration may be within the natural range of river sediments must also be considered. The reported arsenic data could also result from laboratory error. Finally, it is possible that the arsenic data for this sample may represent the combined influence of several, or all, of the above-listed alternative effects.

5.2 Pecos River Surface Investigation

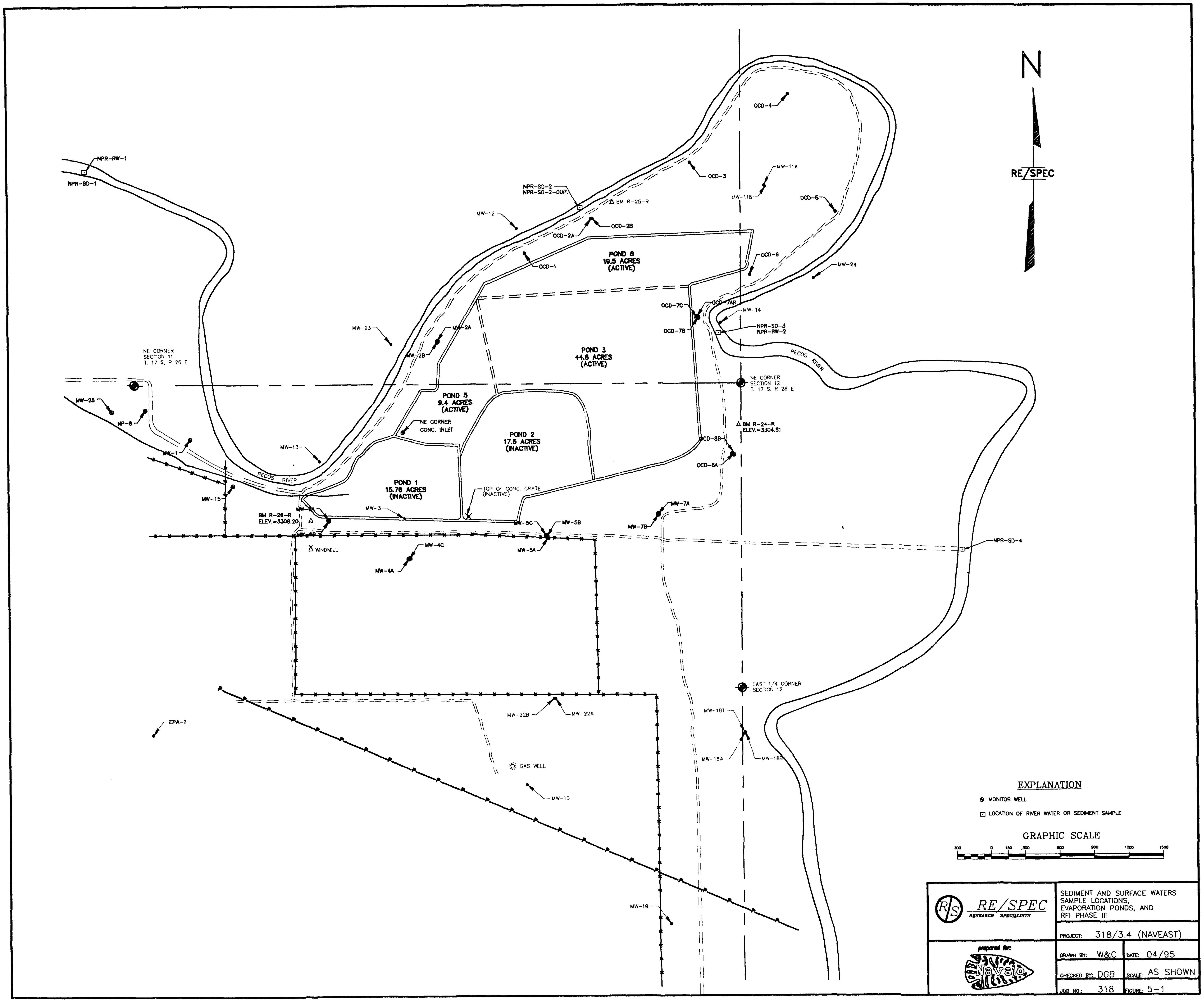
The following sections describe activities and results associated with the characterization of surface waters of the Pecos River in the vicinity of the evaporation ponds.

5.2.1 Surface Water Sampling Procedures

Surface water samples were obtained at two locations on the river (Figure 5-1). The sample locations included: an upstream (background) location approximately 1,000 feet downstream from the confluence of the Pecos River and Eagle Creek and a second location situated due east of the unit where the river is in closest proximity to it.

Surface water samples were obtained as grab samples obtained directly from the river at midstream.

Figure 5-1. Sediment and Surface Water Sample Locations, Evaporation Ponds, RFI Phase III, 1995


N
RE/SPEC
NPR-RW-1
NPR-SD-1
NPR-SD-2
NPR-SD-2-DUP.
BM R-25-R
OCD-4
OCD-3
MW-11A
MW-11B
OCD-5
MW-12
OCD-2B
OCD-2A
OCD-1
POND 6
19.5 ACRES
(ACTIVE)
OCD-6
MW-24
OCD-7C
OCD-7AR
MW-14
OCD-7B
NPR-SD-3
NPR-RW-2
PECOS RIVER
MW-23
MW-2A
MW-2B
POND 3
44.8 ACRES
(ACTIVE)
NE CORNER
SECTION 11
T. 17 S, R 26 E
NE CORNER
SECTION 12
T. 17 S, R 26 E
MW-25
NP-5
POND 5
9.4 ACRES
(ACTIVE)
NE CORNER
CONC. INLET
POND 2
17.5 ACRES
(INACTIVE)
BM R-24-R
ELEV.=3304.51
OCD-8B
OCD-8A
MW-1
MW-13
PECOS RIVER
POND 1
15.78 ACRES
(INACTIVE)
TOP OF CONC. CRATE
(INACTIVE)
MW-15
BM R-26-R
ELEV.=3308.20
MW-3
MW-5C
MW-5B
MW-7A
MW-7B
NPR-SD-4
WINDMILL
MW-4C
MW-4A
MW-5A
EAST 1/4 CORNER
SECTION 12
MW-22B
MW-22A
EPA-1
MW-18T
MW-18A
MW-18B
GAS WELL
MW-10
MW-19
EXPLANATION
MONITOR WELL
LOCATION OF RIVER WATER OR SEDIMENT SAMPLE
GRAPHIC SCALE
300
0
150
300
600
900
1200
1500
RE/SPEC
RESEARCH SPECIALISTS
SEDIMENT AND SURFACE WATERS
SAMPLE LOCATIONS,
EVAPORATION PONDS, AND
RFI PHASE III
PROJECT: 318/3.4 (NAVEAST)
prepared for:
Navajo
DRAWN BY: W&C
DATE: 04/95
CHECKED BY: DGB
SCALE: AS SHOWN
JOB NO.: 318
FIGURE: 5-1

5.2.2 Surface Water Sample Analyses

The Phase III Pecos River surface water samples were analyzed for the following parameters/constituents:

- volatile organics (EPA Method 8240 - BTEX, methyl ethyl ketone and carbon disulfide);
- semivolatile organics (EPA Method 8270 - polycyclic aromatics);
- total arsenic, chromium, lead, and nickel; and
- general water chemistry parameters (pH, TDS, dissolved cations and anions, etc.).

5.2.3 Analytical Results and Discussion

The results of the Phase III Pecos River surface water sample laboratory analyses are presented in Appendix D and Table 5-2. General water chemistry results are included with Table 4-8. In brief, none of the target inorganic constituents or volatile and semivolatile organic constituents were observed at the reported detection limits for either sample. General water chemistry parameters were also highly similar for the two Phase III surface water samples. Consequently, no evidence was obtained from the Phase III investigation to indicate that surface waters of the river are being impacted by the evaporation ponds.

Table 5-2. Summary of Pecos River RFI Phase III Surface Water Sample Analytical Results.

	Sample Location	
Parameter	NPR-RW-1	NPR-RW-2
pH	8.2	7.8
Total Dissolved Solids (mg/L)[1]	4,580	4,610
Volatiles mg/Kg [2]	< 0.005	< 0.005
Semivolatiles (mg/Kg) [2]	< 0.010	< 0.010
Metals (mg/Kg)		
As	< 0.005	< 0.005
Cr	< 0.02	< 0.02
Pb	< 0.01	< 0.01
Ni	< 0.01	< 0.01

Notes: [1] Other inorganic constituents are shown in Table 4-8.
[2] All organic constituents that were evaluated were less than the reported detection limits presented in Table 5-2.

6.0 CONCLUSIONS

6.1 Three-Mile Ditch

6.1.1 Surface Sediments

A component of the RFI Phase III investigation was sampling of residual ditch sediments remaining uncovered at the surface in some areas. This accumulated material from the ditch bed was formerly dredged from the base of the unit and placed atop the ditch bank. This material remains in place along two separate intervals of ditch in the vicinity of Bolton Road and east of the Artesia wastewater treatment plant. The results of this portion of the investigation indicated potential environmental concerns associated with significantly elevated levels of lead present in the dredged materials. Specifically, the sediment sampling and investigation produced the following information:

- Over the lifetime of active use, sediments were removed from the base of the ditch mainly along intervals of the ditch located in topographically flat areas where particulate matter settled out due to low flow velocities. Two of these intervals are east of Bolton Road for a distance of approximately one-half mile, and an interval of about 1,000 feet in length starting about 1,800 feet east of Haldeman Road.

- Although the ditch has been filled in along most of its length, the continual removal of material in the flatter areas during use resulted in the accumulation of shallow piles of sediment that continue to persist. Four samples were taken from the west interval and two samples were obtained from the east interval.

- Metals analyses performed for arsenic, chromium, lead, nickel, and zinc show elevated levels of all five constituents in all six samples. Significant concentrations of arsenic and lead in one or more samples exceed risk-based concentration limits derived for similar materials in Pond 1. Lead, especially, is elevated, with highest sample concentrations coming from the Bolton Road area.

- Because of potential exposure to environmental receptors, Navajo and EPA need to discuss options to evaluate such exposure and to establish mitigation alternatives.

6.1.2 Unit Soils and Groundwater

The information generated during the Phase III study, plus a review of data produced during the Phase II investigation, continue to support the conclusion of the Phase II study that unit soils associated with TMD do not pose a present or future significant threat to human health or the environment. This suggests that remaining residual organic constituents contained within the unit soils present only minimal likelihood for significant contamination of shallow groundwater (i.e., above conservatively-calculated health-based levels). Likewise, analyses for metals support earlier conclusions that evidence does not exist to indicate any residual metal constituents present within the unit soils are migrating or have the potential to migrate from the unit. Examination of water chemistry results in new and existing wells continue to show a lack of evidence of near-surface groundwater impacts from discharge of wastewater effluent to the unlined ditch that ceased in 1987. This and lithologic results from the well borings reflect apparent isolation of wastewater surface flow in the ditch from near-surface groundwater along large segments of the ditch.

These conclusions are based on the following information obtained during the Phase III study:

- Organic volatile and semivolatile constituents were not found to occur at low detection levels in groundwater in new or existing monitor wells installed along the ditch.

- Exceedances of chromium and nickel in groundwater samples from several older stainless steel wells continue to be detected. As observed during the Phase II study, these contaminants continue to be absent from several new and existing monitor wells installed adjacent to and in the vicinity of the stainless steel wells. As noted in the Phase II report, the probable source of contamination is the corrosion of the stainless-steel casing likely caused by naturally occurring salts in the groundwater.

- One newly installed monitor well (MW-28) exhibited elevated levels of arsenic, chromium, lead, and nickel when first sampled. These metals were not present in the filtered sample nor in a verification sample obtained several weeks later. Their presence at elevated levels is attributed to turbidity present in the first sample.

- A slightly elevated level of lead continues to be detected in MW-45, located adjacent to refinery operations areas known to have had underground releases from product storage tanks and lines. The average level of 0.08 mg/L detected during this investigation is slightly above the state and former federal drinking water standard for lead of 0.05 mg/L.

- Using water level elevation information, groundwater flow direction was mapped and shows groundwater movement from Eagle Creek into the NSSZ along the reach of the creek from the refinery to just east of Bolton Road. East of MW-29, the direction of movement is generally parallel to the ditch eastward to the vicinity of the river.

- When surface water is present in Eagle Creek, groundwater recharges to the NSSZ, at least in the area from the refinery to the vicinity of Bolton Road. Eagle Creek is from six to 10 feet lower than the base of TMD and the creek intersects with permeable gravels that compose the shallow groundwater zone. A direct connection with this zone is evidenced by the direction of mapped groundwater contours and, as observed during the Phase II investigation, pooled water supporting aquatic life forms.

- The natural quality of the groundwater along the route of the former ditch continues to be high in TDS with elevated levels of calcium, chloride, and sulfate. Although TDS quality in individual wells ranges from 2,650 to 11,600 mg/L, the average TDS of the 15 monitor wells installed along TMD is in excess of 6,000 mg/L. Because of its poor quality and discontinuous nature, the shallow water in the immediate vicinity of the ditch is not used. Any future use would most likely be limited to livestock in the alluvial plain west of the river. However, as determined by analysis of samples from the monitor wells, this water is also of poor quality.

- In the area of the ditch, water wells completed for domestic or irrigation use are completed in one of two zones at depths from 100 to 300 feet or from about 700 to 1,100 feet. The nearest known usable wells in the proximity of TMD are located about one-quarter mile north of the ditch and are completed in one of these two water-bearing zones.

- The Phase II comparison of the water chemistry of shallow groundwater in the area was revised and updated using the new wells installed for this study. Inorganic constituents of the current and past effluent, and of shallow groundwater along the ditch, were examined using a graphical technique to determine if water from the sources was alike, different, or a mixture of one or more of the sources. The results of the current review support the earlier conclusion that there is no evidence to indicate that the shallow water was from an effluent source. The comparisons offer support to the results of the organic and metal analyses presented previously that show that any current groundwater impacts of past ditch use are at most minimal.

Based on a review of the results of the groundwater portion of this study and the earlier Phase II soil results, no reliable evidence exists to indicate that any residual metal constituents present within the unit are migrating or have the potential to migrate from the unit. As highlighted in the Phase II report and confirmed by the random sampling of dredged sediments, the primary environmental issue associated with long-term management of the unit is the sporadic occurrence of the metal constituents arsenic, chromium, and lead at levels that may be deemed excessive from the perspective of direct, sustained exposure.

Because the privately owned lands in the vicinity of the unit are currently limited to agricultural use, the potential for direct and extensive human exposure to soil-borne contamination from buried material is low. Alternately, excavation and transport of soils from the unit can be expected to significantly increase the potential short-term human exposure to personnel involved in excavation and transport of excavated soils. In addition, the quality of the shallow groundwater underlying the unit is extremely poor, making it essentially unusable. Furthermore, there do not appear to be any existing or potential receptors for the prevailing shallow groundwater aquifer present below the unit.

However, the small number of high concentration samples collected from exposed surface material indicate potential environmental concerns may exist with the dredged sediments. In contrast to the buried soils, these materials were in intimate contact with refinery waste products and those characteristics were imparted to these materials. Based on the nature of these materials and the naturally arid environment at the site, it is likely that these metals remain bound in the sediment matrix and have not migrated downward any significant distance, if at all, after being deposited on the surface. Because of elevated constituent concentration levels found in this material, a determination will need to be made as to the potential exposure to environmental receptors via surface pathways and options for action.

6.2 Evaporation Ponds

The results of the Phase III investigation at the evaporation ponds substantiated and reinforced the conclusions that resulted from the Phase II study completed in 1993. Since the earlier study, a second evaporation pond has been inactivated and sampling of monitor wells reflect improvement in alluvial water quality and overall reduction in hazardous constituents. Additionally, measurements of levels in the monitor wells continue to show upward movement of generally better quality water which provides natural remediation of the shallow groundwater impacted by organics released to the subsurface. An exception to the overall improvement in water quality is the increased level of arsenic in some wells. However, many samples remained turbid notwithstanding efforts to reduce suspended material and the resulting analyses produced elevated levels.

As noted in the Phase II report, the type and number of constituents exceeding health-based standards was minimal relative to the waste types, concentrations, and length of time the pond system has operated. The location of the ponds in an area with naturally high concentrations of salts at the surface has fortuitously limited the impact of many years of pond use.

The major conclusions that support minimal health-related groundwater impacts are summarized in the following listing. Where appropriate, relevant observations made in the Phase II investigation are presented in this enumeration, including any changes from the results presented in that report.

- Groundwater was tested for the six volatile organic target compounds detected in the earlier study. Benzene, ethylbenzene, toluene, and xylenes were confirmed in four wells (down from six) in the immediate vicinity of the ponds. Methyl ethyl ketone and carbon disulfide were not detected in the current sampling.

- Benzene was confirmed in only one well (MW-4A) with an average concentration of approximately 0.014 mg/L, which is less than three times the detection limit and drinking water standard of 0.005 mg/L. In 1993, benzene was found in five wells where the maximum concentration was 0.021 mg/L.

- The maximum concentration for any volatile organic compound was 0.032 mg/L of total xylene, also found in MW-4A. Except for benzene in MW-4A, no exceedances of federal EPA health-based standards for volatile organic constituents were found.

- Based on the Phase II results, analysis of semivolatile organic compounds was limited to polycyclic aromatic hydrocarbons (PAH). These targeted semivolatile compounds were not found in the groundwater at detection levels as low as 0.01 mg/L.

- Except for arsenic, the metals total chromium, lead and nickel exceeded respective EPA health-based standards only in the older wells having stainless steel casing, in wells with high sample turbidity, or in a combination of these. Filtering and/or resampling these wells after purging at very low flow rates eliminated exceedances, and in most cases, detections for these three metals.

- Arsenic concentrations were confirmed to exceed the EPA health-based standard at 11 monitor wells, but only four of the wells exceeded the New Mexico groundwater standard. The maximum exceedance was slightly greater than four times the EPA standard of 0.05 mg/L. The maximum concentration of arsenic in evaporation Pond 3 was approximately 0.5 mg/L.

- Problems during sampling included high turbidity samples obtained from new wells and the movement into suspension of clay particles containing arsenic during purging and bailing. Several new and existing wells were resampled using a low-flow peristaltic pump after high levels were reported in the initial analysis. The follow-up analyses resulted in markedly lower total arsenic values in wells MW-4A, MW-5C, OCD- 7AR, and OCD-8. Resampling of high arsenic concentration wells should be performed using a low-flow pump before making final decisions on groundwater quality issues involving evaporation pond system closure.

- Arsenic problems due to turbidity make comparison of concentration changes from 1993 to 1995 difficult. However, measurable concentration increases are suspected in MW-2A, MW-5A, MW-5B, MW-6A, MW-7A, MW-10, MW-14, MW-15, MW-22A, and 0CD-5. Lowered values are observed in MW-3, MW-4A, MW-6B, MW-7B, OCD-2A, and 0CD-7AR; three of these latter wells are in close proximity to inactive Pond 1.

- Three monitor wells installed to depths of approximately 70 feet during the Phase III investigation did not detect verifiable concentrations of target organic constituents. Arsenic was initially detected at concentrations significantly above the EPA health-based standard in these wells. However, resampling several weeks after installation using a low-flow pump to purge the wells eliminated exceedances in two wells and resulted in a concentration in MW-4C that only slightly exceeded the standard.

- During the drilling of MW-4C, dark gray and odoriferous sediments were detected beginning at about 13 feet. Continuous sampling of these sediments was performed to a total depth of 60 feet. No volatile or semivolatile organic constituents were detected, although these compounds were analyzed at lowest method detection levels. Likewise, metals analyses were close to the range of background values.

- Monitor well sampling did not verify the presence of target organic volatile and semivolatile compounds, except in the area immediately to the south and east of Pond 1. Therefore, any impact outside that area appears to be limited to the presence of odor, foaming, and discoloration, which is probably the result of slightly soluble organic compounds together with sulfur and nitrogen constituents.

- Existing and new monitor wells continue to document the very poor quality of shallow groundwater at locations close to the river and away from the direct influence of the pond. Some of the dissolved salt concentrations in the groundwater at river locations un-impacted by the ponds were in excess of 10,000 mg/L. Analyses by the USGS show river water during certain months of the year approaches these concentrations.

- Eleven sets of shallow and deep pairs of groundwater monitoring wells have been installed in the vicinity of the evaporation ponds. Three additional deeper wells were installed during the Phase III investigation. Deeper monitor wells located away from the direct influence of the active ponds continue to exhibit elevated water levels relative to levels in the adjacent shallow wells.

- The magnitude of the water levels differences among the paired wells has been generally consistent for four sets of measurements beginning in February 1993. Wells located at MW-4, MW-5, MW-6 , MW-7, MW-11, MW-18, MW-22, and OCD-8 continue to show the existence of upward vertical gradients that limit the ability of pond seepage water to migrate downward. This finding collaborates area-wide hydrologic studies published by the USGS and the New Mexico State Engineer Office.

- Although extensive groundwater contour maps in the vicinity of the pond were not prepared during the Phase III investigation, review of the paired monitor well data does not show any obvious changes from 1993 levels. Groundwater mapping during that study showed horizontal movement of groundwater to a discharge area south and east of the ponds in the vicinity of U.S. Highway 82. The area is identified on local topographic maps and was verified as being a marshy area heavily populated with salt cedar, which is considered nuisance vegetation.

- Naturally occurring salts in water discharged from depth to the surface are concentrated as a result of direct surface evaporation and high transpiration by salt-tolerant plants growing in this and other marshy areas adjacent to the Pecos River. Water not evaporated or consumed by vegetation is discharged into the Pecos River during times of low flow.

- Sampling of the Pecos River at two locations during the Phase III investigation did not detect elevated levels of constituents that could be attributed to Navajo Refinery practices. The historically poor-quality water in the river has been documented by state and federal agencies.

- Sediment sampling from the Pecos River at four locations during the Phase III study did not detect any volatile or semivolatile organics. Metals sampled generally were close to background levels. A slightly elevated level of arsenic (5.6 mg/Kg) was found at one site located approximately 4,800 feet downstream from the pond closest to the river. The significance of this value, if any, is unknown.

- The area in the vicinity of the ponds serves as a regional groundwater discharge location that minimizes the possibility that seepage from the pond will migrate to better quality aquifers used for drinking water or irrigation sources.

- Using field-derived information on the local geology, hydraulic conductivity, and horizontal and vertical gradients, a groundwater flow model was developed during the Phase II study to replicate the horizontal and vertical groundwater movement in the study area. Based on review of the potentiometric gradient information generated during the Phase III investigation, upward flow gradients continue to be observed at the magnitudes previously measured. Therefore, the modeling assumptions and calculations performed for the Phase II study remain valid.

- The groundwater model demonstrates limited downward migration of pond constituents before upward gradients cause flow to turn upward. The southeastward horizontal gradient directs groundwater movement to the naturally salty discharge area.

- The upward gradient could be impacted by heavy pumping of deeper, better quality groundwater in the vicinity of the ponds, but water rights allowing such pumping are not available from the State Engineer due to prior appropriation and water flow contractual obligations with Texas.

- The Phase II and Phase III investigations compared the chemistry of the inorganic constituents of the current effluent, of groundwater in the pond monitor wells, and of groundwater in the valley fill alluvium. The review determined that the groundwater in the shallow monitor wells immediately adjacent to the pond and in some deeper monitor wells on the south side of the pond had characteristics indicating partial mixing of the groundwater with pond water.

- Although the Phase II study detected unidentified volatile and semivolatile hydrocarbons in some wells, there is no indication that the groundwater sampled from the deeper monitor wells adjacent to the upgradient, north side of the pond has been salt impacted by the pond. Additionally, unlike deep wells on the south side of the pond, there is an absence of target compounds in the north side deep wells.

- Phase III water chemistry sampling results show improvement in water quality (defined as replacement of sodium chloride water with water having calcium-magnesium sulfate properties) in wells MW-4A, MW-5B, MW-6A, MW-7B, and OCD-2B. Decreases in water quality occurred in MW-11A, MW-11B, MW-18A, MW-22A, and OCD-2A. The MW-11 and OCD-2 pairs are located adjacent to the pond put into service in the late

1980s. The change in MW-18A is related to change in river quality, while the change in MW-22A was not unexpected given the poor quality of the upgradient water.

- The water quality results are consistent with the information presented by the groundwater model. The model indicates limited downward migration of pond constituents in the area beneath the pond and eventual upward movement to the naturally poor-quality groundwater discharge area at the surface.

- The shallow groundwater in the vicinity of the ponds, as well as the water of the Pecos River, is naturally high in TDS. The salty content of the river water makes it unusable for domestic uses, and the salty nature of the shallow groundwater renders it unusable for domestic, agricultural, or industrial purposes.

Phase III study results support the earlier investigation findings, which demonstrated that seepage of wastewater historically discharged to the ponds remains in the shallow subsurface and migrates and mixes with naturally poor quality groundwater. This poor quality groundwater is unusable for drinking, agricultural or industrial use. As a result, no potential environmental receptors for hydrocarbon-impacted groundwater exist downgradient of the ponds.

Modifications to the wastewater treatment system at the refinery have reduced effluent quantity and essentially eliminated discharge of volatile organic constituents to the pond. Additionally, Navajo has committed to cease discharges to the ponds within two years. Natural remediation of water quality is currently being performed as demonstrated by the decrease in organic constituent detections and improvement in water quality in wells adjacent to inactive Pond 1.

Therefore, recommended follow-up actions during continued use of the evaporation ponds include routine monitoring of water quality of the pond and of groundwater in the downgradient monitor wells for constituents known or likely to be in the discharge. Water levels should be measured in the monitor wells to verify vertical and horizontal gradients and groundwater movement. Such sampling will also provide information on the progress of natural remediation as the ponds are closed and water evaporated. To minimize sample turbidity, wells should be purged using a low-flow pump; the use of a bailer or high-capacity pump for purging is not recommended. Use of this equipment will increase on-site sample times, but it is the preferred method to produce accurate arsenic measurement in groundwater.

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APPENDIX A

Selected Laboratory Analytical Data Summaries, RFI Phase I and Phase II Investigations

APPENDIX A

Selected Laboratory Analytical Data Summaries, RFI Phase I and Phase II Investigations

Appendix A-1

Phase I Data Summaries

Table 5.6 Three-Mile Ditch - Trench and Boring Soils Analytical Results, Volatiles, RFI Phase I Report, Navajo Refining Company, October 1990.

		------- Sample Number ----------							
		NMO-TR-000-01	NMO-TR-000-02	NMO-TR-000-03	NMO-TR-001-02	NMO-TR-001-03	NMO-TR-001-04	NMO-TR-001-05	NMO-TR-004-02
Sampling Depth (feet)		2	4	7	.3 -.7	3.5 - 4	8.5 - 9	1.7 - 2	3 - 4
COMPOUND	UNITS								
Chloromethane	mg/kg					0.69	0.31		0.4
Benzene	mg/kg	2	10	5.8					
1,1,2,2-Tetrachloroethane	mg/kg				1.2			0.51	0.78
Toluene	mg/kg	5.7	56	17					0.72
Ethylbenzene	mg/kg	24	34	0.5					0.36
Xylenes	mg/kg	120	60	30					1.5

1/ Blanks and all other analyses were below reported limits.

Table 5.6 (Continued).

		Sample Number									
		NMO-TR-005-02	NMO-TR-005-03	NMO-TR-005-05	NMO-TR-010-01	NMO-TR-010-01SP	NMO-TR-010-01SP	NMO-TR-010-02	NMO-TR-010-03	NMO-TR-010-05	NMO-TR-011-02
Sampling Depth (feet)		4	6	6	2	2	2	4	6	2	2
							Lab. Dup.*				
COMPOUND	UNITS										
Benzene	mg/kg	3.2									
Toluene	mg/kg	4.2	0.78	1.3				8.5	0.33		1.2
Ethylbenzene	mg/kg	4.1	1.4	1.7	0.4	1.5	2.9	15	0.77	0.5	5
Xylenes	mg/kg	15	2.5	3	0.4	1.8	3.5	30	2	0.3	9.7

1/ Blanks and all other analyses were below reported limits.

* Sample analysis was duplicated in the laboratory.

SP = Spiked sample

Table 5.6 (Continued).

		Sample Number						
		NMO-TR-012-01	NMO-TR-012-02	NMO-TR-012-03	NMO-TR-013-01	NMO-TR-013-02	NMO-TR-013-03	NMO-TR-013-05
Sampling Depth (feet)		7	9.5	8	2	6.5	8.5 - 9	
COMPOUND	UNITS							
Benzene	mg/kg	4.5		0.6		1.8	1.4	1.8
1,1,2,2-Tetrachloroethane	mg/kg			0.8				
Toluene	mg/kg	14.4	3.3	7.9	0.67	7	1.2	6.6
Ethylbenzene	mg/kg	13.6	4.2	10		8.5	1.3	8.6
Xylenes	mg/kg	21	7.4	16		19	2.8	19

1/ Blanks and all other analyses were below reported limits.

Table 5.7 Three-Mile Ditch -Trench and Soil Borings, Analytical Results, Semivolatiles, RFI Phase I Report, Navajo Refining Company, October 1990.

		Sample Number								
		NMD-TR-000-01	NMD-TR-000-02	NMD-TR-000-03	NMD-TR-001-01	NMD-TR-001-02	NMD-TR-001-03	NMD-TR-001-04	NMD-TR-001-05	NMD-TR-002-03
Sampling Depth (feet)		2.	4	7	.3 - .7	1.7 - 2	3.5 - 4	8.5 - 9	1.7 - 2	5
COMPOUND	UNITS									
Acenaphthene	mg/kg	31	9.2	4.5						
Anthracene	mg/kg	88	20	23		0.66	0.67		1.7	
Benzo(a)anthracene	mg/kg	7.1	2	1.6						
Benzo(b)fluoranthene	mg/kg	4.9	0.8							
Benzo(a)pyrene	mg/kg	2.7								
Bis(2-ethylhexyl)phthalate	mg/kg	0.79			1.1	1.4	2.6	0.89	1.9	
Butylbenzyl phthalate	mg/kg					0.73				
4-Chloroaniline	mg/kg									
4-Chloro-3-methylphenol	mg/kg									
Chrysene	mg/kg	14	3.4	2.4						
Dibenzofuran	mg/kg	34	9.7	12						
Di-n-butyl phthalate	mg/kg			2.6	2.7	2.2	1.2			
Fluoranthene	mg/kg	120	22	11						
Fluorene	mg/kg		43	25		0.66				
2-Methylnaphthalene	mg/kg	260	65	43		2.7	0.95		0.66	
Naphthalene	mg/kg	89	20	9.1						
Phenanathrene	mg/kg	72	18	15		0.98			4.3	5
Pyrene	mg/kg	53	15	14						0.7

1/ Blanks and all other analyses were below reported limits.

Table 5.7 (Continued).

		Sample Number						
		NMO-TR-002-04	NMO-TR-003-03	NMO-TR-004-01	NMO-TR-004-02	NMO-TR-004-03	NMO-TR-005-01	NMO-TR-005-02
Sampling Depth (feet)		5.5 - 6	5	1	3 - 4	3 - 4	1.5	4
COMPOUND	UNITS							
Acenaphthene	mg/kg							3.2
Anthracene	mg/kg							20.4
Benzo(a)anthracene	mg/kg							6.8
Benzo(g,h,i)perylene	mg/kg						3.6	2
Benzo(a)pyrene	mg/kg						1	1
Bis(2-ethylhexyl)phthalate	mg/kg				1.7	1.7	1	28.2
Chrysene	mg/kg							3.2
Dibenzofuran	mg/kg							5.6
Di-n-butyl phthalate	mg/kg	1.7	2.3			1.1		
Diethylphthalate	mg/kg		4.2					
Fluoranthene	mg/kg							9.8
Fluorene	mg/kg							27.2
2-Methylnaphthalene	mg/kg				0.99			39
Naphthalene	mg/kg							9.4
2-Nitroaniline	mg/kg							
Phenanthrene	mg/kg			8				71
Pyrene	mg/kg						1.2	11

1/ Blanks and all other analyses were below reported limits.

Table 5.7 (Continued).

		Sample Number							
		NMD-TR-005-03	NMD-TR-005-05	NMD-TR-006-01	NMD-TR-006-02	NMD-TR-006-03	NMD-TR-007-01	NMD-TR-007-03	NMD-TR-007-04
Sampling depth (feet)		6	6	1	2	5	1.5 - 2	4	4.5
COMPOUND	UNITS								
Anthracene	mg/kg		0.88						
Benzo(b)fluoranthene	mg/kg		0.82						
Benzo(g,h,i)perylene	mg/kg				2.4				
Bis(2-chloroisopropyl)ether	mg/kg					1.5			
Bis(2-ethylhexyl)phthalate	mg/kg			1.3	1	0.81		1.1	1.1
Butyl benzyl phthalate	mg/kg			1		0.75			1
Di-n-butyl phthalate	mg/kg		1.4	1.3	1.1	1.5			
Fluoranthene	mg/kg	0.7							
Fluorene	mg/kg	2.5	1.2						
2-Methylnaphthalene	mg/kg	2.3	2.3						
Phenanthrene	mg/kg	6.7	2.6		6.8				
Pyrene	mg/kg	1.3					2.3		

1/ Blanks and all other analyses were below reported limits.

Table 5.7 (Continued).

		Sample Number								
		NMD-TR-008-01	NMD-TR-008-02	NMD-TR-008-03	NMD-TR-009-01	NMD-TR-009-02	NMD-TR-009-03	NMD-TR-010-01	NMD-TR-010-01SP	NMD-TR-010-02
Sampling Depth (feet)		.5	1.8 - 2.5	3 - 3.3	1.5	3	5.5	2	2	4
COMPOUND	UNITS									
Acenaphthene	mg/kg									15
Anthracene	mg/kg									21
Benzo(a)anthracene	mg/kg				14					
Benzo(b)fluoranthene	mg/kg				7.5					
Benzo(g,h,i)perylene	mg/kg				5.8					
Benzo(a)pyrene	mg/kg				7.2					11
Bis(2-ethylhexyl)phthalate	mg/kg				6.5	1.2	1.4			
Chrysene	mg/kg				15					
Dibenzofuran	mg/kg									29
Dimethylphthalate	mg/kg								1.4	
Di-n-butyl phthalate	mg/kg				0.67				1	2
2,4-Dinitrotoluene	mg/kg									
2,6-Dinitrotoluene	mg/kg									17
Di-n-octyl phthalate	mg/kg									2
Fluoranthene	mg/kg				6.6					15
Fluorene	mg/kg									56
2-Methylnaphthalene	mg/kg									230
Naphthalene	mg/kg								0.7	46
Pentachlorophenol	mg/kg								1.4	
Phenanathrene	mg/kg				5.1			8.5	6.6	270
Pyrene	mg/kg				25			7.5	3.2	60

1/ Blanks and all other analyses were below reported limits.

* Sample analysis was duplicated in the laboratory.

SP = Spiked sample

Table 5.7 (Continued).

		Sample Number								
		NMO-TR-010-03	NMO-TR-010-04	NMO-TR-010-05	NMO-TR-011-01	NMO-TR-011-02	NMO-TR-011-03	NMO-TR-012-01	NMO-TR-012-02	NMO-TR-013-01
Sampling Depth (feet)		6	9	2	1.3	2	4.5	7	9.5	2
COMPOUND	UNITS									
Acenaphthene	mg/kg	0.77				6.1		15	12.4	
Anthracene	mg/kg								14.1	
Benzo(a)anthracene	mg/kg	2.8				14.7		19.8	27	
Benzo(g,h,i)perylene	mg/kg								6.1	
Benzo(a)pyrene	mg/kg								9.9	
Bis(2-ethylhexyl)phthalate	mg/kg	2.8	1.2							
Chrysene	mg/kg	2.2				15		20	29	
Dibenzofuran	mg/kg	1.8				14.7		27	18.4	
Di-n-butyl phthalate	mg/kg		0.69	0.8	1.6	1.2		1.8	5.3	
2,4-Dinitrotoluene	mg/kg			2.9	7.9	10.2		3.1		
2,6-Dinitrotoluene	mg/kg				1.2	12.8		12.6	13.5	
Fluoranthene	mg/kg	1.2				6.1	0.75	5.4	13.8	
Fluorene	mg/kg	4.1				29.9		37	52	
2-Methylnaphthalene	mg/kg	12								
Naphthalene	mg/kg	2				22.3		55	33	
4-Nitrophenol	mg/kg									
Phenanathrene	mg/kg	18		10.2	15.4	101	2.6		220	3.3
Pyrene	mg/kg	4.1		8.9	14.9	31	3	33	43	1.5

1/ Blanks and all other analyses were below reported limits.

Table 5.7 (Continued).

		Sample Number					
		NMO-TR-013-02	NMO-TR-013-03	NMO-TR-013-05	NMO-TR-SI-01	NMO-TR-SI-02	NMO-TR-SI-03
Sampling Depth (feet)		6.5	8.5 - 9	6.5	1.5	3 - 4	8
COMPOUND	UNITS						
Acenaphthene	mg/kg		0.71	11			
Anthracene	mg/kg		5.9				
Benzo(a)anthracene	mg/kg		1.8	5			
Butyl benzyl phthalate	mg/kg					0.92	1.3
Dibenzofuran	mg/kg	3.8	1.2	4.2			
Di-n-butyl phthalate	mg/kg		10	20	1.4	2.	
2,4-Dinitrotoluene	mg/kg	2.4		8.4			
2,6-Dinitrotoluene	mg/kg	5.1		8			
Fluoranthene	mg/kg		0.9	2.2			
Fluorene	mg/kg	7.2	6.1	13			
2-Methylnaphthalene	mg/kg	2.5	5	37			
Naphthalene	mg/kg	5		5			
Phenanathrene	mg/kg		10	27			
Pyrene	mg/kg		0.82	13			

1/ Blanks and all other analyses were below reported limits.

Table 5.8 Three-Mile Ditch - Trench and Soil Borings Analytical Results, Metals and Oil and Grease, RFI Phase I Report, Navajo Refining Company, October 1990.

		Sample Number								
		NMO-TR-SI-01	NMO-TR-SI-02	NMO-TR-SI-03	NMO-TR-000-01	NMO-TR-000-02	NMO-TR-000-03	NMO-TR-001-01	NMO-TR-001-02	NMO-TR-001-03
Sampling Depth (feet)		1.5	3 - 4	8	2	4	7	.3 - .7	1.7 - 2	3.5 - 4
METAL	UNITS									
Antimony	mg/kg	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Arsenic	mg/kg	15.2	5.29	6.11	12.9	3.03	13.9	3.16	6.92	2.89
Barium	mg/kg	70.8	124	96.1	73.5	75.9	366	75.8	85	99.3
Beryllium	mg/kg	0.621	0.809	0.611	< 0.30	< 0.30	< 0.30	0.85	0.58	< 0.30
Cadmium	mg/kg	5.59	3.95	3.2	3.03	0.94	0.74	6.2	4.98	2.64
Chromium	mg/kg	433	< 0.30	< 0.30	3390	5.9	10.5	19.5	13.7	10.2
Lead	mg/kg	22.3	6.22	< 0.50	2175	0.974	1.01	13.3	10.2	17
Mercury	mg/kg	0.17	< 0.05	< 0.05	1	0.17	0.07	0.09	0.07	0.06
Nickel	mg/kg	14.3	11.5	8.61	12	4.84	0.29	16.1	12.7	6.43
Selenium	mg/kg	< 0.50	< 0.50	< 0.50	1.39	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Silver	mg/kg	2.79	< 0.50	4.72	1.2	3.03	3.25	< 0.50	< 0.50	2.25
Zinc	mg/kg	35.4	22.4	6.4	57.2	4	2.16	47.3	31.2	11.8
Oil and Grease	percent	16.7	0.014	0.034	5.15	2.21	2.19	0.076	0.144	0.026

Table 5.8 (Continued).

COMPOUND/1	UNITS	Monitor Well Number / Date MW-4 3-88	MW-4 6-89	MW-4 7-89	MW-4 7-89	MW-5 9-86	MW-5 8-87	MW-5 11-87	MW-5 7-89	MW-5 7-89	MW-6 9-86
Butyl benzyl phthalate	ug/l										< 5
Cresols (methyl phenols)	ug/l				< 1						
Chrysene	ug/l	< 10		< 10	< 1					< 1	< 5
Dibenzofuran	ug/l										< 5
Dibenzo(a,h)anthracene	ug/l	< 10		< 10	< 1					< 1	< 5
Dibenzo(a,j)acridine	ug/l				< 1					< 1	
Dibenzo(a,e)pyrene	ug/l				< 1					< 1	
Dibenzo(a,h)pyrene	ug/l				< 1					< 1	
Dibenzo(a,i)pyrene	ug/l				< 1					< 1	
Diethyl phthalate	ug/l										< 5
Dimethyl phthalate	ug/l										< 5
Di-n-butyl phthalate	ug/l										< 5
Di-n-octyl phthalate	ug/l										< 5
Fluoranthene	ug/l	< 10		< 10	< 1					< 1	< 5
Fluorene	ug/l	< 10		< 10	< 1					< 1	< 5
Hexachlorobenzene	ug/l										< 5
Hexachlorobutadiene	ug/l										< 5
Hexachloroethane	ug/l										< 5
Hexachlorocyclopentadiene	ug/l										< 5
Indeno(1,2,3-cd)pyrene	ug/l	< 10		< 10	< 1					< 1	< 5
Isophorone	ug/l										< 5
Naphthalene	ug/l	< 10		< 10	< 1.8					< 1.8	< 5
Nitrobenzene	ug/l										< 5
N-nitrosodipropylamine	ug/l										< 5
N-nitrosodiphenylamine	ug/l										< 5
Pentachlorophenol	ug/l			< 50	< 8	< 5			< 50		
Phenanathrene	ug/l	< 10		< 10	< 1					< 1	< 5
Phenol	ug/l			< 10	30	< 5			< 10		
Pyrene	ug/l	< 10		< 10	< 1					< 1	< 5
1,2-Dichlorobenzene	ug/l					< 20					< 5
1,3-Dichlorobenzene	ug/l					< 20					< 5
1,4-Dichlorobenzene	ug/l					< 20					< 5

Table 5.8 (Continued).

		Sample Number										
		NMD-TR-001-04	NMD-TR-001-05	NMD-TR-002-01	NMD-TR-002-03	NMD-TR-002-04	NMD-TR-003-01	NMD-TR-003-02	NMD-TR-003-03	NMD-TR-004-01	NMD-TR-004-02	NMD-TR-004-03
Sampling Depth (feet)		8.5 - 9	1.7 - 2	.3 - .5	5	5.5 - 6	.4 - 1	1.3 - 1.7	5	1	3 - 4	3 - 4
METAL	UNITS											
Antimony	mg/kg	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	0.668	< 0.50	< 0.50
Arsenic	mg/kg	2.79	12.3	2.89	3.5	3.81	32.7	14.6	2.34	22.9	6.01	4.08
Barium	mg/kg	21	93.3	124	78.6	82.2	80.7	135	69.5	210	95.9	79.5
Beryllium	mg/kg	0.46	0.68	0.78	0.32	0.41	0.76	0.62	0.3	0.63	0.72	0.58
Cadmium	mg/kg	3.1	5.52	5.4	2.5	2.8	5.07	4.05	2.31	6.4	6	3
Chromium	mg/kg	19.2	37.4	31.6	10.2	13.5	56.3	18.8	9.53	373	20.1	11
Lead	mg/kg	3.98	30.9	11.6	3.63	4.05	67.7	14.7	2.79	480	682	48.1
Mercury	mg/kg	0.05	0.07	< 0.05	< 0.05	< 0.05	*	< 0.05	< 0.05	1	0.067	0.19
Nickel	mg/kg	7	13	13.3	7	7.5	14.7	11.5	5.26	14.4	13.5	10.2
Selenium	mg/kg	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Silver	mg/kg	< 0.50	< 0.50	1.45	1.28	1.45	1.09	1.41	1.17	2.2	< 0.50	< 0.50
Zinc	mg/kg	16.9	39.8	44.5	17.3	21.3	46.8	33.7	16.5	200	43.4	27.8
Oil and Grease	percent	0.016	0.142	0.206	0.297	0.036	0.379	1.5	0.049	1.35	0.136	0.065

* Insufficient sample

Table 5.8 (Continued).

		Sample Number								
		NMO-TR-004-04	NMO-TR-005-01	NMO-TR-005-02	NMO-TR-005-03	NMO-TR-005-05	NMO-TR-006-01	NMO-TR-006-02	NMO-TR-006-03	NMO-TR-007-01
Sampling Depth (feet)		5	1.5	4	6	6	1	2	5	1.5 - 2
METAL	UNITS									
Antimony	mg/kg	< 0.50	0.616	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Arsenic	mg/kg	5.17	46.1	17.3	11	6.62	3.53	15.2	11	19.6
Barium	mg/kg	195	122	185	110	183	80.2	140	54	148
Beryllium	mg/kg	0.81	0.29	0.62	0.59	1.2	0.48	0.71	< 0.30	< 0.30
Cadmium	mg/kg	7.3	4.7	5.9	2.9	6.9	5.3	7.7	7.2	3.57
Chromium	mg/kg	19.4	16.8	305	22.6	35.3	17.7	76.7	6.05	800
Lead	mg/kg	123	18.03	830	35.2	60.8	340	223	3.3	275
Mercury	mg/kg	< 0.05	1	0.67	< 0.05	0.1	0.08	0.7	0.03	1
Nickel	mg/kg	15.2	25.8	15.3	10.1	21.7	11.9	17.5	8.24	13
Selenium	mg/kg	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Silver	mg/kg	< 0.50	2.64	1.47	1.31	3.31	0.962	2.26	2.44	3.16
Zinc	mg/kg	45.6	352	264	28	59.1	35.6	171	15.7	262
Oil and Grease	percent	< 0.01	3.98	6.5	0.584	0.266	< 0.01	2.95	0.023	4.43

Table 5.8 (Continued).

		Sample Number										
		NMO-TR-007-02	NMO-TR-007-03	NMO-TR-007-04	NMO-TR-008-01	NMO-TR-008-02	NMO-TR-008-03	NMO-TR-009-01	NMO-TR-009-02	NMO-TR-009-03	NMO-TR-009-04	NMO-TR-010-01
Sampling Depth (feet)		2	4	4.5	.5	1.8 - 2.5	3 - 3.3	1.5	3	5.5	6	2
METAL	UNITS											
Antimony	mg/kg	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Arsenic	mg/kg	2.65	18.5	9.49	48.3	4.96	3.91	32.9	2.53	3.42	3.27	91.4
Barium	mg/kg	35	116	82	75.2	90.1	113	171	75.7	46.1	47.8	71.5
Beryllium	mg/kg	< 0.30	< 0.30	0.6	0.39	0.69	0.62	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30
Cadmium	mg/kg	1.53	5.7	4.1	3.7	4.4	3.5	4.06	3.44	1.89	1.75	3.62
Chromium	mg/kg	8.4	171	11.6	61.9	28.3	18.5	594	12.8	9	6.6	1220
Lead	mg/kg	467	863	10.1	2196	15.5	6.63	305	7.7	8.93	2.92	206
Mercury	mg/kg	0.07	0.27	0.03	0.67	< 0.05	< 0.05	0.533	< 0.05	< 0.05	< 0.05	0.153
Nickel	mg/kg	4.36	13.2	12.7	12.2	12.1	10.1	19.4	7.7	5.52	4.08	9.46
Selenium	mg/kg	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Silver	mg/kg	1.57	2.96	< 0.50	1.93	0.83	0.98	2.15	1.38	< 0.50	< 0.50	8.11
Zinc	mg/kg	11.6	336	29.5	84.7	41	35.6	683	29.6	19.1	15	250
Oil and Grease	percent	< 0.01	0.056	< 0.01	4.47	1.66	1.54	12.2	0.208	0.021	< 0.01	5.61

Table 5.8 (Continued).

		Sample Number										
		NMD-TR-010-01SP	NMD-TR-010-02	NMD-TR-010-03	NMD-TR-010-04	NMD-TR-010-05	NMD-TR-011-01	NMD-TR-011-02	NMD-TR-011-03	NMD-TR-011-04	NMD-TR-012-01	NMD-TR-012-02
Sampling Depth (feet)		2	4	6	9	2	1.3	2	4.5	10	7	9.5
METAL	UNITS											
Antimony	mg/kg	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Arsenic	mg/kg	127	29.9	39	8.43	124	108	98	110	69.6	57.4	130
Barium	mg/kg	123	102	224	87	112	82	75	140	64.3	32.8	184
Beryllium	mg/kg	< .3	< 0.30	0.33	0.33	0.3	< 0.30	< 0.30	0.71	0.55	< 0.30	0.61
Cadmium	mg/kg	3.57	3.41	5.14	4.16	4.05	3.13	3.38	5.29	3.41	1.75	5.3
Chromium	mg/kg	1500	1173	500	33	1600	1950	2080	28.7	31.2	2550	1070
Lead	mg/kg	226	252	378	24.9	422	239	362	671	10.9	110	47.1
Mercury	mg/kg	0.17	0.3	< 0.05	< 0.05	0.195	0.067	< 0.05	0.1	< 0.05	0.133	0.133
Nickel	mg/kg	15.2	13	14.4	11.1	13	10.6	11.1	14.9	11.4	10.1	18.4
Selenium	mg/kg	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Silver	mg/kg	6.52	2.22	2.52	1.51	7.73	5.71	7.67	3.25	5.27	1.62	5.33
Zinc	mg/kg	583	480	267	41.2	291	210	571	68.1	30.1	510	400
Oil and Grease	percent	6.68	10.8	5.28	0.046	9.45	15.3	8.09	2.91	0.01	18.3	11.4

SP = Spiked sample

Table 5.8 (Continued).

		Sample Number				
		NMO-TR-012-03	NMO-TR-013-01	NMO-TR-013-02	NMO-TR-013-03	NMO-TR-013-05
Sampling depth (feet)		8	2	6.5	8.5 - 9	6.5
METAL	UNITS					
Antimony	mg/kg	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Arsenic	mg/kg	112	4.48	12.6	4.05	14.7
Barium	mg/kg	136	222	41.7	240	41
Beryllium	mg/kg	0.78	0.47	< 0.30	0.41	< 0.30
Cadmium	mg/kg	5.4	2.93	1.33	2.5	1.17
Chromium	mg/kg	174	47.4	547	11.1	760
Lead	mg/kg	25.1	22.8	14.5	3.08	11
Mercury	mg/kg	< 0.05	0.1	0.07	< 0.05	0.1
Nickel	mg/kg	15.3	11.1	4.1	9	4
Selenium	mg/kg	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Silver	mg/kg	2.79	0.53	1.26	0.58	0.67
Zinc	mg/kg	98.5	40.9	50.5	20.8	63.6
Oil and Grease	percent	5.82	*	4.92	0.562	5.83

* Insufficient sample

Table 5.9 Three-Mile Ditch - Background Soil Borings Analytical Results, Metals and Oil and Grease, RFI Phase I Report, Navajo Refining Company, October 1990.

		Sample Number									
		NMO-SB-002-01	NMO-SB-002-02	NMO-SB-007-01	NMO-SB-007-02	NMO-SB-010-01	NMO-SB-010-02	NMO-SB-012-01N	NMO-SB-012-02N	NMO-SB-012-01S	NMO-SB-012-02S
	Sampling Depth (feet)	1 - 1.5	5 - 5.5	1.5 - 2	5 - 5.5	1.5	5 - 5.5	1 - 1.5	5.5 - 6	1.5 - 2	5 - 5.5
METAL	UNITS										
Antimony	mg/kg	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Arsenic	mg/kg	6.42	4.58	3.58	3.81	7.12	9.09	4.41	1.03	83	70
Barium	mg/kg	106	109	77.4	89.2	87.3	76	270	132	241	59.8
Beryllium	mg/kg	< 0.30	< 0.30	< 0.30	< 0.30	0.3	0.47	0.83	< 0.30	0.68	0.44
Cadmium	mg/kg	4.08	2.21	3.28	3.91	3.01	5.25	4.4	1.4	3.81	3.42
Chromium	mg/kg	17.5	10	12.6	13.2	11.3	15.3	13.8	5.4	26.8	25
Lead	mg/kg	19.7	8.01	9.54	19.7	8.79	10.3	14.6	5.16	9.51	4.91
Mercury	mg/kg	0.05	0.05	< 0.05	0.03	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Nickel	mg/kg	12.4	5.45	9.24	10.8	9.31	13.5	16.5	5.7	15.2	10.4
Selenium	mg/kg	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Silver	mg/kg	2.02	3.53	1.79	2.22	< 0.50	1.47	< 0.50	< 0.50	3.1	1.58
Zinc	mg/kg	41.6	17.4	29.2	34.1	30.5	40.1	35.7	15.9	34.4	26.5
Oil and Grease	percent	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.032	0.002	0.002

N - North, S - South

Table 5.16 Eagle Creek Sediments Analytical Results, Semivolatiles, RFI Phase I Report, Navajo Refining Company, October 1990.

COMPOUND	UNITS	Sample Number NEC-SD-001-01 (Surface Sediment Sample)
Bis(2-ethylhexyl)phthalate	mg/kg	0.81
Di-n-butyl phthalate	mg/kg	1.7

1/ Blanks and all other analyses were below reported limits.

Table 5.17 Eagle Creek Sediments Analytical Results, Metals, RFI Phase I Report, Navajo Refining Company, October 1990.

METAL	UNITS	Sample Number NEC-SD-001-01	NEC-SD-002-01	NEC-SD-003-01	NEC-SD-003-02	NEC-SS-004-01	NEC-SS-005-01
		(Surface Sediment Samples)					
Antimony	mg/kg	3.16	< 3.00	< 3.00	< 3.00	< 3.00	< 3.00
Arsenic	mg/kg	2.47	4.13	3.62	3.03	<8.2	4.87
Barium	mg/kg	85.6	5.9	65.5	100	143	109
Beryllium	mg/kg	0.3	0.254	0.23	0.212	<0.03	0.189
Cadmium	mg/kg	2.4	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Chromium	mg/kg	8.29	5.08	12.3	8.17	17	4.7
Lead	mg/kg	15.4	12.7	37.7	13	69.3	4.06
Mercury	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Nickel	mg/kg	6.45	5.4	5.3	4.5	8.81	7.3
Selenium	mg/kg	< 0.50	< 1.50	< 1.50	< 1.50	< 1.50	< 1.50
Silver	mg/kg	< 0.50	1.9	1.65	2.72	0.85	2.7
Zinc	mg/kg	46.5	11.1	16.1	11.8	48.3	0.31

Table 5.20 Eagle Creek/Three-Mile Ditch - Ground Water Analytical Results, Semivolatiles, RFI Phase I Report, Navajo Refining Company, October 1990.

		Sample Number						
		NNO-GW-006-01	NNO-GW-006-01	NNO-GW-007-01	NNO-GW-007-01	NNO-GW-045-01	NNO-GW-045-01	NNO-GW-046-01
COMPOUND	UNITS	MW-8	Lab. Dup.*	MW-9	Lab. Dup.	# 45	Lab. Dup.	# 46
Bis(2-ethylhexyl)phthalate	ug/l	24	38	31	26	23	20	21

1/ Blanks and all other analyses were below reported limits.

* Sample analysis was duplicated in the laboratory.

Table 5.21 Three-Mile Ditch/Eagle Creek - Ground Water Analytical Results, RFI Phase I Report, Navajo Refining Company, October 1990.

		Sample Number				
		Monitor Well				
		NMO-GW-030-01	NMO-GW-045-01	NMO-GW-046-01	NMO-GW 006-01	NMO-GW 007-01
		#30	#45	#46	MW-8	MW-9
COMPOUND	UNITS					
Antimony	mg/l	<0.1	<0.1	<0.1	<0.1	<0.1
Arsenic	mg/l	0.058	0.055	0.037	0.014	0.035
Barium	mg/l	1.56	0.62	0.33	<0.10	<0.10
Beryllium	mg/l	0.008	0.004	0.001	<0.001	<0.001
Cadmium	mg/l	0.005	<0.005	<0.005	<0.005	<0.005
Chromium	mg/l	0.05	0.1	0.05	2.27	3.99
Lead	mg/l	0.09	1.83	0.028	<0.01	<0.01
Mercury	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	mg/l	0.09	0.09	0.08	0.28	1.2
Selenium	mg/l	<0.05	<0.05	<0.05	<0.05	<0.05
Silver	mg/l	<0.01	0.02	<0.01	<0.01	<0.01
Zinc	mg/l	0.11	0.13	<0.01	<0.01	<0.01

Table 5.22 Three-Mile Ditch/Eagle Creek - Ground Water Analytical Results, Inorganics, RFI Phase I Report, Navajo Refining Company, October 1990.

		Sample Number Monitor Well				
		NMD-GW-030-01	NMD-GW-045-01	NMD-GW-046-01	NMD-GW 006-01	NMD-GW 007-01
		#30	#45	#46	MW-8	MW-9
COMPOUND	UNITS					
Bicarbonate	mg/l	460	338	358		
Chloride	mg/l	354	283	638		
Fluoride	mg/l	1.67	2.59	3.17		
Sulfate	mg/l	964	1310	1250		
Total Dissolved Solids	mg/l	2820	3160	364	5640	5450

Table 6.1 Evaporation Ponds - Historical Ground Water Quality, Volatiles, RFI Phase I Report, Navajo Refining Company, October 1990.

		Monitor Well Number Date									
COMPOUND /1	UNITS	OCD-1 7/89b	OCD-2 7/89b	OCD-3 7/89b	OCD-4 7/89b	ODC-5 7/89b	OCD-6 7/89b	OCD-7 7/89b	OCD-8 7/89a	OCD-8 7/89b	OCD-8 6/89
1,1,1,2-Tetrachloroethane	ug/l								< 1		
1,1,1-Trichloroethane	ug/l	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 1	< 5	
1,1,2,2-Tetrachloroethane	ug/l	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 1	< 5	
1,1,2-Trichloroethane	ug/l	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 1	< 5	
1,1-Dichloroethane	ug/l	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 1	< 5	
1,2,3-Trichloropropane	ug/l								< 1		
1,2-Dichloroethane	ug/l	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 1	< 5	
1,2-Dichloropropane	ug/l	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 1	< 5	
1,3-Dichloropropylene	ug/l								< 1		
1-Chloroethyl vinyl ether	ug/l								< 1		
1-Chlorohexane	ug/l								< 1		
1-Methylnaphthalene	ug/l										
2,2-Dichloropropane	ug/l								< 1		
2-Chloroethyl vinyl ether	ug/l	< 10	< 10	< 10	< 10	< 10	< 10	< 10		< 10	
2-Methylnaphthalene	ug/l										
2-Sec-butyl-4,6-dinitrophenol	ug/l										
Benzene	ug/l	< 5	< 5	< 5	< 5	6.0	< 5	< 5	<0.2	< 5	4.4
Benzyl chloride	ug/l								< 1		
Bromobenzene	ug/l								< 1		
Bromodichloromethane	ug/l	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 1	< 5	
Bromoform	ug/l	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 1	< 5	
Bromomethane	ug/l	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 1	< 10	
Carbon tetrachloride	ug/l	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 1	< 5	
Chloracetaldehyde	ug/l								< 1		
Chlorobenzene	ug/l	< 5	< 5	< 5	< 5	< 5	< 5	< 5	<0.2	< 5	
Chloroethane	ug/l	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 1	< 10	
Chloroform	ug/l	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 1	< 5	
Chloromethane	ug/l	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 1	< 10	
Chloromethyl methyl ether	ug/l								< 1		
Chlorotoluene	ug/l								< 1		
Cis-1,3-dichloropropene	ug/l	< 5	< 5	< 5	< 5	< 5	< 5	< 5		< 5	

Table 6.1 (Continued).

COMPOUND /1	UNITS	OCO-1 7/89b	OCO-2 7/89b	OCO-3 7/89b	OCO-4 7/89b	ODC-5 7/89b	OCO-6 7/89b	OCO-7 7/89b	OCO-8 7/89a	OCO-8 7/89b	OCO-8 6/89
		Monitor Well Number Date									
Dibromochloromethane	ug/l	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 1	< 5	
Dibromomethane	ug/l								< 1		
Dichlorodifluoromethane	ug/l								< 1		
Dichloromethane	ug/l								< 1		
Ethylbenzene	ug/l	< 5	< 5	< 5	< 5	< 5	< 5	< 5	<0.2	< 5	14
Freon	ug/l	< 5	< 5	< 5	< 5	< 5	< 5	< 5		< 5	
Methylene chloride	ug/l	< 5	< 5	< 5	< 5	< 5	< 5	< 5		< 5	
m-Xylene	ug/l								<0.2		
o-Xylene	ug/l								<0.2		
p-Xylene	ug/l								<0.2		
Tetrachloroethene	ug/l	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 1	< 5	
Tetrachlorophenol	ug/l										
Toluene	ug/l	< 5	< 5	< 5	< 5	6.0	< 5	< 5	18.38	< 5	
Trans-1,2-dichloroethene	ug/l	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 1	< 5	
Trans-1,3-dichloropropene	ug/l	< 5	< 5	< 5	< 5	< 5	< 5	< 5		< 5	
Trichloroethene	ug/l	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 1	< 5	
Trichlorofluoromethane	ug/l								< 1		
Trichlorophenol	ug/l										
Vinyl chloride	ug/l	< 1	< 1	< 1	< 1	< 1	< 1	< 1		< 1	
Xylenes	ug/l	< 10	< 10	< 10	< 10	< 10	< 10	< 10		< 10	35

Source: Evaporation Ponds Special Analysis. Scientific Laboratory, June 01, 1988; April 27, 1987; August 12, 1987; November 12, 1987
Evaporation Ponds Special Analysis. Rocky Mountain Laboratories, March 16, 1988; June 22, 1988
Evaporation Ponds Special Analysis. Inter-mountain Laboratories, July 25, 1989; July 26, 1989
Evaporation Ponds Special Analysis. Ana-Lab, July 25, 1989; July 26, 1989
Evaporation Ponds Special Analysis. ENESCO, June 22, 1989

1/ Blanks designate components for which no analyses were requested.

Table 6.1 (Continued).

COMPOUND/1	UNITS	Monitor Well Number / Date									
		MW-1 9/86	MW-1 7/89a	MW-2 9/86	MW-2 7/89a	MW-3 9/86	MW-3 7/89a	MW-3 7/89b	MW-4 9/86	MW-4 8/87	MW-4 11/87
1,1,1,2-Tetrachloroethane	ug/l	< 5				< 5		< 1			
1,1,1-Trichloroethane	ug/l	< 5	< 5		< 5	< 5	< 5	< 1			
1,1,2,2-Tetrachloroethane	ug/l		< 5		< 5		< 5	< 1			
1,1,2-Trichloroethane	ug/l	< 5	< 5		< 5	< 5	< 5	< 1			
1,1-Dichloroethane	ug/l	< 5	< 5		< 5	< 5	< 5	< 1			
1,2,3-Trichloropropane	ug/l							< 1			
1,2-Dichloroethane	ug/l	< 5	< 5		< 5	< 5	< 5	< 1			
1,2-Dichloropropane	ug/l	< 5	< 5		< 5	< 5	< 5	< 1			
1,3-Dichloropropylene	ug/l	< 5				< 5		< 1			
1-Chloroethyl vinyl ether	ug/l							< 1			
1-Chlorohexane	ug/l							< 1			
1-Methylnaphthalene	ug/l									98	
2,2-Dichloropropane	ug/l							< 1			
2-Chloroethyl vinyl ether	ug/l	< 5	< 10		< 10	< 5	< 10				
2-Methylnaphthalene	ug/l									< 10	
2-Sec-butyl-4,6-dinotrophenol	ug/l							< 1			
Benzene	ug/l	< 5	< 5	< 0.5	< 5	< 5	< 5	<0.2	< 5	45	51
Benzyl chloride	ug/l							< 1			
Bromobenzene	ug/l							< 1			
Bromodichloromethane	ug/l		< 5		< 5		< 5				
Bromoform	ug/l	< 5	< 5		< 5	< 5	< 5	< 1			
Bromomethane	ug/l		< 10		< 10		< 10	< 1			
Carbon tetrachloride	ug/l	< 5	< 5		< 5	< 5	< 5	< 1			
Chloracetaldehyde	ug/l							< 1			
Chlorobenzene	ug/l	< 5	< 5	< 1	< 5	< 5	< 5	<0.2	< 10		
Chloroethane	ug/l	< 10	< 10		< 10	< 10	< 10	< 1			
Chloroform	ug/l	< 5	< 5		< 5	< 5	< 5	< 1			
Chloromethane	ug/l		< 10		< 10		< 10	< 1			
Chloromethyl methyl ether	ug/l							< 1			
Chlorotoluene	ug/l							< 1			
Cis-1,3-dichloropropene	ug/l		< 5		< 5		< 5				

Table 6.1 (Continued).

COMPOUND/1	UNITS	MW-1 9/86	MW-1 7/89a	MW-2 9/86	MW-2 7/89a	MW-3 9/86	MW-3 7/89a	MW-3 7/89b	MW-4 9/86	MW-4 8/87	MW-4 11/87
		Monitor Well Number Date									
Dibromochloromethane	ug/l		< 5		< 5		< 5	< 1			
Dibromomethane	ug/l							< 1			
Dichlorodifluoromethane	ug/l							< 1			
Dichloromethane	ug/l							< 1			
Ethylbenzene	ug/l	< 5	< 5	< 1	< 5	< 5	< 5	<0.2	< 10	130	156
Freon	ug/l		< 5		< 5		< 5				
Methylene chloride	ug/l	< 10	< 5		< 5	< 10	< 5				
m-Xylene	ug/l							<0.2		942	12
o-Xylene	ug/l							<0.2		40	32
p-Xylene	ug/l							<0.2		10	15
Tetrachloroethene	ug/l	< 5	< 5		< 5	< 5	< 5	< 1			
Tetrachlorophenol	ug/l										
Toluene	ug/l	< 5	< 5	6.4	< 5	< 5	< 5	21.9	< 10	280	25
Trans-1,2-dichloroethene	ug/l		< 5		< 5		< 5	< 1			
Trans-1,3-dichloropropene	ug/l		< 5		< 5		< 5				
Trichloroethene	ug/l	< 5	< 5		< 5	< 5	< 5	< 1			
Trichlorofluoromethane	ug/l							< 1			
Trichlorophenol	ug/l										
Vinyl chloride	ug/l	< 10	< 1		< 1	< 10	< 1				
Xylenes	ug/l		< 10		< 10		< 10				

Table 6.1 (Continued).

Monitor Well Number
Date

COMPOUND/1	UNITS	MW-4 3/88	MW-4 6/89	MW-4 7/89a	MW-4 7/89b	MW-5 9/86	MW-5 8/87	MW-5 11/87	MW-5 7/89a	MW-5 7/89b	MW-6 9/86
1,1,1,2-Tetrachloroethane	ug/l				< 1					< 1	
1,1,1-Trichloroethane	ug/l			< 5	< 1				< 5	< 1	< 5
1,1,2,2-Tetrachloroethane	ug/l			< 5	< 1				< 5	< 1	< 5
1,1,2-Trichloroethane	ug/l			< 5	< 1				< 5	< 1	< 5
1,1-Dichloroethane	ug/l			< 5	< 1				< 5	< 1	< 5
1,2,3-Trichloropropane	ug/l				< 1					< 1	
1,2-Dichloroethane	ug/l			< 5	< 1				< 5	< 1	< 5
1,2-Dichloropropane	ug/l			< 5	< 1				< 5	< 1	< 5
1,3-Dichloropropylene	ug/l				< 1					< 1	< 5
1-Chloroethyl vinyl ether	ug/l				< 1					< 1	
1-Chlorohexane	ug/l				< 1					< 1	
1-Methylnaphthalene	ug/l										
2,2-Dichloropropane	ug/l				< 1					< 1	
2-Chloroethyl vinyl ether	ug/l			< 10					< 10		< 5
2-Methylnaphthalene	ug/l										
2-Sec-butyl-4,6-dinotrophenol	ug/l				< 1					< 1	
Benzene	ug/l	30	14	< 5	<0.2	< 5	TR		< 5	<0.2	< 5
Benzyl chloride	ug/l				< 1					< 1	
Bromobenzene	ug/l				< 1					< 1	
Bromodichloromethane	ug/l			< 5	< 1				< 5	< 1	
Bromoform	ug/l			< 5	< 1				< 5	< 1	< 5
Bromomethane	ug/l			< 10	< 1				< 10	< 1	
Carbon tetrachloride	ug/l			< 5	< 1				< 5	< 1	< 5
Chloracetaldehyde	ug/l				< 1					< 1	
Chlorobenzene	ug/l			< 5	< 1	< 10			< 5	< 1	< 5
Chloroethane	ug/l			< 10	< 1				< 10	< 1	< 10
Chloroform	ug/l			< 5	< 1				< 5	< 1	< 5
Chloromethane	ug/l			< 10	< 1				< 10	< 1	
Chloromethyl methyl ether	ug/l				< 1					< 1	
Chlorotoluene	ug/l				< 1					< 1	
Cis-1,3-dichloropropene	ug/l			< 5					< 5		

Table 6.1 (Continued).

		Monitor Well Number Date									
COMPOUND/1	UNITS	MW-4 3/88	MW-4 6/89	MW-4 7/89a	MW-4 7/89b	MW-5 9/86	MW-5 8/87	MW-5 11/87	MW-5 7/89a	MW-5 7/89b	MW-6 9/86
Dibromochloromethane	ug/l			< 5	< 1				< 5	< 1	
Dibromomethane	ug/l				< 1					< 1	
Dichlorodifluoromethane	ug/l				< 1					< 1	
Dichloromethane	ug/l				< 1					< 1	
Ethylbenzene	ug/l	78	65	< 5	<0.2	< 10	656	52	< 5	<0.2	< 5
Freon	ug/l			< 5					< 5		
Methylene chloride	ug/l			< 5					< 5		< 10
m-Xylene	ug/l	53			<0.2		830	755		<0.2	
o-Xylene	ug/l				<0.2					<0.2	
p-Xylene	ug/l				<0.2			TR		<0.2	
Tetrachloroethene	ug/l			< 5	< 1				< 5	< 1	
Tetrachlorophenol	ug/l				< 1						
Toluene	ug/l	220	160	< 5	35.72	< 10	TR		< 5	27.58	< 5
Trans-1,2-dichloroethene	ug/l			< 5	< 1				< 5	< 1	
Trans-1,3-dichloropropene	ug/l			< 5					< 5		
Trichloroethene	ug/l			< 5	< 1				< 5	< 1	< 5
Trichlorofluoromethane	ug/l				< 1				< 1		
Trichlorophenol	ug/l				< 1						
Vinyl chloride	ug/l			< 1					< 1		< 10
Xylenes	ug/l	203	93	< 10					< 10		

Table 6.1 (Continued).

COMPOUND/1	UNITS	MW-6 7/89a	MW-6 7/89b	MW-7 9/86	MW-7 7/89a	MW-7 7/89b
		Monitor Well Number Date				
1,1,1,2-Tetrachloroethane	ug/l		< 1			
1,1,1-Trichloroethane	ug/l	< 5	< 1		< 5	
1,1,2,2-Tetrachloroethane	ug/l	< 5	< 1		< 5	
1,1,2-Trichloroethane	ug/l	< 5	< 1		< 5	
1,1-Dichloroethane	ug/l	< 5	< 1		< 5	
1,2,3-Trichloropropane	ug/l		< 1			
1,2-Dichloroethane	ug/l	< 5	< 1		< 5	
1,2-Dichloropropane	ug/l	< 5	< 1		< 5	
1,3-Dichloropropylene	ug/l		< 1			
1-Chloroethyl vinyl ether	ug/l		< 1			
1-Chlorohexane	ug/l		< 1			
1-Methylnaphthalene	ug/l					
2,2-Dichloropropane	ug/l		< 1			
2-Chloroethyl vinyl ehter	ug/l	< 10			< 10	
2-Methylnaphthalene	ug/l					
2-Sec-butyl-4,6-dinotrophenol	ug/l		< 1			< 1
Benzene	ug/l	26	<0.2	< 0.5	< 5	
Benzyl chloride	ug/l		< 1			
Bromobenzene	ug/l		< 1			
Bromodichloromethane	ug/l	< 5	< 1		< 5	
Bromoform	ug/l	< 5	< 1		< 5	
Bromomethane	ug/l	< 10	< 1		< 10	
Carbon tetrachloride	ug/l	< 5	< 1		< 5	
Chloracetaldehyde	ug/l		< 1			
Chlorobenzene	ug/l	< 5	<0.2	< 1	< 5	
Chloroethane	ug/l	< 10	< 1		< 10	
Chloroform	ug/l	< 5	< 1		< 5	
Chloromethane	ug/l	< 10	< 1		< 10	
Chloromethyl methyl ether	ug/l		< 1			
Chlorotoluene	ug/l		< 1			
Cis-1,3-dichloropropene	ug/l	< 5			< 5	

Table 6.1 (Continued).

				Monitor Well Number Date		
COMPOUND/1	UNITS	MW-6 7/89a	MW-6 7/89b	MW-7 9/86	MW-7 7/89a	MW-7 7/89b
Dibromochloromethane	ug/l	< 5	< 1		< 5	
Dibromomethane	ug/l		< 1			
Dichlorodifluoromethane	ug/l		< 1			
Dichloromethane	ug/l		< 1			
Ethylbenzene	ug/l	< 5	<0.2	< 1	< 5	
Freon	ug/l	< 5			< 5	
Methylene chloride	ug/l	< 5			< 5	
m-Xylene	ug/l		<0.2			
o-Xylene	ug/l		<0.2			
p-Xylene	ug/l		<0.2			
Tetrachloroethene	ug/l	< 5	< 1		< 5	
Tetrachlorophenol	ug/l					
Toluene	ug/l	20	27.01	7.2	< 5	
Trans-1,2-dichloroethene	ug/l	< 5	< 1		< 5	
Trans-1,3-dichloropropene	ug/l	< 5			< 5	
Trichloroethene	ug/l	< 5	< 1		< 5	
Trichlorofluoromethane	ug/l		< 1			
Trichlorophenol	ug/l					
Vinyl chloride	ug/l	< 1			< 1	
Xylenes	ug/l	20			< 10	

Table 6.2 Evaporation Ponds - Historical Ground Water Quality, Semivolatiles, RFI Phase I Report, Navajo Refining Company, October 1990.

Monitor Well Number
Date

COMPOUND /1	UNITS	MW-1 9-86	MW-1 7-89	MW-2 9-86	MW-2 7-89	MW-3 9-86	MW-3 7-89	MW-3 9-86	MW-4 9-86	MW-4 8-87	MW-4 11-87
1,2,4-Tricholorobenzene	ug/l										
2,4,5-Trichlorophenol	ug/l										
2,4,6-Trichlorophenol	ug/l	< 5		< 5		< 5	< 10		< 5		
2,4-Dichlorophenol	ug/l	< 5		< 5		< 5	< 10		< 5		
2,4-Dimethylphenol	ug/l	< 5		< 5		< 5	< 10		< 5		
2,4-Dinitrophenol	ug/l	< 10		< 10		< 10	< 50		< 10		
2,4-Dinitrotoluene	ug/l	< 5				< 5					
2,6-Dichlorophenol	ug/l										
2,6-Dinitrotoluene	ug/l	< 5				< 5					
2-Chloronaphthalene	ug/l	< 5				< 5					
2-Chlorophenol	ug/l	< 5		< 5		< 5	< 10		< 5		
2-Cylohexyl-4,6-dinitrophenol	ug/l										
2-Methyl-4,6-dinitrophenol	ug/l						< 50				
2-Methylnaphthalene	ug/l	< 5				< 5				< 10	
2-Methylphenol	ug/l	< 5		< 5		< 5					
2-Nitroaniline	ug/l										
2-Nitrophenol	ug/l	< 5		< 5		< 5	< 10		< 5		
3,3'-Dichlorobenzidine	ug/l	< 5				< 5					
3-Methylcholanthrene	ug/l						< 1				
3-Nitroaniline	ug/l										
4,6-Dinitro-2-methylphenol	ug/l										
4-Bromophenyl phenyl ether	ug/l	< 5				< 5					
4-Chloroaniline	ug/l										
4-Chlorophenyl phenyl ether	ug/l	< 5				< 5					
4-Chloro-3-methylphenol	ug/l						< 20				
4-Methylphenol	ug/l			< 5							
4-Nitroaniline	ug/l										
4-Nitrophenol	ug/l	< 10		< 10		< 10	< 50		< 10		
7H-Dibenzo(c,g)carbazole	ug/l							< 1			
Acenaphthene	ug/l	< 5				< 5		<1.8		< 10	
Acenaphthylene	ug/l	< 5				< 5		<2.3		31	
Anthracene	ug/l	< 5				< 5		< 1			
Benzoic acid	ug/l										
Benzo(a)anthracene	ug/l	< 5				< 5		33.4			
Benzo(a)pyrene	ug/l	< 5				< 5		< 1			
Benzo(b)fluoranthene	ug/l							< 1			
Benzo(g,h,i)perylene	ug/l	< 5				< 5		< 1			
Benzo(j)fluoranthene	ug/l							< 1			
Benzo(k)fluoranthene	ug/l	< 5				< 5		< 1			
Benzyl alcohol	ug/l										
Bis(2-chloroethyl)ether	ug/l	< 5				< 5					
Bis(2-chloroethoxy)methane	ug/l	< 5				< 5		< 1			
Bis(2-chloroisopropyl)ether	ug/l	< 5				< 5		< 1			
Bis(2-ethylhexyl)phthalate	ug/l	< 5				< 5					

Table 6.2 (Continued).

COMPOUND/1	UNITS	Date									
		MW-1 9-86	MW-1 7-89	MW-2 9-86	MW-2 7-89	MW-3 9-86	MW-3 7-89	MW-3 7-89	MW-4 9-86	MW-4 8-87	MW-4 11-87
Butyl benzyl phthalate	ug/l	< 5				< 5					
Cresols (methyl phenols)	ug/l										
Chrysene	ug/l	< 5				< 5		< 1			
Dibenzofuran	ug/l	< 5				< 5					
Dibenzo(a,h)anthracene	ug/l							< 1			
Dibenzo(a,j)acridine	ug/l							< 1			
Dibenzo(a,e)pyrene	ug/l							< 1			
Dibenzo(a,h)pyrene	ug/l							< 1			
Dibenzo(a,i)pyrene	ug/l							< 1			
Diethyl phthalate	ug/l										
Dimethyl phthalate	ug/l	< 5				< 5					
Di-n-butyl phthalate	ug/l	< 5				< 5					
Di-n-octyl phthalate	ug/l	< 5				< 5					
Fluoranthene	ug/l	< 5				< 5		< 1			
Fluorene	ug/l	< 5				< 5		< 1		< 10	
Hexachlorobenzene	ug/l	< 5				< 5					
Hexachlorobutadiene	ug/l	< 5				< 5					
Hexachloroethane	ug/l	< 5				< 5					
Hexachlorocyclopentadiene	ug/l	< 5				< 5					
Indeno(1,2,3-cd)pyrene	ug/l	< 5				< 5		< 1			
Isophorone	ug/l	< 5				< 5					
Naphthalene	ug/l	< 5				< 5		< 1.8		< 10	
Nitrobenzene	ug/l	< 5				< 5					
N-nitrosodipropylamine	ug/l	< 5				< 5					
N-nitrosodiphenylamine	ug/l	< 5				< 5					
Pentachlorophenol	ug/l	< 5		< 5		< 5	< 50		< 5		
Phenanathrene	ug/l	< 5				< 5		< 1			
Phenol	ug/l	< 5		< 5		< 5	< 10		< 5		
Pyrene	ug/l	< 5				< 5		25.4			
1,2-Dichlorobenzene	ug/l	< 5		< 2		< 5			< 20		
1,3-Dichlorobenzene	ug/l	< 5		< 2		< 5			< 20		
1,4-Dichlorobenzene	ug/l	< 5		< 2		< 5			< 20		

Source: Evaporation Ponds Special Analysis. Scientific Laboratory, June 01, 1988; April 27, 1987; August 12, 1987; November 12, 1987
Evaporation Ponds Special Analysis. Rocky Mountain Laboratories, March 16, 1988; June 22, 1988
Evaporation Ponds Special Analysis. Inter-mountain Laboratories, July 25, 1989; July 26, 1989
Evaporation Ponds Special Analysis. Ana-Lab, July 25, 1989; July 26, 1989
Evaporation Ponds Special Analysis. ENESCO, June 22, 1989

1/ Blanks designate components for which no analyses were requested.

Table 6.2 (Continued).

Monitor Well Number
Date

COMPOUND/1	UNITS	MW-4 3-88	MW-4 6-89	MW-4 7-89	MW-4 7-89	MW-5 9-86	MW-5 8-87	MW-5 11-87	MW-5 7-89	MW-5 7-89	MW-6 9-86
1,2,4-Tricholorobenzene	ug/l										< 5
2,4,5-Trichlorophenol	ug/l										
2,4,6-Trichlorophenol	ug/l			< 10	< 1	< 5			< 10		
2,4-Dichlorophenol	ug/l			< 10	< 1	< 5			< 10		
2,4-Dimethylphenol	ug/l			< 10	59	< 5			< 10		
2,4-Dinitrophenol	ug/l			< 50	< 15	< 10			< 50		
2,4-Dinitrotoluene	ug/l										< 5
2,6-Dichlorophenol	ug/l				< 1						
2,6-Dinitrotoluene	ug/l										< 5
2-Chloronaphthalene	ug/l			< 10							< 5
2-Chlorophenol	ug/l			< 10	3.1	< 5			< 10		
2-Cylohexyl-4,6-dinitrophenol	ug/l				< 1						
2-Methyl-4,6-dinitrophenol	ug/l			< 50	< 15				80		
2-Methylnaphthalene	ug/l										< 5
2-Methylphenol	ug/l					< 5					
2-Nitroaniline	ug/l										
2-Nitrophenol	ug/l			< 10	< 1	< 5			< 10		
3,3'-Dichlorobenzidine	ug/l										< 20
3-Methylcholanthrene	ug/l				< 1					< 1	
3-Nitroaniline	ug/l										
4,6-Dinitro-2-methylphenol	ug/l										
4-Bromophenyl phenyl ether	ug/l										
4-Chloroaniline	ug/l										
4-Chlorophenyl phenyl ether	ug/l										< 5
4-Chloro-3-methylphenol	ug/l			< 20	< 1				< 20		
4-Methylphenol	ug/l					< 5					
4-Nitroaniline	ug/l										
4-Nitrophenol	ug/l			< 50	30	< 10			< 50		
7H-Dibenzo(c,g)carbazole	ug/l				< 1					< 1	
Acenaphthene	ug/l	< 10		< 10	<1.8					<1.8	< 5
Acenaphthylene	ug/l	< 10		< 10	<2.3					<2.3	< 5
Anthracene	ug/l	< 10			< 1					< 1	< 5
Benzoic acid	ug/l										
Benzo(a)anthracene	ug/l	< 10		< 10	< 1					< 1	< 5
Benzo(a)pyrene	ug/l	< 10		< 10	< 1					< 1	< 5
Benzo(b)fluoranthene	ug/l	< 10		< 10	< 1					< 1	
Benzo(g,h,i)perylene	ug/l	< 10		< 10	< 1					< 1	< 5
Benzo(j)fluoranthene	ug/l				< 1					< 1	
Benzo(k)fluoranthene	ug/l	< 10		< 10	< 1					< 1	< 5
Benzyl alcohol	ug/l										
Bis(2-chloroethyl)ether	ug/l										< 5
Bis(2-chloroethoxy)methane	ug/l				< 1					< 1	< 5
Bis(2-cloroisopropyl)ether	ug/l				< 1					< 1	< 5
Bis(2-ethylhexyl)phthalate	ug/l										< 5

Table 6.2 (Continued).

COMPOUND/1	UNITS	Monitor Well Number Date				
		MW-6 7-89	MW-6 7-89	MW-7 9-86	MW-7 7-89	MW-7 7-89
1,2,4-Tricholorobenzene	ug/l					
2,4,5-Trichlorophenol	ug/l					
2,4,6-Trichlorophenol	ug/l	< 10		< 5	< 10	
2,4-Dichlorophenol	ug/l	< 10		< 5	< 10	
2,4-Dimethylphenol	ug/l	< 10		< 5	< 10	
2,4-Dinitrophenol	ug/l	< 50		< 10	< 50	
2,4-Dinitrotoluene	ug/l					
2,6-Dichlorophenol	ug/l					
2,6-Dinitrotoluene	ug/l					
2-Chloronaphthalene	ug/l					
2-Chlorophenol	ug/l	< 10		< 5	< 10	
2-Cylohexyl-4,6-dinitrophenol	ug/l					
2-Methyl-4,6-dinitrophenol	ug/l	< 50			< 50	
2-Methylnaphthalene	ug/l					
2-Methylphenol	ug/l			< 5		
2-Nitroaniline	ug/l					
2-Nitrophenol	ug/l	< 10		< 5	< 10	
3,3'-Dichlorobenzidine	ug/l					
3-Methylcholanthrene	ug/l		< 1			< 1
3-Nitroaniline	ug/l					
4,6-Dinitro-2-methylphenol	ug/l					
4-Bromophenyl phenyl ether	ug/l					
4-Chloroaniline	ug/l					
4-Chlorophenyl phenyl ether	ug/l					
4-Chloro-3-methylphenol	ug/l	< 20			< 20	
4-Methylphenol	ug/l			< 5		
4-Nitroaniline	ug/l					
4-Nitrophenol	ug/l	< 50		< 10	< 50	
7H-Dibenzo(c,g)carbazole	ug/l		< 1			< 1
Acenaphthene	ug/l		14.3			<1.8
Acenaphthylene	ug/l		12.9			<2.3
Anthracene	ug/l		< 1			< 1
Benzoic acid	ug/l					
Benzo(a)anthracene	ug/l		< 1			< 1
Benzo(a)pyrene	ug/l		< 1			< 1
Benzo(b)fluoranthene	ug/l		< 1			< 1
Benzo(g,h,i)perylene	ug/l		< 1			< 1
Benzo(j)fluoranthene	ug/l		< 1			< 1
Benzo(k)fluoranthene	ug/l		< 1			< 1
Benzyl alcohol	ug/l					
Bis(2-chloroethyl)ether	ug/l					
Bis(2-chloroethoxy)methane	ug/l		< 1			
Bis(2-chloroisopropyl)ether	ug/l		< 1			
Bis(2-ethylhexyl)phthalate	ug/l					

Table 6.2 (Continued).

COMPOUND/1	UNITS	Monitor Well Number Date MW-6 7-89	MW-6 7-89	MW-7 9-86	MW-7 7-89	MW-7 7-89
Butyl benzyl phthalate	ug/l					
Cresols (methyl phenols)	ug/l					
Chrysene	ug/l		< 1			< 1
Dibenzofuran	ug/l					
Dibenzo(a,h)anthracene	ug/l		< 1			< 1
Dibenzo(a,j)acridine	ug/l		< 1			< 1
Dibenzo(a,e)pyrene	ug/l		< 1			< 1
Dibenzo(a,h)pyrene	ug/l		< 1			< 1
Dibenzo(a,i)pyrene	ug/l		< 1			< 1
Diethyl phthalate	ug/l					
Dimethyl phthalate	ug/l					
Di-n-butyl phthalate	ug/l					
Di-n-octyl phthalate	ug/l					
Fluoranthene	ug/l		94.1			< 1
Fluorene	ug/l		< 1			< 1
Hexachlorobenzene	ug/l					
Hexachlorobutadiene	ug/l					
Hexachloroethane	ug/l					
Hexachlorocyclopentadiene	ug/l					
Indeno(1,2,3-cd)pyrene	ug/l		< 1			< 1
Isophorone	ug/l					
Naphthalene	ug/l		114			<1.8
Nitrobenzene	ug/l					
N-nitrosodipropylamine	ug/l					
N-nitrosodiphenylamine	ug/l					
Pentachlorophenol	ug/l			< 5		
Phenanathrene	ug/l		206			< 1
Phenol	ug/l			< 5		
Pyrene	ug/l		< 1			12.5
1,2-Dichlorobenzene	ug/l			2		
1,3-Dichlorobenzene	ug/l			2		
1,4-Dichlorobenzene	ug/l			2		

Table 6.5 Evaporation Ponds - Soils Analytical Results, Semivolatiles, RFI Phase I Report, Navajo Refining Company, October 1990.

COMPOUND	UNITS	-- Sample Number -- NEP-SS-001-01 (Surface Sediment Samples)	NEP-SS-002-01
Bis(2-ethylhexyl)phthalate	mg/kg	0.95	0.66

1/ Blanks and all other analyses were below reported limits.

Table 6.6 Evaporation Ponds - Soils Analytical Results, Metals and Oil and Grease, RFI Phase I Report, Navajo Refining Company, October 1990.

METAL	UNITS	NEP-SS-001-01	NEP-SS-002-01	NEP-SS-003-01	NEP-SS-004-01	NEP-SS-005-01	NEP-SS-006-01
		Sample Number (Surface Sediment Samples)					
Antimony	mg/kg	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Arsenic	mg/kg	3.32	2.74	1.02	2.13	14.1	2.21
Barium	mg/kg	165	210	140	133	241	159
Beryllium	mg/kg	0.41	0.47	< 0.30	< 0.30	0.59	< 0.30
Cadmium	mg/kg	2.7	2.6	1.6	0.94	4.4	1.49
Chromium	mg/kg	23.6	10	5.6	4	259	6.39
Lead	mg/kg	20.6	7.93	5.72	4.14	90.6	3.47
Mercury	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05	0.23	< 0.05
Nickel	mg/kg	8.6	10.7	5.7	3.2	11.9	7.18
Selenium	mg/kg	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Silver	mg/kg	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Zinc	mg/kg	27.9	24.7	16.1	11.8	109	16.2
Oil and Grease	percent	0.062	0.712	0.01	0.013	0.412	0.068

Table 6.10 Evaporation Ponds - Ground Water Analytical Results, Volatiles, RFI Phase I Report, Navajo Refining Company, October 1990.

		Well Number						
		NEP-GW-005-01	NEP-GW-005-01	NEP-GW-008-01	NEP-GW-008-01	NEP-GW-010-01	NEP-GW-010-01	NEP-GW-021-01
COMPOUND	UNITS	MW-3	Lab. Dup.	MW-6	Lab. Dup.	MW-4	Lab. Dup.	OCD-8
Benzene	ug/l	41			41			
Toluene	ug/l			13	14			
Ethylbenzene	ug/l			11	11	32	31	
Xylenes	ug/l			19	18	23	23	
2-Hexanone	ug/l	14	26	23	18			12

1/ Blanks and all other analyses were below reported limits.

Table 6.11 Evaporation Ponds - Ground Water Analytical Results, Semivolatiles, RFI Phase I Report, Navajo Refining Company, October 1990.

		Sample Number Monitor Well									
COMPOUND	UNITS	NEP-GW-002-01 OCD-7	NEP-GW-005-01 MW-3	NEP-GW-005-01 Lab. Dup.*	NEP-GW-008-01 MW-6	NEP-GW-008-01 Lab. Dup.	NEP-GW-009-01 MW-7	NEP-GW-009-01 Lab. Dup.	NEP-GW-010-01 MW-4	NEP-GW-010-01 Lab. Dup.	NEP-GW-011-01 MW-5
Bis(2-chloroisopropyl)ether	ug/l			63	22	36					
Bis(2-ethylhexyl)phthalate	ug/l	44	22	31	20	20	17	18	11	10	16
Di-n-butyl phthalate	ug/l									31	
Diethylphthalate	ug/l									140	

1/ Blanks and all other analyses were below reported limits.

* Sample analysis was duplicated in the laboratory.

Table 6.11 (Continued).

COMPOUND	UNITS	NEP-GW-019-01 OCD-5	NEP-GW-019-01 Lab. Dup.*	NEP-GW-020-01 EPA-1	NEP-GW-020-01 Lab. Dup.	NEP-GW-021-01 OCD-8	NEP-GW-021-01 Lab. Dup.	NEP-GW-022-01 OCD-6	NEP-GW-022-01 Lab. Dup.
		Sample Number Monitor Well							
Bis(2-ethylhexyl)phthalate	ug/l	16	13	14	16	26	11	18	24
Di-n-butyl phthalate	ug/l	31							

1/ Blanks and all other analyses were below reported limits.

* Sample analysis was duplicated in the laboratory.

Table 6.12 Evaporation Ponds - Ground Water Analytical Results, Metals, RFI Phase I Report, Navajo Refining Company, October 1990.

		Sample Number Monitor Well								
		NEP-GW-001-01	NEP-GW-002-01	NEP-GW-004-01	NEP-GW-005-01	NEP-GW-008-01	NEP-GW-009-01	NEP-GW-010-01	NEP-GW-011-01	
METAL	UNITS	OCD-3	OCD-7	Windmill	MW-3	MW-6	MW-7	MW-4	MW-5	
Antimony	mg/l	< 0.01	< 0.01	< 0.01	< 0.10	<.1	<0.01	<.1	<.1	
Arsenic	mg/l	< 0.01	0.05	< 0.01	0.11	0.056	0.09	0.22	0.14	0.05
Barium	mg/l	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.14	0.07	2
Beryllium	mg/l	< 0.01	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	
Cadmium	mg/l	0.025	< 0.001	< 0.001	<0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.005
Chromium	mg/l		< 0.01	< 0.01	0.01	0.01	0.02	0.02	0.04	0.1
Lead	mg/l	< 0.01	0.01	< 0.01	< 0.01	< 0.01	0.117	< 0.01	< 0.01	0.015
Mercury	mg/l	< 0.001	< 0.001	< 0.001	<0.001	< 0.001	< 0.001	< 0.001	< 0.001	
Nickel	mg/l	0.01	0.02	< 0.01	0.01	< 0.01	0.01	0.07	0.07	0.1
Selenium	mg/l	< 0.01	< 0.01	< 0.01	<0.05	<0.05	<0.05	<=0.05	<0.05	
Silver	mg/l	0.02	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.03	0.1
Zinc	mg/l	0.073	0.037	0.038	<0.01	<0.01	<0.01	<0.01	0.03	5

1/ Blanks represent metals for which no analyses were requested.

Table 6.12 (Continued).

		Sample Number Monitor Well									
		NEP-GW-012-01	NEP-GW-013-01	NEP-GW-014-01	NEP-GW-015-01	NEP-GW-017-01	NEP-GW-018-01	NEP-GW-019-01	NEP-GW-020-01	NEP-GW-021-01	NEP-GW-022-01
METAL	UNITS	MW-1	MW-2	OCD-1	OCD-1	OCD-2	OCD-4	OCD-5	EPA-1	OCD-8	OCD-6
Antimony	mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Arsenic	mg/l	0.02	0.19	0.21	0.21	<0.005	0.005	0.23	0.012	0.11	0.12
Barium	mg/l	0.06	0.05	0.08	0.1	0.02	0.06	0.07	0.25	0.15	0.56
Beryllium	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002
Cadmium	mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chromium	mg/l	1	0.18	0.03	0.07	0.02	0.02	0.02	<0.01	0.02	0.04
Lead	mg/l	<0.01	0.027	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.048
Mercury	mg/l	<0.001	<0.001	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	mg/l	0.13	0.07	0.05	0.07	0.08	0.11	0.06	0.02	0.04	0.07
Selenium	mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Silver	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02
Zinc	mg/l	<0.01	<0.01	<0.01	<0.01	0.045	<0.01	<0.01	<0.01	0.02	0.15

Table 6.13 Evaporation Ponds - Ground Water Analytical Results, Inorganics, RFI Phase I Report, Navajo Refining Company, October 1990.

		Sample Number Monitor Well									
COMPONENT	UNITS	NEP-GW-001-01 OCD-3	NEP-GW-002-01 OCD-7	NEP-GW 004-01 Windmill	NEP-GW-005-01 MW-3	NEP-GW-008-01 MW-6	NEP-GW-009-01 MW-7	NEP-GW-010-01 MW-4	NEP-GW-011-01 MW-5	NEP-GW-012-01 MW-1	NEP-GW-013-01 MW-2
Bicarbonate	mg/l	236	567	167				245	413	421	478
Chloride	mg/l	5000	1910	1240				2130	5110	4180	2410
Fluoride	mg/l	1.41	2.44	1.31				1.75	6.15	1.7	6.77
Sulfate	mg/l	954	954	1010				2020	3530	2390	2710
Total Dissolved Solids	mg/l	11400	9360	4800	601	4540	1120	4060	15800	11400	6240

1/ Blanks designate components for which no analyses were performed.

Table 6.13 (Continued).

		Sample Number Monitor Well							
COMPONENT	UNITS	NEP-GW-014-01 OCD-1	NEP-GW-015-01 OCD-1	NEP-GW-017-01 OCD-2	NEP-GW-018-01 OCD-4	NEP-GW-019-01 OCD-5	NEP-GW-020-01 EPA-1	NEP-GW-021-01 OCD-8	NEP-GW-022-01 OCD-6
Bicarbonate	mg/l	504	472	511	255	181	181	490	424
Chloride	mg/l	2130	2570	4890	5600	4960	950	2550	3760
Fluoride	mg/l	5.56	4.12	1.82	1.58	1.58	1.1	1.12	1.66
Sulfate	mg/l	2760	2130	3870	2870	2770	1220	2240	2610
Total Dissolved Solids	mg/l	8760	8410	10100	9930	8780	3570	8640	426

Table 6.14 Evaporation Ponds - Aquifer Parameters, RFI Phase I Report, Navajo Refining Company, October 1990.

Well Number	Assumed Aquifer Thickness (ft)	Hydraulic Conductivity (k) (ft/sec)	Average Ground Water Velocity (v) (ft/yr)
MW-4	200	1.15×10^{-4}	
MW-4	100	1.17×10^{-4}	18.45
MW-4	200	8.27×10^{-5}	13.04
MW-4	100	8.41×10^{-5}	13.26
MW-6	200	3.07×10^{-4}	48.41
MW-6	100	3.12×10^{-4}	49.19
MW-6	200	4.56×10^{-5}	7.19
MW-6	100	4.61×10^{-5}	7.27
MW-7	200	3.06×10^{-5}	4.83
MW-7	100	3.10×10^{-5}	4.89
MW-7	200	1.26×10^{-5}	1.99
MW-7	100	1.27×10^{-5}	2.00
OCD-3	200	2.27×10^{-5}	3.58
OCD-3	100	2.30×10^{-5}	3.63
OCD-3	200	2.62×10^{-5}	4.13
OCD-3	100	2.66×10^{-5}	4.19
EPA-1	200	2.90×10^{-5}	4.57
EPA-1	100	3.06×10^{-5}	4.83
EPA-1	200	2.18×10^{-5}	3.47
EPA-1	100	2.30×10^{-5}	3.63

Appendix A-2

Phase II Data Summaries

Table 4. RFI Phase II soil sampling, Three-Mile Ditch — oil and grease and volatile organic compounds (mg/kg).

Sample	Sample depth (ft)	Oil and grease (%)	Acetone	Benzene	Ethyl-benzene	Methylene chloride	Toluene	Xylenes (total)
BG-TR-001-01	5	<0.05	NA	NA	NA	NA	NA	NA
BG-TR-001-02	8	0.17	NA	NA	NA	NA	NA	NA
TMD-TR-001-01	4.5	0.72	< 0.695	< 0.348	5.55	< 0.348	2.48	13.6
TMD-TR-001-02	9	0.05	< 0.631	< 0.316	2.32	< 0.316	0.798	4.84
TMD-TR-001-03	14	<0.05	< 0.014	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007
TMD-TR-001-04	8	<6	< 0.013	< 0.006	< 0.006	< 0.006	< 0.006	< 0.006
TMD-TR-002-01	4.5	0.68	< 0.429	2.68	16	< 0.214	12	36.3
TMD-TR-002-02	7.5	0.68	< 1.25	< 0.625	< 0.625	< 0.625	< 0.625	< 0.625
TMD-TR-002-03	11	<0.05	< 0.620	< 0.310	1.34	< 0.310	< 0.310	3.35
TMD-TR-003-01	8.5	<0.05	< 0.013	< 0.006	< 0.006	< 0.006	< 0.006	< 0.006
TMD-TR-003-02	11	<0.05	<0.012	< 0.006	< 0.006	< 0.006	< 0.006	< 0.006
TMD-TR-003-03	5.5	6.09	< 0.279	< 0.140	2.12	< 0.140	0.192	6.46
TMD-TR-004-01	3.5	0.22	0.463	< 0.032	0.054	< 0.032	< 0.032	0.15
TMD-TR-004-02	6.5	0.05	0.035	< 0.007	< 0.007	0.04	< 0.007	< 0.007
TMD-TR-004-03	8.5	0.05	< 0.013	< 0.007	< 0.007	0.245	< 0.007	< 0.007

NA = not analyzed.

Table 5. RFI Phase II soil sampling, Three-Mile Ditch — semivolatile organic compounds (mg/kg).

Sample	Di-n-butyl phthalate	Fluorene	2-methyl-naphthalene	Phenanthrene
BG-TR-001-01	NA	NA	NA	NA
BG-TR-001-02	NA	NA	NA	NA
TMD-TR-001-01	< 42.4	22.5	20	77.5
TMD-TR-001-02	2.6	< 0.6	< 0.6	1.1
TMD-TR-001-03	1.7	< 0.7	< 0.7	< 0.7
TMD-TR-001-04	< 1.6	< 0.6	< 0.6	< 0.6
TMD-TR-002-01	< 340	< 140	< 140	234
TMD-TR-002-02	< 110	< 45	< 45	< 45
TMD-TR-002-03	1.8	< 0.4	< 0.4	< 0.4
TMD-TR-003-01	6.6 J	< 0.4	< 0.4	< 0.4
TMD-TR-003-02	2.2	< 0.5	< 0.5	< 0.5
TMD-TR-003-03	< 590	< 240	< 240	310
TMD-TR-004-01	< 22	< 8.7	< 8.7	< 8.7
TMD-TR-004-02	4.2	< 0.7	< 0.7	< 0.7
TMD-TR-004-03	1.9	< 0.6	< 0.6	< 0.6

NA = not analyzed.

Table 6. RFI Phase II soil sampling, Three-Mile Ditch — pH, electrical conductivity, and total metals concentrations (mg/kg).

Sample	Sample depth (ft)	pH	Electrical conductivity (mmhos/cm)	Arsenic	Chromium	Lead	Nickel	Zinc
BG-TR-001-01	5	8.2	8.1	1.3	10	6	1	23
BG-TR-001-02	8	7.8	12.4	2.1	13	7	12	34
TMD-TR-001-01	4.5	8.6	6.0	7.1	40	19	30	68
TMD-TR-001-02	9	7.7	5.6	10.6	16	7	12	38
TMD-TR-001-03	14	7.8	3.7	3.6	40	16	25	122
TMD-TR-001-04	8	7.7	6.7	1.8	14	2	5	12
TMD-TR-002-01	4.5	9.3	4.4	18.1	148	55	41	170
TMD-TR-002-02	7.5	7.4	7.4	9.2	32	23	32	83
TMD-TR-002-03	11	7.5	6.5	5.6	28	12	28	68
TMD-TR-003-01	8.5	7.6	1.7	4.8	15	5	17	15
TMD-TR-003-02	11	7.6	1.8	2.2	7	<1.0	11	13
TMD-TR-003-03	5.5	7.2	5.8	2.7	33	163	191	222
TMD-TR-004-01	3.5	8.8	3.9	2.2	34	13	26	80
TMD-TR-004-02	6.5	7.9	4.2	10.2	22	8	28	47
TMD-TR-004-03	8.5	7.7	3.1	16.1	14	7	18	33

Table A-2-1. Summary of Navajo Three-Mile Ditch RFI Phase II groundwater volatile/semivolatile sample analyses

		Volatile Organics (mg/l)						Semivolatile Organics
Sample ID	**Date**	**Benzene**	**Toluene**	**Ethyl-benzene**	**Xylenes (total)**	**Methyl ethyl ketone**	**Carbon Disulfide**	
MW-45	14-Nov-92	< 0.005	< 0.005	< 0.005	< 0.013	< 0.010	< 0.034	< 0.010

Notes:
Analysis by Inter-Mountain Laboratories, College Station, Texas
All semivolatile constituents that were evaluated were less than the reported detection limits presented in the table.
Health and Groundwater Standards:
EPA MCL: Benzene, 0.005 mg/L; ethylbenzene, 0.70 mg/L; toluene, 1.0 mg/L; xylenes, 10.0 mg/L.
NM WQCC: Benzene, 0.010 mg/L; ethylbenzene, 0.75 mg/L; toluene, 0.75 mg/L; xylenes, 0.62 mg/L.

Table 11. Results of metals analyses (mg/L), Three-Mile Ditch groundwater sampling, Navajo Refinery, RFI Phase II.

Well sample identification	Lab number	Date sampled	TAS [a]	TAS [b]	TAS [c]	DAS [d]	TCR [e]	DCR [f]	TPB [g]	DPB [h]	TNI [i]	TNI [j]	DNI [k]	pH	EC [l]
TMD-GW-MW-45	C922354/15667	11/14/92	0.009	0.008	0.011	0.008	0.03	ND	0.05	ND	0.10	ND	0.09	7.1	5050
TMD-GW-MW-45	W09083/G02747	10/29/93	0.007				0.03		0.05		0.04				
TMD-GW-MW-46	C922359/15671	11/15/92	0.010	0.008	NV	ND	0.02	ND	ND	ND	0.12	NV	0.09	6.9	5890
TMD-GW-MW-46	W09084/G02748	11/01/93	0.006				ND		0.01		0.01				
TMD-GW-MW-20	C930223/W00269	1/26/93	0.008	0.007	NV	0.005	ND	ND	ND	ND	0.03	NV	ND	7.5	8510
TMD-GW-MW-08	C922352/15665	11/14/92	0.014	0.014	0.027	ND	2.26	ND	ND	ND	0.74	0.71	0.36	7.0	6510
TMD-GW-MW-21	C930224/W00270	1/26/93	0.005	ND	NV	ND	ND	ND	ND	ND	ND	NV	ND	7.2	6380
TMD-GW-MW-09	C922353/15666	11/14/92	0.021	0.025	0.015	ND	18.42	0.03	ND	ND	8.04	9.02	2.60	6.6	6720
TMD-GW-MW-16	C930211/W00190	1/26/93	ND	NV	NV	ND	ND	ND	ND	ND	0.03	NV	0.01	7.5	4870
NEP-GW-MW-01-01	C922278/15632	11/10/92	0.020	0.023	0.010	ND	3.65	ND	ND	ND	0.35	0.22	0.20	7.5	14900
NEP-GW-MW-01-01	C922278/15635 (DUP)	11/10/92	0.022	NV	NV	ND	3.62	ND	ND	ND	0.34	NV	0.18	7.5	14900
NEP-GW-MW-15	C930105/W00055	1/20/93	0.010	0.006	NV	0.006	0.03	ND	ND	ND	ND	NV	ND	7.5	3590

Key:	Test description/method	Detection limits
a	Total arsenic — Method 7061	0.005
b	Total arsenic — Method 7061 — verification	0.005
c	Total arsenic — Method 7060 — verification	0.005
d	Dissolved arsenic — Method 701	0.01
e	Total chromium — Method 7191	0.02
f	Dissolved chromium — Method 7191	0.02
g	Total lead — Method 7421	0.02 (0.01, 10/29/93 sample event)
h	Dissolved lead — Method 7421	0.02
i	Total nickel — Method 7520	0.01
j	Total nickel — Method 7520 — verification	0.05
k	Dissolved nickel — Method 7250	0.01
l	Electrical conductivity, µmhos/cm @ 25_C	

ND = Not detected.
NV = No verification test.

Standards	EPA Drinking Water (mg/L)	NMWQCC Groundwater
As	0.05	0.1
Cr	0.1	0.05
Pb	0.015 (Action level)	0.05
Ni	0.1	0.2 (irrigation)

Table 12. Results of inorganic water quality analyses, groundwater sampling of Three-Mile Ditch, Navajo Refinery RFI, Phase II.

Well sample ID	Laboratory no.	Date sampled	Detection level Units	pH (Laboratory)	Electrical conductivity at 25°C (Laboratory)	Total dissolved solids at 180°C	Total dissolved solids (calc)	Total alkalinity	Total hardness	Fluoride	Calcium	Calcium	Magne-sium	Magne-sium	Potas-sium	Potas-sium
				0.1 (s.u.)	1 (μmhos/cm)	1 (mg/L)	1 mg/l	1 (mg/L)	1 (mg/L)	0.1 (mg/L)	1 (mg/L)	(meq/L)	1 (mg/L)	(meq/L)	1 (mg/L)	(meq/L)
NEP-GW-MW-01-01	C922278/15632	10-Nov-92		7.5	14900	11200	10500	406	3880	1.1	764	38.12	480	39.47	14.0	0.36
NEP-GW-MW-01-01	C922278/15635	10-Nov-92		7.5	14900	11300	NA	408	NA	1.1	769	NA	480	NA	16.0	NA
(Lab Dup)	C922278/15635	10-Nov-92		7.5	14900	11300	NA	408	NA	1.1	769	NA	480	NA	16.0	NA
TMD-GW-MW-08	C922352/15665	14-Nov-92		7.0	6510	6120	5490	312	3270	2.2	574	28.64	446	36.68	4.4	0.10
TMD-GW-MW-09	C922353/15666	14-Nov-92		6.6	6720	6270	5640	252	3280	2.3	608	30.34	428	35.20	4.8	0.13
TMD-GW-MW-15	C930105/W00055	20-Jan-93		7.5	3590	2790	2670	150	1190	1.1	308	15.37	102	8.39	11.0	0.28
TMD-GW-MW-16	C930211/W00190	26-Jan-93		7.5	4870	4250	2910	307	1600	2.2	257	12.82	232	19.08	15.0	0.38
TMD-GW-MW-20	C930223/W00269	26-Jan-93		7.5	8510	8460	7680	359	4560	3.5	470	23.45	824	67.76	8.0	0.20
TMD-GW-MW-21	C930224/W00270	26-Jan-93		7.2	6380	6140	5560	313	3420	2.1	603	30.09	466	38.32	9.0	0.23
TMD-GW-MW-45	C922354/15667	14-Nov-92		7.1	5050	3740	3740	330	2130	2.5	477	23.80	228	18.75	11.0	0.28
TMD-GW-MW-46	C922359/15671	15-Nov-92		6.9	5890	5210	4750	375	2640	2.9	495	24.70	341	28.04	5.6	0.13
NMD-EC-SW-1	C922349/15663	14-Nov-92		7.7	6840	6510	5930	306	3520	2.7	565	28.19	512	42.11	3.9	0.10

Table 12. Continued.

				Sodium	Sodium	HCO_3	HCO_3	CO_3	CO_3	OH	OH	Chloride	Chloride	SO_4	SO_4	Cation sum	Anion sum	Percent difference
Well sample ID	Laboratory no.	Date sampled	Detection level Units	1 (mg/L)	(meq/L)	1 (mg/L)	(meq/L)	1 (mg/L)	(meq/L)	1 (mg/L)	(meq/L)	1 (mg/L)	(meq/L)	1 (mg/L)	(meq/L)	(meq)	(meq)	(%)
NEP-GW-MW-01-01	C922278/15632	10-Nov-92		2130	92.65	495	8.11	0	0.00	0	0.00	3750	105.78	3020	62.88	170.60	176.77	-1.78
NEP-GW-MW-01-01	C922278/15635	10-Nov-92		2130	NA	NA	NA	NA	NA	NA	NA	3740	NA	3010	NA	NA	NA	NA
(Lab Dup)	C922278/15635	10-Nov-92		2130	NA	NA	NA	NA	NA	NA	NA	3740	NA	3010	NA	NA	NA	NA
TMD-GW-MW-08	C922352/15665	14-Nov-92		453	19.70	380	6.23	0	0.00	0	0.00	550	15.51	3280	68.29	85.12	90.03	-2.80
TMD-GW-MW-09	C922353/15666	14-Nov-92		498	21.66	307	5.03	0	0.00	0	0.00	616	17.38	3330	69.33	87.33	91.74	-2.46
TMD-GW-MW-15	C930105/W00055	20-Jan-93		447	19.44	182	2.98	0	0.00	0	0.00	564	15.91	1150	23.94	43.48	42.83	0.75
TMD-GW-MW-16	C930211/W00190	26-Jan-93		403	17.53	375	6.15	0	0.00	0	0.00	457	12.89	1360	28.32	49.81	47.36	2.52
TMD-GW-MW-20	C930223/W00269	26-Jan-93		752	32.71	438	7.18	0	0.00	0	0.00	552	15.57	4860	101.19	124.12	123.94	0.07
TMD-GW-MW-21	C930224/W00270	26-Jan-93		432	18.79	381	6.25	0	0.00	0	0.00	518	14.61	3340	69.54	87.43	90.40	-1.67
TMD-GW-MW-45	C922354/15667	14-Nov-92		372	16.18	402	6.59	0	0.00	0	0.00	671	18.93	1780	37.06	59.01	62.58	-2.94
TMD-GW-MW-46	C922359/15671	15-Nov-92		471	20.49	458	7.51	0	0.00	0	0.00	636	17.94	2580	53.72	73.36	79.17	-3.81
NMD-EC-SW-1	C922349/15663	14-Nov-92		489	21.27	373	6.11	0	0.00	0	0.00	540	15.23	3630	75.58	91.67	96.92	-2.78

Table 14. Results of metals analyses (mg/L), groundwater sampling of domestic wells near Three-Mile Ditch, Navajo Refinery, RFI Phase II.

Well sample identification	Laboratory number	Date sampled Detection level	Total As 0.005	Total Cr 0.02	Total Pb 0.02	Total Ni 0.01
TMD-GW-3282-1 (Simmons)	C922346/15660	15-Nov-92	ND	ND	ND	0.07
TMD-GW-3368-1 (Chase Farms)	C922347/15661	14-Nov-92	ND	ND	ND	0.06
TMD-GW-6650-1 (McLurg)	C922348/15662	14-Nov-92	ND	ND	ND	0.06

Table 15. Results of inorganic water quality analyses, groundwater sampling of domestic wells near Three-Mile Ditch, Navajo Refinery, RFI Phase II.

				pH (Laboratory)	Electrical Conductivity at 25°C (Laboratory)	Total dissolved solids at 180°C	Total calcium	Total alkalinity	Total hardness	Flouride	Calcium	Calcium	Magne-sium	Magne-sium	Potas-sium	Potas-sium
Well sample ID	Laboratory no.	Date sampled	Detection Level Units	0.1 (s.u.)	1 (µmhos/cm)	1 (mg/L)	1 (mg/L)	1 (mg/L)	1 (mg/L)	0.1 (mg/L)	1 (mg/L)	(meq/L)	1 (mg/L)	(meq/L)	1 (mg/L)	(meq/L)
TMD-GW-3282-1 (Simmons)	C922346/15660	15-Nov-92		7.4	1620	1250	1170	149	837	0.8	225	11.23	67	5.51	5.2	0.13
TMD-GW-3368-1 (Chase Farms)	C922347/15661	14-Nov-92		7.0	3790	3090	2870	179	1880	0.6	483	24.10	163	13.40	4.1	0.13
TMD-GW-6650-1 (McLurg)	C922348/15662	14-Nov-92		7.2	4320	3800	3580	164	2230	0.5	637	31.79	156	12.83	4.9	0.13

Table 15. Continued.

Well sample ID	Laboratory no.	Date sampled	Detection Level Units	Sodium	Sodium	HCO_3	HCO_3	CO_3	CO_3	OH	OH	Chloride	Chloride	SO_4	SO_4	Cation sum	Anion sum	Percent difference
				1 (mg/L)	(meq/L)	1 (mg/L)	(meq/L)	1 (mg/L)	(meq/L)	1 (mg/L)	(meq/L)	1 (mg/L)	(meq/L)	1 (mg/L)	(meq/L)	(meq)	(meq)	(%)
TMD-GW-3282-1 (Simmons)	C922346/15660	15-Nov-92		38	1.65	182	2.98	0	0.00	0	0.00	37	1.04	709	14.76	18.52	18.78	-0.70
TMD-GW-3368-1 (Chase Farms)	C922347/15661	14-Nov-92		190	8.26	218	3.57	0	0.00	0	0.00	390	11.00	1530	31.86	45.89	46.43	-0.58
TMD-GW-6650-1 (McLurg)	C922348/15662	14-Nov-92		272	11.83	199	3.26	0	0.00	0	0.00	304	8.58	2110	43.93	56.58	55.77	0.72

Table 16. RFI Phase II soil sampling, Evaporation Pond 1 — oil and grease and volatile organic compounds (mg/kg).

Sample	Sample depth (ft)	Oil and grease (%)	Acetone	Benzene	Ethyl-benzene	Methylene chloride	Toluene	Xylenes (total)
EP-TR-001-01	1	8.27	0.387	0.03	0.443	< 0.028	0.622	2.05
EP-TR-001-02	3	1.11	0.437	< 0.034	0.128	< 0.034	0.082	0.484
EP-TR-001-03	6	0.4	0.295	< 0.025	0.052	< 0.025	0.032	0.159
EP-TR-001-04	9	0.06	0.176	< 0.006	< 0.006	< 0.006	< 0.006	< 0.006
EP-TR-001-05	13	< 0.05	< 0.012	< 0.006	< 0.006	0.014	< 0.006	< 0.006
EP-TR-002-01	1	18.49	< 0.391	< 0.196	0.59	< 0.196	0.376	1.57
EP-TR-002-02 [b]	3	0.96	0.442	< 0.007	0.488	< 0.007	0.083	1270
EP-TR-002-03 [c]	6	0.08	0.556	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007
EP-TR-002-04	9	0.08	0.043	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008
EP-TR-002-05	13	< 0.05	< 0.014	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007
EP-TR-003-01	1	7.05	< 0.061	< 0.031	< 0.031	< 0.031	< 0.031	0.264
EP-TR-003-02	3	< 0.05	0.228	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007
EP-TR-003-03	3 (duplicate)	0.26	0.189	< 0.007	< 0.007	0.015	< 0.007	< 0.007
EP-TR-003-04	6	0.05	< 0.014	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007
EP-TR-003-05	11	<0.05	0.033	< 0.006	< 0.006	< 0.006	< 0.006	< 0.006
EP-TR-004-01	1	16.07	< 0.314	< 0.157	0.332	< 0.157	< 0.157	< 0.157
EP-TR-004-02	3	0.10	0.079	< 0.006	< 0.006	< 0.006	< 0.006	< 0.006
EP-TR-004-03	6	< 0.05	0.184	< 0.034	< 0.034	< 0.034	< 0.034	< 0.034
EP-TR-004-04	9	< 0.05	< 0.012	< 0.006	< 0.006	< 0.006	< 0.006	< 0.006
EP-TR-005-01	1	0.19	< 0.012	< 0.006	< 0.006	< 0.006	< 0.006	< 0.006
EP-TR-005-02	3	0.11	0.264	< 0.007	< 0.007	<7	< 0.007	< 0.007
EP-TR-005-03	6	0.13	0.235	< 0.007	< 0.007	91	< 0.007	< 0.007
EP-TR-005-04	9	0.10	0.172	< 0.006	< 0.006	0.122	< 0.006	< 0.006
EP-TR-006-01	1	12.56	< 0.263	< 0.132	< 0.132	< 0.132	0.147	< 0.132
EP-TR-006-02	3	0.12	0.7	< 0.032	< 0.032	0.147	< 0.032	< 0.032
EP-TR-006-03	6	0.05	0.054	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007
EP-TR-006-04	9	< 0.05	0.028	< 0.006	< 0.006	0.008	< 0.006	< 0.006
EP-TR-006-05	0-1	18.61	< 4.320	< 2.160	2.34	< 2.160	3.06	6.51

a = Trackhoe bucket grab sample of pond surface sludges adjacent to trench EP-TR-006.
b = 2-butanone (0.127 mg/kg) and carbon disulfide (0.033 mg/kg) also detected.
c = 2-butanone (146 mg/kg) also detected.

Table 17. RFI Phase II soil sampling, Evaporation Pond — pH, electrical conductivity, and total metals concentrations (mg/kg).

Sample	Sample depth (ft)	pH	Electrical conductivity (mmhos/cm)	Arsenic	Chromium	Lead	Nickel	Zinc
EP-TR-001-01	1	8.5	2.9	26.1	74	389	21	54
EP-TR-001-02	3	8.5	4.9	3.9	29	17	26	64
EP-TR-001-03	6	7.5	6.4	7.6	17	7	24	44
EP-TR-001-04	9	7.6	5.0	2.2	16	4	23	25
EP-TR-001-05	13	8.1	2.6	2.4	16	1	20	36
EP-TR-002-01	1	8.3	3.6	38.6	1011	93	37	303
EP-TR-002-02	3	8.8	2.8	1.8	19	10	21	49
EP-TR-002-03	6	7.5	6.1	8.6	17	6	24	41
EP-TR-002-04	9	7.9	5.3	4	16	5	28	37
EP-TR-002-05	13	7.9	5.3	9.9	16	6	31	42
EP-TR-003-01	1	8.1	3.1	22.6	633	73	14	434
EP-TR-003-02	3	7.8	5.8	9.1	30	14	23	57
EP-TR-003-03	3 (duplicate)	7.7	6.5	10.3	26	12	22	55
EP-TR-003-04	6	7.7	5.0	7.1	24	7	14	53
EP-TR-003-05	11	7.7	4.0	3.3	20	6	10	32
EP-TR-004-01	1	8.2	8.0	19.7	398	28	12	194
EP-TR-004-02	3	9.1	3.3	1.4	14	4	7	21
EP-TR-004-03	6	9.5	2.7	8.7	34	14	22	73
EP-TR-004-04	9	8.2	1.9	3.1	9	3	5	37
EP-TR-005-01	1	7.6	6.6	1.6	32	9	14	40
EP-TR-005-02	3	8.5	6.4	1.5	19	7	13	33
EP-TR-005-03	6	9.4	4.2	3.9	25	11	18	48
EP-TR-005-04	9	8.7	5.1	11.6	26	8	14	38
EP-TR-006-01	1	7.7	7.0	39.9	235	153	37	161
EP-TR-006-02	3	9.1	3.9	2.4	29	9	13	63
EP-TR-006-03	6	7.6	6.3	6.5	18	4	10	31
EP-TR-006-04	9	8.7	2.6	2.2	12	7	10	31
EP-TR-006-05 [a]	1	8.6	6.0	16.1	320	36	14	320

a = Trackhoe bucket grab sample of pond surface sludges adjacent to trench EP-TR-006.

Table 25. Volatile organic compounds detected during field sampling, Evaporation Pond area, Navajo Refinery, RFI Phase II.

			Acetone		Benzene		2-Butanone (MEK)		Carbon disulfide		Ethylbenzene		Methylene chloride		Toluene		Xylenes (total)	
Well ID	Laboratory	Date sampled	Result (mg/L)	PQL (mg/L)	Result (mg/L)	PQL (mg/L)	Result (mg/L)	PQL (mg/L)	Result (mg/L)	PQL (mg/L)	Result (mg/L)	PQL (mg/L)	Result (mg/L)	PQL (mg/L)	Result (mg/L)	PQL (mg/L)	Result (mg/L)	PQL (mg/L)
Evaporation Pond	C922424	11/20/92	0.092	0.010	0.043	0.005			0.032	0.005	0.016	0.005			0.061	0.005	0.045	0.005
MW-03	C922322	11/12/92			0.017	0.005					0.016	0.005			0.021	0.005	0.025	0.005
MW-04	C922333	11/12/92			0.021	0.005					0.019	0.005			0.009	0.005	0.032	0.005
MW-05A(Field Duplicate)	C922335	11/11/92			0.013	0.005					0.006	0.005			0.028	0.005	0.008	0.005
MW-06A	C922323	11/12/92									0.007	0.005			0.006	0.005	0.014	0.005
MW-06B	C930278	1/30/93			0.009	0.005	0.048	0.010	0.117	0.005					0.006	0.005		
MW-12	C922658	12/18/92											0.007	0.005				
MW-14	C922655	12/17/92											0.020	0.005				
OCD-7B	C930279	1/30/93			0.009	0.005												
Windmill	C922656	12/17/92											0.010	0.005				

PQL = Practical quantitation limit.

Table 26. Semivolatile organic compounds detected during field sampling, Evaporation pond area, Navajo Refinery, RFI Phase II.

Well ID	Laboratory number	Date sampled	B2EP Result (µg/L)	B2EP PQL (µg/L)	DNBP Result (µg/L)	DNBP PQL (µg/L)	DM24 Result (µg/L)	DM24 PQL (µg/L)
MW-2B	C922653	12/16/92	28	25				
MW-14	C922655	12/17/92			66	25		
MW-14 (Field Dup)	C922654	12/17/92			78	25		
MW-20	C930223	1/26/93			27	25		
OCD-8B	C930203	1/23/93	35	25				
OCD-8B (Field Dup)	C930204	1/23/93	21	20				
Evaporation Pond	C922424	11/20/92					180	50

PQL = Practical Quantitative Limit
B2EP = bis(2-Ethylhexyl)phthalate
DNBP = Di-n-butyl phthalate
DM24 = 2,4-Dimethylphenol
MN1 = 1-Methylnaphthalene
MN2 = 2-Methylnaphthalene
NAPH = Naphthalene

Table 28. Results of metals analyses, Evaporation Ponds, Navajo Refinery, RFI Phase II.

Well sample identification	Laboratory number	Date samples	TAS [a]	TAS [b]	TAS [c]	DAS [d]	TCR [e]	DCR [f]	TPB [g]	DPB [h]	TNI [i]	TNI [j]	DNI [k]	pH	EC [l]
NEP-GW-EPA-1	C922391/15722	18-Nov-92	ND	ND		ND	ND	ND	ND	ND	0.08	ND	0.06	7.2	5340
NEP-GW-MW-01-01	C922278/15632	10-Nov-92	0.02	0.023	0.01	ND	3.65	ND	ND	ND	0.35	0.22	0.2	7.5	14900
NEP-GW-MW-01-01 (Lab Dup)	C922278/15635	10-Nov-92	0.022			ND	3.62	ND	ND	ND	0.34		0.18	7.5	14900
NEP-GW-MW-02A	C922280/15633	10-Nov-92	0.087	0.117	0.09	0.073	0.1	ND	ND	ND	0.12	ND	0.1	7.4	11300
NEP-GW-MW-02B	C922653/16029	16-Dec-92	ND	ND		ND	ND	ND	ND	ND	0.04		ND	7.4	3430
NEP-GW-MW-02B (Lab Dup)	C922653/16036	16-Dec-92	ND			ND	ND	ND	ND	ND	0.03		ND	7.4	3430
NEP-GW-MW-03	C922322/15647	12-Nov-92	0.078	0.096		0.054	0.03	ND	ND	ND	0.12	0.04	0.08	7.3	7220
NEP-GW-MW-04	C922333/15644	12-Nov-92	0.08	0.112	0.136	0.069	ND	ND	ND	ND	0.11	ND	0.07	7.3	7610
NEP-GW-MW-04 (Lab Dup)	C922333/15651	12-Nov-92	0.085			0.071	ND	ND	ND	ND	0.09		0.07	7.3	7620
NEP-GW-MW-05A	C922334/15645	11-Nov-92	0.074	0.089		0.063	0.03	ND	ND	ND	0.27	0.12	0.25	7.2	28000
NEP-GW-MW-05A (Fld Dup)	C922335/15646	11-Nov-92	0.077			0.062	0.02	ND	ND	ND	0.26		0.26	7.2	28100
NEP-GW-MW-05B	C930136/W00059	22-Jan-93	0.131	0.15	0.162	0.106	ND	ND	ND	ND	ND		ND	7.1	9310
NEP-GW-MW-06A	C922323/15648	12-Nov-92	0.065			0.03	0.05	ND	ND	ND	0.11	0.04	0.04	7.4	4950
NEP-GW-MW-06B	C930278/W00344	30-Jan-93	0.021	0.02		0.016	ND	ND	ND	ND	ND		ND	11.9	6410
NEP-GW-MW-07A	C922281/15634	11-Nov-92	0.038	0.037	0.05	0.03	0.07	ND	ND	ND	0.13	ND	0.09	7.2	13900
NEP-GW-MW-07B	C930106/W00056	21-Jan-93	0.014	0.013	0.016	0.011	ND	ND	ND	ND	ND		ND	7.5	10700
NEP-GW-MW-10	C922390/15721	18-Nov-92	0.011	0.011		0.007	0.02	ND	ND	ND	0.09		0.07	7.2	6190
NEP-GW-MW-11A	C922567/15975	12-Dec-92	ND	ND		ND	ND	ND	ND	ND	0.19		0.18	7.1	23700
NEP-GW-MW-11B	C930205/W00184	23-Jan-93	ND	ND		ND	ND	ND	ND	ND	0.01		ND	7.3	20500
NEP-GW-MW-12	C922658/16033	18-Dec-92	ND	ND		ND	0.02	ND	ND	ND	0.05		ND	7.2	18700
NEP-GW-MW-13	C922659/16034	18-Dec-92	ND	ND		ND	ND	ND	ND	ND	0.03		ND	7.5	5180
NEP-GW-MW-14	C922655/16031	17-Dec-92	0.012	0.012		0.01	ND	ND	ND	ND	0.04		ND	7.4	11200
NEP-GW-MW-14 (Fld Dup)	C922654/16030	17-Dec-92	0.01			0.007	0.02	ND	ND	ND	0.03		ND	7.3	10900
TMD-GW-MW-15	C930105/W00055	20-Jan-93	0.01	0.006		0.006	0.03	ND	ND	ND	ND		ND	7.5	3590
NEP-GW-MW-17	C930209/W00189	26-Jan-93	ND	ND		ND	ND	ND	ND	ND	0.01		0.01	7.7	2600
NEP-GW-MW-18A	C930207/W00187	25-Jan-93	ND	ND		ND	ND	ND	ND	ND	0.03		0.01	7.3	16400
NEP-GW-MW-18B	C930602/W01466	11-Mar-93	ND	ND			0.02		ND		ND			7.7	4650
NEP-GW-MW-18B (Lab Dup)	C930602/W1467	11-Mar-93	ND				0.02		ND		ND			7.7	4640
NEP-GW-MW-19	C930208/W00188	26-Jan-93	ND	ND		ND	ND	ND	ND	ND	0.01		ND	7.6	7280
NEP-GW-MW-22A	C930282/W00347	29-Jan-93	0.013	0.013		0.011	ND	ND	ND	ND	ND		ND	7.4	5750
NEP-GW-MW-22A (Fld Dup)	C930284/W00349	29-Jan-93	0.014			0.011	ND	ND	ND	ND	0.02		ND	7.4	5790
NEP-GW-MW-22B	C930283/W00348	29-Jan-93	0.007	0.008		0.005	ND	ND	ND	ND	0.01		0.01	7.1	6180
NEP-GW-MW-22B (Lab Dup)	C930283/W00351	29-Jan-93	0.008			0.005	ND	ND	ND	ND	ND		ND	7.1	6180
NEP-GW-MW-23	C930229/W00271	28-Jan-93	0.007	0.008		0.006	ND	ND	ND	ND	ND		ND	7.2	15900
NEP-GW-MW-23 (Lab Dup)	C930229/W00274	28-Jan-93	0.007			0.006	ND	ND	ND	ND	ND		ND	7.2	15900
NEP-GW-MW-24	C930281/W00346	28-Jan-93	ND	ND		ND	ND	ND	ND	ND	ND		ND	7.3	16300
NEP-GW-OCD-1	C922324/15649	13-Nov-92	0.097	0.115	0.154	0.071	0.06	ND	0.03	ND	0.16	0.05	0.11	7.2	14200
NEP-GW-OCD-2A	C922357/15669	15-Nov-92	0.067	0.084		0.043	0.04	ND	ND	ND	0.15	ND	0.12	7	15400
NEP-GW-OCD-2B	C930134/W00057	21-Jan-93	0.007	0.005	0.018	0.006	ND	ND	ND	ND	0.01		ND	7.3	14700
NEP-GW-OCD-2A (Lab Dup)	C922357/15673	15-Nov-92	0.069			0.043	0.04	ND	ND	ND	0.14		0.13	7	15400
NEP-GW-OCD-3	C922358/15670	16-Nov-92	0.021	0.022		ND	0.19	ND	0.06	ND	0.28	0.09	0.12	7.1	17300
NEP-GW-OCD-4-1	C922398/15727	16-Nov-92	0.015	0.017		0.005	ND	ND	ND	ND	0.15		0.11	7.2	19000

Table 28. Continued.

Well sample identification	Laboratory number	Date samples	TAS [a]	TAS [b]	TAS [c]	DAS [d]	TCR [e]	DCR [f]	TPB [g]	DPB [h]	TNI [i]	TNI [j]	DNI [k]	pH	EC [l]
NEP-GW-OCD-5	C922399/15728	16-Nov-92	0.008	0.008		0.007	ND	ND	ND	ND	0.13	ND	0.12	7.2	17800
NEP-GW-OCD-5 (Fld Dup)	C922394/15724	17-Nov-92	0.009			0.008	ND	ND	ND	ND	0.12		0.12	7.2	17900
NEP-GW-OCD-5 (Dup of Fld D)	C922394/15731	17-Nov-92	0.008			0.007	ND	ND	ND	ND	0.13		0.12	7.2	17900
NEP-GW-OCD-6-1	C922400/15729	16-Nov-92	0.036	0.048		0.028	ND	ND	ND	ND	0.14	ND	0.13	7.1	14500
NEP-GW-OCD-7 (Fld Blank)	C922395/15725	18-Nov-92	ND				ND		ND		0.04				
NEP-GW-OCD-7A	C922389/15720	18-Nov-92	0.021	0.023		0.012	0.02	ND	ND	ND	0.15		0.13	7.3	13300
NEP-GW-OCD-7A R	C930104/W00054	19-Jan-93	0.175			0.154	0.02	ND	ND	ND	0.02		0.02	7.3	10500
NEP-GW-OCD-7B	C930279/W00345	30-Jan-93	0.005	0.005		ND	ND	ND	ND	ND	0.01		ND	7.6	6110
NEP-GW-OCD-8A	C922393/15723	17-Nov-92	0.032	0.037		0.019	ND	ND	ND	ND	0.12	ND	0.11	7	12400
NEP-GW-OCD-8B	C930203/W00182	23-Jan-93	ND	ND		ND	ND	ND	ND	ND	0.02		ND	7.3	7490
NEP-GW-OCD-8B (Fld Dup)	C930204/W00183	23-Jan-93	ND			ND	ND	ND	ND	ND	0.03		0.01	7.7	7270
Pecos River at OCD 7	C922425/W01464	20-Nov-92												7.3	7080
NEP-Windmill	C922656/16032	17-Dec-92	ND	ND		ND	ND	ND	ND	ND	0.02		ND	7.4	6610
Evaporation Pond at OCD-7	C922424/15745/W01463	20-Nov-92	0.167				ND		ND		0.06			7.6	10900

Key	**Test description/method**	**Detection limits**
a	Total arsenic — Method 7061	0.005
b	Total arsenic — Method 7061 — Verification	0.005
c	Total arsenic — Method 7060 — Verification	0.005
d	Dissolved arsenic — Method 701	0.01
e	Total chromium — Method 7191	0.02
f	Dissolved chromium — Method 7191	0.02
g	Total lead — Method 7421	0.02
h	Dissolved lead — Method 7421	0.02
i	Total nickel — Method 7520	0.01
j	Total nickel — Method 7520 — verification	0.05
k	Dissolved nickel — Method 7520	0.01
l	Electrical conductivity, µmhos/cm at 25 ° C	

ND = Not detected.

Standards	**EPA Drinking Water (mg/L)**	**NMWQCC Groundwater**
As	0.05	0.1
Cr	0.1	0.5
Pb	0.015 (Action level)	0.05
Ni	0.1	0.2 (irrigation)

Table 29. Results of inorganic water quality analyses, Evaporation Pond, Navajo Refinery, RFI Phase II.

Well sample ID	Laboratory no.	Date sampled	Detection level Units	pH (Laboratory)	Electrical Conductivity at 25°C (Laboratory)	Total dissolved solids at 180°C	Total calcium	Total alkalinity	Total hardness	Flouride	Calcium	Calcium	Magne-sium	Magne-sium	Potas-sium	Potas-sium
				0.1 (s.u.)	1 (µmhos/cm)	1 (mg/L)	1 (mg/L)	1 (mg/L)	1 (mg/L)	0.1 (mg/L)	1 (mg/L)	(meq/L)	1 (mg/L)	(meq/L)	1 (mg/L)	(meq/L)
NEP-GW-EPA-1	C922391/15722	18-Nov-92		7.2	5340	3750	3670	167	1960	0.8	495	24.70	176	14.47	7.1	0.18
NEP-GW-MW-01-01	C922278/15632	10-Nov-92		7.5	14900	11200	10500	406	3880	1.1	764	38.12	480	39.47	14.0	0.36
NEP-GW-MW-01-01 (Lab Dup)	C922278/15635	10-Nov-92		7.5	14900	11300	NA	408	NA	1.1	769	NA	480	NA	16.0	NA
NEP-GW-MW-02A	C922280/15633	10-Nov-92		7.4	11300	8430	8430	523	1980	9.9	573	28.59	134	11.02	14.0	0.36
NEP-GW-MW-02B	C922653/16029	16-Dec-93		7.4	3430	2500	2320	160	1220	1.2	304	15.17	112	9.21	20.0	0.51
NEP-GW-MW-02B (Lab Dup)	C922653/16036	16-Dec-92		7.4	3430	2540	NA	160	NA	1.2	300	NA	112	NA	18.0	NA
NEP-GW-MW-03	C922322/15647	11-Nov-92		7.3	7220	5310	4570	285	1630	3.0	457	22.80	119	9.79	12.0	0.31
NEP-GW-MW-04	C922333/15644	12-Nov-92		7.3	7610	5360	5080	234	1410	1.8	370	18.46	119	9.79	5.5	0.15
NEP-GW-MW-04 (Lab Dup)	C922333/15651	12-Nov-92		7.3	7620	5360	NA	233	NA	1.8	376	NA	121	NA	5.0	NA
NEP-GW-MW-05A	C922334/15645	11-Nov-92		7.2	28000	24300	22300	423	5650	3.3	585	29.19	1020	83.88	9.0	0.23
NEP-GW-MW-05A (Fld Dup)	C922335/15646	11-Nov-92		7.2	28100	24400	22200	427	5640	3.3	579	28.89	1020	83.88	9.3	0.23
NEP-GW-MW-05B	C930136/W00059	22-Jan-93		7.1	9310	7350	7160	328	2460	1.5	650	32.44	204	16.78	13.0	0.33
NEP-GW-MW-06A	C922323/15648	12-Nov-92		7.4	4950	3540	3300	136	1090	2.7	282	14.07	93	7.65	3.5	0.10
NEP-GW-MW-06B	C930278/W00344	30-Jan-93		11.9	6410	3800	3660	428	1620	0.4	648	32.34	1	0.08	27.0	0.69
NEP-GW-MW-07A	C922281/15634	11-Nov-92		7.2	13900	11500	11000	302	2780	1.4	471	23.50	389	31.99	12.0	0.31
NEP-GW-MW-07B	C930106/W00056	21-Jan-93		7.5	10700	9220	7980	293	1670	1.4	547	27.30	74	6.09	14.0	0.36
NEP-GW-MW-10	C922390/15721	18-Nov-92		7.2	6190	4400	4380	223	1340	1.1	417	20.81	72	5.92	7.4	0.18
NEP-GW-MW-11A	C922567/15975	12-Dec-92		7.1	23700	16100	15200	331	3980	1.0	964	48.10	384	31.58	31.0	0.79
NEP-GW-MW-11B	C930205/W00184	23-Jan-93		7.3	20500	14000	13600	217	5950	0.9	961	47.95	317	26.07	41.0	1.05
NEP-GW-MW-12	C922658/16033	18-Dec-92		7.2	18700	13500	12400	358	4470	1.1	788	39.32	608	50.00	19.0	0.49
NEP-GW-MW-13	C922659/16034	18-Dec-92		7.5	5180	3630	3370	254	1340	0.7	352	17.56	112	9.21	17.0	0.43
NEP-GW-MW-14	C922655/16031	17-Dec-93		7.4	11200	8230	7780	405	2320	1.0	456	22.75	288	23.68	18.0	0.46
NEP-GW-MW-14 (Fld Dup)	C922654/16030	17-Dec-93		7.3	10900	7890	7550	396	2260	1.0	444	22.16	280	23.03	21.0	0.54
TMD-GW-MW-15	C930105/W00055	20-Jan-93		7.5	3590	2790	2670	150	1190	1.1	308	15.37	102	8.39	11.0	0.28
NEP-GW-MW-17	C930209/W00189	26-Jan-93		7.7	2600	2230	2020	121	1370	1.1	387	19.31	99	8.14	13.0	0.33
NEP-GW-MW-18A	C930207/W00187	25-Jan-93		7.3	16400	12600	11900	286	4530	1.6	721	35.98	664	54.61	30.0	0.77
NEP-GW-MW-18B	C930602/W01466	11-Mar-93		7.7	4650	3710	3550	164	2110	1.1	588	29.34	157	12.91	17.0	0.43
NEP-GW-MW-18B (Lab Dup)	C930602/W1467	11-Mar-94		7.7	4640	3710	NA	164	NA	1.1	577	NA	154	NA	16.0	NA
NEP-GW-MW-19	C930208/W00188	26-Jan-93		7.6	7280	5720	5150	210	2790	0.9	745	37.18	226	18.59	10.0	0.26
NEP-GW-MW-22A	C930282/W00347	29-Jan-93		7.4	5750	4410	4220	159	1520	1.5	421	21.01	114	9.38	6.0	0.15
NEP-GW-MW-22A (Fld Dup)	C930284/W00349	29-Jan-93		7.4	5790	4400	4290	159	1560	1.5	434	21.66	117	9.62	7.0	0.18
NEP-GW-MW-22B	C930283/W00348	29-Jan-93		7.1	6180	4700	4510	213	1720	1.0	461	23.00	139	11.43	4.0	0.10
NEP-GW-MW-22B (Lab Dup)	C930283/W00351	29-Jan-93		7.1	6180	4720	NA	212	NA	1.0	464	NA	139	NA	5.0	NA
NEP-GW-MW-23	C930229/W00271	28-Jan-93		7.2	15900	11700	10500	349	3890	0.8	988	49.30	347	28.54	14.0	0.36
NEP-GW-MW-23 (Lab Dup)	C930229/W00274	28-Jan-93		7.2	15900	11700	NA	349	NA	0.8	986	NA	342	NA	14.0	NA
NEP-GW-MW-24	C930281/W00346	28-Jan-93		7.3	16300	11600	10786	242	2951	1.0	787	39.27	240	19.74	38.0	0.97
NEP-GW-OCD-1	C922324/15649	13-Nov-92		7.2	14200	10300	8570	526	1860	5.7	487	24.30	156	12.83	7.2	0.18
NEP-GW-OCD-2A	C922357/15669	15-Nov-92		7.0	15400	11800	10900	404	2780	1.2	565	28.19	333	27.38	8.1	0.20
NEP-GW-OCD-2A (Lab Dup)	C922357/15673	15-Nov-92		7.0	15400	11700	NA	394	NA	1.2	567	NA	313	NA	9.0	NA
NEP-GW-OCD-2B	C930134/W00057	21-Jan-93		7.3	14700	11600	11100	408	4140	0.9	844	42.12	494	40.63	13.0	0.33
NEP-GW-OCD-3	C922358/15670	16-Nov-92		7.1	17300	11600	10300	281	3340	0.9	922	46.01	268	22.04	29.0	0.74
NEP-GW-OCD-4-1	C922398/15727	16-Nov-92		7.2	19000	13100	11800	197	2790	0.9	724	36.13	240	19.74	50.0	1.28
NEP-GW-OCD-5	C922399/15728	16-Nov-92		7.2	17800	12400	12000	199	3070	1.0	847	42.27	232	19.08	37.0	0.95
NEP-GW-OCD-5 (Fld Dup)	C922394/15724	17-Nov-92		7.2	17900	12400	11900	202	3050	1.0	846	42.22	228	18.75	36.0	0.92
NEP-GW-OCD-5 (LabDup of Fld D)	C922394/15731	17-Nov-92		7.2	17900	12400	NA	205	NA	1.0	849	NA	225	NA	36.0	NA
NEP-GW-OCD-6-1	C922400/15729	16-Nov-92		7.1	14500	10900	10400	495	2550	2.9	675	33.68	210	17.27	15.0	0.38
NEP-GW-OCD-7A	C922389/15720	18-Nov-92		7.3	13300	10300	9570	564	2670	4.1	620	30.94	274	22.53	8.5	0.23
NEP-GW-OCD-7A R	C930104/W00054	19-Jan-93		7.3	10500	8350	7940	511	2390	6.6	652	32.53	186	15.30	14.0	0.36
NEP-GW-OCD-7B	C930279/W00345	30-Jan-93		7.6	6110	5060	4840	141	1850	1.2	547	27.30	117	9.62	10.0	0.26
NEP-GW-OCD-8A	C922393/15723	17-Nov-92		7.0	12400	9670	9050	434	2850	2.5	633	31.59	308	25.33	11.0	0.28
NEP-GW-OCD-8B	C930203/W00182	23-Jan-93		7.3	7490	5400	5240	164	2930	0.9	834	41.62	207	17.02	12.0	0.31
NEP-GW-OCD-8B (Fld Dup)	C930204/W00183	23-Jan-93		7.7	7270	5270	5130	163	2840	0.9	807	40.27	202	16.61	14.0	0.36
NEP-Navajo Effluent	C930367/W00731	11-Feb-93		8.9	9300	7348	4840	829	279	151.0	21	1.05	55	4.52	22.0	0.56
Evaporation Pond at OCD 7	C922424/15745	16-Nov-92		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Evaporation Pond at OCD 7	C922424/15745/W01463	16-Nov-92		7.6	10900	7080	6620	534	354	36.3	46	2.30	58	4.77	67.0	1.31
NEP-Windmill	C922656/16032	17-Dec-92		7.4	6610	4740	4450	163	1530	1.1	316	15.77	180	14.80	14.0	0.36
Pecos River at OCD 7	C922425/W01464	16-Nov-92		7.3	7080	5110	4735	165	2190	0.9	571	28.49	186	15.30	13.0	0.33

Table 29. Continued.

Well sample ID	Laboratory no.	Date sampled	Detection level Units	Sodium 1 (mg/L)	Sodium (meq/L)	HCO_3 1 (mg/L)	HCO_3 (meq/L)	CO_3 1 (mg/L)	CO_3 (meq/L)	OH 1 (mg/L)	OH (meq/L)	Chloride 1 (mg/L)	Chloride (meq/L)	SO_4 1 (mg/L)	SO_4 (meq/L)	Cation sum (meq)	Anion sum (meq)	Percent difference (%)
NEP-GW-EPA-1	C922391/15722	18-Nov-92		480	20.88	204	3.34	0	0.00	0	0.00	989	27.90	1420	29.56	60.23	60.80	-0.47
NEP-GW-MW-01-01	C922278/15632	10-Nov-92		2130	92.65	495	8.11	0	0.00	0	0.00	3750	105.78	3020	62.88	170.60	176.77	-1.78
NEP-GW-MW-01-01 (Lab Dup)	C922278/15635	10-Nov-92		2130	NA	NA	NA	NA	NA	NA	NA	3740	NA	3010	NA	NA	NA	NA
NEP-GW-MW-02A	C922280/15633	10-Nov-92		2170	94.39	638	10.46	0	0.00	0	0.00	2120	59.8	3180	66.21	134.36	134.47	-0.78
NEP-GW-MW-02B	C922653/16029	16-Dec-93		268	11.66	195	3.20	0	0.00	0	0.00	497	14.02	1020	21.24	36.55	38.46	-2.55
NEP-GW-MW-02B (Lab Dup)	C922653/16036	16-Dec-92		268	NA	NA	NA	NA	NA	NA	NA	498	NA	1020	NA	NA	NA	NA
NEP-GW-MW-03	C922322/15647	11-Nov-92		975	42.41	348	5.70	0	0.00	0	0.00	1820	51.34	1020	21.24	75.31	78.28	-1.93
NEP-GW-MW-04	C922333/15644	12-Nov-92		1180	51.33	285	4.67	0	0.00	0	0.00	1380	38.93	1880	39.14	79.73	82.74	-1.85
NEP-GW-MW-04 (Lab Dup)	C922333/15651	12-Nov-92		1170	NA	NA	NA	NA	NA	NA	NA	1410	NA	1870	NA	NA	NA	NA
NEP-GW-MW-05A	C922334/15645	11-Nov-92		5250	228.36	516	8.46	0	0.00	0	0.00	5410	152.61	9770	203.41	341.66	364.48	-3.23
NEP-GW-MW-05A (Fld Dup)	C922335/15646	11-Nov-92		5150	224.01	520	8.52	0	0.00	0	0.00	5470	154.30	9740	202.79	337.01	365.61	-4.07
NEP-GW-MW-05B	C930136/W00059	22-Jan-93		1600	69.60	400	6.56	0	0.00	0	0.00	1760	49.65	2730	56.84	119.15	113.05	2.63
NEP-GW-MW-06A	C922323/15648	12-Nov-92		700	30.45	166	2.72	0	0.00	0	0.00	654	18.45	1490	31.02	52.27	52.19	0.08
NEP-GW-MW-06B	C930278/W00344	30-Jan-93		574	24.97	0	0.00	37	1.22	125	7.33	968	27.31	1180	24.57	58.08	60.43	-1.98
NEP-GW-MW-07A	C922281/15634	11-Nov-92		2930	127.45	368	6.03	0	0.00	0	0.00	2750	77.57	4260	88.69	183.25	172.29	3.08
NEP-GW-MW-07B	C930106/W00056	21-Jan-93		1990	86.56	357	5.85	0	0.00	0	0.00	1880	53.03	3300	68.71	120.31	127.59	-2.94
NEP-GW-MW-10	C922390/15721	18-Nov-92		970	42.19	272	4.46	0	0.00	0	0.00	982	27.70	1800	37.48	69.10	69.64	-0.39
NEP-GW-MW-11A	C922567/15975	12-Dec-92		3860	167.90	404	6.62	0	0.00	0	0.00	7108	200.51	2610	54.34	248.37	261.47	-2.57
NEP-GW-MW-11B	C930205/W00184	23-Jan-93		3410	148.33	265	4.34	0	0.00	0	0.00	5950	167.84	2790	58.09	223.40	230.27	-1.51
NEP-GW-MW-12	C922658/16033	18-Dec-92		2560	111.35	437	7.16	0	0.00	0	0.00	4980	140.48	3250	67.67	201.16	215.31	-3.40
NEP-GW-MW-13	C922659/16034	18-Dec-92		596	25.92	310	5.08	0	0.00	0	0.00	914	25.78	1230	25.61	53.12	56.47	-3.06
NEP-GW-MW-14	C922655/16031	17-Dec-93		1720	74.82	493	8.08	0	0.00	0	0.00	2150	60.65	2900	60.38	121.71	129.11	-2.95
NEP-GW-MW-14 (Fld Dup)	C922654/16030	17-Dec-93		1650	71.77	483	7.92	0	0.00	0	0.00	2080	58.67	2830	58.92	117.50	125.51	-3.30
TMD-GW-MW-15	C930105/W00055	20-Jan-93		447	19.44	182	2.98	0	0.00	0	0.00	564	15.91	1150	23.94	43.48	42.83	0.75
NEP-GW-MW-17	C930209/W00189	26-Jan-93		109	4.74	147	2.41	0	0.00	0	0.00	122	3.44	1220	25.40	32.52	31.25	1.99
NEP-GW-MW-18A	C930207/W00187	25-Jan-93		2420	105.26	348	5.70	0	0.00	0	0.00	3930	110.86	3950	82.24	196.62	198.80	-0.55
NEP-GW-MW-18B	C930602/W01466	11-Mar-93		356	15.48	200	3.28	0	0.00	0	0.00	661	18.65	1670	34.77	58.16	56.70	1.27
NEP-GW-MW-18B (Lab Dup)	C930602/W1467	11-Mar-94		353	NA	NA	NA	NA	NA	NA	NA	668	NA	1690	NA	NA	NA	NA
NEP-GW-MW-19	C930208/W00188	26-Jan-93		718	31.23	256	4.20	0	0.00	0	0.00	1370	38.65	1950	40.60	87.26	83.45	2.23
NEP-GW-MW-22A	C930282/W00347	29-Jan-93		799	34.75	193	3.16	0	0.00	0	0.00	835	23.55	1950	40.60	65.29	67.31	-1.52
NEP-GW-MW-22A (Fld Dup)	C930284/W00349	29-Jan-93		809	35.19	193	3.16	0	0.00	0	0.00	844	23.81	1990	41.43	66.65	68.40	-1.30
NEP-GW-MW-22B	C930283/W00348	29-Jan-93		830	36.10	259	4.25	0	0.00	0	0.00	983	27.73	1970	41.02	70.63	73.00	-1.65
NEP-GW-MW-22B (Lab Dup)	C930283/W00351	29-Jan-93		827	NA	NA	NA	NA	NA	NA	NA	983	NA	1950	NA	NA	NA	NA
NEP-GW-MW-23	C930229/W00271	28-Jan-93		2180	94.82	425	6.97	0	0.00	0	0.00	4240	119.61	2570	53.51	173.02	180.09	-2.00
NEP-GW-MW-23 (Lab Dup)	C930229/W00274	28-Jan-93		2160	NA	NA	NA	NA	NA	NA	NA	4260	NA	2660	NA	NA	NA	NA
NEP-GW-MW-24	C930281/W00346	28-Jan-93		2500	108.74	295	4.84	0	0.00	0	0.00	4170	117.63	2910	60.59	168.72	183.06	-4.08
NEP-GW-OCD-1	C922324/15649	13-Nov-92		2230	97.00	642	10.52	0	0.00	0	0.00	1930	54.44	3450	71.83	134.31	136.79	-0.91
NEP-GW-OCD-2A	C922357/15669	15-Nov-92		2510	109.18	493	8.08	0	0.00	0	0.00	3220	90.83	3990	83.07	164.95	181.98	-4.91
NEP-GW-OCD-2A (Lab Dup)	C922357/15673	15-Nov-92		2600	NA	NA	NA	NA	NA	NA	NA	3200	NA	3980	NA	NA	NA	NA
NEP-GW-OCD-2B	C930134/W00057	21-Jan-93		2320	100.91	498	8.16	0	0.00	0	0.00	3710	104.65	3450	71.83	183.99	184.64	-0.18
NEP-GW-OCD-3	C922358/15670	16-Nov-92		2330	101.35	281	4.61	0	0.00	0	0.00	4130	116.50	2520	52.47	170.14	173.58	-1.00
NEP-GW-OCD-4-1	C922398/15727	16-Nov-92		3120	135.71	240	3.93	0	0.00	0	0.00	4500	126.94	3010	62.67	192.86	193.54	-0.18
NEP-GW-OCD-5	C922399/15728	16-Nov-92		3030	131.80	243	3.98	0	0.00	0	0.00	4720	133.15	2980	62.04	194.10	199.17	-1.29
NEP-GW-OCD-5 (Fld Dup)	C922394/15724	17-Nov-92		2930	127.45	246	4.03	0	0.00	0	0.00	4760	134.27	3000	62.46	189.34	200.76	-2.93
NEP-GW-OCD-5 (LabDup of Fld D)	C922394/15731	17-Nov-92		2970	NA	NA	NA	NA	NA	NA	NA	4780	NA	2990	NA	NA	NA	NA
NEP-GW-OCD-6-1	C922400/15729	16-Nov-92		2550	110.92	603	9.89	0	0.00	0	0.00	3000	84.63	3670	76.41	162.25	170.93	-2.61
NEP-GW-OCD-7A	C922389/15720	18-Nov-92		2120	92.21	687	11.26	0	0.00	0	0.00	2480	69.96	3730	77.66	145.91	158.88	-4.26
NEP-GW-OCD-7A R	C930104/W00054	19-Jan-93		1950	84.82	623	10.21	0	0.00	0	0.00	2040	57.55	2800	58.30	133.01	126.06	2.68
NEP-GW-OCD-7B	C930279/W00345	30-Jan-93		813	35.36	172	2.82	0	0.00	0	0.00	690	19.46	2570	53.51	72.54	75.79	-2.19
NEP-GW-OCD-8A	C922393/15723	17-Nov-92		1930	83.95	529	8.67	0	0.00	0	0.00	2290	64.60	3620	75.37	141.15	148.64	-2.58
NEP-GW-OCD-8B	C930203/W00182	23-Jan-93		651	28.32	200	3.28	0	0.00	0	0.00	1630	45.98	1810	37.68	87.27	86.94	0.19
NEP-GW-OCD-8B (Fld Dup)	C930204/W00183	23-Jan-93		628	27.32	199	3.26	0	0.00	0	0.00	1580	44.57	1800	37.48	84.56	85.31	-0.44
NEP-Navajo Effluent	C930367/W00731	11-Feb-93		1290	56.11	1011	16.57	0	0.00	0	0.00	1920	54.16	1034	21.53	62.24	92.26	-19.43
Evaporation Pond at OCD 7	C922424/15745	16-Nov-92		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Evaporation Pond at OCD 7	C922424/15745/W01463	16-Nov-92		2000	86.99	651	10.67	0	0.00	0	0.00	2180	61.50	1950	40.60	95.77	112.77	-8.15
NEP-Windmill	C922656/16032	17-Dec-92		872	37.93	199	3.26	0	0.00	0	0.00	1190	33.57	1780	37.06	68.86	73.89	-3.52
Pecos River at OCD 7	C922425/W01464	16-Nov-92		733	31.88	201	3.30	0	0.00	0	0.00	1470	41.47	1660	34.56	76.00	79.32	-2.14

Table 31. Summary of soil sample TCLP data for volatile organic compounds, Three-Mile Ditch.

Volatile organic compound	Number of detections [a]	Maximum analytical concentration (mg/L)	TC regulatory concentration (mg/L)
Trichloroethylene	1	0.019	0.5
Carbon disulfide	1	0.008	-
Ethylbenzene	3	0.047	-
Methylene chloride [b]	13	0.245	-
Toluene	3	0.038	-
m,p-xylenes	4	0.075	-
o-xylene	3	0.035	-

a = Total out of a possible maximum of 13 samples.
b = Detected in accompanying method blanks for all Three-Mile Ditch TCLP data for soil samples.

Table 33. Summary of soil sample TCLP data for volatile organic compounds, Evaporation Pond 1.

Volatile organic compound	Number of detections [a]	Maximum analytical concentration (mg/L)	TC regulatory concentration (mg/L)
Benzene	1	0.014	0.5
Trichloroethylene	4	0.038	0.5
Acetone	8	0.088	-
Ethylbenzene	4	0.019	-
Methylene chloride [b]	26	0.177 (1)	-
Toluene	5	0.026	-
m,p-xylenes	4	0.033	-
o-xylene	4	0.015	-

a = Total out of a possible maximum of 28 samples.
b = Detected in either accompanying daily blanks or method blanks for all Evaporation Pond 1 TCLP data for soil samples.

Table 34. Comparision of Arsenic and Nickel sampling and verification, RFI, Phase II.

Well Sample Identification	Lab. Number (Units)	Date Sampled	TAs (Initial) (mg/L)	TAs (Verif.) (mg/L)	TAs (7060) (mg/L)	As, PRC Value (mg/L)	TNi (Initial) (mg/L)	TNi (Verif) (mg/L)	PRC Value (mg/L)	EC (µmho/cm)
NEP-GW-MW-01	C922278/15632	11/10/92	0.020	0.023	0.010	0.008(J)	0.35	0.22	0.284	14,900
NEP-GW-MW-02A	C922280/15633	11/10/92	0.087	0.117	0.090	0.212(J)	0.12	ND	0.040(U)	11,300
NEP-GW-MW-04	C922333/15644	11/12/92	0.080	0.112	0.136	0.213(J)	0.11	ND	0.040(U)	7,610
NEP-GW-MW-05B	C930136/W00059	1/22/93	0.131	0.150	0.162	0.200	ND	NA	0.040(U)	9,310
NEP-GW-MW-07A	C922281/15634	11/11/92	0.038	0.037	0.050	0.143(J)	0.13	ND	0.040(U)	13,900
NEP-GW-MW-07B	C930106/W00056	1/21/93	0.014	0.013	0.016	0.017	ND	NA	0.040(U)	10,700
NEP-GW-OCD-01	C922324/15649	11/13/92	0.097	0.115	0.154	0.235(J)	0.16	0.05	0.040(U)	14,200
NEP-GW-OCD-02B	C930134/W00057	1/21/93	0.007	0.005	0.018	0.029	0.01	NA	0.040(U)	14,700
TMD-GW-MW-08	C922352/15665	11/14/92	0.014	0.014	0.027	0.008(J)	0.74	0.71	0.527	6,510
TMD-GW-MW-09	C922353/15666	11/14/92	0.021	0.025	0.015	0.018(J)	8.04	9.02	6.040	6,720
TMD-GW-MW-45	C922354/15667	11/14/92	0.009	0.008	0.011	0.011(J)	0.10	ND	0.040(U)	5,050

TAs(Initial) = Total Arsenic, initial analysis, method 7061, detection limit=0.005 (mg/L).
TAs(Verif) = Total Arsenic, verification analysis, method 7061, detection limit=0.005 (mg/L).
TAs(7060) = Total Arsenic, verification analysis, method 7060, detection limit=0.005 (mg/L).
As, PRC = Total Arsenic, PRC Value, method 7060.
TNi(Initial) = Total Nickel, initial analysis, method 7520, detection limit=0.01 (mg/L).
TNi(Verif) = Total Nickel, verification analysis, method 7520, detection limit=0.05 (mg/L).
Ni, PRC = Total Nickel, PRC Value, method 7520.
ND = Not detected.
NA = Not analyzed.
(J) = Estimated concentration.
(U) = Undetected at practical quantitation limit listed.
EC = Laboratory electrical conductivity, µmhos/cm at 25°C .

APPENDIX B

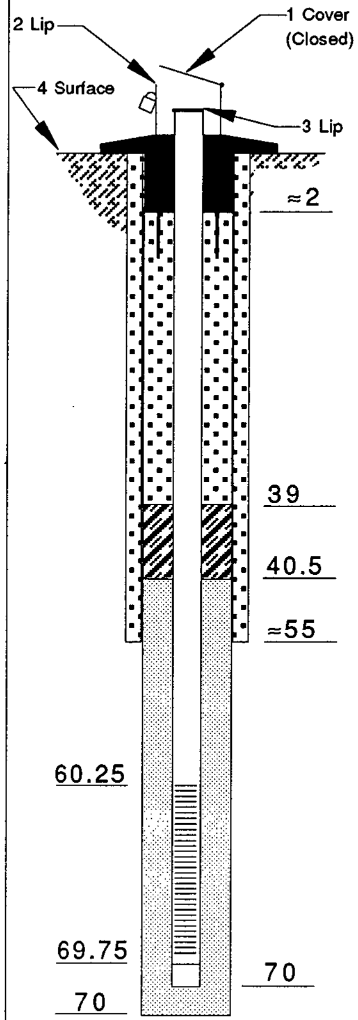
Monitoring Well and Piezometer Boring Logs

Samp. Meth.	Samp. Log	PID (ppm)	Depth (Feet)	Geologic Description	
				Start 1/14/95, 1000	
				0-1'	Silt, light brown.
			2	1-2'	Silty sand, light brown
				2-7.8'	Clay, dark brown with calcite crystals. Dry, stiff 4-5'
			4	7.8-8.2'	Sandy clay, light brown, moist.
			6	8.2-10'	Clayey silt, light brown, slight odor.
				10-12'	Clay, light brown with light gray streaking, moist.
RB			8	12-12.8'	Sand, light brown with dark gray zones, strong HC odor.
			10	12.8-15'	No recovery. Added clean water to counteract flowing sand.
			12	15-20'	No recovery (inserted sand catcher).
				17-20'	No recovery with sand catcher.
			14		
				20-25'	No recovery (omitted sand catcher).
			16		
				25-25.6'	Sand, fine-grained light gray brown, HC odor.
			18	25.6-26.2'	Sand, very fine-grained, light brown.
				26.2-26.6'	Gravelly clay, gray black grading to gravel, 1/8-3/8", HC odor.
			20		
				(HC=Hydrocarbon.)	

Sample Method Symbols

☒ RB=Recovery Barrel ☒ 5' ☐ ____
ST=Shelby Tube | SS=Split Spoon | C=Cutting

Monitoring Well ☒
Piezometer
Protective Casing YES



Depths in Feet from Ground Surface (Not to Scale)
LOG - 1

Design Specifications

Elevations: 1 3309.37 2 ____
(feet MSL) 3 3308.89 4 3305.6
Coordinates: X 18314.15 Y 2775.59

Bore Hole Diameter:(Inner) 8 1/4" (Outer) 12"

Type of Casing:(Inner) ☒ PVC Sched. 40 Flush Thread ☐ Stainless Steel ☐ ____
(Outer) ____

Casing Diam.: (Inner) ☒ 2" ☐ 4" ☐ 6" ☐ ____
(Outer) ☐ 2" ☐ 4" ☐ 6" ☒ 10"

Screen Slot: ☐ 0.008 ☒ 0.010 ☐ ____
Screen Style: ☒ Machine Slot ☐ Wire Wrap ☐ ____
Sand Pack: CSSI 16-40 silica sand
Bentonite Seal: ☐ 1/4" Pellets ☒ 1/2" Pellets
☐ 1/2" Chips ☐ Hole Plug ☐ ____

Grout Type: 6% bentonite/Portland Weight: ____
Drill Rig: ☒ Hollow Stem ☐ Rotary ☐ ____
Drilled by: Precision Engineering Lic.#: ____
Logged by: DGB/BPS
Completion Date: 1/18/95
Depth First Encountered Water: 12' BLS

Date	D-T-W	D-T-P	Prod Thick	Field pH	Field EC
1/20/95	10.79			7.5	6100
2/4/95	10.50			---	---
2/24/95	10.27			7.0	5000

Comments: Flowing sand moved ≈15' into inner casing. Purged 200 gallons 1/19/95 to clean and develop. D-T-W from casing lip.

RE/SPEC

MW-4C

>Page 1of 4<

Project: 318/3
Location: Artesia, New Mexico

Samp. Meth.	Samp. Log	PID (ppm)	Depth (Feet)	Geologic Description	
RB			22	26.6-30'	No recovery-drilling harder at 28'.
			24	30-31.4'	Sand, coarse-grained, black, HC odor.
			26	31.4-31.8'	Clay, reddish brown.
			28	31.8-32.1'	Sandy gravel, mixed granules and pebbles 1/8" to 1/4".
			30	32.1-32.4'	Clay, reddish brown.
			32	32.4-33.2'	Gravel, granules and pebbles mixed, 1/4 to 3/4", well-rounded quartz and limestone.
			34	33.2-35'	No recovery.
			36	35-35.3'	Sand, fine-grained, light gray.
			38	35.3-36.7'	Sand, medium- to coarse grained, some mixed pebbles and gravels, gray black.
			40	36.7-37.2'	Sand, fine-grained, light brown.
				37.2-37.4'	Clayey sand, light gray, HC odor 35-37.4'.
				37.4-40'	No recovery.
				40-42.1'	Sand, medium-grained, gray brown, uniform, moderate HC odor.

(SAA=Same as above.)

Sample Method Symbols

☒ RB=Recovery Barrel	☒ 5'	☐ ________	
ST=Shelby Tube	SS=Split Spoon	C=Cutting	

Monitoring Well	X
Piezometer	
Protective Casing	YES

Refer to MW-4C Page 1

Design Specifications

Refer to MW-4C Page 1

RE/SPEC

MW-4C
(CONTINUED)

Project: 318/3
Location: Artesia, New Mexico

Samp. Meth.	Samp. Log	PID (ppm)	Depth (Feet)	Geologic Description
RB			42	42.1-42.4' Sand, light gray with mixed gravels (<3/4"), slight odor.
				42.4-45' Bo recovery.
			44	45-50' No recovery, switched to 2" diameter 2' split spoon.
				50-52' 14" recovery, sand, fine, light gray, uniform, HC odor.
			46	55-57' 2' recovery sand and gravelly sand, gray, HC odor.
				Pulled augers 1610
			48	Extra 5' auger in hole, 55-57' sample was from inside auger flight.
				55-60' (from cutings) clay, light brown, moist, no odor.
SS			50	
				1/16/95 0830 on-site
			52	Drilled with 12" auger to ≈60'.
				Wind >50mph.
				Pushed in 10" casing and cemented.
			54	
				(HC=Hydrocarbon.)
SS			56	
C			58	
			60	

Sample Method Symbols
☒ RB=Recovery Barrel ☒ 5' ☐ ______
☐ ST=Shelby Tube ☒ SS=Split Spoon ☒ C=Cutting

Monitoring Well	X
Piezometer	
Protective Casing	YES

Refer to MW-4C Page 1

Design Specifications

Refer to MW-4C Page 1

RE/SPEC

MW-4C
(CONTINUED)
>Page 3 of 4<

Project: 318/3
Location: Artesia, New Mexico

Samp. Meth.	Samp. Log	PID (ppm)	Depth (Feet)	Geologic Description
				1/18/95
SS				60-62' No recovery.
			62	
			64	65-67' 18" (1.5') recovery.
				65-67.2' Clayey gravel, brown, irregular, 1/4"-1 1/2", saturated, no odor.
SS				65.2-66.4' Sand, medium to fine, brown, saturated.
			66	66.4-66.5' Clay, brown, moist.
			68	70-72" 21.5" (1.8') recovery.
				70-70.1 Gravel (1/8"-1 1/2") and sand, saturated.
SS			70	70.1-71.8' Sand, fine- to medium grained, light brown, saturated, no apparent HC odor.
			72	
			74	
			76	
			78	
			80	

Sample Method Symbols

RB=Recovery Barrel ☐ 5' ☐ ______

ST=Shelby Tube ☒ SS=Split Spoon ☐ C=Cutting

Monitoring Well	X
Piezometer	
Protective Casing	YES

Refer to MW-4C Page 1

Design Specifications

Refer to MW-4C Page 1

RE/SPEC

MW-4C (CONTINUED)

Project: 318/3

Location: Artesia, New Mexico

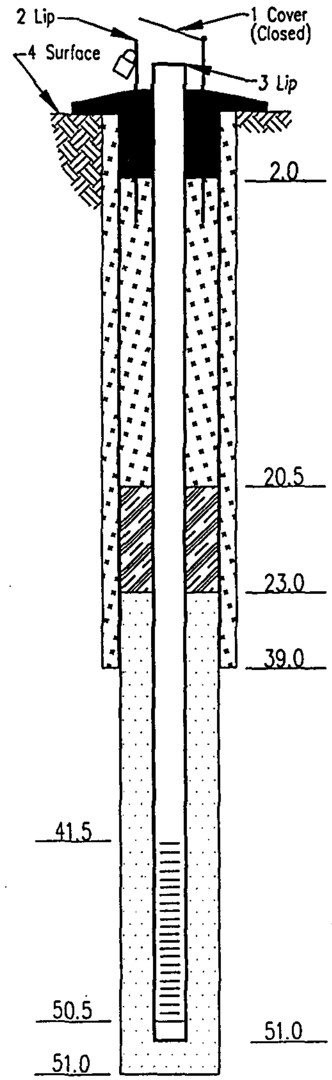
Samp. Meth.	Samp. Log	PID (ppm)	Depth (Feet)	Geologic Description
RB			2	0–3' SAND, reddish brown, fine grained, white rootlets, dry, hard at 0–2', no odor.
			4	
			6	3–13' CLAYEY SAND, reddish brown, fine grained, roots at 3–5', white nodules at 3–7', dark gray coloration starting at 8', moist, hydrocarbon odor below 8', light to dark gray staining at 11.5–13', saturated at 11.5'.
			8	
			10	
			12	
			14	13–15' CLAY, reddish brown, gray coloration starting at 14', moist, soft, hydrocarbon odor.
			16	
			18	
C			20	15–51' SAND, light gray to dark gray coloration, medium to coarse grained, interbedded clay seams (2" thick) at 16–18.5', some gravel starting at 23', saturated (heaving), hydrocarbon odor.
			22	
			24	
			26	TD = 51'
			28	
			30	
			32	
			34	
			36	
			38	
			40	
			42	
			44	
SS			46	
			48	

Sample Method Symbols

☒ RB=Recovery Barrel ☒ 5' ☐ ____

ST=Shelby Tube ☒ SS=Split Spoon ☒ C=Cutting

Monitoring Well	X
Piezometer	
Protective Casing	YES



Depths in Feet from Ground Surface (Not to Scale)

LOG-7

Design Specifications

Elevations: 1 3306.18 2 3306.16
(feet MSL) 3 3305.94 4 3303.30

Coordinates: X 19511.68 Y 2964.70

Bore Hole Diameter: (Inner) 8" (Outer) 14"

Type of Casing: (Inner) ☒ PVC Sched. 40 Flush Thread ☐ Stainless Steel ☐ ____
(Outer) ☒ PVC Sched. 40

Casing Diameter: (Inner) ☒ 2" ☐ 4" ☐ 6" ☐ ____
(Outer) ☐ 2" ☐ 4" ☐ 6" ☒ 10"

Screen Slot: ☐ 0.008 ☒ 0.010 ☐ ____

Screen Style: ☒ Machine Slot ☐ Wire Wrap ☐ ____

Sand Pack: Colorado Silica 16–40

Bentonite Seal: ☐ 1/4" Pellets ☒ 1/2" Pellets ☐ 1/2" Chips ☐ Hole Plug ☐ ____

Grout Type: Portland/Bentonite Weight: ____

Drill Rig: ☒ Hollow Stem ☐ Rotary ☐ ____

Drilled By: Precision Engineering Lic. #: ____

Logged By: WCZ

Completion Date: 12/16/92

Depth First Encountered Water: 11.5' BLS

Date	D-T-W	D-T-P	Prod Thick	Field pH	Field EC
1/22/93	7.34			6.75	7,400
2/10/93	7.22				

Comments:

KWBES

Navajo

MW-5B

Project: 622092005-110 (MW-5B)
Location: Artesia, New Mexico

Samp. Meth.	Samp. Log	PID (ppm)	Depth (Feet)
SS			61
			62
			64
SS			66
			68
			70
SS			72

Geologic Description

1/17/95
Drilled, set and cemented surface casing at 56'.
No log kept--used adjacent MW-5B.

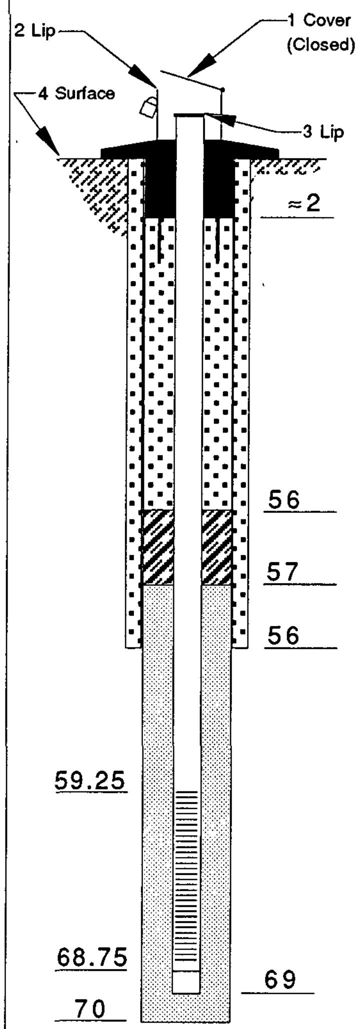
1/19/95

60-62'	No recovery.
65-67'	10" (0.8') recovery. Medium sand, brown, saturated, with grout dropped from base of outer casing. No hydrocarbon odor.
70-72'	16" (1.3') recovery
70-70.2'	Clay, redish brown with black inclusions, no odor.
70.2-71.3'	Sand, medium to coarse, light brown with some fine gravels, slight odor.

Sample Method Symbols

RB=Recovery Barrel ☐ 5' ☐
ST=Shelby Tube ☒ SS=Split Spoon C=Cutting

Monitoring Well ☒
Piezometer
Protective Casing YES



Depths in Feet from Ground Surface (Not to Scale)
LOG - 1

Design Specifications

Elevations: 1 3306.54 2
(feet MSL) 3 3306.23 4 3303.7
Coordinates: X 19500.46 Y 2972.4

Bore Hole Diameter:(Inner) 8 1/4" (Outer) 12"

Type of Casing:(Inner) ☒PVC Sched. 40 Flush Thread
☐Stainless Steel ☐
(Outer)

Casing Diam.: (Inner) ☒ 2" ☐ 4" ☐ 6" ☐
(Outer) ☐ 2" ☐ 4" ☐ 6" ☒ 10"

Screen Slot: ☐ 0.008 ☐ 0.010 ☒
Screen Style: ☒ Machine Slot ☐ Wire Wrap ☐
Sand Pack: CSSI 16-40 silica sand
Bentonite Seal: ☐ 1/4" Pellets ☒ 1/2" Pellets
☐ 1/2" Chips ☐ Hole Plug ☐

Grout Type: 6% bentonite/Portland Weight:
Drill Rig: ☒Hollow Stem ☐ Rotary ☐
Drilled by: Precision Engineering Lic.#:
Logged by: DGB/BPS
Completion Date: 1/19/95
Depth First Encountered Water: ---

Date	D-T-W	D-T-P	Prod Thick	Field pH	Field EC
1/20/95	10.22			7.5	4300
2/4/95	8.19				
2/24/95	7.98			7.0	4200

Comments: D-T-W from casing lip.

RE/SPEC

Navajo

MW-5C

Project: 318/3
Location: Artesia, New Mexico

Samp. Meth.	Samp. Log	PID (ppm)	Depth (Feet)	Geologic Description	
RB			0-2	0-1'	Clayey silt, light brown with some roots and pebbles (cliche).
				1-2.5'	Clayey silt, brown.
			4	2.5-16'	Clay, brown, some calcarous streaking, no odor, slightly moist at 12.5', no odor, black streaks.
			8	16-20.5'	Clay, light gray, grades to silty clay, soft, granular, no odor.
			10	20.5-29.5'	Clay, brown, stiff, plastic, no streaks, moist zone from 27.6-28', clay grading brown to gray at 29.5', slightly moist.
			14		Stop drilling at 1120. At 1320 D-T-W 12' BLS. Backfill hole with clay followed by sand to 25.5'.

Depth scale: 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 25, 26, 28, 30

Sample Method Symbols

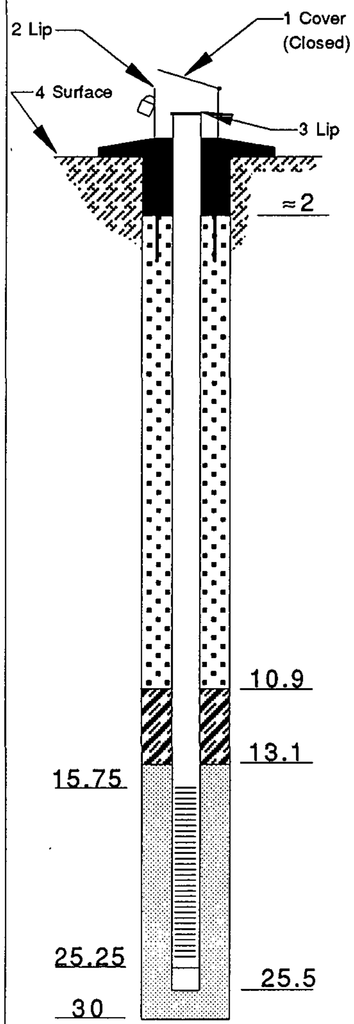
☒ RB=Recovery Barrel ☒ 5' ☐ ____

ST=Shelby Tube | SS=Split Spoon | C=Cutting

Monitoring Well ☒

Piezometer

Protective Casing YES



Depths in Feet from Ground Surface (Not to Scale)

LOG - 1

Design Specifications

Elevations: 1 3310.91 2 ____
(feet MSL) 3 3310.32 4 3308.4

Coordinates: X 15721.26 Y 4059.08

Bore Hole Diameter: 8 1/4"

Type of Casing: ☒ PVC Sched. 40 Flush Thread
☐ Stainless Steel ☐ ____

Casing Diameter: ☒ 2" ☐ 4" ☐ 6" ☐ ____

Screen Slot: ☐ 0.008 ☒ 0.010 ☐ ____

Screen Style: ☒ Machine Slot ☐ Wire Wrap ☐ ____

Sand Pack: CSSI 16-40 silica sand

Bentonite Seal: ☐ 1/4" Pellets ☒ 1/2" Pellets
☐ 1/2" Chips ☐ Hole Plug ☐ ____
(No water added for hydration.)

Grout Type: 6% bentonite/Portland Weight: ____

Drill Rig: ☒ Hollow Stem ☐ Rotary ☐ ____

Drilled by: Precision Engineering Lic.#: ____

Logged by: DGB

Completion Date: 1/13/95

Depth First Encountered Water: 12.5 ft. BLS

Date	D-T-W	D-T-P	Prod Thick	Field pH	Field EC
1/14/95	12.71			6.5	19,000
1/19/95	12.81			7.0	17,000
2/5/95	12.70				

Comments: Purged 170 gallons to clean and develop 1/14, D-T-W from casing lip.

RE/SPEC

Navajo

MW-25

Project: 318/3

Location: Artesia, New Mexico

Samp. Meth.	Samp. Log	PID (ppm)	Depth (Feet)	Geologic Description	
RB				0-0.5'	Clayey silt, topsoil with some sand and roots.
			2	0.5-5'	Silty clay, dark brown with calcite streaking and inclusions, with very fine sand 3-5'.
			4		
			6	5-11'	Clay, brown with calcite crystals, stiff, slightly moist, plastic, no odor (structure with crystals is like sandy clay-granular).
			8		
			10	11-13'	Clayey silt, light brown, some caliche, soft, moist, some fine gravel at 13'.
			12	13-15'	Clay, brown with zones of light gray.
			14	15-15.7'	Gravelly clay with caliche, gray, saturated.
			16	15.7-19'	Clay, reddish brown, with zones of saturation, otherwise stiff plastic.
			18	19-20.5'	Clay and caliche gravel, saturated, no odor. 6" clay, brown at 19.5'.
			20	20.5-23.5'	Sandy silt, light brown, some clay. Very fine-grained sands at 23', saturated, no odor.
			25		
			26	23.5-25'	No recovery.
			28		
			30		

Sample Method Symbols

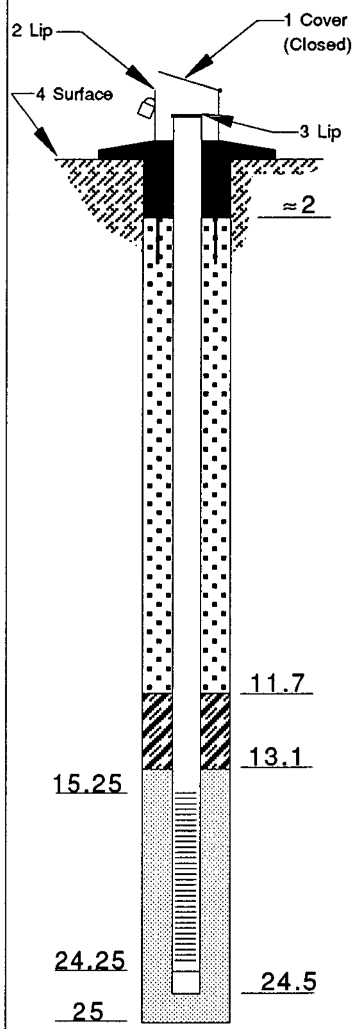
☒ RB=Recovery Barrel ☒ 5' ☐ ____

ST=Shelby Tube | SS=Split Spoon | C=Cutting

Monitoring Well ☒

Piezometer

Protective Casing YES



Depths in Feet from Ground Surface (Not to Scale)

LOG - 1

Design Specifications

Elevations: 1 3314.56 2 ____

(feet MSL) 3 3314.30 4 3311.4

Coordinates: X 13109.14 Y 4889.12

Bore Hole Diameter: 8 1/4"

Type of Casing: ☒ PVC Sched. 40 Flush Thread ☐ Stainless Steel ☐ ____

Casing Diameter: ☒ 2" ☐ 4" ☐ 6" ☐ ____

Screen Slot: ☐ 0.008 ☒ 0.010 ☐ ____

Screen Style: ☒ Machine Slot ☐ Wire Wrap ☐ ____

Sand Pack: CSSI 16-40 silica sand

Bentonite Seal: ☐ 1/4" Pellets ☒ 1/2" Pellets ☐ 1/2" Chips ☐ Hole Plug ☐ ____

(No water added for hydration.)

Grout Type: 6% bentonite/Portland Weight: ____

Drill Rig: ☒ Hollow Stem ☐ Rotary ☐ ____

Drilled by: Precision Engineering Lic.#: ____

Logged by: DGB

Completion Date: 1/13/95

Depth First Encountered Water: 15 ft. BLS

Date	D-T-W	D-T-P	Prod Thick	Field pH	Field EC
1/13/95	- - -			7	7900
1/15/95	11.77			7	8200
2/5/95	11.58				

Comments: Purged 100 gallons to clean and develop, 1/13 D-T-W from casing lip.

RE/SPEC

MW-26

Project: 318/3

Location: Artesia, New Mexico

Samp. Meth.	Samp. Log	PID (ppm)	Depth (Feet)
RB			2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 25, 26, 28, 30

Geologic Description

Depth	Description
0-0.5'	Top soil, organic matter, rocks.
0.5-2.5'	Silt, gray-brown, with roots.
2.5-8.6'	Clayey silt, light brown, dry, hard, calcite(?) crystals 6.3-7.6', increasing clay with depth.
8.6-10'	Silty clay, light gray, some clacite grains, stiff, plastic,
no	odor.
10-20'	Clay, light gray, stiff, plastic, some silt and slightly moist at 14'. Brown staining 14-15', damp at 15', darker from 18-19', no odor. Gray clay with calcite fragments, saturated 19-20'.
20-25'	No recovery, core tip mixture clay and very fine sand.
25-27.3'	Clayey silt, light gray with brown mottling, saturated.
27.3-29.5'	Silty gravel with some clay, saturated. Gravel sizes from pebbles to 2" diameter.
29.5-30	Fine sand with some gravel, no odor.

Sample Method Symbols

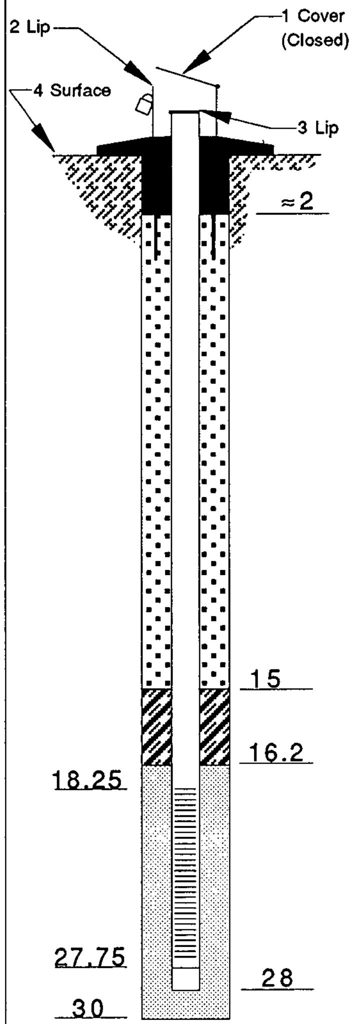
☒ RB=Recovery Barrel ☒ 5' ☐ ______

ST=Shelby Tube | SS=Split Spoon | C=Cutting

Monitoring Well ☒

Piezometer

Protective Casing YES



Depths in Feet from Ground Surface (Not to Scale)

LOG - 1

Design Specifications

Elevations: 1 3320.62 2 ______
(feet MSL) 3 3320.13 4 3318.2
Coordinates: X 10711.87 Y 3142.48

Bore Hole Diameter: 8 1/4"

Type of Casing: ☒ PVC Sched. 40 Flush Thread
☐ Stainless Steel ☐ ______
Casing Diameter: ☒ 2" ☐ 4" ☐ 6" ☐ ______

Screen Slot: ☐ 0.008 ☒ 0.010 ☐ ______
Screen Style: ☒ Machine Slot ☐ Wire Wrap ☐ ______
Sand Pack: CSSI 16-40 silica sand
Bentonite Seal: ☐ 1/4" Pellets ☒ 1/2" Pellets
☐ 1/2" Chips ☐ Hole Plug ☐ ______
Hydrated w/ 5 gallons water
Grout Type: 6% bentonite/Portland Weight: ______
Drill Rig: ☒ Hollow Stem ☐ Rotary ☐ ______
Drilled by: Precision Engineering Lic.#: ______
Logged by: DGB
Completion Date: 1/12/95
Depth First Encountered Water: 19 ft. BLS

Date	D-T-W	D-T-P	Prod Thick	Field pH	Field EC
1/13/95	13.05			7	3100
1/15/95	13.02			7	3100
2/5/95	12.62				

Comments: Purged 170 gallons, D-T-W from casing lip.

RE/SPEC

MW-27

Project: 318/3.3
Location: Artesia, New Mexico

Geologic Description

Samp. Meth.	Depth (Feet)	Interval	Description
RB		0-1'	Sandy silt, light brown, roots, calcite(?) crystals at 1'.
	2	2-5'	Clayey silt, light brown, calcite increasing with depth.
	4	5-9'	Silty clay, light gray with brown streaks, clacite crystals, dry. Increasing moisture 8.5-9'.
	6, 8	9-17'	Clay, brown, stiff, slightly moist, caliche fine gravels as inclusions, crumbly at 10', light gray, plastic 10-11.3', brown reduced zones 11.3 11.5', gray, stiff, plastic, slightly moist 11.5-15', reduced zone 14.5-15'.
	10, 12, 14	17-17.5'	Clayey gravel, limestone gravels, rounded, ellipsoid 2"x1" and smaller.
		17.5-20'	Missing.
	16, 18	20-22'	Clayey gravel, medium brown, saturated, with fine-grained sand, no odor.
		22-23.5'	Clay, light brown, moist, reduced zone at 23'.
	20, 22	23.5'	Clayey sandy gravel, very fine sand, saturated, 24-25' missing.
	24, 26		

Sample Method Symbols

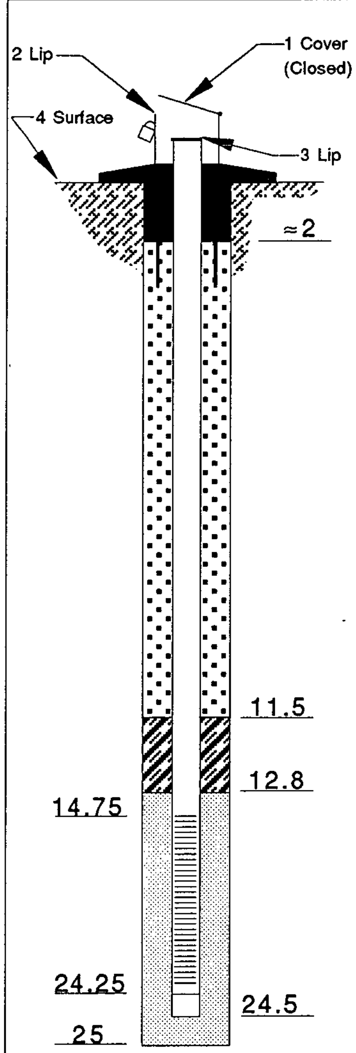
☒ RB=Recovery Barrel ☒ 5' ☐ ______

ST=Shelby Tube | SS=Split Spoon | C=Cutting

Monitoring Well ☒

Piezometer

Protective Casing YES



Depths in Feet from Ground Surface (Not to Scale)

LOG - 1

Design Specifications

Elevations: 1 3327.51 2 ______
(feet MSL) 3 3327.24 4 3324.9

Coordinates: X 9236.14 Y 2940.33

Bore Hole Diameter: 8 1/4"

Type of Casing: ☒ PVC Sched. 40 Flush Thread
☐ Stainless Steel ☐ ______

Casing Diameter: ☒ 2" ☐ 4" ☐ 6" ☐ ______

Screen Slot: ☐ 0.008 ☒ 0.010 ☐ ______

Screen Style: ☒ Machine Slot ☐ Wire Wrap ☐ ______

Sand Pack: CSSI 16-40 silica sand

Bentonite Seal: ☐ 1/4" Pellets ☒ 1/2" Pellets
☐ 1/2" Chips ☐ Hole Plug ☐ ______
Hydrated w/ 5 gallons water

Grout Type: 6% bentonite/Portland Weight: ______

Drill Rig: ☒ Hollow Stem ☐ Rotary ☐ ______

Drilled by: Precision Engineering Lic.#: ______

Logged by: DGB

Completion Date: 1/11/95

Depth First Encountered Water: 18 ft. BLS

Date	D-T-W	D-T-P	Prod Thick	Field pH	Field EC
1/11/95	17.25			7	3500
1/15/95	17.78			7	4400
2/5/95	16.69				

Comments: D-T-W from casing lip.

RE/SPEC

MW-28

Project: 318/3.3

Location: Artesia, New Mexico

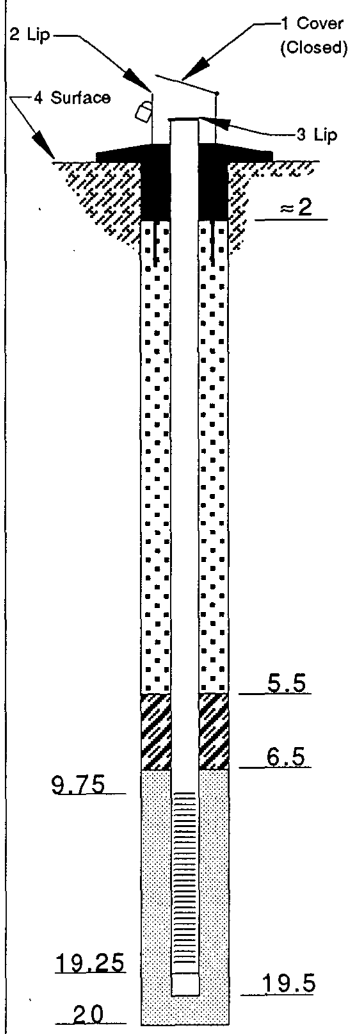
Samp. Meth.	Samp. Log	PID (ppm)	Depth (Feet)	Geologic Description	
RB			0	0-0.5'	Silt, roots, topsoil.
				1-7'	Silty clay, light gray, dry 1-3', crystals (calcite?) 3-4', brown with some black, no odor, roots 4-4.5', brown olive brown mottling with crystals 5-6', less mottling 6-7'.
				7-8'	Clay, light gray, fine gravel, crystals, very plastic, no odor.
				8-10'	Missing.
				10-13'	Clay, light gray, granular, saturated at 10', light gray brown, moist and plastic 10.5-13'.
				13 -15.5'	Silty clay, light brown, moist, 2" piece of broken limestone gravel at 15'.
				15.5-17'	Clay, light brown, plastic, slightly moist, platy caliche 16.5-17'.
				17-17.5'	Gravely clay, light gray, 3/4" gravel, cemented, saturated.
				17.5-20'	Silty clay, light brown, slightly moist and plastic.

Depth (Feet): 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26

Sample Method Symbols

☒ RB=Recovery Barrel ☒ 5' ☐ ______
ST=Shelby Tube | SS=Split Spoon | C=Cutting

Monitoring Well	☒
Piezometer	
Protective Casing	YES



Depths in Feet from Ground Surface (Not to Scale)
LOG - 1

Design Specifications

Elevations: 1 3334.52 2 ______
(feet MSL) 3 3334.29 4 3331.6
Coordinates: X 7336.58 Y 1645.21

Bore Hole Diameter: 8 1/4"

Type of Casing: ☒ PVC Sched. 40 Flush Thread ☐ Stainless Steel ☐ ______
Casing Diameter: ☒ 2" ☐ 4" ☐ 6" ☐ ______

Screen Slot: ☐ 0.008 ☒ 0.010 ☐ ______
Screen Style: ☒ Machine Slot ☐ Wire Wrap ☐ ______
Sand Pack: CSSI 16-40 silica sand
Bentonite Seal: ☐ 1/4" Pellets ☒ 1/2" Pellets ☐ 1/2" Chips ☐ Hole Plug ☐ ______
Hydrated w/ 5 gallons water
Grout Type: 6% bentonite/Portland Weight: ______
Drill Rig: ☒ Hollow Stem ☐ Rotary ☐ ______
Drilled by: Precision Engineering Lic.#: ______
Logged by: DGB
Completion Date: 1/10/95
Depth First Encountered Water: 10 ft. BLS

Date	D-T-W	D-T-P	Prod Thick	Field pH	Field EC
1/10/95	11.07				
1/12/95	11.05			6.5	6100
2/5/95	11.19				

Comments: D-T-W from casing lip.

RE/SPEC

MW-29

Project: 318/3.3
Location: Artesia, New Mexico

Samp. Meth.	Samp. Log	PID (ppm)	Depth (Feet)
RB			2, 4, 6, 8, 10, 12, 14, 16, 18, 20

Geologic Description

0–4.0' SAND TO SILTY SAND, brown, slightly moist to saturated at 4.0', many fine roots.
- thin bands of CLAYEY SAND (<4" thick) appear at 1.5', 2.5', and 3.5'.
- slight hydrocarbon odor detected at 4.0'.

4.0–6.0' SAND, brown, saturated, thin clay layers, hydrocarbon odor noted.

6.0–9.0' CLAY, reddish/brown, saturated to moist, hydrocarbon odor noted.

9.0–18.0' CLAY, alternating with SAND, brown, clay very moist, sand is saturated, sand is fine to medium grain, hydrocarbon odor and gray discoloration noted.

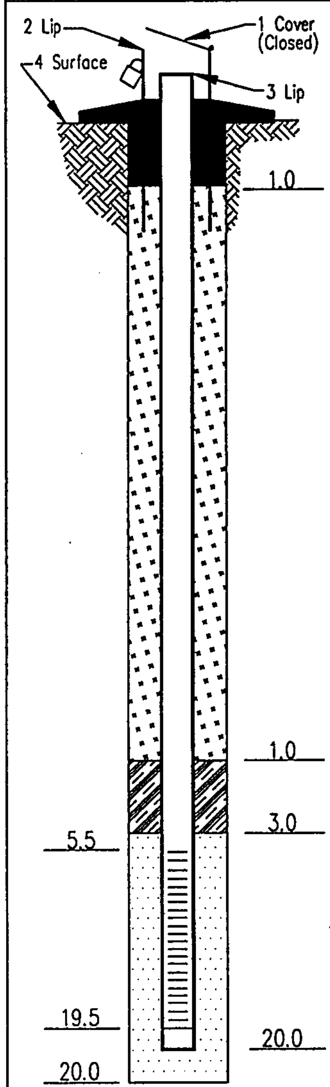
18.0–20.0' SAND, gray, saturated, fine to medium grain, hydrocarbon odor and staining.

TD = 20.0'

Sample Method Symbols

☒ RB=Recovery Barrel	☒ 5'	☐ ____	
ST=Shelby Tube	SS=Split Spoon	C=Cutting	

Monitoring Well	X
Piezometer	
Protective Casing	YES



Depths in Feet from Ground Surface (Not to Scale)

LOG-1

Design Specifications

Elevations: 1 3308.10 2 3308.08
(feet MSL) 3 3307.05 4 3304.50

Coordinates: X 20834.63 Y 4870.19

Bore Hole Diameter: 12"

Type of Casing: ☒ PVC Sched. 40 Flush Thread ☐ Stainless Steel ☐ ____

Casing Diameter: ☐ 2" ☒ 4" ☐ 6" ☐ ____

Screen Slot: ☐ 0.008 ☒ 0.010 ☐ ____

Screen Style: ☒ Machine Slot ☐ Wire Wrap ☐ ____

Sand Pack: CSSI 10/20 and 12/20

Bentonite Seal: ☐ 1/4" Pellets ☒ 1/2" Pellets ☐ 1/2" Chips ☐ Hole Plug ☐ ____

Grout Type: Portland Cement Weight: ____

Drill Rig: ☒ Hollow Stem ☐ Rotary ☐ ____

Drilled By: Pool Environmental Drilling Lic. #: WD 1266

Logged By: PWC

Completion Date: 12/15/92

Depth First Encountered Water: 4.0' BLS

Date	D-T-W	D-T-P	Prod Thick	Field pH	Field EC
12/19/93	7.52			7.04	9,700
2/10/93	7.89				

Comments: This well is a replacement for OCD-7, which was removed and grouted back to surface. Bentonite pellets were placed to within 1.0' of the surface.

KWBES

Navajo

OCD-7AR

Project: 622092005-110 (OCD-7R)
Location: Artesia, New Mexico

Samp. Meth.	Samp. Log	PID (ppm)	Depth (Feet)
RB			3
			6
			9
			12
			15
			18
C			21
			24
			27
			30
			33
			36
			39
			42
			45
			48
SS			51
			54

Geologic Description

0–4.0' SAND AND SILTY SAND, brown, slightly moist to saturated at 3.8', many fine roots and root channels.
- –thin layers (<4") of CLAYEY SAND, brown, moist interbedded @ 1.5', 2.5', 3.5'.
- –root near 4' is discolored black and hydrocarbon odor

4.0–6.0' SAND, brown to gray, saturated, hydrocarbon odor and discoloration.

6.0–9.0' CLAY, reddish/brown, very moist, hydrocarbon odor decreasing with depth.

9.0–18.0' Alternating bands of CLAY AND SAND, sand is saturated, clay is very moist, hydrocarbon odor still detectable.

18.0–51.0' SAND, tan to gray, saturated, fine to medium grain.

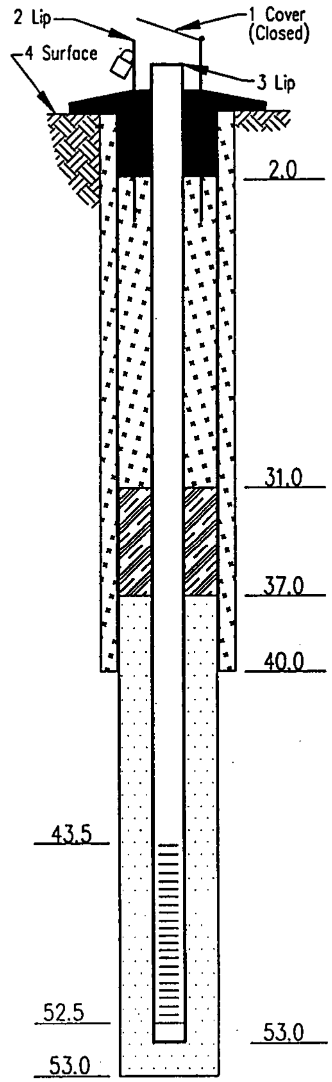
51.0–53.0' CLAY, reddish/brown, moist, plastic, no hydrocarbon odor.

TD = 53.0'

Sample Method Symbols

☒ RB=Recovery Barrel ☒ 5' ☐ ______
ST=Shelby Tube ☒ SS=Split Spoon ☒ C=Cutting

Monitoring Well	X
Piezometer	
Protective Casing	YES



Depths in Feet from Ground Surface (Not to Scale)

LOG-7

Design Specifications

Elevations: 1 3306.58 2 3306.56
(feet MSL) 3 3306.30 4 3303.10

Coordinates: X 20487.76 Y 3145.47

Bore Hole Diameter: (Inner) 8" (Outer) 14"

Type of Casing: (Inner) ☒ PVC Sched. 40 Flush Thread ☐ Stainless Steel ☐ ______
(Outer) ☒ PVC Schedule 40

Casing Diameter: (Inner) ☒ 2" ☐ 4" ☐ 6" ☐ ______
(Outer) ☐ 2" ☐ 4" ☐ 6" ☒ 10"

Screen Slot: ☐ 0.008 ☒ 0.010 ☐ ______

Screen Style: ☒ Machine Slot ☐ Wire Wrap ☐ ______

Sand Pack: CSSI 10/20 12/20

Bentonite Seal: ☐ 1/4" Pellets ☐ 1/2" Pellets ☐ 1/2" Chips ☐ Hole Plug ☒ Slurry

Grout Type: Portland/Bentonite Weight: ______

Drill Rig: ☒ Hollow Stem ☐ Rotary ☐ ______

Drilled By: Pool Environmental Drilling Lic. #: WD 1266

Logged By: PWC

Completion Date: 12/15/92

Depth First Encountered Water: 3.8' BLS

Date	D-T-W	D-T-P	Prod Thick	Field pH	Field EC
1/30/93	8.23			8.32	5,150
2/10/93	8.21				

Comments: ______

KWBES

Navajo

OCD-7B

Project: 622092005-110 (OCD-7B)
Location: Artesia, New Mexico

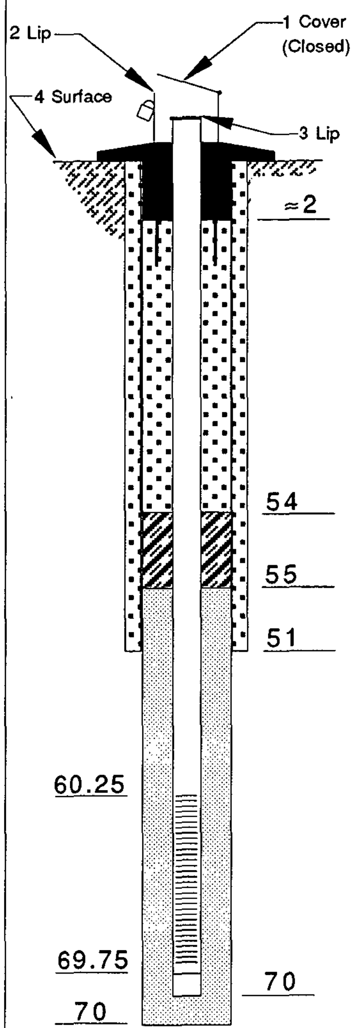
Samp. Meth.	Samp. Log	PID (ppm)	Depth (Feet)	Geologic Description
				1/18/95
				Drilled, set and cemented surface casing at 51'.
			62	No log kept--used adjacent OCD-7B.
				1/20/95
			64	65-67' 2' recovery.
SS				65-66.5' Sand, fine-grained brown, some fine gravel 65.7-65.9', slight odor.
			66	66.5-67' Gravelly sand, coarse, brown, gravel to 1.8", limestone origin.
			68	70-72' 2' recovery
				70-71.2' Clay, dark gray, mottled colors, gray, greenish gray, brown.
SS			70	71.2-72' Clay, light gray to light brown, grading to clayey silt at bottom, septic odor.
			72	

Sample Method Symbols

RB=Recovery Barrel ☐ 5' ☐

ST=Shelby Tube ☒ SS=Split Spoon C=Cutting

Monitoring Well	☒
Piezometer	
Protective Casing	YES



Depths in Feet from Ground Surface (Not to Scale)

LOG - 1

Design Specifications

Elevations: (feet MSL) 1 3307.31 2 ____ 3 3306.92 4 3304.6

Coordinates: X 20831.82 Y 4856.18

Bore Hole Diameter: (Inner) 8 1/4" (Outer) 12"

Type of Casing: (Inner) ☒ PVC Sched. 40 Flush Thread ☐ Stainless Steel ☐ ____

(Outer) ____

Casing Diam.: (Inner) ☒ 2" ☐ 4" ☐ 6" ☐ ____

(Outer) ☐ 2" ☐ 4" ☐ 6" ☒ 10"

Screen Slot: ☐ 0.008 ☒ 0.010 ☐ ____

Screen Style: ☒ Machine Slot ☐ Wire Wrap ☐ ____

Sand Pack: CSSI 16-40 silica sand

Bentonite Seal: ☐ 1/4" Pellets ☒ 1/2" Pellets ☐ 1/2" Chips ☐ Hole Plug ☐ ____

Grout Type: 6% bentonite/Portland Weight: ____

Drill Rig: ☒ Hollow Stem ☐ Rotary ☐ ____

Drilled by: Precision Engineering Lic.#: ____

Logged by: DGB/BPS

Completion Date: 1/20/95

Depth First Encountered Water: ---

Date	D-T-W	D-T-P	Prod Thick	Field pH	Field EC
1/21/95	---			7	7600
2/4/95	8.58			---	---
2/24/95	8.36			7.0	4200

Comments: Purged approximately 200 gallons to clean and develop, sampled immediately after development. D-T-W from casing lip.

RE/SPEC

OCD-7C

Project: 318/3

Location: Artesia, New Mexico

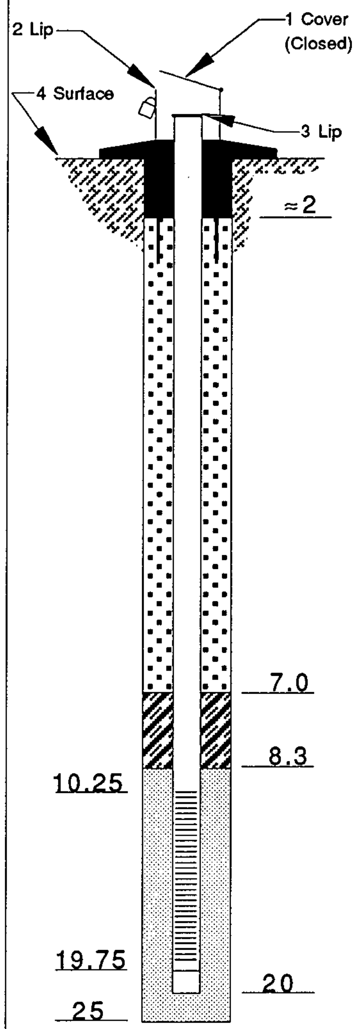
Depth (Feet)	Geologic Description	
	0-1.5'	Clayey silt, light brown, some white staining.
	1.5-4'	Silty clay, light brown, slightly moist, dry, some white staining.
	5-8'	Silty clay, light gray, increasing clay with depth.
	8-10'	Clay, white (chalk) color with some black streaks, some silt, moist.
	10'	Clay with gravel, moist fine gravel to 3/4".
	10-11'	Clay, chalk color, very moist.
	11-12.5'	Clay, chalk color, slightly moist, some fine gravel (≈5%).
	12.5-15'	Clay, gray and brown mottling, shiny-grained inclusions (dissolve in water), no odor, very plastic.
	15-17'	Silty clay, brown, some sand and fine gravel, very moist.
	17-20'	Clay, gray and light brown, moist at 17.5'.
	20-25'	Clay, gray, massive, some fine gravel at inclusions, moist from 22-22.5'.

Samp. Meth.: RB

Sample Method Symbols: ☒ RB=Recovery Barrel ☒ 5' ☐ ST=Shelby Tube SS=Split Spoon C=Cutting

Monitoring Well ☐ Piezometer ☒

Protective Casing YES



Depths in Feet from Ground Surface (Not to Scale)

LOG - 1

Design Specifications

Elevations: 1 3353.66 2 3351.50
(feet MSL) 3 3353.41 4
Coordinates: X 2659.36 Y 3408.23

Bore Hole Diameter: 8 1/4"

Type of Casing: ☒ PVC Sched. 40 Flush Thread ☐ Stainless Steel ☐
Casing Diameter: ☒ 2" ☐ 4" ☐ 6" ☐

Screen Slot: ☐ 0.008 ☒ 0.010 ☐
Screen Style: ☒ Machine Slot ☐ Wire Wrap ☐
Sand Pack: CSSI 16-40 silica sand
Bentonite Seal: ☐ 1/4" Pellets ☒ 1/2" Pellets ☐ 1/2" Chips ☐ Hole Plug ☐
Hydrated w/ 5 gallons water
Grout Type: 6% bentonite/Portland Weight:
Drill Rig: ☒ Hollow Stem ☐ Rotary ☐
Drilled by: Precision Engineering Lic.#:
Logged by: DGB
Completion Date: 1/11/95
Depth First Encountered Water: 15 ft. BLS

Date	D-T-W	D-T-P	Prod Thick	Field pH	Field EC
1/11/95	10.71				4500
2/5/95	10.95				

Comments: Pumped 60 gallons to clean.
Pumped 3.8 gpm, D-T-W from casing lip.

RE/SPEC

NP-5

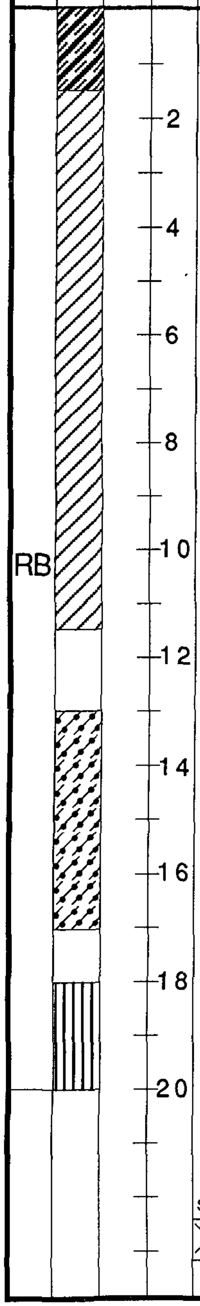
Project: 318/3.3
Location: Artesia, New Mexico

Geologic Description

Depth	Description
0-1.6'	Clayey sand, brown, topsoil
1.6-5'	Silty clay, light gray, dry, friable, white (caliche?) streaks.
5-6.4'	Silty clay, brown, dry stiff, gray streaks.
6.4-7'	Silty clay, light gray, dry.
7-10'	Silty clay, moist, increasing silt at 10.
10-11.5'	Silty clay, alternating brown and gray, moist.
11.5-13'	Missing.
13-15'	Clayey gravel (caliche) gray, crumbly, saturated.
15-17'	Clayey gravel, gray, cemented.
17-18'	Missing.
18-20'	Clayey silt to silty clay, light brown.

Samp. Meth. | Samp. Log | PID (ppm) | Depth (Feet)

RB

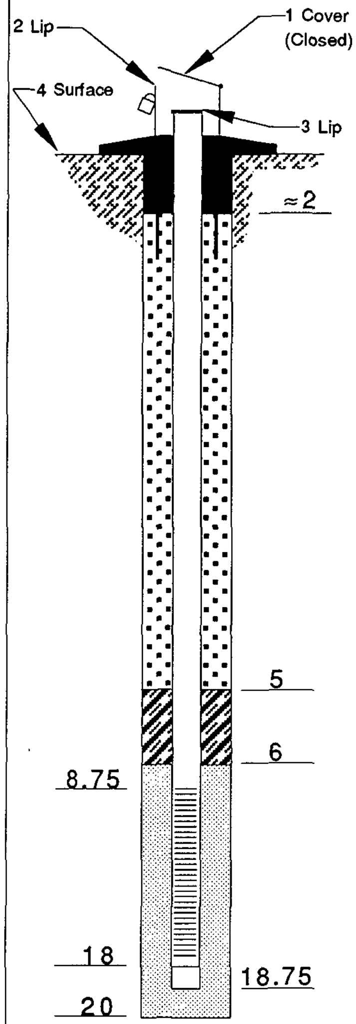


Sample Method Symbols

☒ RB=Recovery Barrel ☒ 5' ☐ ______

ST=Shelby Tube | SS=Split Spoon | C=Cutting

Monitoring Well ☐
Piezometer ☒
Protective Casing YES



Depths in Feet
from Ground Surface
(Not to Scale)
LOG - 1

Design Specifications

Elevations: 1 3337.12 2 ______
(feet MSL) 3 3336.96 4 3335.20
Coordinates: X 6860.05 Y 1571.60

Bore Hole Diameter: 8 1/4"

Type of Casing: ☒ PVC Sched. 40 Flush Thread ☐ Stainless Steel ☐ ______

Casing Diameter: ☒ 2" ☐ 4" ☐ 6" ☐ ______

Screen Slot: ☐ 0.008 ☒ 0.010 ☐ ______
Screen Style: ☒ Machine Slot ☐ Wire Wrap ☐ ______
Sand Pack: CSSI 16-40 silica sand
Bentonite Seal: ☐ 1/4" Pellets ☒ 1/2" Pellets ☐ 1/2" Chips ☐ Hole Plug ☐ ______
Hydrated w/ 5 gallons water
Grout Type: 6% bentonite/Portland Weight: ______
Drill Rig: ☒ Hollow Stem ☐ Rotary ☐ ______
Drilled by: Precision Engineering Lic.#: ______
Logged by: DGB
Completion Date: 1/10/95
Depth First Encountered Water: 13 ft. BLS

Date	D-T-W	D-T-P	Prod Thick	Field pH	Field EC
1/10/95	9.88				
2/5/95	10.06				

Comments: Pumped 60 gallons to clean, slightly whitish. Pumped 1.7 gpm, D-T-W from casing lip.

RE/SPEC

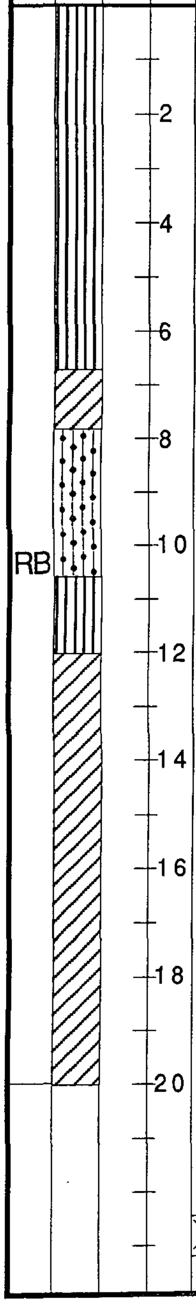
NP-6

Project: 318/3.3
Location: Artesia, New Mexico

Geologic Description

Depth	Description
0-2'	Silt, dark brown with black mottling, some fine gravel.
2-6.8'	Clayey silt, light brown, calcite streaks, increasing calcite and fine gravels 5-6'.
6.8-7.8'	Clay, reddish brown, calcite stiff.
7.8-10.5'	Silty gravel, varying sized to 2" diameter, dry.
10.5-12'	Clayey silt, dark brown, some calcite.
12-20'	Silty clay, mottled gray and light brown, clay increasing with depth, calcite inclusions, light gray, stiff 14-15', caliche zones 1-2" thick at 15', 16.5', 17.5', dry to 20'.
20-20.5'	Silt, light brown, some clay.
20.5-25.5'	Clay, dark brown with mottling, some white caliche inclusions, numerous small gravel to 3/8", 24.5-25'.
25.5-26'	Caliche gravel and clay, saturated.
26-27.5'	Clay, stiff with occasional caliche gravel, gravel and saturated from 27.3-27.5'.
27.5-30'	Clay, lightbrown to gray, slightly moist, with caliche gravel and pebbles.

Samp. Meth. | Samp. Log | PID (ppm) | Depth (Feet)



Sample Method Symbols

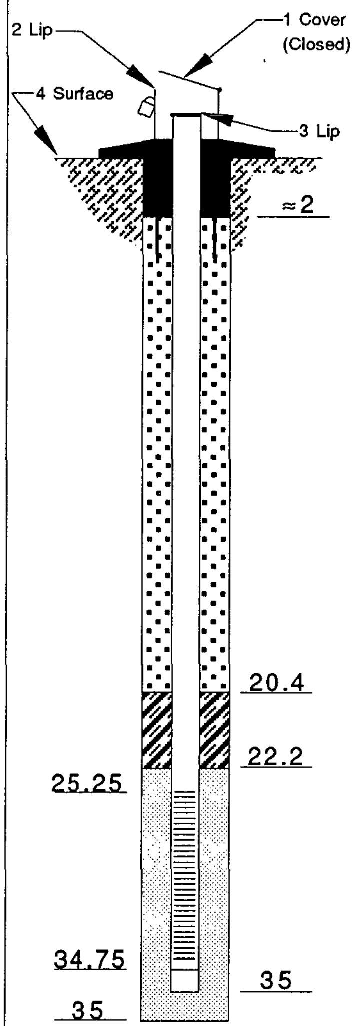
☒ RB=Recovery Barrel ☒ 5' ☐ ____

ST=Shelby Tube | SS=Split Spoon | C=Cutting

Monitoring Well ☒

Piezometer

Protective Casing YES



Depths in Feet from Ground Surface (Not to Scale)

LOG - 1

Design Specifications

Elevations: 1 3329.27 2 ____
(feet MSL) 3 3328.86 4 3326.3

Coordinates: X 10097.01 Y 3452.81

Bore Hole Diameter: 8 1/4"

Type of Casing: ☒ PVC Sched. 40 Flush Thread
☐ Stainless Steel ☐ ____

Casing Diameter: ☒ 2" ☐ 4" ☐ 6" ☐ ____

Screen Slot: ☐ 0.008 ☒ 0.010 ☐ ____

Screen Style: ☒ Machine Slot ☐ Wire Wrap ☐ ____

Sand Pack: CSSI 16-40 silica sand

Bentonite Seal: ☐ 1/4" Pellets ☒ 1/2" Pellets
☐ 1/2" Chips ☐ Hole Plug ☐ ____
Hydrated with 5 gallons of water.

Grout Type: 6% bentonite/Portland Weight: ____

Drill Rig: ☒ Hollow Stem ☐ Rotary ☐ ____

Drilled by: Precision Engineering Lic.#: ____

Logged by: DGB

Completion Date: 1/11/95

Depth First Encountered Water: 25.5 ft. BLS

Date	D-T-W	D-T-P	Prod Thick	Field pH	Field EC
1/12/95	25.21			7	3700
2/5/95	24.61				

Comments: Purged 65 gallons to clean and develop, pumped a 2-9 gpm1/12. D-T-W from casing lip.

RE/SPEC

NP-7

>Page 1of 2<

Project: 318/3

Location: Artesia, New Mexico

Samp. Meth.	Samp. Log	PID (ppm)	Depth (Feet)	Geologic Description
RB			22, 24, 26, 28, 30, 32, 34, 36, 38, 40	30-31.4' Clay and silty clay, light brown to gray, with caliche gravel and pebbles. 31.4-32.7' Sandy clay with increasing sand to total depth, sand fine to medium, light brown. 32.7-35' No recovery.

Sample Method Symbols

☒ RB=Recovery Barrel	☒ 5'	☐ ____	
ST=Shelby Tube	SS=Split Spoon	C=Cutting	

Monitoring Well	X
Piezometer	
Protective Casing	YES

Refer to NP-7 Page 1

Design Specifications

Refer to NP-7 Page 1

RE/SPEC

NP-7
(CONTINUED)

Project: 318/3
Location: Artesia, New Mexico

APPENDIX C

Aquifer Test Data and Graphs

Appendix C

Slug Test Data Set Configuration for Hydraulic Conductivity Determination

Well	OCD-7C Slug In	OCD-7C Slug Out	MW-5C Slug In	MW-5C Slug Out	MW-4C Slug In	MW-4C Slug Out
Test Date:	4 Feb. 95	4 Feb. 95	4 Feb. 95	4 Feb. 95	4 Feb. 95	4 Feb. 95
Initial rise/drawdown in well, s_o (ft.)	3.00	3.67	2.13	2.90	3.26	3.15
Radius of well casing, $\mathbf{r_c}$ (ft.)	0.08333	0.08333	0.08333	0.08333	0.08333	0.08333
Radius of well borehole, $\mathbf{r_w}$ (ft.)	0.3333	0.3333	0.3333	0.3333	0.3333	0.3333
Saturated aquifer thickness, **b** (ft.)	100	100	100	100	100	100
Screen length, **L** (ft.)	9.5	9.5	9.5	9.5	9.5	9.5
Height of water in well, **H** (ft.)	64	64	64.3	64.3	62	62
Hydraulic Conductivity, **K** (ft/min)	0.00806	0.00882	0.00867	0.00925	0.00187	0.00186

Hydraulic conductivity determined using Bouwer and Rice Method:

$$\ln s_o - \ln s_t = (2\,K\,L\,t) / (r_c^2 \ln(r_e/r_w))$$

where:

- $\mathbf{K}$ = hydraulic conductivity (ft/min)
- s_o = initial drawdown in well due to instantaneous removal of water from well (ft.)
- s_t = drawdown in well at time t (ft.)
- $\mathbf{L}$ = length of well screen (ft.)
- $\mathbf{r_c}$ = radius of well casing (ft.)
- $\mathbf{\ln(r_e/r_w)}$ = empirical "shape factor" determined from tables provided by Bouwer and Rice
- $\mathbf{r_e}$ = equivalent radius over which head loss occurs (ft.)
- $\mathbf{r_w}$ = radius of well, including sand pack (ft.)
- $\mathbf{H}$ = static height of water in well (ft.)
- $\mathbf{b}$ = saturated thickness of aquifer ft.)

References:

Bouwer, H. and R.C. Rice, 1976. *A slug test method for determining hydraulic conductivity of unconfined aquifers with completely or partially penetrating wells*, Water Resources Research, vol. 12, no. 3, pp. 423-428.

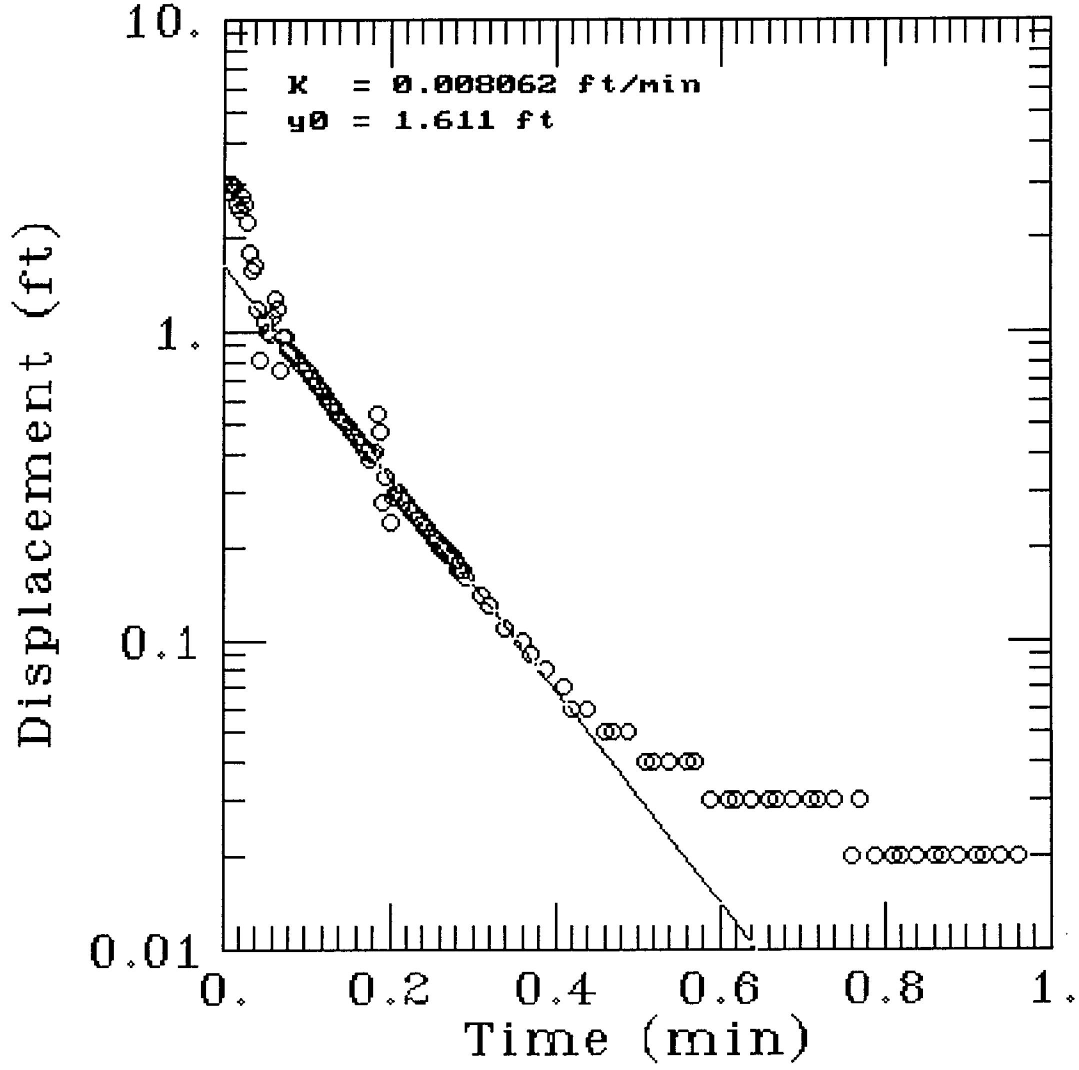
Bouwer, H., 1989. *The Bouwer and Rice slug test -- an update*, Ground Water, vol. 27, no. 3, pp. 304-309.

Time	Channel 2	Channel 3	Channel 4	Channel 5	Channel 6	Channel 7
2/4/95	OCD-7C In	OCD-7C Out	MW-5C In	MW-5C Out	MW-4C In	MW-4C Out
Start:	1411	1430	1532	1546	1635	1650
0.0000	-0.02	0.00	-0.01	0.03	-0.04	-0.04
0.0033	-0.01	1.51	-0.01	0.91	-0.04	-0.04
0.0067	-0.01	2.23	-0.01	1.37	-0.04	0.94
0.0100	-0.06	2.59	-0.01	0.03	-0.04	2.11
0.0133	-0.02	1.78	-0.01	-0.24	-0.04	1.39
0.0167	0.00	2.66	-0.01	1.99	-0.04	0.64
0.0200	-0.03	1.82	-0.01	1.53	-0.03	1.95
0.0233	-0.49	**3.67**	0.00	2.12	-0.04	1.77
0.0267	-0.36	3.17	-0.01	2.17	-0.06	1.58
0.0300	-0.60	2.87	-0.01	1.44	-0.10	2.39
0.0333	-1.24	2.84	-0.60	2.64	-0.03	2.65
0.0367	-2.10	1.94	-0.59	2.27	-0.04	2.70
0.0400	-2.33	2.03	-0.70	1.75	-0.04	2.53
0.0433	-2.80	1.79	-1.43	**2.90**	-0.05	**3.15**
0.0467	-2.99	1.75	-1.66	2.31	-1.29	2.51
0.0500	**-3.00**	1.70	-2.00	2.01	-1.03	2.49
0.0533	-2.94	1.76	-1.86	1.92	-1.77	2.44
0.0567	-2.56	1.54	-1.53	1.82	-2.30	2.45
0.0600	-2.46	1.55	-1.67	1.81	-1.38	2.43
0.0633	-2.69	1.40	-1.90	1.72	-2.15	2.42
0.0667	-2.54	1.41	-1.85	1.67	-2.40	2.39
0.0700	-2.25	1.36	-2.11	1.64	-2.31	2.37
0.0733	-1.77	1.37	-2.12	1.53	-2.22	2.37
0.0767	-1.57	1.30	-2.00	1.51	-2.92	2.32
0.0800	-1.62	1.24	-2.10	1.49	-2.84	2.35
0.0833	-1.17	1.23	**-2.13**	1.47	-2.06	2.27
0.0867	-0.81	1.19	-2.10	1.44	-2.93	2.31
0.0900	-1.07	1.14	-1.96	1.37	-2.99	2.27
0.0933	-1.00	1.13	-1.83	1.32	-2.85	2.30
0.0967	-0.97	1.07	-1.83	1.28	**-3.26**	2.24
0.1000	-1.11	1.05	-1.76	1.25	-3.24	2.23
0.1033	-1.28	1.02	-1.78	1.21	-3.05	2.22
0.1067	-1.17	0.98	-1.76	1.15	-3.05	2.19
0.1100	-0.75	0.96	-1.65	1.18	-2.40	2.19
0.1133	-0.95	0.93	-1.56	1.09	-2.66	2.18
0.1167	-0.95	0.90	-1.19	1.01	-2.96	2.21
0.1200	-0.87	0.88	-0.84	1.06	-2.52	2.17
0.1233	-0.85	0.87	-1.05	1.03	-2.23	2.15
0.1267	-0.84	0.83	-1.23	0.99	-2.08	2.13
0.1300	-0.82	0.80	-1.26	0.96	-2.45	2.11
0.1333	-0.79	0.77	-1.11	0.92	-2.32	2.11
0.1367	-0.78	0.74	-1.04	0.90	-2.05	2.08
0.1400	-0.75	0.72	-0.82	0.87	-1.78	2.06
0.1433	-0.73	0.70	-0.47	0.85	-2.08	2.05
0.1467	-0.71	0.73	-0.96	0.83	-2.13	2.05
0.1500	-0.69	0.65	-0.87	0.80	-2.28	2.04
0.1533	-0.67	0.64	-0.73	0.78	-2.02	2.02
0.1567	-0.65	0.62	-0.79	0.76	-2.10	1.97

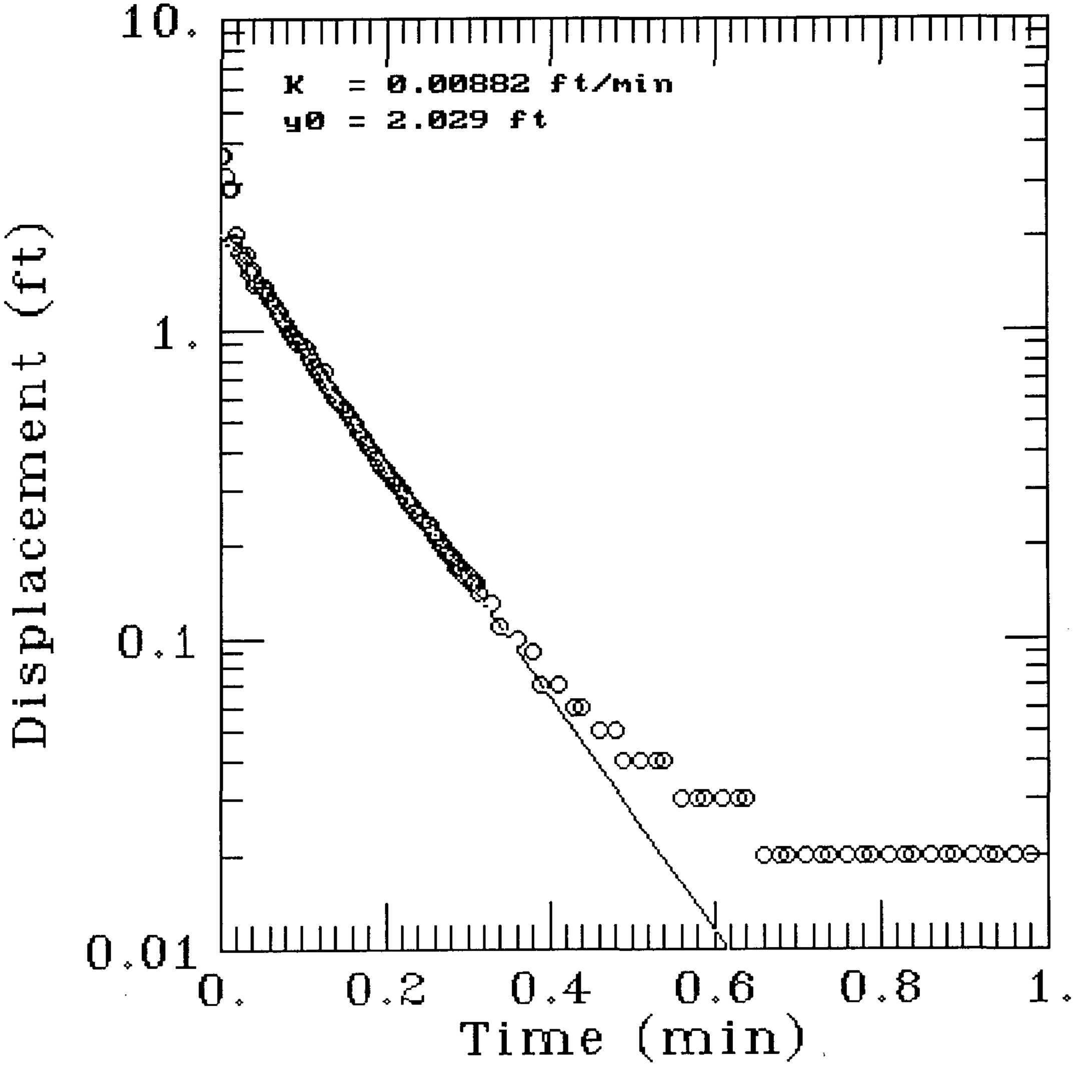
Time	Channel 2	Channel 3	Channel 4	Channel 5	Channel 6	Channel 7
2/4/95	OCD-7C In	OCD-7C Out	MW-5C In	MW-5C Out	MW-4C In	MW-4C Out
0.1600	-0.64	0.60	-0.77	0.74	-2.07	2.02
0.1633	-0.62	0.59	-0.75	0.72	-2.07	1.99
0.1667	-0.60	0.57	-0.73	0.69	-2.07	2.00
0.1700	-0.59	0.55	-0.72	0.67	-2.06	1.97
0.1733	-0.57	0.53	-0.70	0.65	-2.04	1.96
0.1767	-0.55	0.52	-0.68	0.64	-2.03	1.95
0.1800	-0.53	0.50	-0.67	0.62	-2.18	1.93
0.1833	-0.52	0.49	-0.65	0.60	-1.91	1.92
0.1867	-0.51	0.47	-0.63	0.58	-2.04	1.91
0.1900	-0.49	0.46	-0.61	0.57	-1.95	1.90
0.1933	-0.48	0.45	-0.60	0.55	-1.96	1.89
0.1967	-0.47	0.43	-0.58	0.53	-1.96	1.88
0.2000	-0.46	0.42	-0.56	0.52	-1.95	1.86
0.2033	-0.44	0.41	-0.55	0.50	-1.94	1.85
0.2067	-0.43	0.40	-0.53	0.49	-1.93	1.84
0.2100	-0.42	0.39	-0.52	0.47	-2.11	1.83
0.2133	-0.41	0.37	-0.51	0.46	-1.78	1.81
0.2167	-0.39	0.36	-0.49	0.45	-1.86	1.81
0.2200	-0.40	0.35	-0.48	0.43	-1.86	1.80
0.2233	-0.41	0.34	-0.46	0.42	-1.93	1.79
0.2267	-0.54	0.33	-0.45	0.41	-1.84	1.78
0.2300	-0.48	0.32	-0.44	0.39	-1.84	1.77
0.2333	-0.28	0.32	-0.43	0.39	-1.84	1.76
0.2367	-0.34	0.31	-0.42	0.37	-1.83	1.75
0.2400	-0.24	0.30	-0.40	0.36	-1.81	1.74
0.2433	-0.29	0.29	-0.39	0.35	-1.80	1.73
0.2467	-0.30	0.28	-0.38	0.34	-1.79	1.72
0.2500	-0.30	0.27	-0.37	0.33	-1.78	1.71
0.2533	-0.29	0.27	-0.36	0.32	-1.77	1.70
0.2567	-0.28	0.26	-0.35	0.31	-1.76	1.69
0.2600	-0.28	0.25	-0.34	0.30	-1.75	1.68
0.2633	-0.27	0.25	-0.33	0.29	-1.74	1.67
0.2667	-0.26	0.24	-0.32	0.28	-1.73	1.66
0.2700	-0.26	0.23	-0.32	0.28	-1.72	1.65
0.2733	-0.25	0.23	-0.31	0.27	-1.71	1.64
0.2767	-0.25	0.22	-0.30	0.26	-1.70	1.63
0.2800	-0.24	0.21	-0.29	0.25	-1.69	1.62
0.2833	-0.23	0.21	-0.28	0.25	-1.68	1.61
0.2867	-0.23	0.20	-0.27	0.24	-1.67	1.60
0.2900	-0.22	0.20	-0.27	0.23	-1.66	1.59
0.2933	-0.21	0.19	-0.26	0.22	-1.65	1.58
0.2967	-0.21	0.19	-0.25	0.22	-1.64	1.57
0.3000	-0.20	0.18	-0.25	0.21	-1.63	1.57
0.3033	-0.20	0.18	-0.24	0.20	-1.62	1.56
0.3067	-0.20	0.17	-0.23	0.20	-1.62	1.55
0.3100	-0.19	0.17	-0.23	0.19	-1.60	1.54
0.3133	-0.19	0.17	-0.22	0.19	-1.59	1.53
0.3167	-0.19	0.16	-0.21	0.18	-1.58	1.52
0.3200	-0.18	0.16	-0.21	0.17	-1.57	1.51

Time 2/4/95	Channel 2 OCD-7C In	Channel 3 OCD-7C Out	Channel 4 MW-5C In	Channel 5 MW-5C Out	Channel 6 MW-4C In	Channel 7 MW-4C Out
0.3233	-0.17	0.15	-0.20	0.17	-1.57	1.50
0.3267	-0.17	0.15	-0.19	0.16	-1.56	1.49
0.3300	-0.17	0.15	-0.19	0.16	-1.55	1.49
0.3333	-0.16	0.14	-0.19	0.15	-1.54	1.48
0.35	-0.14	0.13	-0.16	0.13	-1.49	1.43
0.36	-0.13	0.11	-0.13	0.11	-1.44	1.39
0.38	-0.11	0.10	-0.12	0.09	-1.40	1.35
0.40	-0.10	0.09	-0.10	0.08	-1.35	1.31
0.41	-0.09	0.07	-0.08	0.06	-1.31	1.26
0.43	-0.08	0.07	-0.07	0.05	-1.27	1.23
0.45	-0.07	0.06	-0.06	0.04	-1.23	1.19
0.46	-0.06	0.06	-0.05	0.03	-1.19	1.15
0.48	-0.06	0.05	-0.05	0.03	-1.16	1.12
0.50	-0.05	0.05	-0.04	0.02	-1.12	1.09
0.51	-0.05	0.04	-0.03	0.02	-1.09	1.05
0.53	-0.05	0.04	-0.03	0.01	-1.05	1.02
0.55	-0.04	0.04	-0.03	0.01	-1.02	0.99
0.56	-0.04	0.04	-0.02	0.01	-0.99	0.96
0.58	-0.04	0.03	-0.02	0.00	-0.96	0.93
0.60	-0.04	0.03	-0.02	0.00	-0.93	0.91
0.61	-0.04	0.03	-0.02	0.00	-0.91	0.88
0.63	-0.03	0.03	-0.01	0.00	-0.88	0.85
0.65	-0.03	0.03	-0.01	0.00	-0.85	0.83
0.66	-0.03	0.03	-0.01	0.00	-0.83	0.80
0.68	-0.03	0.02	-0.01	0.00	-0.80	0.78
0.70	-0.03	0.02	-0.01	0.00	-0.78	0.76
0.71	-0.03	0.02	-0.01	0.00	-0.76	0.73
0.73	-0.03	0.02	-0.01	0.00	-0.73	0.71
0.75	-0.03	0.02	-0.01	0.00	-0.71	0.69
0.76	-0.03	0.02	-0.01	0.00	-0.69	0.67
0.78	-0.03	0.02	-0.01	0.00	-0.67	0.65
0.80	-0.02	0.02	-0.01	0.00	-0.65	0.63
0.81	-0.03	0.02	-0.01	0.00	-0.64	0.61
0.83	-0.02	0.02	-0.01	0.00	-0.62	0.59
0.85	-0.02	0.02	-0.01	0.00	-0.60	0.58
0.86	-0.02	0.02	-0.01	0.00	-0.58	0.56
0.88	-0.02	0.02	-0.01	0.00	-0.57	0.54
0.90	-0.02	0.02	-0.01	0.00	-0.55	0.53
0.91	-0.02	0.02	-0.01	0.00	-0.53	0.51
0.93	-0.02	0.02	-0.01	0.00	0.52	0.50
0.95	-0.02	0.02	-0.01	0.00	-0.51	0.48
0.96	-0.02	0.02	-0.01	0.00	-0.49	0.47
0.98	-0.02	0.02	-0.01	0.00	-0.48	0.45
1.00	-0.02	0.02	-0.01	0.00	-0.46	0.44

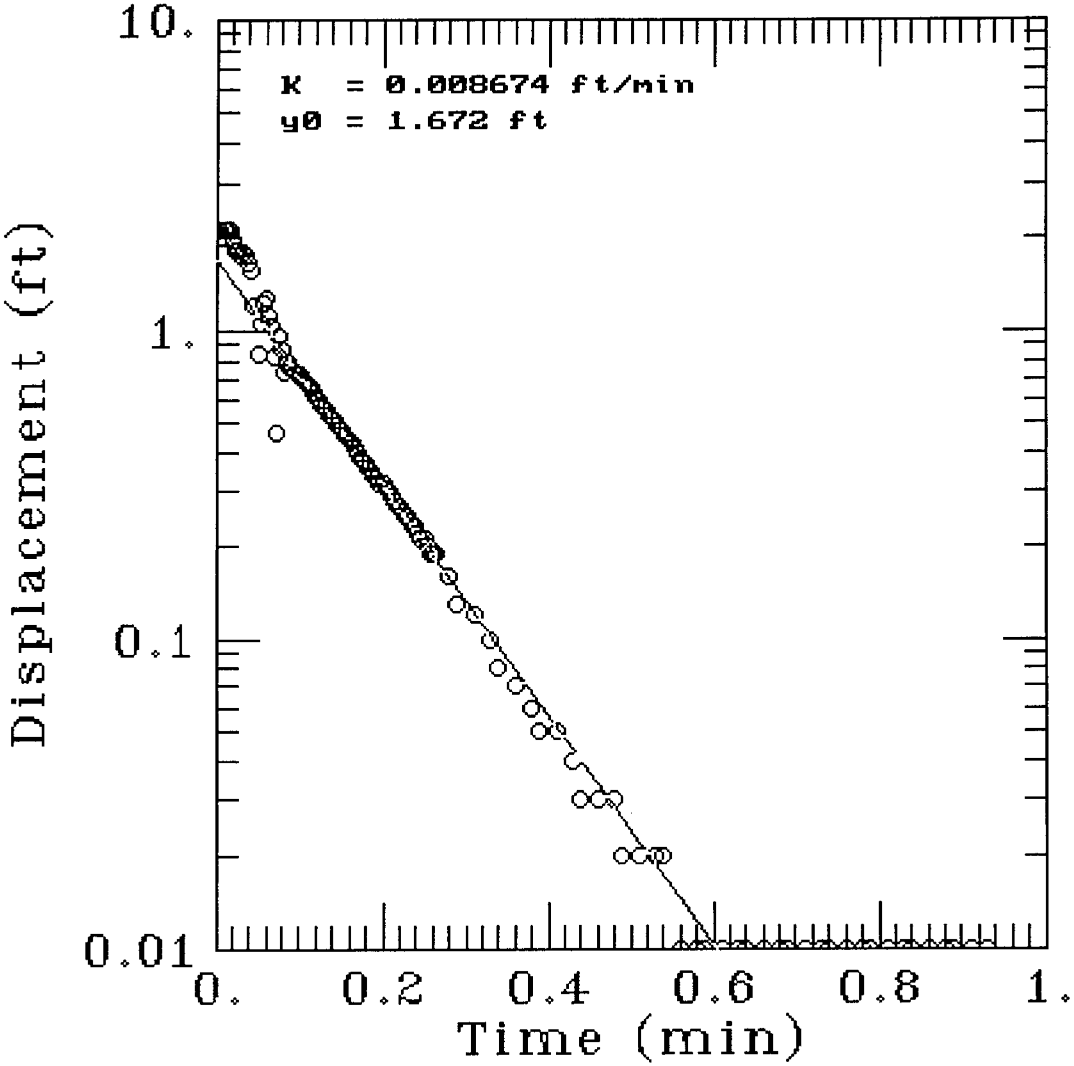
SLUG IN, OCD-7C, 2/4/95

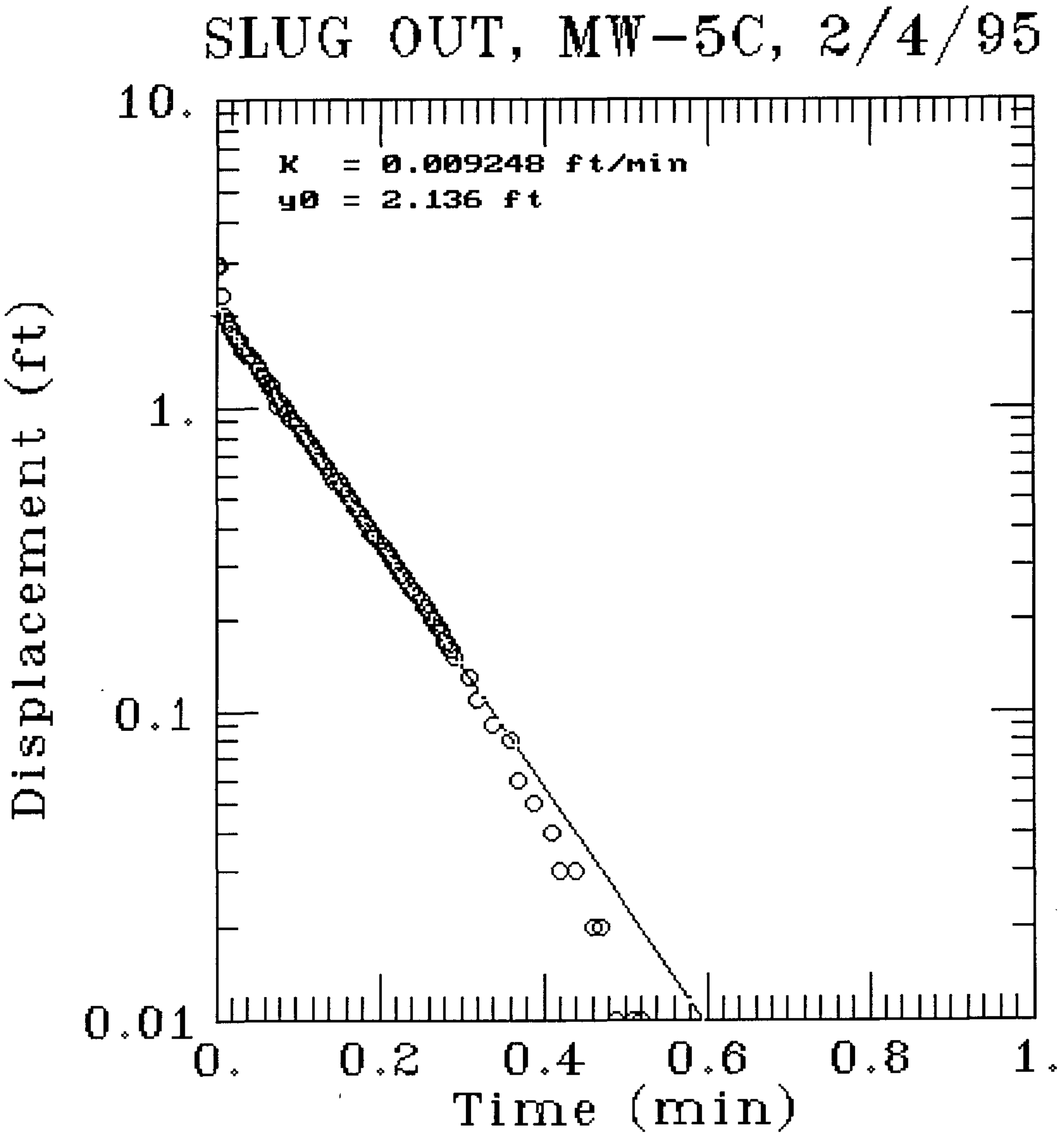


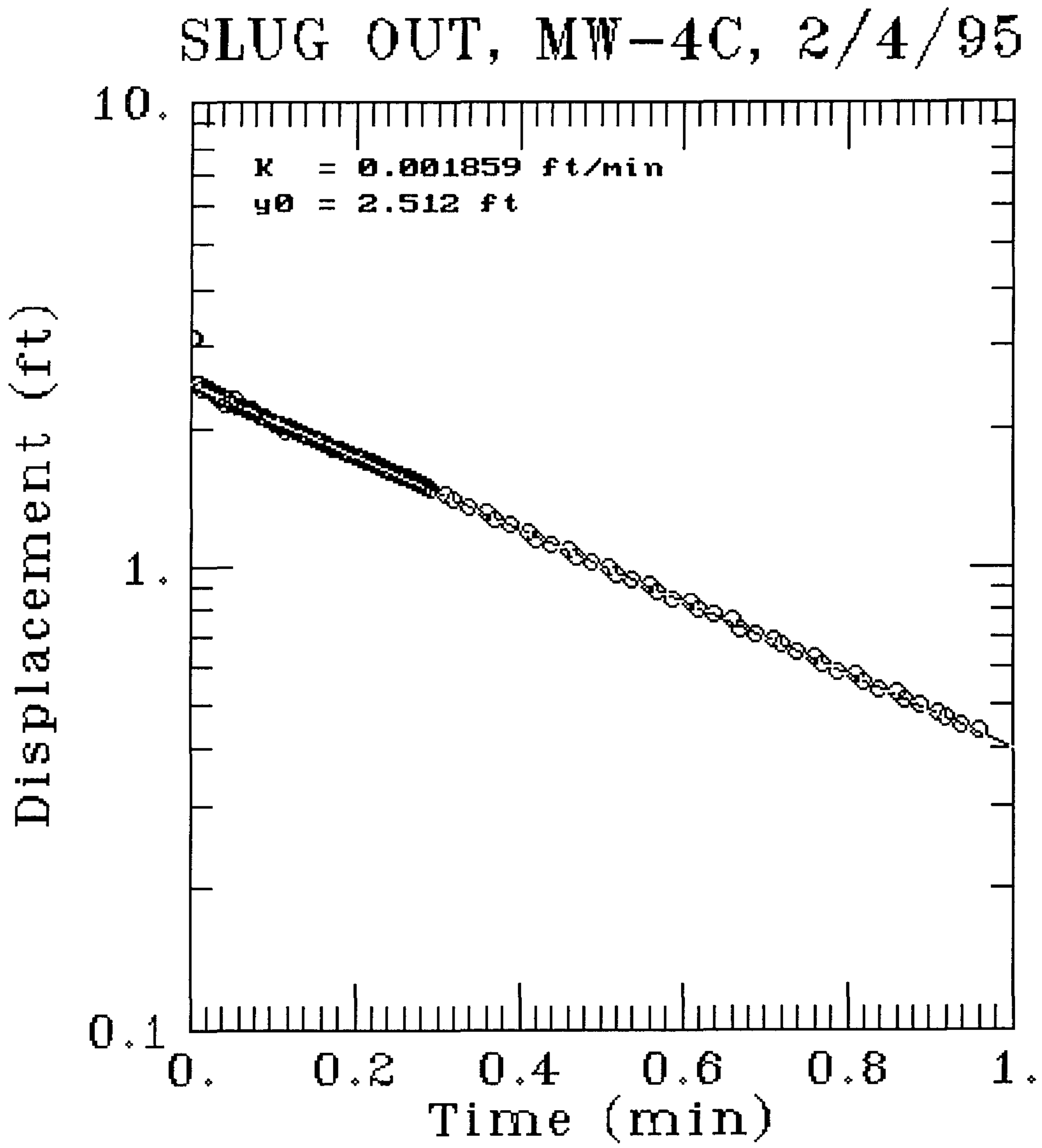
SLUG OUT, OCD-7C, 2/4/95



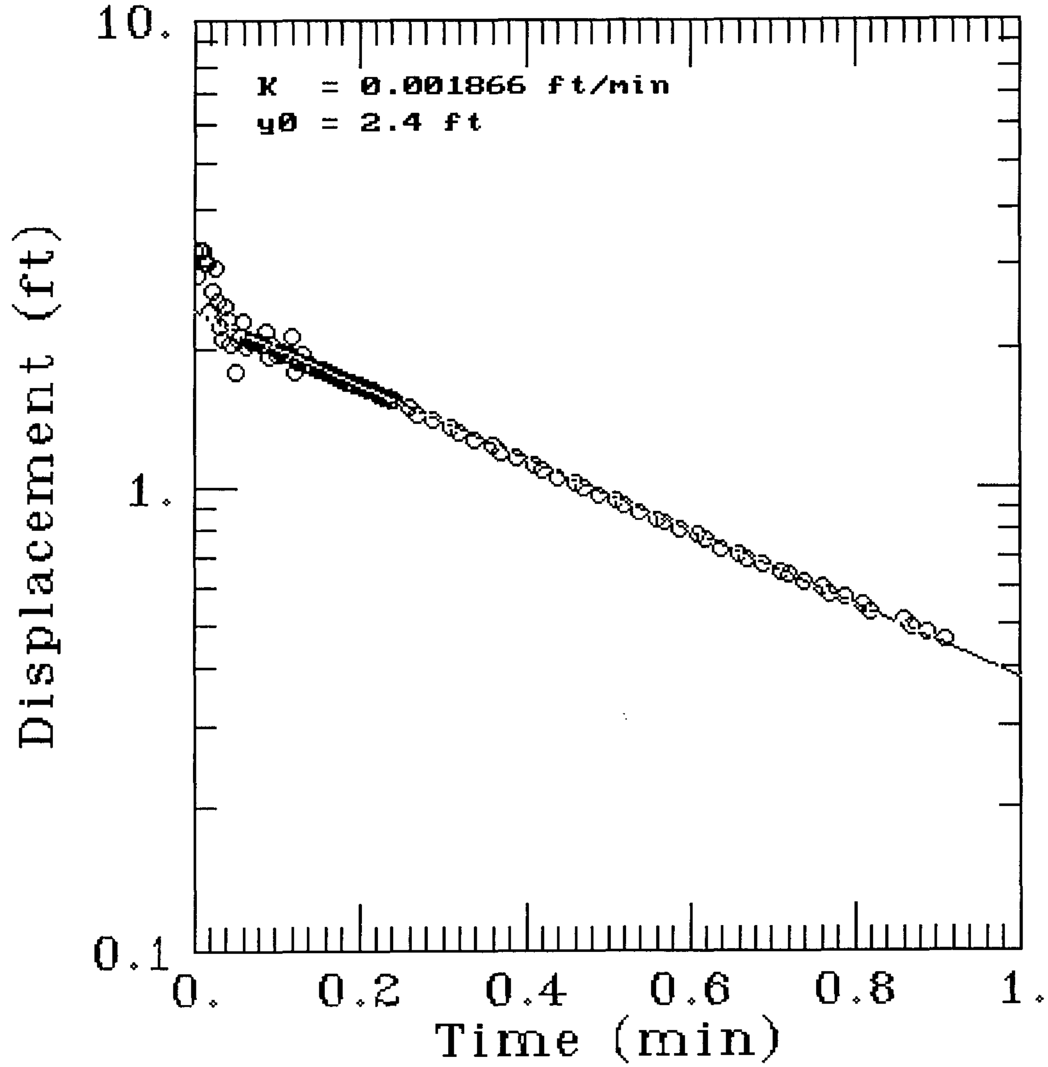
SLUG IN, MW-5C, 2/4/95




SLUG OUT, MW-5C, 2/4/95
K = 0.009248 ft/min
y0 = 2.136 ft
Displacement (ft)
10.
1.
0.1
0.01
0.
0.2
0.4
0.6
0.8
1.
Time (min)


SLUG OUT, MW-4C, 2/4/95
K = 0.001859 ft/min
y0 = 2.512 ft
Displacement (ft)
10.
1.
0.1
0.
0.2
0.4
0.6
0.8
1.
Time (min)

SLUG IN, MW-4C, 2/4/95



Inter-Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

David Boyer
RE/SPEC
4775 Indian School Road
NE Ste. 300
Albuquerque, New Mexico 87110-3927

December 14, 1994

Dear Mr. Boyer,

On various dates from November 5, 1994, to November 14, 1994, fifty-two water samples, nine trip blanks, two field blanks, five equipment blanks, six soil samples, and five sediment samples were received, cool and intact, by Inter-Mountain Laboratories - College Station. Analyses for Volatile (8240), Semivolatile (8270), Pesticides (8141), Herbicides (8151), Metals and a variety of general chemistry parameters were performed as requested on the accompanying chains of custody. On COC 23857 the Trip Blank was broken upon receipt. On COC 20048 the sample labeled "MW - 5B" for volatile analysis was received with one volatile vial broken. The remaining vial froze and burst in the refrigerator so no analysis was performed on the sample.

The volatile analyses were completed within holding time for all samples. Samples "MW - 6A" and "MW - 6B" exhibited an interference with Internal Standard Chlorobenzene-d5. The interference was such that the area of the internal standard was inappropriately high. Since this effect did not occur with method blanks or other samples, it was concluded that the sample matrix was causing this effect. The sample was diluted until the internal standard was no longer effected.

The samples for pesticide analysis by method 8141 were extracted by Inter-Mountain Laboratories because holding times were about to expire and we had difficulty finding a laboratory to analyze the complete list of compounds in the method. These extracts were subcontracted for analysis because IML does not own a GC with a Nitrogen-Phosphorous detector. The analysis was performed by Midwest Laboratories, Inc. in Omaha, Nebraska.

It is the policy of this laboratory to employ, whenever possible, preparatory and analytical methods which have been approved by regulatory agencies. The methods used in the analysis of the sample reported here are found in "Test Methods for Evaluating Solid Waste", SW-846, USEPA, 1986 and Final Update I, July 1992. All reports in this package reference the methods utilized.

All detection limits are practical quantitation limits (PQLs). PQLs have been corrected for dilutions, volume of the sample analyzed, sample dry weight and the final volume of the extract analyzed.

Quality Control reports have been included for your information and use. These reports appear at the end of the analytical package and may be identified by title. If there are any questions regarding the information presented in this package, feel free to call at your convenience.

Sincerely,

Ramona R. Dennis

Ramona R. Dennis
Manager

Inter-Mountain Laboratories, Inc.

CHAIN OF CUSTODY RECORD

Client/Project Name	Project Location
Navajo	Artesia
Sampler: (Signature)	Chain of Custody Tape No.
Ron [signature]	

ANALYSES / PARAMETERS

Sample No./ Identification	Date	Time	Lab Number	Matrix	No. of Containers	VOA 8240	SVOA 8270	Metals	Gen Chem	Remarks
MW-8	11/4/94	1104	0694602055	Ground water	6					Metals - Both
MW-9	11/4/94	1228	0694602056	Ground Water	6					Filtered & UN-
MW-21	11/4/94	1138	0694602057	Ground Water	6					Filtered for
MW-20	11/4/94	0955	0694602058	Ground Water	6					Arsenic, Chromium, Lead & Nickel

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
[signature]	11/04/94	1545	Connie Glazier	11-5-94	1033
Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
Relinquished by: (Signature)	Date	Time	Received by laboratory: (Signature)	Date	Time

Inter-Mountain Laboratories, Inc.

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☐ 1714 Phillips Circle, Gillette, Wyoming 82716, Telephone (307) 682-8945

☐ 2506 West Main Street, Farmington, NM 87401, Telephone (505) 326-4737

☐ 1160 Research Dr., Bozeman, Montana 59715, Telephone (406) 586-8450

☐ 11183 SH 30, College Station, TX 77845, Telephone (409) 776-8945

☐ 3304 Longmire Drive, College Station, TX 77845, Telephone (409) 774-4999

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Inter-Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project :	RFI Phase III / Artesia, NM	Report Date:	11/10/94
Sample ID:	MW-8	Date Sampled:	11/04/94
Laboratory ID:	0694G02055	Date Received:	11/05/94
Sample Matrix:	Water	Date Extracted:	11/10/94
Preservative:	Cool, HCl	Date Analyzed:	11/10/94
Condition:	Intact, pH<2		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	ND	0.005
Toluene	ND	0.005
Ethylbenzene	ND	0.005
m,p-Xylene	ND	0.005
o-Xylene	ND	0.005
Methyl ethyl ketone	ND	0.005
Carbon disulfide	ND	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	99%	86 - 118%
Toluene - d8	102%	88 - 110%
Bromofluorobenzene	102%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

Review

Inter-Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project:	RFI Phase III / Artesia, NM	Report Date:	11/10/94
Sample ID:	MW - 8	Date Sampled:	11/04/94
Laboratory ID:	0694G02055	Date Received:	11/05/94
Sample Matrix:	Water	Date Extracted:	11/09/94
Condition:	Intact	Date Analyzed:	11/10/94
Preservative:	Cool		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Acenaphthene	ND	0.010
Acenaphthylene	ND	0.010
Anthracene	ND	0.010
Benzo(a)anthracene	ND	0.010
Benzo(b)fluoranthene	ND	0.010
Benzo(k)fluoranthene	ND	0.010
Benzo(g,h,i)perylene	ND	0.010
Benzo(a)pyrene	ND	0.010
Chrysene	ND	0.010
Dibenz(a,h)anthracene	ND	0.010
Fluoranthene	ND	0.010
Fluorene	ND	0.010
Ideno(1,2,3-cd)pyrene	ND	0.010
Naphthalene	ND	0.010
Phenanthrene	ND	0.010
Pyrene	ND	0.010

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	52%	21 - 110%
Phenol - d5	54%	10 - 110%
Nitrobenzene - d5	60%	35 - 114%
2 - Fluorobiphenyl	63%	43 - 116%
2,4,6 - Tribromophenol	74%	10 - 123%
Terphenyl - d14	73%	33 - 141%

References: Method 3510: Separatory Funnel Liquid-Liquid Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments:

Ramona R. Dennis
Analyst

Wendi M Roy
Review

iml
Inter-Mountain Laboratories, Inc.
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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: MW-8
Lab ID: 0494W10018/0694G02055
Matrix: Water
Condition: Intact

Report Date: 03/27/95
Receipt Date: 11/07/94
Sample Date: 11/04/94

Parameter	Concentration		PQL	Method
pH (Lab)	7.2 s.u.		0.1	SW-846 9040
Conductivity (Lab)	5880 µmhos/cm		1	SW-846 9050
Total Dissolved Solids (180° C)	5730 mg/L		10	EPA 160.1
Total Alkalinity (as CaCO3)	328 mg/L		1	EPA 310.1
Total Hardness (as CaCO3)	3360 mg/L		1	Calculation
Fluoride	2.2 mg/L		0.1	EPA 340.2
Calcium	556 mg/L	27.74 meq/L	1 mg/L	SW-846 6010A
Magnesium	480 mg/L	39.51 meq/L	1 mg/L	SW-846 6010A
Potassium	3 mg/L	0.07 meq/L	1 mg/L	SW-846 6010A
Sodium	358 mg/L	15.57 meq/L	1 mg/L	SW-846 6010A
rbonate	400 mg/L	6.56 meq/L	1 mg/L	EPA 310.1
bonate	ND*	0.00	1 mg/L	EPA 310.1
Chloride	524 mg/L	14.78 meq/L	1 mg/L	SW-846 9251
Sulfate	3020 mg/L	62.94 meq/L	5 mg/L	SW-846 9036
Major Cation Sum	82.89 meq/L		N/A	Calculation
Major Anion Sum	84.28 meq/L		N/A	Calculation
Cation/Anion Balance	-0.83 % Diff		N/A	Calculation

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

ved By:

David N. Poelstra

David N. Poelstra
Laboratory Manager

iml

Inter-Mountain Laboratories, Inc.

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11183 SH 30 College Station, Texas 77845

WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: MW-8
Lab ID: 0494W10018/0694G02055
Matrix: Water
Condition: Intact

Report Date: 03/27/95
Receipt Date: 11/07/94
Sample Date: 11/04/94

Parameter	Concentration	PQL	Method
Total Metals			
Total Arsenic	0.029 mg/L	0.005	SW-846 7061A
Total Chromium	8.32 mg/L	0.02	SW-846 6010A
Total Lead	ND*	0.01 mg/L	SW-846 7421
Total Nickel	1.45 mg/L	0.01	SW-846 6010A

Dissolved Metals			
Dissolved Arsenic	ND*	0.005 mg/L	SW-846 7061A
Dissolved Chromium	0.06 mg/L	0.02	SW-846 6010A
Dissolved Lead	ND*	0.01 mg/L	SW-846 7421
Dissolved Nickel	0.50 mg/L	0.01	SW-846 6010A

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

...wed By:

David N. Poelstra

David N. Poelstra
Laboratory Manager

Inter-Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project :	RFI Phase III / Artesia, NM	Report Date:	11/10/94
Sample ID:	MW-9	Date Sampled:	11/04/94
Laboratory ID:	0694G02056	Date Received:	11/05/94
Sample Matrix:	Water	Date Extracted:	11/10/94
Preservative:	Cool, HCl	Date Analyzed:	11/10/94
Condition:	Intact, pH<2		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	ND	0.005
Toluene	ND	0.005
Ethylbenzene	ND	0.005
m,p-Xylene	ND	0.005
o-Xylene	ND	0.005
Methyl ethyl ketone	ND	0.005
Carbon disulfide	ND	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	99%	86 - 118%
Toluene - d8	100%	88 - 110%
Bromofluorobenzene	101%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

Review

Inter-Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project:	RFI Phase III / Artesia, NM	Report Date:	11/10/94
Sample ID:	MW - 9	Date Sampled:	11/04/94
Laboratory ID:	0694G02056	Date Received:	11/05/94
Sample Matrix:	Water	Date Extracted:	11/09/94
Condition:	Intact	Date Analyzed:	11/10/94
Preservative:	Cool		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Acenaphthene	ND	0.010
Acenaphthylene	ND	0.010
Anthracene	ND	0.010
Benzo(a)anthracene	ND	0.010
Benzo(b)fluoranthene	ND	0.010
Benzo(k)fluoranthene	ND	0.010
Benzo(g,h,i)perylene	ND	0.010
Benzo(a)pyrene	ND	0.010
Chrysene	ND	0.010
Dibenz(a,h)anthracene	ND	0.010
Fluoranthene	ND	0.010
Fluorene	ND	0.010
Ideno(1,2,3-cd)pyrene	ND	0.010
Naphthalene	ND	0.010
Phenanthrene	ND	0.010
Pyrene	ND	0.010

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	52%	21 - 110%
Phenol - d5	57%	10 - 110%
Nitrobenzene - d5	53%	35 - 114%
2 - Fluorobiphenyl	69%	43 - 116%
2,4,6 - Tribromophenol	88%	10 - 123%
Terphenyl - d14	80%	33 - 141%

References: Method 3510: Separatory Funnel Liquid-Liquid Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments:

Ramona P. Dennis
Analyst

Wend M Kog
Review

iml

Inter-Mountain Laboratories, Inc.

Phone (409) 776-8945 FAX (409) 774-4705

11183 SH 30 College Station, Texas 77845

WATER QUALITY REPORT

Client: Navajo Refining Co.

Project: RFI Phase III / Artesia, NM

Sample ID: MW-9

Lab ID: 0494W10019/0694G02056

Matrix: Water

Condition: Intact

Report Date: 03/27/95

Receipt Date: 11/07/94

Sample Date: 11/04/94

Parameter	Concentration	PQL	Method
pH (Lab)	6.8 s.u.	0.1	SW-846 9040
Conductivity (Lab)	6380 µmhos/cm	1	SW-846 9050
Total Dissolved Solids (180° C)	6160 mg/L	10	EPA 160.1
Total Alkalinity (as CaCO3)	240 mg/L	1	EPA 310.1
Total Hardness (as CaCO3)	3600 mg/L	1	Calculation
Fluoride	2.0 mg/L	0.1	EPA 340.2

Calcium	637 mg/L	31.79 meq/L	1 mg/L	SW-846 6010A
Magnesium	488 mg/L	40.16 meq/L	1 mg/L	SW-846 6010A
Potassium	5 mg/L	0.12 meq/L	1 mg/L	SW-846 6010A
Sodium	416 mg/L	18.09 meq/L	1 mg/L	SW-846 6010A
Bicarbonate	293 mg/L	4.80 meq/L	1 mg/L	EPA 310.1
Carbonate	ND*	0.00	1 mg/L	EPA 310.1
Chloride	621 mg/L	17.52 meq/L	1 mg/L	SW-846 9251
Sulfate	3250 mg/L	67.62 meq/L	5 mg/L	SW-846 9036
Major Cation Sum	90.16 meq/L		N/A	Calculation
Major Anion Sum	89.94 meq/L		N/A	Calculation
Cation/Anion Balance	0.12 % Diff		N/A	Calculation

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

David N. Poelstra

David N. Poelstra

Laboratory Manager

iml Inter-Mountain Laboratories, Inc.
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11183 SH 30 College Station, Texas 77845

WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: MW-9
Lab ID: 0494W10019/0694G02056
Matrix: Water
Condition: Intact

Report Date: 03/27/95
Receipt Date: 11/07/94
Sample Date: 11/04/94

Parameter	Concentration	PQL	Method
Total Metals			
Total Arsenic	0.068 mg/L	0.005	SW-846 7061A
Total Chromium	24.52 mg/L	0.02	SW-846 6010A
Total Lead	ND*	0.01 mg/L	SW-846 7421
Total Nickel	4.96 mg/L	0.01	SW-846 6010A

Dissolved Metals			
Dissolved Arsenic	ND*	0.005 mg/L	SW-846 7061A
Dissolved Chromium	0.03 mg/L	0.02	SW-846 6010A
Dissolved Lead	ND*	0.01 mg/L	SW-846 7421
Dissolved Nickel	4.11 mg/L	0.01	SW-846 6010A

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

David N. Poelstra

David N. Poelstra
Laboratory Manager

Inter-Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project :	RFI Phase III / Artesia, NM	Report Date:	11/10/94
Sample ID:	MW-21	Date Sampled:	11/04/94
Laboratory ID:	0694G02057	Date Received:	11/05/94
Sample Matrix:	Water	Date Extracted:	11/10/94
Preservative:	Cool, HCl	Date Analyzed:	11/10/94
Condition:	Intact, pH<2		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	ND	0.005
Toluene	ND	0.005
Ethylbenzene	ND	0.005
m,p-Xylene	ND	0.005
o-Xylene	ND	0.005
Methyl ethyl ketone	ND	0.005
Carbon disulfide	ND	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	98%	86 - 118%
Toluene - d8	100%	88 - 110%
Bromofluorobenzene	99%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

Review

3304 Longmire
College Station, Texas 77845

EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project:	RFI Phase III / Artesia, NM	Report Date:	11/10/94
Sample ID:	MW - 21	Date Sampled:	11/04/94
Laboratory ID:	0694G02057	Date Received:	11/05/94
Sample Matrix:	Water	Date Extracted:	11/09/94
Condition:	Intact	Date Analyzed:	11/10/94
Preservative:	Cool		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Acenaphthene	ND	0.010
Acenaphthylene	ND	0.010
Anthracene	ND	0.010
Benzo(a)anthracene	ND	0.010
Benzo(b)fluoranthene	ND	0.010
Benzo(k)fluoranthene	ND	0.010
Benzo(g,h,i)perylene	ND	0.010
Benzo(a)pyrene	ND	0.010
Chrysene	ND	0.010
Dibenz(a,h)anthracene	ND	0.010
Fluoranthene	ND	0.010
Fluorene	ND	0.010
Ideno(1,2,3-cd)pyrene	ND	0.010
Naphthalene	ND	0.010
Phenanthrene	ND	0.010
Pyrene	ND	0.010

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	66%	21 - 110%
Phenol - d5	58%	10 - 110%
Nitrobenzene - d5	57%	35 - 114%
2 - Fluorobiphenyl	51%	43 - 116%
2,4,6 - Tribromophenol	81%	10 - 123%
Terphenyl - d14	79%	33 - 141%

References: Method 3510: Separatory Funnel Liquid-Liquid Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments:

Ramona R. Dennis
Analyst

Review

iml **Inter-Mountain Laboratories, Inc.**

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11183 SH 30 College Station, Texas 77845

WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: MW-21
Lab ID: 0494W10020/0694G02057
Matrix: Water
Condition: Intact

Report Date: 03/27/95
Receipt Date: 11/07/94
Sample Date: 11/04/94

Parameter	Concentration	PQL	Method
pH (Lab)	7.3 s.u.	0.1	SW-846 9040
Conductivity (Lab)	5800 µmhos/cm	1	SW-846 9050
Total Dissolved Solids (180° C)	5690 mg/L	10	EPA 160.1
Total Alkalinity (as CaCO3)	302 mg/L	1	EPA 310.1
Total Hardness (as CaCO3)	3450 mg/L	1	Calculation
Fluoride	2.1 mg/L	0.1	EPA 340.2

Calcium	589 mg/L	29.39 meq/L	1 mg/L	SW-846 6010A
Magnesium	480 mg/L	39.51 meq/L	1 mg/L	SW-846 6010A
Potassium	2 mg/L	0.06 meq/L	1 mg/L	SW-846 6010A
Sodium	321 mg/L	13.96 meq/L	1 mg/L	SW-846 6010A
Bicarbonate	368 mg/L	6.03 meq/L	1 mg/L	EPA 310.1
Carbonate	ND*	0.00	1 mg/L	EPA 310.1
Chloride	466 mg/L	13.15 meq/L	1 mg/L	SW-846 9251
Sulfate	2990 mg/L	62.17 meq/L	5 mg/L	SW-846 9036
Major Cation Sum	82.92 meq/L		N/A	Calculation
Major Anion Sum	81.35 meq/L		N/A	Calculation
Cation/Anion Balance	0.96 % Diff		N/A	Calculation

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Approved By:

David N. Poelstra

David N. Poelstra
Laboratory Manager

iml

Inter-Mountain Laboratories, Inc.

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11183 SH 30 College Station, Texas 77845

WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: MW-21
Lab ID: 0494W10020/0694G02057
Matrix: Water
Condition: Intact

Report Date: 03/27/95
Receipt Date: 11/07/94
Sample Date: 11/04/94

Parameter	Concentration	PQL	Method
Total Metals			
Total Arsenic	0.007 mg/L	0.005	SW-846 7061A
Total Chromium	ND*	0.005 mg/L	SW-846 7191
Total Lead	ND*	0.01 mg/L	SW-846 7421
Total Nickel	0.04 mg/L	0.01	SW-846 6010A

Dissolved Metals			
Dissolved Arsenic	ND*	0.005 mg/L	SW-846 7061A
Dissolved Chromium	ND*	0.02 mg/L	SW-846 6010A
Dissolved Lead	ND*	0.01 mg/L	SW-846 7421
Dissolved Nickel	ND*	0.01 mg/L	SW-846 6010A

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

ved By:

David N. Poelstra

David N. Poelstra
Laboratory Manager

Inter-Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project :	RFI Phase III / Artesia, NM	Report Date:	11/10/94
Sample ID:	MW-20	Date Sampled:	11/04/94
Laboratory ID:	0694G02058	Date Received:	11/05/94
Sample Matrix:	Water	Date Extracted:	11/10/94
Preservative:	Cool, HCl	Date Analyzed:	11/10/94
Condition:	Intact, pH<2		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	ND	0.005
Toluene	ND	0.005
Ethylbenzene	ND	0.005
m,p-Xylene	ND	0.005
o-Xylene	ND	0.005
Methyl ethyl ketone	ND	0.005
Carbon disulfide	ND	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	98%	86 - 118%
Toluene - d8	102%	88 - 110%
Bromofluorobenzene	99%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

Review

3304 Longmire
College Station, Texas 77845

EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project:	RFI Phase III / Artesia, NM	Report Date:	11/10/94
Sample ID:	MW - 20	Date Sampled:	11/04/94
Laboratory ID:	0694G02058	Date Received:	11/05/94
Sample Matrix:	Water	Date Extracted:	11/09/94
Condition:	Intact	Date Analyzed:	11/10/94
Preservative:	Cool		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Acenaphthene	ND	0.010
Acenaphthylene	ND	0.010
Anthracene	ND	0.010
Benzo(a)anthracene	ND	0.010
Benzo(b)fluoranthene	ND	0.010
Benzo(k)fluoranthene	ND	0.010
Benzo(g,h,i)perylene	ND	0.010
Benzo(a)pyrene	ND	0.010
Chrysene	ND	0.010
Dibenz(a,h)anthracene	ND	0.010
Fluoranthene	ND	0.010
Fluorene	ND	0.010
Ideno(1,2,3-cd)pyrene	ND	0.010
Naphthalene	ND	0.010
Phenanthrene	ND	0.010
Pyrene	ND	0.010

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	56%	21 - 110%
Phenol - d5	55%	10 - 110%
Nitrobenzene - d5	53%	35 - 114%
2 - Fluorobiphenyl	68%	43 - 116%
2,4,6 - Tribromophenol	87%	10 - 123%
Terphenyl - d14	79%	33 - 141%

References: Method 3510: Separatory Funnel Liquid-Liquid Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments:

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Analyst

Wend Mley
Review

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: MW-20
Lab ID: 0494W10021/0694G02058
Matrix: Water
Condition: Intact

Report Date: 03/27/95
Receipt Date: 11/07/94
Sample Date: 11/04/94

Parameter	Concentration	PQL	Method
pH (Lab)	7.4 s.u.	0.1	SW-846 9040
Conductivity (Lab)	8220 µmhos/cm	1	SW-846 9050
Total Dissolved Solids (180° C)	8630 mg/L	10	EPA 160.1
Total Alkalinity (as CaCO3)	370 mg/L	1	EPA 310.1
Total Hardness (as CaCO3)	5080 mg/L	1	Calculation
Fluoride	3.2 mg/L	0.1	EPA 340.2

Parameter	Concentration		PQL	Method
Calcium	499 mg/L	24.90 meq/L	1 mg/L	SW-846 6010A
Magnesium	932 mg/L	76.71 meq/L	1 mg/L	SW-846 6010A
Potassium	2 mg/L	0.04 meq/L	1 mg/L	SW-846 6010A
Sodium	456 mg/L	19.83 meq/L	1 mg/L	SW-846 6010A
Bicarbonate	451 mg/L	7.39 meq/L	1 mg/L	EPA 310.1
Carbonate	ND*	0.00	1 mg/L	EPA 310.1
Chloride	628 mg/L	17.72 meq/L	1 mg/L	SW-846 9251
Sulfate	4800 mg/L	100.00 meq/L	5 mg/L	SW-846 9036
Major Cation Sum	121.48 meq/L		N/A	Calculation
Major Anion Sum	125.11 meq/L		N/A	Calculation
Cation/Anion Balance	-1.47 % Diff		N/A	Calculation

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

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Laboratory Manager

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: MW-20
Lab ID: 0494W10021/0694G02058
Matrix: Water
Condition: Intact

Report Date: 03/27/95
Receipt Date: 11/07/94
Sample Date: 11/04/94

Parameter	Concentration	PQL	Method
Total Metals			
Total Arsenic	0.008 mg/L	0.005	SW-846 7061A
Total Chromium	ND*	0.005 mg/L	SW-846 7191
Total Lead	ND*	0.01 mg/L	SW-846 7421
Total Nickel	0.03 mg/L	0.01	SW-846 6010A
Dissolved Metals			
Dissolved Arsenic	0.007 mg/L	0.005	SW-846 7061A
Dissolved Chromium	0.020 mg/L	0.02	SW-846 6010A
Dissolved Lead	ND*	0.01 mg/L	SW-846 7421
Dissolved Nickel	ND*	0.01 mg/L	SW-846 6010A

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

ved By:

David N. Poelstra
Laboratory Manager

Inter-Mountain Laboratories, Inc.

CHAIN OF CUSTODY RECORD

Client/Project Name	Project Location	ANALYSES / PARAMETERS
Navajo Refinery	Artesia NM	

Sampler: (Signature)	Chain of Custody Tape No.
Brian Sullivan	

Sample No./ Identification	Date	Time	Lab Number	Matrix	No. of Containers	VOAs	SVOAs	General Chem.	metals As, Cr, Ni, Pb	Remarks
OCD-1	11/5	1350		water	6					0694602074
OCD-2B		1512								0694602075
OCD-3		1625								0694602076
OCD-2A		1733		0694602077						+ plus NMGW. Qual. metals
Field Duplicate				0694602078						

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
Brian P. Sullivan	11/7/94	1500	Jarvis Lehman (IML)	11/08/94	0717
Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
Relinquished by: (Signature)	Date	Time	Received by laboratory: (Signature)	Date	Time

Inter-Mountain Laboratories, Inc.

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☐ 1160 Research Dr., Bozeman, Montana 59715, Telephone (406) 586-8450

☐ 11183 SH 30, College Station, TX 77845, Telephone (409) 776-8945

☐ 3304 Longmire Drive, College Station, TX 77845, Telephone (409) 774-4999

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Inter-Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project :	RFI Phase III / Artesia, NM	Report Date:	11/10/94
Sample ID:	OCD-1	Date Sampled:	11/05/94
Laboratory ID:	0694G02074	Date Received:	11/08/94
Sample Matrix:	Water	Date Extracted:	11/10/94
Preservative:	Cool, HCl	Date Analyzed:	11/10/94
Condition:	Intact, pH<2		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	ND	0.005
Toluene	ND	0.005
Ethylbenzene	ND	0.005
m,p-Xylene	ND	0.005
o-Xylene	ND	0.005
Methyl ethyl ketone	ND	0.005
Carbon disulfide	ND	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	101%	86 - 118%
Toluene - d8	101%	88 - 110%
Bromofluorobenzene	98%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

Review

Inter-Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project:	RFI Phase III / Artesia, NM	Report Date:	11/13/94
Sample ID:	OCD - 1	Date Sampled:	11/05/94
Laboratory ID:	0694G02074	Date Received:	11/08/94
Sample Matrix:	Water	Date Extracted:	11/10/94
Condition:	Intact	Date Analyzed:	11/11/94
Preservative:	Cool		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Acenaphthene	ND	0.010
Acenaphthylene	ND	0.010
Anthracene	ND	0.010
Benzo(a)anthracene	ND	0.010
Benzo(b)fluoranthene	ND	0.010
Benzo(k)fluoranthene	ND	0.010
Benzo(g,h,i)perylene	ND	0.010
Benzo(a)pyrene	ND	0.010
Chrysene	ND	0.010
Dibenz(a,h)anthracene	ND	0.010
Fluoranthene	ND	0.010
Fluorene	ND	0.010
Ideno(1,2,3-cd)pyrene	ND	0.010
Naphthalene	ND	0.010
Phenanthrene	ND	0.010
Pyrene	ND	0.010

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	63%	21 - 110%
Phenol - d5	68%	10 - 110%
Nitrobenzene - d5	68%	35 - 114%
2 - Fluorobiphenyl	76%	43 - 116%
2,4,6 - Tribromophenol	90%	10 - 123%
Terphenyl - d14	80%	33 - 141%

References: Method 3510: Separatory Funnel Liquid-Liquid Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments:

Ramona R. Dennis
Analyst

Wendi M Roy
Review

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: OCD-1
Lab ID: 0494W10139/0694G02074
Matrix: Water
Condition: Intact

Report Date: 03/27/95
Receipt Date: 11/10/94
Sample Date: 11/05/94

Parameter	Concentration	PQL	Method
pH (Lab)	7.2 s.u.	0.1	SW-846 9040
Conductivity (Lab)	11700 µmhos/cm	1	SW-846 9050
Total Dissolved Solids (180° C)	8970 mg/L	10	EPA 160.1
Total Alkalinity (as CaCO3)	620 mg/L	1	EPA 310.1
Total Hardness (as CaCO3)	2080 mg/L	1	Calculation
Fluoride	6.0 mg/L	0.1	EPA 340.2

Calcium	601 mg/L	29.99 meq/L	1 mg/L	SW-846 6010A
Magnesium	142 mg/L	11.69 meq/L	1 mg/L	SW-846 6010A
Potassium	7 mg/L	0.17 meq/L	1 mg/L	SW-846 6010A
Sodium	2170 mg/L	94.52 meq/L	1 mg/L	SW-846 6010A
Bicarbonate	756 mg/L	12.39 meq/L	1 mg/L	EPA 310.1
Carbonate	ND*	0.00	1 mg/L	EPA 310.1
Chloride	2200 mg/L	62.17 meq/L	1 mg/L	SW-846 9251
Sulfate	2940 mg/L	61.11 meq/L	5 mg/L	SW-846 9036
Major Cation Sum	136.37 meq/L		N/A	Calculation
Major Anion Sum	135.68 meq/L		N/A	Calculation
Cation/Anion Balance	0.25 % Diff		N/A	Calculation

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

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Laboratory Manager

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11183 SH 30 College Station, Texas 77845

WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: OCD-1
Lab ID: 0494W10139/0694G02074
Matrix: Water
Condition: Intact

Report Date: 03/28/95
Receipt Date: 11/10/94
Sample Date: 11/05/94

Parameter	Concentration	PQL	Method
Total Metals			
Total Arsenic	0.103 mg/L	0.005	SW-846 7061A
Total Chromium	0.024 mg/L	0.005	SW-846 7191
Total Lead	0.02 mg/L	0.01	SW-846 7421
Total Nickel	0.07 mg/L	0.05	SW-846 7520

Dissolved Metals			
Dissolved Arsenic	0.072 mg/L	0.005	SW-846 7061A
Dissolved Chromium	ND*	0.02 mg/L	SW-846 6010A
Dissolved Lead	ND*	0.01 mg/L	SW-846 7421
Dissolved Nickel	0.04 mg/L	0.01	SW-846 6010A

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

David N Poelstra

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Laboratory Manager

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3304 Longmire
College Station, Texas 77845

EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client:	NAVAJO REFINING COMPANY		
Project :	RFI Phase III / Artesia, NM	Report Date:	11/10/94
Sample ID:	OCD-2B	Date Sampled:	11/05/94
Laboratory ID:	0694G02075	Date Received:	11/08/94
Sample Matrix:	Water	Date Extracted:	11/10/94
Preservative:	Cool, HCl	Date Analyzed:	11/10/94
Condition:	Intact, pH<2		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	ND	0.005
Toluene	ND	0.005
Ethylbenzene	ND	0.005
m,p-Xylene	ND	0.005
o-Xylene	ND	0.005
Methyl ethyl ketone	ND	0.005
Carbon disulfide	ND	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	100%	86 - 118%
Toluene - d8	100%	88 - 110%
Bromofluorobenzene	97%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

Review

Inter-Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project:	RFI Phase III / Artesia, NM	Report Date:	11/13/94
Sample ID:	OCD - 2B	Date Sampled:	11/05/94
Laboratory ID:	0694G02075	Date Received:	11/08/94
Sample Matrix:	Water	Date Extracted:	11/10/94
Condition:	Intact	Date Analyzed:	11/11/94
Preservative:	Cool		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Acenaphthene	ND	0.010
Acenaphthylene	ND	0.010
Anthracene	ND	0.010
Benzo(a)anthracene	ND	0.010
Benzo(b)fluoranthene	ND	0.010
Benzo(k)fluoranthene	ND	0.010
Benzo(g,h,i)perylene	ND	0.010
Benzo(a)pyrene	ND	0.010
Chrysene	ND	0.010
Dibenz(a,h)anthracene	ND	0.010
Fluoranthene	ND	0.010
Fluorene	ND	0.010
Ideno(1,2,3-cd)pyrene	ND	0.010
Naphthalene	ND	0.010
Phenanthrene	ND	0.010
Pyrene	ND	0.010

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	64%	21 - 110%
Phenol - d5	65%	10 - 110%
Nitrobenzene - d5	64%	35 - 114%
2 - Fluorobiphenyl	63%	43 - 116%
2,4,6 - Tribromophenol	97%	10 - 123%
Terphenyl - d14	85%	33 - 141%

References: Method 3510: Separatory Funnel Liquid-Liquid Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments:

Ramona R. Dennis
Analyst

[signature]
Review

iml

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WATER QUALITY REPORT

Client: Navajo Refining Co.

Project: RFI Phase III / Artesia, NM

Sample ID: OCD-2B

Lab ID: 0494W10140/0694G02075

Matrix: Water

Condition: Intact

Report Date: 03/27/95

Receipt Date: 11/10/94

Sample Date: 11/05/94

Parameter	Concentration		PQL	Method
pH (Lab)	7.6	s.u.	0.1	SW-846 9040
Conductivity (Lab)	5190	µmhos/cm	1	SW-846 9050
Total Dissolved Solids (180° C)	4070	mg/L	10	EPA 160.1
Total Alkalinity (as CaCO3)	38	mg/L	1	EPA 310.1
Total Hardness (as CaCO3)	1920	mg/L	1	Calculation
Fluoride	0.4	mg/L	0.1	EPA 340.2

Calcium	692 mg/L	34.53 meq/L		1 mg/L	SW-846 6010A
Magnesium	46 mg/L	3.79 meq/L		1 mg/L	SW-846 6010A
Potassium	12 mg/L	0.31 meq/L		1 mg/L	SW-846 6010A
Sodium	480 mg/L	20.88 meq/L		1 mg/L	SW-846 6010A
Bicarbonate	46 mg/L	0.75 meq/L		1 mg/L	EPA 310.1
Carbonate	ND*	0.00		1 mg/L	EPA 310.1
Chloride	828 mg/L	23.36 meq/L		1 mg/L	SW-846 9251
Sulfate	1630 mg/L	33.96 meq/L		5 mg/L	SW-846 9036
Major Cation Sum	59.51	meq/L		N/A	Calculation
Major Anion Sum	58.08	meq/L		N/A	Calculation
Cation/Anion Balance	1.22	% Diff		N/A	Calculation

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: OCD-2B
Lab ID: 0494W10140/0694G02075
Matrix: Water
Condition: Intact

Report Date: 03/27/95
Receipt Date: 11/10/94
Sample Date: 11/05/94

Parameter	Concentration	PQL	Method
Total Metals			
Total Arsenic	0.006 mg/L	0.005	SW-846 7061A
Total Chromium	ND*	0.02 mg/L	SW-846 6010A
Total Lead	ND*	0.01 mg/L	SW-846 7421
Total Nickel	ND*	0.01 mg/L	SW-846 6010A
Dissolved Metals			
Dissolved Arsenic	ND*	0.005 mg/L	SW-846 7061A
Dissolved Chromium	ND*	0.02 mg/L	SW-846 6010A
Dissolved Lead	ND*	0.01 mg/L	SW-846 7421
Dissolved Nickel	ND*	0.01 mg/L	SW-846 6010A

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

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Laboratory Manager

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EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project :	RFI Phase III / Artesia, NM	Report Date:	11/10/94
Sample ID:	OCD-3	Date Sampled:	11/05/94
Laboratory ID:	0694G02076	Date Received:	11/08/94
Sample Matrix:	Water	Date Extracted:	11/10/94
Preservative:	Cool, HCl	Date Analyzed:	11/10/94
Condition:	Intact, pH<2		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	ND	0.005
Toluene	ND	0.005
Ethylbenzene	ND	0.005
m,p-Xylene	ND	0.005
o-Xylene	ND	0.005
Methyl ethyl ketone	ND	0.005
Carbon disulfide	ND	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	104%	86 - 118%
Toluene - d8	100%	88 - 110%
Bromofluorobenzene	95%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

Review

Inter-Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project:	RFI Phase III / Artesia, NM	Report Date:	11/13/94
Sample ID:	OCD - 3	Date Sampled:	11/05/94
Laboratory ID:	0694G02076	Date Received:	11/08/94
Sample Matrix:	Water	Date Extracted:	11/10/94
Condition:	Intact	Date Analyzed:	11/11/94
Preservative:	Cool		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Acenaphthene	ND	0.010
Acenaphthylene	ND	0.010
Anthracene	ND	0.010
Benzo(a)anthracene	ND	0.010
Benzo(b)fluoranthene	ND	0.010
Benzo(k)fluoranthene	ND	0.010
Benzo(g,h,i)perylene	ND	0.010
Benzo(a)pyrene	ND	0.010
Chrysene	ND	0.010
Dibenz(a,h)anthracene	ND	0.010
Fluoranthene	ND	0.010
Fluorene	ND	0.010
Ideno(1,2,3-cd)pyrene	ND	0.010
Naphthalene	ND	0.010
Phenanthrene	ND	0.010
Pyrene	ND	0.010

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	51%	21 - 110%
Phenol - d5	55%	10 - 110%
Nitrobenzene - d5	65%	35 - 114%
2 - Fluorobiphenyl	70%	43 - 116%
2,4,6 - Tribromophenol	81%	10 - 123%
Terphenyl - d14	83%	33 - 141%

References: Method 3510: Separatory Funnel Liquid-Liquid Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments:

Ramona R. Dennis
Analyst

Wanda M Rog
Review

iml

Inter-Mountain Laboratories, Inc.

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: OCD-3
Lab ID: 0494W10141/0694G02076
Matrix: Water
Condition: Intact

Report Date: 03/27/95
Receipt Date: 11/10/94
Sample Date: 11/05/94

Parameter	Concentration	PQL	Method
pH (Lab)	7.2 s.u.	0.1	SW-846 9040
Conductivity (Lab)	17500 µmhos/cm	1	SW-846 9050
Total Dissolved Solids (180° C)	12200 mg/L	10	EPA 160.1
Total Alkalinity (as CaCO3)	246 mg/L	1	EPA 310.1
Total Hardness (as CaCO3)	3690 mg/L	1	Calculation
Fluoride	0.8 mg/L	0.1	EPA 340.2

Calcium	1025 mg/L	51.15 meq/L	1 mg/L	SW-846 6010A
Magnesium	274 mg/L	22.55 meq/L	1 mg/L	SW-846 6010A
Potassium	27 mg/L	0.69 meq/L	1 mg/L	SW-846 6010A
Sodium	2750 mg/L	119.57 meq/L	1 mg/L	SW-846 6010A
Bicarbonate	300 mg/L	4.92 meq/L	1 mg/L	EPA 310.1
Carbonate	ND*	0.00	1 mg/L	EPA 310.1
Chloride	5680 mg/L	160.17 meq/L	1 mg/L	SW-846 9251
Sulfate	2000 mg/L	41.64 meq/L	5 mg/L	SW-846 9036
Major Cation Sum	193.96 meq/L		N/A	Calculation
Major Anion Sum	206.73 meq/L		N/A	Calculation
Cation/Anion Balance	-3.19 % Diff		N/A	Calculation

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

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David N. Poelstra
Laboratory Manager

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: OCD-3
Lab ID: 0494W10141/0694G02076
Matrix: Water
Condition: Intact

Report Date: 03/28/95
Receipt Date: 11/10/94
Sample Date: 11/05/94

Parameter	Concentration	PQL	Method
Total Metals			
Total Arsenic	0.028 mg/L	0.005	SW-846 7061A
Total Chromium	0.043 mg/L	0.005	SW-846 7191
Total Lead	0.02 mg/L	0.01	SW-846 7421
Total Nickel	0.04 mg/L	0.01	SW-846 6010A

Dissolved Metals			
Dissolved Arsenic	ND*	0.005 mg/L	SW-846 7061A
Dissolved Chromium	ND*	0.02 mg/L	SW-846 6010A
Dissolved Lead	ND*	0.01 mg/L	SW-846 7421
Dissolved Nickel	ND*	0.01 mg/L	SW-846 6010A

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

David N Poelstra

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Laboratory Manager

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EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project :	RFI Phase III / Artesia, NM	Report Date:	11/11/94
Sample ID:	OCD-2A	Date Sampled:	11/05/94
Laboratory ID:	0694G02077	Date Received:	11/08/94
Sample Matrix:	Water	Date Extracted:	11/11/94
Preservative:	Cool, HCl	Date Analyzed:	11/11/94
Condition:	Intact, pH<2		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	ND	0.005
Toluene	ND	0.005
Ethylbenzene	ND	0.005
m,p-Xylene	ND	0.005
o-Xylene	ND	0.005
Methyl ethyl ketone	ND	0.005
Carbon disulfide	ND	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	101%	86 - 118%
Toluene - d8	97%	88 - 110%
Bromofluorobenzene	102%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

Review

Inter·Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project:	RFI Phase III / Artesia, NM	Report Date:	11/13/94
Sample ID:	OCD - 2A	Date Sampled:	11/05/94
Laboratory ID:	0694G02077	Date Received:	11/08/94
Sample Matrix:	Water	Date Extracted:	11/10/94
Condition:	Intact	Date Analyzed:	11/11/94
Preservative:	Cool		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Acenaphthene	ND	0.010
Acenaphthylene	ND	0.010
Anthracene	ND	0.010
Benzo(a)anthracene	ND	0.010
Benzo(b)fluoranthene	ND	0.010
Benzo(k)fluoranthene	ND	0.010
Benzo(g,h,i)perylene	ND	0.010
Benzo(a)pyrene	ND	0.010
Chrysene	ND	0.010
Dibenz(a,h)anthracene	ND	0.010
Fluoranthene	ND	0.010
Fluorene	ND	0.010
Ideno(1,2,3-cd)pyrene	ND	0.010
Naphthalene	ND	0.010
Phenanthrene	ND	0.010
Pyrene	ND	0.010

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	75%	21 - 110%
Phenol - d5	74%	10 - 110%
Nitrobenzene - d5	69%	35 - 114%
2 - Fluorobiphenyl	64%	43 - 116%
2,4,6 - Tribromophenol	104%	10 - 123%
Terphenyl - d14	85%	33 - 141%

References: Method 3510: Separatory Funnel Liquid-Liquid Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments:

Analyst

Wendi M Rog[signature]
Review

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III
Sample ID: OCD-2A
Lab ID: 0494W10185/0694G02077
Matrix: Water
Condition: Intact

Report Date: 03/28/95
Receipt Date: 11/10/94
Sample Date: 11/15/94

Parameter	Concentration	PQL	Method
pH (Lab)	7.1 s.u.	0.1	SW-846 9040
Conductivity (Lab)	14400 µmhos/cm	1	SW-846 9050
Total Dissolved Solids (180° C)	11000 mg/L	10	EPA 160.1
Total Alkalinity (as CaCO3)	504 mg/L	1	EPA 310.1
Total Hardness (as CaCO3)	2430 mg/L	1	Calculation
Fluoride	1.2 mg/L	0.1	EPA 340.2

Calcium	581 mg/L	28.99 meq/L	1 mg/L	SW-846 6010A
Magnesium	238 mg/L	19.59 meq/L	1 mg/L	SW-846 6010A
Potassium	11 mg/L	0.28 meq/L	1 mg/L	SW-846 6010A
Sodium	2830 mg/L	123.01 meq/L	1 mg/L	SW-846 6010A
Bicarbonate	615 mg/L	10.08 meq/L	1 mg/L	EPA 310.1
Carbonate	ND*	0.00	1 mg/L	EPA 310.1
Chloride	2800 mg/L	79.07 meq/L	1 mg/L	SW-846 9251
Sulfate	3510 mg/L	73.16 meq/L	5 mg/L	SW-846 9036
Major Cation Sum	171.87 meq/L		N/A	Calculation
Major Anion Sum	162.31 meq/L		N/A	Calculation
Cation/Anion Balance	2.86 % Diff		N/A	Calculation

Total Metals			
Total Arsenic	0.048 mg/L	0.005	SW-846 7061A
Total Chromium	0.077 mg/L	0.005	SW-846 7191
Total Lead	0.03 mg/L	0.01	SW-846 7421
Total Nickel	0.08 mg/L	0.05	SW-846 7520

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III
Sample ID: OCD-2A
Lab ID: 0494W10185/0694G02077
Matrix: Water
Condition: Intact

Report Date: 03/28/95
Receipt Date: 11/10/94
Sample Date: 11/15/94

Parameter	Concentration	PQL	Method
Dissolved Aluminum	ND*	0.1 mg/L	SW-846 6010A
Dissolved Antimony	ND*	0.1 mg/L	SW-846 6010A
Dissolved Arsenic	0.041 mg/L	0.005	SW-846 7061A
Dissolved Barium	ND*	0.05 mg/L	SW-846 6010A
Dissolved Beryllium	ND*	0.01 mg/L	SW-846 6010A
Dissolved Boron	0.47 mg/L	0.05	SW-846 6010A
Dissolved Cadmium	ND*	0.02 mg/L	SW-846 6010A
Dissolved Chromium	ND*	0.02 mg/L	SW-846 6010A
Dissolved Cobalt	ND*	0.02 mg/L	SW-846 6010A
Dissolved Copper	ND*	0.01 mg/L	SW-846 6010A
Dissolved Iron	5.34 mg/L	0.05	SW-846 6010A
Dissolved Lead	ND*	0.1 mg/L	SW-846 6010A
Dissolved Manganese	1.38 mg/L	0.02	SW-846 6010A
Dissolved Molybdenum	ND*	0.05 mg/L	SW-846 6010A
Dissolved Nickel	ND*	0.01 mg/L	SW-846 6010A
Dissolved Selenium	ND*	0.2 mg/L	SW-846 6010A
Dissolved Silica	15.37 mg/L	0.05	SW-846 6010A
Dissolved Silver	ND*	0.01 mg/L	SW-846 6010A
Dissolved Thallium	ND*	0.2 mg/L	SW-846 6010A
Dissolved Vanadium	0.01 mg/L	0.01	SW-846 6010A
Dissolved Zinc	ND*	0.01 mg/L	SW-846 6010A

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

David N Poelstra

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Laboratory Manager

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3304 Longmire
College Station, Texas 77845

EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project :	RFI Phase III / Artesia, NM	Report Date:	11/11/94
Sample ID:	Field Duplicate	Date Sampled:	11/05/94
Laboratory ID:	0694G02078	Date Received:	11/08/94
Sample Matrix:	Water	Date Extracted:	11/11/94
Preservative:	Cool, HCl	Date Analyzed:	11/11/94
Condition:	Intact, pH<2		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	ND	0.005
Toluene	ND	0.005
Ethylbenzene	ND	0.005
m,p-Xylene	ND	0.005
o-Xylene	ND	0.005
Methyl ethyl ketone	ND	0.005
Carbon disulfide	ND	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	102%	86 - 118%
Toluene - d8	95%	88 - 110%
Bromofluorobenzene	96%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

Review

Inter-Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project:	RFI Phase III / Artesia, NM	Report Date:	11/13/94
Sample ID:	Field Duplicate	Date Sampled:	11/05/94
Laboratory ID:	0694G02078	Date Received:	11/08/94
Sample Matrix:	Water	Date Extracted:	11/10/94
Condition:	Intact	Date Analyzed:	11/11/94
Preservative:	Cool		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Acenaphthene	ND	0.010
Acenaphthylene	ND	0.010
Anthracene	ND	0.010
Benzo(a)anthracene	ND	0.010
Benzo(b)fluoranthene	ND	0.010
Benzo(k)fluoranthene	ND	0.010
Benzo(g,h,i)perylene	ND	0.010
Benzo(a)pyrene	ND	0.010
Chrysene	ND	0.010
Dibenz(a,h)anthracene	ND	0.010
Fluoranthene	ND	0.010
Fluorene	ND	0.010
Ideno(1,2,3-cd)pyrene	ND	0.010
Naphthalene	ND	0.010
Phenanthrene	ND	0.010
Pyrene	ND	0.010

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	55%	21 - 110%
Phenol - d5	60%	10 - 110%
Nitrobenzene - d5	60%	35 - 114%
2 - Fluorobiphenyl	71%	43 - 116%
2,4,6 - Tribromophenol	84%	10 - 123%
Terphenyl - d14	79%	33 - 141%

References: Method 3510: Separatory Funnel Liquid-Liquid Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments:

Ramona R. Dennis
Analyst

Review

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: FIELD DUPLICATE
Lab ID: 0494W10142/0694G02078
Matrix: Water
Condition: Intact

Report Date: 03/27/95
Receipt Date: 11/10/94
Sample Date: 11/05/94

Parameter	Concentration	PQL	Method
pH (Lab)	7.4 s.u.	0.1	SW-846 9040
Conductivity (Lab)	3330 µmhos/cm	1	SW-846 9050
Total Dissolved Solids (180° C)	2610 mg/L	10	EPA 160.1
Total Alkalinity (as CaCO3)	162 mg/L	1	EPA 310.1
Total Hardness (as CaCO3)	1390 mg/L	1	Calculation
Fluoride	1.0 mg/L	0.1	EPA 340.2

Calcium	359 mg/L	17.91 meq/L	1 mg/L	SW-846 6010A
Magnesium	120 mg/L	9.88 meq/L	1 mg/L	SW-846 6010A
Potassium	3 mg/L	0.08 meq/L	1 mg/L	SW-846 6010A
Sodium	280 mg/L	12.18 meq/L	1 mg/L	SW-846 6010A
rbonate	198 mg/L	3.25 meq/L	1 mg/L	EPA 310.1
bonate	ND*	0.00	1 mg/L	EPA 310.1
Chloride	738 mg/L	20.82 meq/L	1 mg/L	SW-846 9251
Sulfate	746 mg/L	15.53 meq/L	5 mg/L	SW-846 9036
Major Cation Sum	40.05 meq/L		N/A	Calculation
Major Anion Sum	39.59 meq/L		N/A	Calculation
Cation/Anion Balance	0.58 % Diff		N/A	Calculation

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

ved By:

David N Poelstra

David N. Poelstra
Laboratory Manager

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11183 SH 30 College Station, Texas 77845

WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: FIELD DUPLICATE
Lab ID: 0494W10142/0694G02078
Matrix: Water
Condition: Intact

Report Date: 03/27/95
Receipt Date: 11/10/94
Sample Date: 11/05/94

Parameter	Concentration	PQL	Method
Total Metals			
Total Arsenic	ND*	0.005 mg/L	SW-846 7061A
Total Chromium	ND*	0.02 mg/L	SW-846 6010A
Total Lead	ND*	0.01 mg/L	SW-846 7421
Total Nickel	ND*	0.01 mg/L	SW-846 6010A
Dissolved Metals			
Dissolved Arsenic	ND*	0.005 mg/L	SW-846 7061A
Dissolved Chromium	ND*	0.02 mg/L	SW-846 6010A
Dissolved Lead	ND*	0.01 mg/L	SW-846 7421
Dissolved Nickel	ND*	0.01 mg/L	SW-846 6010A

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

David N. Poelstra

David N. Poelstra
Laboratory Manager

Inter-Mountain Laboratories, Inc.

CHAIN OF CUSTODY RECORD

Client/Project Name	Project Location	
Navajo Refinery	Artesia NM	ANALYSES / PARAMETERS

Sampler: (Signature) Brian Sullivan

Chain of Custody Tape No.

Sample No./ Identification	Date	Time	Lab Number	Matrix	No. of Containers	VOAs	SVOAs	metals As, Cr, Ni, Pb	General Chemistry	Remarks
MW-16	11/5/94	0915	069460 2079	water	6	X	X	X	X	
MW-1		1035	2080		6	X	X	X	X	plus NMG. W.Qual metals
MW-2A		1218	2081		6	X	X	X	X	" " " "
Field Blank 1		1240	2082		1			X		metals only
MW-2B		1245	2083		6	X	X	X	X	
Field Blank 2		1256	2084		2	X				VOAs only
Trip Blank			2085							

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
[illegible]	11/7/94	1500	[illegible] /BB	11/8/94	0919
Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
Relinquished by: (Signature)	Date	Time	Received by laboratory: (Signature)	Date	Time

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Bozeman, Montana 59715
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Telephone (409) 776-8945

☐ 3304 Longmire Drive
College Station, TX 77845
Telephone (409) 774-4999

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3304 Longmire
College Station, Texas 77845

EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project :	RFI Phase III / Artesia, NM	Report Date:	11/11/94
Sample ID:	MW-16	Date Sampled:	11/05/94
Laboratory ID:	0694G02079	Date Received:	11/08/94
Sample Matrix:	Water	Date Extracted:	11/11/94
Preservative:	Cool, HCl	Date Analyzed:	11/11/94
Condition:	Intact, pH<2		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	ND	0.005
Toluene	ND	0.005
Ethylbenzene	ND	0.005
m,p-Xylene	ND	0.005
o-Xylene	ND	0.005
Methyl ethyl ketone	ND	0.005
Carbon disulfide	ND	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	100%	86 - 118%
Toluene - d8	98%	88 - 110%
Bromofluorobenzene	94%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

Ulonda M Rog
Review

Inter-Mountain Laboratories, Inc.

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EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project:	RFI Phase III / Artesia, NM	Report Date:	11/13/94
Sample ID:	MW - 16	Date Sampled:	11/05/94
Laboratory ID:	0694G02079	Date Received:	11/08/94
Sample Matrix:	Water	Date Extracted:	11/10/94
Condition:	Intact	Date Analyzed:	11/11/94
Preservative:	Cool		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Acenaphthene	ND	0.010
Acenaphthylene	ND	0.010
Anthracene	ND	0.010
Benzo(a)anthracene	ND	0.010
Benzo(b)fluoranthene	ND	0.010
Benzo(k)fluoranthene	ND	0.010
Benzo(g,h,i)perylene	ND	0.010
Benzo(a)pyrene	ND	0.010
Chrysene	ND	0.010
Dibenz(a,h)anthracene	ND	0.010
Fluoranthene	ND	0.010
Fluorene	ND	0.010
Ideno(1,2,3-cd)pyrene	ND	0.010
Naphthalene	ND	0.010
Phenanthrene	ND	0.010
Pyrene	ND	0.010

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	59%	21 - 110%
Phenol - d5	62%	10 - 110%
Nitrobenzene - d5	56%	35 - 114%
2 - Fluorobiphenyl	59%	43 - 116%
2,4,6 - Tribromophenol	98%	10 - 123%
Terphenyl - d14	80%	33 - 141%

References: Method 3510: Separatory Funnel Liquid-Liquid Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments:

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Analyst

Ulond M Log
Review

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Inter-Mountain Laboratories, Inc.

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11183 SH 30 College Station, Texas 77845

WATER QUALITY REPORT

Client: Navajo Refining Co.

Project: RFI Phase III / Artesia, NM

Sample ID: MW-16

Lab ID: 0494W10119/0694G02079

Matrix: Water

Condition: Intact

Report Date: 03/27/95

Receipt Date: 11/10/94

Sample Date: 11/05/94

Parameter	Concentration	PQL	Method
pH (Lab)	7.4 s.u.	0.1	SW-846 9040
Conductivity (Lab)	4600 µmhos/cm	1	SW-846 9050
Total Dissolved Solids (180° C)	4080 mg/L	10	EPA 160.1
Total Alkalinity (as CaCO3)	311 mg/L	1	EPA 310.1
Total Hardness (as CaCO3)	2400 mg/L	1	Calculation
Fluoride	2.3 mg/L	0.1	EPA 340.2

Calcium	570 mg/L	28.44 meq/L	1 mg/L	SW-846 6010A
Magnesium	238 mg/L	19.59 meq/L	1 mg/L	SW-846 6010A
Potassium	14 mg/L	0.36 meq/L	1 mg/L	SW-846 6010A
Sodium	424 mg/L	18.44 meq/L	1 mg/L	SW-846 6010A
Bicarbonate	379 mg/L	6.21 meq/L	1 mg/L	EPA 310.1
Carbonate	ND*	0.00	1 mg/L	EPA 310.1
Chloride	704 mg/L	19.86 meq/L	1 mg/L	SW-846 9251
Sulfate	1920 mg/L	39.95 meq/L	5 mg/L	SW-846 9036
Major Cation Sum	66.83 meq/L		N/A	Calculation
Major Anion Sum	66.03 meq/L		N/A	Calculation
Cation/Anion Balance	0.60 % Diff		N/A	Calculation

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

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David N. Poelstra

Laboratory Manager

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: MW-16
Lab ID: 0494W10119/0694G02079
Matrix: Water
Condition: Intact

Report Date: 03/27/95
Receipt Date: 11/10/94
Sample Date: 11/05/94

Parameter	Concentration	PQL	Method
Total Metals			
Total Arsenic	ND*	0.005 mg/L	SW-846 7061A
Total Chromium	ND*	0.02 mg/L	SW-846 6010A
Total Lead	ND*	0.01 mg/L	SW-846 7421
Total Nickel	0.02 mg/L	0.01	SW-846 6010A

Dissolved Metals			
Dissolved Arsenic	ND*	0.005 mg/L	SW-846 7061A
Dissolved Chromium	ND*	0.02 mg/L	SW-846 6010A
Dissolved Lead	ND*	0.01 mg/L	SW-846 7421
Dissolved Nickel	0.02 mg/L	0.01	SW-846 6010A

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

David N Poelstra

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Laboratory Manager

3304 Longmire
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EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project :	RFI Phase III / Artesia, NM	Report Date:	11/11/94
Sample ID:	MW-1	Date Sampled:	11/05/94
Laboratory ID:	0694G02080	Date Received:	11/08/94
Sample Matrix:	Water	Date Extracted:	11/11/94
Preservative:	Cool, HCl	Date Analyzed:	11/11/94
Condition:	Intact, pH<2		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	ND	0.005
Toluene	ND	0.005
Ethylbenzene	ND	0.005
m,p-Xylene	ND	0.005
o-Xylene	ND	0.005
Methyl ethyl ketone	ND	0.005
Carbon disulfide	ND	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	100%	86 - 118%
Toluene - d8	100%	88 - 110%
Bromofluorobenzene	101%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

Review

Inter-Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project:	RFI Phase III / Artesia, NM	Report Date:	11/13/94
Sample ID:	MW - 1	Date Sampled:	11/05/94
Laboratory ID:	0694G02080	Date Received:	11/08/94
Sample Matrix:	Water	Date Extracted:	11/10/94
Condition:	Intact	Date Analyzed:	11/11/94
Preservative:	Cool		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Acenaphthene	ND	0.010
Acenaphthylene	ND	0.010
Anthracene	ND	0.010
Benzo(a)anthracene	ND	0.010
Benzo(b)fluoranthene	ND	0.010
Benzo(k)fluoranthene	ND	0.010
Benzo(g,h,i)perylene	ND	0.010
Benzo(a)pyrene	ND	0.010
Chrysene	ND	0.010
Dibenz(a,h)anthracene	ND	0.010
Fluoranthene	ND	0.010
Fluorene	ND	0.010
Ideno(1,2,3-cd)pyrene	ND	0.010
Naphthalene	ND	0.010
Phenanthrene	ND	0.010
Pyrene	ND	0.010

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	58%	21 - 110%
Phenol - d5	59%	10 - 110%
Nitrobenzene - d5	62%	35 - 114%
2 - Fluorobiphenyl	53%	43 - 116%
2,4,6 - Tribromophenol	81%	10 - 123%
Terphenyl - d14	85%	33 - 141%

References: Method 3510: Separatory Funnel Liquid-Liquid Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments:

Ramona R. Dennis
Analyst

Review

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III
Sample ID: MW-1
Lab ID: 0494W10190/0694G02080
Matrix: Water
Condition: Intact

Report Date: 03/28/95
Receipt Date: 11/10/94
Sample Date: 11/05/94

Parameter	Concentration		PQL	Method
pH (Lab)	7.7 s.u.		0.1	SW-846 9040
Conductivity (Lab)	14500 µmhos/cm		1	SW-846 9050
Total Dissolved Solids (180° C)	10200 mg/L		10	EPA 160.1
Total Alkalinity (as CaCO3)	387 mg/L		1	EPA 310.1
Total Hardness (as CaCO3)	4040 mg/L		1	Calculation
Fluoride	1.2 mg/L		0.1	EPA 340.2
Calcium	862 mg/L	43.01 meq/L	1 mg/L	SW-846 6010A
Magnesium	459 mg/L	37.78 meq/L	1 mg/L	SW-846 6010A
Potassium	8 mg/L	0.20 meq/L	1 mg/L	SW-846 6010A
Sodium	2130 mg/L	92.43 meq/L	1 mg/L	SW-846 6010A
Bicarbonate	472 mg/L	7.74 meq/L	1 mg/L	EPA 310.1
Carbonate	ND*	0.00	1 mg/L	EPA 310.1
Chloride	3590 mg/L	101.38 meq/L	1 mg/L	SW-846 9251
Sulfate	2800 mg/L	58.34 meq/L	5 mg/L	SW-846 9036
Major Cation Sum	173.42 meq/L		N/A	Calculation
Major Anion Sum	167.46 meq/L		N/A	Calculation
Cation/Anion Balance	1.75 % Diff		N/A	Calculation
Total Metals				
Total Arsenic	0.013 mg/L		0.005	SW-846 7061A
Total Chromium	0.184 mg/L		0.005	SW-846 7191
Total Lead	ND*		0.01 mg/L	SW-846 7421
Total Nickel	0.08 mg/L		0.05	SW-846 7520

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III
Sample ID: MW-1
Lab ID: 0494W10190/0694G02080
Matrix: Water
Condition: Intact

Report Date: 03/28/95
Receipt Date: 11/10/94
Sample Date: 11/05/94

Parameter	Concentration	PQL	Method
Dissolved Aluminum	ND*	0.1 mg/L	SW-846 6010A
Dissolved Antimony	0.1 mg/L	0.1	SW-846 6010A
Dissolved Arsenic	ND*	0.005 mg/L	SW-846 7061A
Dissolved Barium	ND*	0.05 mg/L	SW-846 6010A
Dissolved Beryllium	ND*	0.01 mg/L	SW-846 6010A
Dissolved Boron	0.40 mg/L	0.05	SW-846 6010A
Dissolved Cadmium	0.07 mg/L	0.02	SW-846 6010A
Dissolved Chromium	ND*	0.02 mg/L	SW-846 6010A
Dissolved Cobalt	ND*	0.02 mg/L	SW-846 6010A
Dissolved Copper	ND*	0.01 mg/L	SW-846 6010A
Dissolved Iron	0.99 mg/L	0.05	SW-846 6010A
Dissolved Lead	ND*	0.1 mg/L	SW-846 6010A
Dissolved Manganese	2.43 mg/L	0.02	SW-846 6010A
Dissolved Molybdenum	ND*	0.05 mg/L	SW-846 6010A
Dissolved Nickel	ND*	0.05 mg/L	SW-846 7520
Dissolved Selenium	ND*	0.2 mg/L	SW-846 6010A
Dissolved Silica	12.63 mg/L	0.05	SW-846 6010A
Dissolved Silver	ND*	0.01 mg/L	SW-846 6010A
Dissolved Thallium	ND*	0.2 mg/L	SW-846 6010A
Dissolved Vanadium	0.01 mg/L	0.01	SW-846 6010A
Dissolved Zinc	0.04 mg/L	0.01	SW-846 6010A

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

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3304 Longmire
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EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project :	RFI Phase III / Artesia, NM	Report Date:	11/11/94
Sample ID:	MW-2A	Date Sampled:	11/05/94
Laboratory ID:	0694G02081	Date Received:	11/08/94
Sample Matrix:	Water	Date Extracted:	11/11/94
Preservative:	Cool, HCl	Date Analyzed:	11/11/94
Condition:	Intact, pH<2		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	ND	0.005
Toluene	ND	0.005
Ethylbenzene	ND	0.005
m,p-Xylene	ND	0.005
o-Xylene	ND	0.005
Methyl ethyl ketone	ND	0.005
Carbon disulfide	ND	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	98%	86 - 118%
Toluene - d8	95%	88 - 110%
Bromofluorobenzene	95%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

Review

Inter-Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project:	RFI Phase III / Artesia, NM	Report Date:	11/13/94
Sample ID:	MW - 2A	Date Sampled:	11/05/94
Laboratory ID:	0694G02081	Date Received:	11/08/94
Sample Matrix:	Water	Date Extracted:	11/10/94
Condition:	Intact	Date Analyzed:	11/11/94
Preservative:	Cool		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Acenaphthene	ND	0.010
Acenaphthylene	ND	0.010
Anthracene	ND	0.010
Benzo(a)anthracene	ND	0.010
Benzo(b)fluoranthene	ND	0.010
Benzo(k)fluoranthene	ND	0.010
Benzo(g,h,i)perylene	ND	0.010
Benzo(a)pyrene	ND	0.010
Chrysene	ND	0.010
Dibenz(a,h)anthracene	ND	0.010
Fluoranthene	ND	0.010
Fluorene	ND	0.010
Ideno(1,2,3-cd)pyrene	ND	0.010
Naphthalene	ND	0.010
Phenanthrene	ND	0.010
Pyrene	ND	0.010

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	70%	21 - 110%
Phenol - d5	78%	10 - 110%
Nitrobenzene - d5	71%	35 - 114%
2 - Fluorobiphenyl	80%	43 - 116%
2,4,6 - Tribromophenol	102%	10 - 123%
Terphenyl - d14	90%	33 - 141%

References: Method 3510: Separatory Funnel Liquid-Liquid Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments:

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III
Sample ID: MW-2A
Lab ID: 0494W10191/0694G02081
Matrix: Water
Condition: Intact

Report Date: 03/28/95
Receipt Date: 11/10/94
Sample Date: 11/05/94

Parameter	Concentration	PQL	Method
pH (Lab)	7.1 s.u.	0.1	SW-846 9040
Conductivity (Lab)	10600 µmhos/cm	1	SW-846 9050
Total Dissolved Solids (180° C)	7620 mg/L	10	EPA 160.1
Total Alkalinity (as CaCO3)	575 mg/L	1	EPA 310.1
Total Hardness (as CaCO3)	1730 mg/L	1	Calculation
Fluoride	14.3 mg/L	0.1	EPA 340.2

Calcium	542 mg/L	27.05 meq/L	1 mg/L	SW-846 6010A
Magnesium	91 mg/L	7.49 meq/L	1 mg/L	SW-846 6010A
Potassium	10 mg/L	0.26 meq/L	1 mg/L	SW-846 6010A
Sodium	2100 mg/L	91.47 meq/L	1 mg/L	SW-846 6010A
Bicarbonate	701 mg/L	11.49 meq/L	1 mg/L	EPA 310.1
Carbonate	ND*	0.00	1 mg/L	EPA 310.1
Chloride	1910 mg/L	53.74 meq/L	1 mg/L	SW-846 9251
Sulfate	2610 mg/L	54.30 meq/L	5 mg/L	SW-846 9036
Major Cation Sum	126.27 meq/L		N/A	Calculation
Major Anion Sum	119.53 meq/L		N/A	Calculation
Cation/Anion Balance	2.74 % Diff		N/A	Calculation

Total Metals			
Total Arsenic	0.156 mg/L	0.005	SW-846 7061A
Total Chromium	0.02 mg/L	0.02	SW-846 6010A
Total Lead	ND*	0.01 mg/L	SW-846 7421
Total Nickel	0.03 mg/L	0.01	SW-846 6010A

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III
Sample ID: MW-2A
Lab ID: 0494W10191/0694G02081
Matrix: Water
Condition: Intact

Report Date: 03/28/95
Receipt Date: 11/10/94
Sample Date: 11/05/94

Parameter	Concentration	PQL	Method
Dissolved Aluminum	ND*	0.1 mg/L	SW-846 6010A
Dissolved Antimony	ND*	0.1 mg/L	SW-846 6010A
Dissolved Arsenic	0.208 mg/L	0.2	SW-846 6010A
Dissolved Barium	ND*	0.05 mg/L	SW-846 6010A
Dissolved Beryllium	ND*	0.01 mg/L	SW-846 6010A
Dissolved Boron	0.37 mg/L	0.05	SW-846 6010A
Dissolved Cadmium	ND*	0.02 mg/L	SW-846 6010A
Dissolved Chromium	ND*	0.02 mg/L	SW-846 6010A
Dissolved Cobalt	ND*	0.02 mg/L	SW-846 6010A
Dissolved Copper	ND*	0.01 mg/L	SW-846 6010A
Dissolved Iron	4.72 mg/L	0.05	SW-846 6010A
Dissolved Lead	ND*	0.1 mg/L	SW-846 6010A
Dissolved Manganese	2.50 mg/L	0.02	SW-846 6010A
Dissolved Molybdenum	ND*	0.05 mg/L	SW-846 6010A
Dissolved Nickel	0.02 mg/L	0.01	SW-846 6010A
Dissolved Selenium	ND*	0.2 mg/L	SW-846 6010A
Dissolved Silica	20.97 mg/L	0.05	SW-846 6010A
Dissolved Silver	ND*	0.01 mg/L	SW-846 6010A
Dissolved Thallium	ND*	0.2 mg/L	SW-846 6010A
Dissolved Vanadium	ND*	0.01 mg/L	SW-846 6010A
Dissolved Zinc	ND*	0.01 mg/L	SW-846 6010A

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: FIELD BLANK 1
Lab ID: 0494W10210/0694G02082
Matrix: Water
Condition: Intact

Report Date: 03/28/95
Receipt Date: 11/10/94
Sample Date: 11/05/94

Parameter	Concentration	PQL	Method
Total Metals			
Total Arsenic	ND*	0.005 mg/L	SW-846 7061A
Total Chromium	ND*	0.02 mg/L	SW-846 6010A
Total Lead	ND*	0.01 mg/L	SW-846 7421
Total Nickel	ND*	0.01 mg/L	SW-846 6010A

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

Reviewed By:

David n Poelstra

David N. Poelstra
Laboratory Manager

Inter-Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project :	RFI Phase III / Artesia, NM	Report Date:	11/11/94
Sample ID:	MW-2B	Date Sampled:	11/05/94
Laboratory ID:	0694G02083	Date Received:	11/08/94
Sample Matrix:	Water	Date Extracted:	11/11/94
Preservative:	Cool, HCl	Date Analyzed:	11/11/94
Condition:	Intact, pH<2		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	ND	0.005
Toluene	ND	0.005
Ethylbenzene	ND	0.005
m,p-Xylene	ND	0.005
o-Xylene	ND	0.005
Methyl ethyl ketone	ND	0.005
Carbon disulfide	ND	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	98%	86 - 118%
Toluene - d8	98%	88 - 110%
Bromofluorobenzene	99%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

Review

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EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client: **NAVAJO REFINING COMPANY**
Project: RFI Phase III / Artesia, NM
Sample ID: MW - 2B
Laboratory ID: 0694G02083
Sample Matrix: Water
Condition: Intact
Preservative: Cool

Report Date: 11/13/94
Date Sampled: 11/05/94
Date Received: 11/08/94
Date Extracted: 11/10/94
Date Analyzed: 11/11/94

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Acenaphthene	ND	0.010
Acenaphthylene	ND	0.010
Anthracene	ND	0.010
Benzo(a)anthracene	ND	0.010
Benzo(b)fluoranthene	ND	0.010
Benzo(k)fluoranthene	ND	0.010
Benzo(g,h,i)perylene	ND	0.010
Benzo(a)pyrene	ND	0.010
Chrysene	ND	0.010
Dibenz(a,h)anthracene	ND	0.010
Fluoranthene	ND	0.010
Fluorene	ND	0.010
Ideno(1,2,3-cd)pyrene	ND	0.010
Naphthalene	ND	0.010
Phenanthrene	ND	0.010
Pyrene	ND	0.010

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	37%	21 - 110%
Phenol - d5	39%	10 - 110%
Nitrobenzene - d5	35%	35 - 114%
2 - Fluorobiphenyl	44%	43 - 116%
2,4,6 - Tribromophenol	62%	10 - 123%
Terphenyl - d14	65%	33 - 141%

References: Method 3510: Separatory Funnel Liquid-Liquid Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments:

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: MW-2B
Lab ID: 0494W10121/0694G02083
Matrix: Water
Condition: Intact

Report Date: 03/27/95
Receipt Date: 11/10/94
Sample Date: 11/05/94

Parameter	Concentration	PQL	Method
Total Metals			
Total Arsenic	ND*	0.005 mg/L	SW-846 7061A
Total Chromium	ND*	0.02 mg/L	SW-846 6010A
Total Lead	ND*	0.01 mg/L	SW-846 7421
Total Nickel	ND*	0.01 mg/L	SW-846 6010A

Dissolved Metals			
Dissolved Arsenic	ND*	0.005 mg/L	SW-846 7061A
Dissolved Chromium	ND*	0.02 mg/L	SW-846 6010A
Dissolved Lead	ND*	0.01 mg/L	SW-846 7421
Dissolved Nickel	ND*	0.01 mg/L	SW-846 6010A

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

[Revi]ewed By:

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Laboratory Manager

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: MW-2B
Lab ID: 0494W10121/0694G02083
Matrix: Water
Condition: Intact

Report Date: 03/27/95
Receipt Date: 11/10/94
Sample Date: 11/05/94

Parameter	Concentration	PQL	Method
pH (Lab)	7.5 s.u.	0.1	SW-846 9040
Conductivity (Lab)	3310 µmhos/cm	1	SW-846 9050
Total Dissolved Solids (180° C)	2490 mg/L	10	EPA 160.1
Total Alkalinity (as CaCO3)	163 mg/L	1	EPA 310.1
Total Hardness (as CaCO3)	1490 mg/L	1	Calculation
Fluoride	1.1 mg/L	0.1	EPA 340.2

Calcium	379 mg/L	18.91 meq/L	1 mg/L	SW-846 6010A
Magnesium	133 mg/L	10.95 meq/L	1 mg/L	SW-846 6010A
Potassium	4 mg/L	0.09 meq/L	1 mg/L	SW-846 6010A
Sodium	295 mg/L	12.83 meq/L	1 mg/L	SW-846 6010A
Bicarbonate	199 mg/L	3.26 meq/L	1 mg/L	EPA 310.1
Carbonate	ND*	0.00	1 mg/L	EPA 310.1
Chloride	868 mg/L	24.49 meq/L	1 mg/L	SW-846 9251
Sulfate	746 mg/L	15.53 meq/L	5 mg/L	SW-846 9036
Major Cation Sum	42.78 meq/L		N/A	Calculation
Major Anion Sum	43.28 meq/L		N/A	Calculation
Cation/Anion Balance	-0.58 % Diff		N/A	Calculation

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

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EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project :	RFI Phase III / Artesia, NM	Report Date:	11/14/94
Sample ID:	Field Blank 2	Date Sampled:	11/05/94
Laboratory ID:	0694G02084	Date Received:	11/08/94
Sample Matrix:	Water	Date Extracted:	11/14/94
Preservative:	Cool, HCl	Date Analyzed:	11/14/94
Condition:	Intact, pH<2		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	ND	0.005
Toluene	ND	0.005
Ethylbenzene	ND	0.005
m,p-Xylene	ND	0.005
o-Xylene	ND	0.005
Methyl ethyl ketone	ND	0.005
Carbon disulfide	ND	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	99%	86 - 118%
Toluene - d8	98%	88 - 110%
Bromofluorobenzene	101%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

Review

Inter-Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client:	NAVAJO REFINING COMPANY
Project :	RFI Phase III / Artesia, NM
Sample ID:	Trip Blank
Laboratory ID:	0694G02085
Sample Matrix:	Water
Preservative:	Cool, HCl
Condition:	Intact, pH<2

Report Date:	11/14/94
Date Sampled:	NA
Date Received:	11/08/94
Date Extracted:	11/14/94
Date Analyzed:	11/14/94

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	ND	0.005
Toluene	ND	0.005
Ethylbenzene	ND	0.005
m,p-Xylene	ND	0.005
o-Xylene	ND	0.005
Methyl ethyl ketone	ND	0.005
Carbon disulfide	ND	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	99%	86 - 118%
Toluene - d8	99%	88 - 110%
Bromofluorobenzene	100%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

Review

Inter- Mountain Laboratories, Inc.

CHAIN OF CUSTODY RECORD

Client/Project Name	Project Location
Navajo	Artesia
Sampler: (Signature)	**Chain of Custody Tape No.**

ANALYSES / PARAMETERS

Sample No./ Identification	Date	Time	Lab Number	Matrix	No. of Containers	VOAs	SVOAs	Metals As Cr Ni Pb	Gen. Chem.	Remarks
OCD-4	11/6	0825		Water 06942086	6					- plus NM GW Qual metals
OCD-5		0920		06942087						
OCD-6		1005		2088						- plus NM GW Qual metals
MW-11B		1055		2089						
MW-11A		1120		2090						~~40ml~~ VOA BROKEN ON ARRIVAL / [illegible]
OCD-8B		1225		2091						
OCD-8A		1240		2092						- plus NM GW Qual metals
				~~20~~						
Trip Blank				2093		X		(vial		Broken upon receipt [illegible] 12/21/94)

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
Brian P. Sullivan	11/8/94	1400	[illegible]	11/9/94	0900
Relinquished by: (Signature)	**Date**	**Time**	**Received by: (Signature)**	**Date**	**Time**
Relinquished by: (Signature)	**Date**	**Time**	**Received by laboratory: (Signature)**	**Date**	**Time**

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☐ 11183 SH 30, College Station, TX 77845, Telephone (409) 776-8945
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Inter-Mountain Laboratories, Inc.

3304 Longmire
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EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**
Project :	RFI Phase III / Artesia, NM
Sample ID:	OCD-4
Laboratory ID:	0694G02086
Sample Matrix:	Water
Preservative:	Cool, HCl
Condition:	Intact, pH<2

Report Date:	11/14/94
Date Sampled:	11/06/94
Date Received:	11/09/94
Date Extracted:	11/14/94
Date Analyzed:	11/14/94

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	ND	0.005
Toluene	ND	0.005
Ethylbenzene	ND	0.005
m,p-Xylene	ND	0.005
o-Xylene	ND	0.005
Methyl ethyl ketone	ND	0.005
Carbon disulfide	ND	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	109%	86 - 118%
Toluene - d8	92%	88 - 110%
Bromofluorobenzene	98%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

Review

Inter-Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project:	RFI Phase III / Artesia, NM	Report Date:	11/14/94
Sample ID:	OCD - 4	Date Sampled:	11/06/94
Laboratory ID:	0694G02086	Date Received:	11/09/94
Sample Matrix:	Water	Date Extracted:	11/12/94
Condition:	Intact	Date Analyzed:	11/13/94
Preservative:	Cool		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Acenaphthene	ND	0.010
Acenaphthylene	ND	0.010
Anthracene	ND	0.010
Benzo(a)anthracene	ND	0.010
Benzo(b)fluoranthene	ND	0.010
Benzo(k)fluoranthene	ND	0.010
Benzo(g,h,i)perylene	ND	0.010
Benzo(a)pyrene	ND	0.010
Chrysene	ND	0.010
Dibenz(a,h)anthracene	ND	0.010
Fluoranthene	ND	0.010
Fluorene	ND	0.010
Ideno(1,2,3-cd)pyrene	ND	0.010
Naphthalene	ND	0.010
Phenanthrene	ND	0.010
Pyrene	ND	0.010

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	51%	21 - 110%
Phenol - d5	59%	10 - 110%
Nitrobenzene - d5	62%	35 - 114%
2 - Fluorobiphenyl	71%	43 - 116%
2,4,6 - Tribromophenol	87%	10 - 123%
Terphenyl - d14	84%	33 - 141%

References: Method 3510: Separatory Funnel Liquid-Liquid Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments:

Ramona R. Dennis
Analyst

Review

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III
Sample ID: OCD-4
Lab ID: 0494W10187/0694G02086
Matrix: Water
Condition: Intact

Report Date: 03/28/95
Receipt Date: 11/10/94
Sample Date: 11/06/94

Parameter	Concentration	PQL	Method
pH (Lab)	7.2 s.u.	0.1	SW-846 9040
Conductivity (Lab)	18000 µmhos/cm	1	SW-846 9050
Total Dissolved Solids (180° C)	12400 mg/L	10	EPA 160.1
Total Alkalinity (as CaCO3)	192 *mg/L*	1	EPA 310.1
Total Hardness (as CaCO3)	3000 mg/L	1	Calculation
Fluoride	1.0 mg/L	0.1	EPA 340.2

Calcium	795 mg/L	39.67 meq/L	1 mg/L	SW-846 6010A
Magnesium	248 mg/L	20.41 meq/L	1 mg/L	SW-846 6010A
Potassium	62 mg/L	1.59 meq/L	1 mg/L	SW-846 6010A
Sodium	3270 mg/L	142.15 meq/L	1 mg/L	SW-846 6010A
Bicarbonate	234 mg/L	3.84 meq/L	1 mg/L	EPA 310.1
Carbonate	ND*	0.00	1 mg/L	EPA 310.1
Chloride	4820 mg/L	135.85 meq/L	1 mg/L	SW-846 9251
Sulfate	2690 mg/L	56.09 meq/L	5 mg/L	SW-846 9036
Major Cation Sum	203.82 meq/L		N/A	Calculation
Major Anion Sum	195.77 meq/L		N/A	Calculation
Cation/Anion Balance	2.01 % Diff		N/A	Calculation

Total Metals			
Total Arsenic	0.024 mg/L	0.005	SW-846 7061A
Total Chromium	0.028 mg/L	0.005	SW-846 7191
Total Lead	0.02 mg/L	0.01	SW-846 7421
Total Nickel	ND*	0.01 mg/L	SW-846 6010A

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III
Sample ID: OCD-4
Lab ID: 0494W10187/0694G02086
Matrix: Water
Condition: Intact

Report Date: 03/28/95
Receipt Date: 11/10/94
Sample Date: 11/06/94

Parameter	Concentration	PQL	Method
Dissolved Aluminum	ND*	0.1 mg/L	SW-846 6010A
Dissolved Antimony	ND*	0.1 mg/L	SW-846 6010A
Dissolved Arsenic	0.005 mg/L	0.005	SW-846 7061A
Dissolved Barium	ND*	0.05 mg/L	SW-846 6010A
Dissolved Beryllium	ND*	0.01 mg/L	SW-846 6010A
Dissolved Boron	1.38 mg/L	0.05	SW-846 6010A
Dissolved Cadmium	0.02 mg/L	0.02	SW-846 6010A
Dissolved Chromium	ND*	0.02 mg/L	SW-846 6010A
Dissolved Cobalt	ND*	0.02 mg/L	SW-846 6010A
Dissolved Copper	ND*	0.01 mg/L	SW-846 6010A
Dissolved Iron	2.99 mg/L	0.05	SW-846 6010A
Dissolved Lead	ND*	0.1 mg/L	SW-846 6010A
Dissolved Manganese	0.30 mg/L	0.02	SW-846 6010A
Dissolved Molybdenum	ND*	0.05 mg/L	SW-846 6010A
Dissolved Nickel	ND*	0.01 mg/L	SW-846 6010A
Dissolved Selenium	ND*	0.2 mg/L	SW-846 6010A
Dissolved Silica	12.37 mg/L	0.05	SW-846 6010A
Dissolved Silver	ND*	0.01 mg/L	SW-846 6010A
Dissolved Thallium	ND*	0.2 mg/L	SW-846 6010A
Dissolved Vanadium	ND*	0.01 mg/L	SW-846 6010A
Dissolved Zinc	ND*	0.01 mg/L	SW-846 6010A

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

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3304 Longmire
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EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client: **NAVAJO REFINING COMPANY**
Project : RFI Phase III / Artesia, NM
Sample ID: OCD-5
Laboratory ID: 0694G02087
Sample Matrix: Water
Preservative: Cool, HCl
Condition: Intact, pH<2

Report Date: 11/14/94
Date Sampled: 11/06/94
Date Received: 11/09/94
Date Extracted: 11/14/94
Date Analyzed: 11/14/94

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	ND	0.005
Toluene	ND	0.005
Ethylbenzene	ND	0.005
m,p-Xylene	ND	0.005
o-Xylene	ND	0.005
Methyl ethyl ketone	ND	0.005
Carbon disulfide	ND	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	99%	86 - 118%
Toluene - d8	100%	88 - 110%
Bromofluorobenzene	105%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

Wanda M Rogers

Review

Inter-Mountain Laboratories, Inc.

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EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project:	RFI Phase III / Artesia, NM	Report Date:	11/14/94
Sample ID:	OCD - 5	Date Sampled:	11/06/94
Laboratory ID:	0694G02087	Date Received:	11/09/94
Sample Matrix:	Water	Date Extracted:	11/12/94
Condition:	Intact	Date Analyzed:	11/13/94
Preservative:	Cool		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Acenaphthene	ND	0.010
Acenaphthylene	ND	0.010
Anthracene	ND	0.010
Benzo(a)anthracene	ND	0.010
Benzo(b)fluoranthene	ND	0.010
Benzo(k)fluoranthene	ND	0.010
Benzo(g,h,i)perylene	ND	0.010
Benzo(a)pyrene	ND	0.010
Chrysene	ND	0.010
Dibenz(a,h)anthracene	ND	0.010
Fluoranthene	ND	0.010
Fluorene	ND	0.010
Ideno(1,2,3-cd)pyrene	ND	0.010
Naphthalene	ND	0.010
Phenanthrene	ND	0.010
Pyrene	ND	0.010

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	37%	21 - 110%
Phenol - d5	40%	10 - 110%
Nitrobenzene - d5	44%	35 - 114%
2 - Fluorobiphenyl	47%	43 - 116%
2,4,6 - Tribromophenol	50%	10 - 123%
Terphenyl - d14	51%	33 - 141%

References: Method 3510: Separatory Funnel Liquid-Liquid Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments:

Ramona R. Dennis
Analyst

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Review

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WATER QUALITY REPORT

Client: Navajo Refining Co.

Project: RFI Phase III / Artesia, NM

Sample ID: OCD-5

Lab ID: 0494W10128/0694G02087

Matrix: Water

Condition: Intact

Report Date: 03/27/95

Receipt Date: 11/10/94

Sample Date: 11/06/94

Parameter	Concentration	PQL	Method
pH (Lab)	7.4 s.u.	0.1	SW-846 9040
Conductivity (Lab)	16800 μmhos/cm	1	SW-846 9050
Total Dissolved Solids (180° C)	12100 mg/L	10	EPA 160.1
Total Alkalinity (as CaCO3)	236 mg/L	1	EPA 310.1
Total Hardness (as CaCO3)	2800 mg/L	1	Calculation
Fluoride	1.0 mg/L	0.1	EPA 340.2

Calcium	744 mg/L	37.13 meq/L	1 mg/L	SW-846 6010A
Magnesium	230 mg/L	18.93 meq/L	1 mg/L	SW-846 6010A
Potassium	36 mg/L	0.92 meq/L	1 mg/L	SW-846 6010A
Sodium	3040 mg/L	132.36 meq/L	1 mg/L	SW-846 6010A
Bicarbonate	287 mg/L	4.70 meq/L	1 mg/L	EPA 310.1
Carbonate	ND*	0.00	1 mg/L	EPA 310.1
Chloride	4520 mg/L	127.53 meq/L	1 mg/L	SW-846 9251
Sulfate	2620 mg/L	54.57 meq/L	5 mg/L	SW-846 9036
Major Cation Sum	189.34 meq/L		N/A	Calculation
Major Anion Sum	186.81 meq/L		N/A	Calculation
Cation/Anion Balance	0.67 % Diff		N/A	Calculation

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: OCD-5
Lab ID: 0494W10128/0694G02087
Matrix: Water
Condition: Intact

Report Date: 03/27/95
Receipt Date: 11/10/94
Sample Date: 11/06/94

Parameter	Concentration	PQL	Method
Total Metals			
Total Arsenic	0.041 mg/L	0.005	SW-846 7061A
Total Chromium	0.03 mg/L	0.02	SW-846 6010A
Total Lead	0.02 mg/L	0.01	SW-846 7421
Total Nickel	0.02 mg/L	0.01	SW-846 6010A
Dissolved Metals			
Dissolved Arsenic	0.008 mg/L	0.005	SW-846 7061A
Dissolved Chromium	ND*	0.02 mg/L	SW-846 6010A
Dissolved Lead	ND*	0.01 mg/L	SW-846 7421
Dissolved Nickel	ND*	0.01 mg/L	SW-846 6010A

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

David N Poelstra

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Laboratory Manager

Inter-Mountain Laboratories, Inc.

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EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project :	RFI Phase III / Artesia, NM	Report Date:	11/14/94
Sample ID:	OCD-6	Date Sampled:	11/06/94
Laboratory ID:	0694G02088	Date Received:	11/09/94
Sample Matrix:	Water	Date Extracted:	11/14/94
Preservative:	Cool, HCl	Date Analyzed:	11/14/94
Condition:	Intact, pH<2		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	ND	0.005
Toluene	ND	0.005
Ethylbenzene	ND	0.005
m,p-Xylene	ND	0.005
o-Xylene	ND	0.005
Methyl ethyl ketone	ND	0.005
Carbon disulfide	ND	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	102%	86 - 118%
Toluene - d8	96%	88 - 110%
Bromofluorobenzene	98%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

Review

Inter-Mountain Laboratories, Inc.

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EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project:	RFI Phase III / Artesia, NM	Report Date:	11/14/94
Sample ID:	OCD - 6	Date Sampled:	11/06/94
Laboratory ID:	0694G02088	Date Received:	11/09/94
Sample Matrix:	Water	Date Extracted:	11/12/94
Condition:	Intact	Date Analyzed:	11/13/94
Preservative:	Cool		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Acenaphthene	ND	0.010
Acenaphthylene	ND	0.010
Anthracene	ND	0.010
Benzo(a)anthracene	ND	0.010
Benzo(b)fluoranthene	ND	0.010
Benzo(k)fluoranthene	ND	0.010
Benzo(g,h,i)perylene	ND	0.010
Benzo(a)pyrene	ND	0.010
Chrysene	ND	0.010
Dibenz(a,h)anthracene	ND	0.010
Fluoranthene	ND	0.010
Fluorene	ND	0.010
Ideno(1,2,3-cd)pyrene	ND	0.010
Naphthalene	ND	0.010
Phenanthrene	ND	0.010
Pyrene	ND	0.010

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	64%	21 - 110%
Phenol - d5	72%	10 - 110%
Nitrobenzene - d5	75%	35 - 114%
2 - Fluorobiphenyl	77%	43 - 116%
2,4,6 - Tribromophenol	94%	10 - 123%
Terphenyl - d14	81%	33 - 141%

References: Method 3510: Separatory Funnel Liquid-Liquid Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments:

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Analyst

[illegible] M [illegible]
Review

iml

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III
Sample ID: OCD-6
Lab ID: 0494W10188/0694G02088
Matrix: Water
Condition: Intact

Report Date: 03/28/95
Receipt Date: 11/10/94
Sample Date: 11/06/94

Parameter	Concentration	PQL	Method
pH (Lab)	7.7 s.u.	0.1	SW-846 9040
Conductivity (Lab)	12800 µmhos/cm	1	SW-846 9050
Total Dissolved Solids (180° C)	9500 mg/L	10	EPA 160.1
Total Alkalinity (as CaCO3)	618 mg/L	1	EPA 310.1
Total Hardness (as CaCO3)	1990 mg/L	1	Calculation
Fluoride	3.7 mg/L	0.1	EPA 340.2

Parameter	Concentration (mg/L)	Concentration (meq/L)	PQL	Method
Calcium	527 mg/L	26.30 meq/L	1 mg/L	SW-846 6010A
Magnesium	164 mg/L	13.50 meq/L	1 mg/L	SW-846 6010A
Potassium	13 mg/L	0.33 meq/L	1 mg/L	SW-846 6010A
Sodium	2590 mg/L	112.83 meq/L	1 mg/L	SW-846 6010A
Bicarbonate	754 mg/L	12.36 meq/L	1 mg/L	EPA 310.1
Carbonate	ND*	0.00	1 mg/L	EPA 310.1
Chloride	2210 mg/L	62.31 meq/L	1 mg/L	SW-846 9251
Sulfate	3510 mg/L	73.16 meq/L	5 mg/L	SW-846 9036
Major Cation Sum	152.96 meq/L		N/A	Calculation
Major Anion Sum	147.83 meq/L		N/A	Calculation
Cation/Anion Balance	1.71 % Diff		N/A	Calculation

Total Metals			
Total Arsenic	0.039 mg/L	0.005	SW-846 7061A
Total Chromium	0.040 mg/L	0.005	SW-846 7191
Total Lead	0.03 mg/L	0.01	SW-846 7421
Total Nickel	0.04 mg/L	0.01	SW-846 6010A

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III
Sample ID: OCD-6
Lab ID: 0494W10188/0694G02088
Matrix: Water
Condition: Intact

Report Date: 03/28/95
Receipt Date: 11/10/94
Sample Date: 11/06/94

Parameter	Concentration	PQL	Method
Dissolved Aluminum	ND*	0.1 mg/L	SW-846 6010A
Dissolved Antimony	ND*	0.1 mg/L	SW-846 6010A
Dissolved Arsenic	0.053 mg/L	0.005	SW-846 7061A
Dissolved Barium	ND*	0.05 mg/L	SW-846 6010A
Dissolved Beryllium	ND*	0.01 mg/L	SW-846 6010A
Dissolved Boron	0.55 mg/L	0.05	SW-846 6010A
Dissolved Cadmium	ND*	0.02 mg/L	SW-846 6010A
Dissolved Chromium	ND*	0.02 mg/L	SW-846 6010A
Dissolved Cobalt	ND*	0.02 mg/L	SW-846 6010A
Dissolved Copper	ND*	0.01 mg/L	SW-846 6010A
Dissolved Iron	7.95 mg/L	0.05	SW-846 6010A
Dissolved Lead	ND*	0.1 mg/L	SW-846 6010A
Dissolved Manganese	1.88 mg/L	0.02	SW-846 6010A
Dissolved Molybdenum	ND*	0.05 mg/L	SW-846 6010A
Dissolved Nickel	0.01 mg/L	0.01	SW-846 6010A
Dissolved Selenium	ND*	0.2 mg/L	SW-846 6010A
Dissolved Silica	14.94 mg/L	0.05	SW-846 6010A
Dissolved Silver	ND*	0.01 mg/L	SW-846 6010A
Dissolved Thallium	ND*	0.2 mg/L	SW-846 6010A
Dissolved Vanadium	ND*	0.01 mg/L	SW-846 6010A
Dissolved Zinc	ND*	0.01 mg/L	SW-846 6010A

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

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3304 Longmire
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EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client: **NAVAJO REFINING COMPANY**
Project : RFI Phase III / Artesia, NM
Sample ID: MW-11B
Laboratory ID: 0694G02089
Sample Matrix: Water
Preservative: Cool, HCl
Condition: Intact, pH<2

Report Date: 11/14/94
Date Sampled: 11/06/94
Date Received: 11/09/94
Date Extracted: 11/14/94
Date Analyzed: 11/14/94

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	ND	0.005
Toluene	ND	0.005
Ethylbenzene	ND	0.005
m,p-Xylene	ND	0.005
o-Xylene	ND	0.005
Methyl ethyl ketone	ND	0.005
Carbon disulfide	ND	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	99%	86 - 118%
Toluene - d8	99%	88 - 110%
Bromofluorobenzene	101%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

Review

3304 Longmire
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EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client: **NAVAJO REFINING COMPANY**
Project: RFI Phase III / Artesia, NM
Sample ID: MW - 11B
Laboratory ID: 0694G02089
Sample Matrix: Water
Condition: Intact
Preservative: Cool

Report Date: 11/14/94
Date Sampled: 11/06/94
Date Received: 11/09/94
Date Extracted: 11/12/94
Date Analyzed: 11/13/94

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Acenaphthene	ND	0.010
Acenaphthylene	ND	0.010
Anthracene	ND	0.010
Benzo(a)anthracene	ND	0.010
Benzo(b)fluoranthene	ND	0.010
Benzo(k)fluoranthene	ND	0.010
Benzo(g,h,i)perylene	ND	0.010
Benzo(a)pyrene	ND	0.010
Chrysene	ND	0.010
Dibenz(a,h)anthracene	ND	0.010
Fluoranthene	ND	0.010
Fluorene	ND	0.010
Ideno(1,2,3-cd)pyrene	ND	0.010
Naphthalene	ND	0.010
Phenanthrene	ND	0.010
Pyrene	ND	0.010

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	29%	21 - 110%
Phenol - d5	32%	10 - 110%
Nitrobenzene - d5	30%	35 - 114%
2 - Fluorobiphenyl	39%	43 - 116%
2,4,6 - Tribromophenol	41%	10 - 123%
Terphenyl - d14	42%	33 - 141%

References: Method 3510: Separatory Funnel Liquid-Liquid Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States
Environmental Protection Agency, July 1992.

Comments: Two base/neutral surrogates are out of acceptance limits. Sample formed emulsions during extraction.

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Analyst

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: MW-11B
Lab ID: 0494W10129/0694G02089
Matrix: Water
Condition: Intact

Report Date: 03/27/95
Receipt Date: 11/10/94
Sample Date: 11/06/94

Parameter	Concentration	PQL	Method
pH (Lab)	7.2 s.u.	0.1	SW-846 9040
Conductivity (Lab)	19600 µmhos/cm	1	SW-846 9050
Total Dissolved Solids (180° C)	13600 mg/L	10	EPA 160.1
Total Alkalinity (as CaCO3)	110 mg/L	1	EPA 310.1
Total Hardness (as CaCO3)	2870 mg/L	1	Calculation
Fluoride	0.8 mg/L	0.1	EPA 340.2

Calcium	842	mg/L	42.02	meq/L	1 mg/L	SW-846 6010A
Magnesium	187	mg/L	15.39	meq/L	1 mg/L	SW-846 6010A
Potassium	38	mg/L	0.97	meq/L	1 mg/L	SW-846 6010A
Sodium	3640	mg/L	158.42	meq/L	1 mg/L	SW-846 6010A
Bicarbonate	134	mg/L	2.20	meq/L	1 mg/L	EPA 310.1
Carbonate	ND*		0.00		1 mg/L	EPA 310.1
Chloride	5890	mg/L	166.12	meq/L	1 mg/L	SW-846 9251
Sulfate	1840	mg/L	38.25	meq/L	5 mg/L	SW-846 9036
Major Cation Sum	216.80	meq/L			N/A	Calculation
Major Anion Sum	206.57	meq/L			N/A	Calculation
Cation/Anion Balance	2.42	% Diff			N/A	Calculation

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

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Laboratory Manager

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: MW-11B
Lab ID: 0494W10129/0694G02089
Matrix: Water
Condition: Intact

Report Date: 03/27/95
Receipt Date: 11/10/94
Sample Date: 11/06/94

Parameter	Concentration	PQL	Method
Total Metals			
Total Arsenic	0.013 mg/L	0.005	SW-846 7061A
Total Chromium	ND*	0.02 mg/L	SW-846 6010A
Total Lead	ND*	0.01 mg/L	SW-846 7421
Total Nickel	ND*	0.01 mg/L	SW-846 6010A

Dissolved Metals			
Dissolved Arsenic	ND*	0.005 mg/L	SW-846 7061A
Dissolved Chromium	ND*	0.02 mg/L	SW-846 6010A
Dissolved Lead	ND*	0.01 mg/L	SW-846 7421
Dissolved Nickel	ND*	0.01 mg/L	SW-846 6010A

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

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3304 Longmire
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EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client: **NAVAJO REFINING COMPANY**
Project : RFI Phase III / Artesia, NM
Sample ID: MW-11A
Laboratory ID: 0694G02090
Sample Matrix: Water
Preservative: Cool, HCl
Condition: Intact, pH<2

Report Date: 11/14/94
Date Sampled: 11/06/94
Date Received: 11/09/94
Date Extracted: 11/14/94
Date Analyzed: 11/14/94

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	ND	0.005
Toluene	ND	0.005
Ethylbenzene	ND	0.005
m,p-Xylene	ND	0.005
o-Xylene	ND	0.005
Methyl ethyl ketone	ND	0.005
Carbon disulfide	ND	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	99%	86 - 118%
Toluene - d8	98%	88 - 110%
Bromofluorobenzene	99%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

Review

Inter-Mountain Laboratories, Inc.

3304 Longmire
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EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client: **NAVAJO REFINING COMPANY**
Project: RFI Phase III / Artesia, NM
Sample ID: MW - 11A
Laboratory ID: 0694G02090
Sample Matrix: Water
Condition: Intact
Preservative: Cool

Report Date: 11/14/94
Date Sampled: 11/06/94
Date Received: 11/09/94
Date Extracted: 11/12/94
Date Analyzed: 11/13/94

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Acenaphthene	ND	0.010
Acenaphthylene	ND	0.010
Anthracene	ND	0.010
Benzo(a)anthracene	ND	0.010
Benzo(b)fluoranthene	ND	0.010
Benzo(k)fluoranthene	ND	0.010
Benzo(g,h,i)perylene	ND	0.010
Benzo(a)pyrene	ND	0.010
Chrysene	ND	0.010
Dibenz(a,h)anthracene	ND	0.010
Fluoranthene	ND	0.010
Fluorene	ND	0.010
Ideno(1,2,3-cd)pyrene	ND	0.010
Naphthalene	ND	0.010
Phenanthrene	ND	0.010
Pyrene	ND	0.010

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	49%	21 - 110%
Phenol - d5	52%	10 - 110%
Nitrobenzene - d5	48%	35 - 114%
2 - Fluorobiphenyl	56%	43 - 116%
2,4,6 - Tribromophenol	60%	10 - 123%
Terphenyl - d14	78%	33 - 141%

References: Method 3510: Separatory Funnel Liquid-Liquid Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments:

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Analyst

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: MW-11A
Lab ID: 0494W10130/0694G02090
Matrix: Water
Condition: Intact

Report Date: 03/27/95
Receipt Date: 11/10/94
Sample Date: 11/06/94

Parameter	Concentration	PQL	Method
pH (Lab)	7.1 s.u.	0.1	SW-846 9040
Conductivity (Lab)	27800 µmhos/cm	1	SW-846 9050
Total Dissolved Solids (180° C)	19200 mg/L	10	EPA 160.1
Total Alkalinity (as CaCO3)	334 mg/L	1	EPA 310.1
Total Hardness (as CaCO3)	4480 mg/L	1	Calculation
Fluoride	0.8 mg/L	0.1	EPA 340.2

Calcium	1065 mg/L	53.14 meq/L	1 mg/L	SW-846 6010A
Magnesium	442 mg/L	36.38 meq/L	1 mg/L	SW-846 6010A
Potassium	23 mg/L	0.59 meq/L	1 mg/L	SW-846 6010A
Sodium	4920 mg/L	213.83 meq/L	1 mg/L	SW-846 6010A
Bicarbonate	407 mg/L	6.67 meq/L	1 mg/L	EPA 310.1
Carbonate	ND*	0.00	1 mg/L	EPA 310.1
Chloride	9260 mg/L	261.16 meq/L	1 mg/L	SW-846 9251
Sulfate	1770 mg/L	36.89 meq/L	5 mg/L	SW-846 9036
Major Cation Sum	303.94 meq/L		N/A	Calculation
Major Anion Sum	304.72 meq/L		N/A	Calculation
Cation/Anion Balance	-0.13 % Diff		N/A	Calculation

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: MW-11A
Lab ID: 0494W10130/0694G02090
Matrix: Water
Condition: Intact

Report Date: 03/27/95
Receipt Date: 11/10/94
Sample Date: 11/06/94

Parameter	Concentration	PQL	Method
Total Metals			
Total Arsenic	0.013 mg/L	0.005	SW-846 7061A
Total Chromium	ND*	0.02 mg/L	SW-846 6010A
Total Lead	ND*	0.01 mg/L	SW-846 7421
Total Nickel	ND*	0.01 mg/L	SW-846 6010A
Dissolved Metals			
Dissolved Arsenic	ND*	0.005 mg/L	SW-846 7061A
Dissolved Chromium	ND*	0.02 mg/L	SW-846 6010A
Dissolved Lead	ND*	0.01 mg/L	SW-846 7421
Dissolved Nickel	ND*	0.01 mg/L	SW-846 6010A

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

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EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client: **NAVAJO REFINING COMPANY**
Project : RFI Phase III / Artesia, NM
Sample ID: OCD-8B
Laboratory ID: 0694G02091
Sample Matrix: Water
Preservative: Cool, HCl
Condition: Intact, pH<2

Report Date: 11/14/94
Date Sampled: 11/06/94
Date Received: 11/09/94
Date Extracted: 11/14/94
Date Analyzed: 11/14/94

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	ND	0.005
Toluene	ND	0.005
Ethylbenzene	ND	0.005
m,p-Xylene	ND	0.005
o-Xylene	ND	0.005
Methyl ethyl ketone	ND	0.005
Carbon disulfide	ND	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	101%	86 - 118%
Toluene - d8	99%	88 - 110%
Bromofluorobenzene	100%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

Review

Inter-Mountain Laboratories, Inc.

3304 Longmire
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EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project:	RFI Phase III / Artesia, NM	Report Date:	11/14/94
Sample ID:	OCD - 8B	Date Sampled:	11/06/94
Laboratory ID:	0694G02091	Date Received:	11/09/94
Sample Matrix:	Water	Date Extracted:	11/12/94
Condition:	Intact	Date Analyzed:	11/13/94
Preservative:	Cool		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Acenaphthene	ND	0.010
Acenaphthylene	ND	0.010
Anthracene	ND	0.010
Benzo(a)anthracene	ND	0.010
Benzo(b)fluoranthene	ND	0.010
Benzo(k)fluoranthene	ND	0.010
Benzo(g,h,i)perylene	ND	0.010
Benzo(a)pyrene	ND	0.010
Chrysene	ND	0.010
Dibenz(a,h)anthracene	ND	0.010
Fluoranthene	ND	0.010
Fluorene	ND	0.010
Ideno(1,2,3-cd)pyrene	ND	0.010
Naphthalene	ND	0.010
Phenanthrene	ND	0.010
Pyrene	ND	0.010

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	68%	21 - 110%
Phenol - d5	78%	10 - 110%
Nitrobenzene - d5	64%	35 - 114%
2 - Fluorobiphenyl	78%	43 - 116%
2,4,6 - Tribromophenol	87%	10 - 123%
Terphenyl - d14	84%	33 - 141%

References: Method 3510: Separatory Funnel Liquid-Liquid Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments:

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: OCD-8B
Lab ID: 0494W10131/0694G02091
Matrix: Water
Condition: Intact

Report Date: 03/27/95
Receipt Date: 11/10/94
Sample Date: 11/06/94

Parameter	Concentration	PQL	Method
pH (Lab)	7.6 s.u.	0.1	SW-846 9040
Conductivity (Lab)	7460 µmhos/cm	1	SW-846 9050
Total Dissolved Solids (180° C)	5550 mg/L	10	EPA 160.1
Total Alkalinity (as CaCO3)	135 mg/L	1	EPA 310.1
Total Hardness (as CaCO3)	2830 mg/L	1	Calculation
Fluoride	0.8 mg/L	0.1	EPA 340.2

Calcium	822 mg/L	41.02 meq/L	1 mg/L	SW-846 6010A
Magnesium	190 mg/L	15.64 meq/L	1 mg/L	SW-846 6010A
Potassium	6 mg/L	0.15 meq/L	1 mg/L	SW-846 6010A
Sodium	588 mg/L	25.58 meq/L	1 mg/L	SW-846 6010A
Bicarbonate	164 mg/L	2.69 meq/L	1 mg/L	EPA 310.1
Carbonate	ND*	0.00	1 mg/L	EPA 310.1
Chloride	1740 mg/L	49.14 meq/L	1 mg/L	SW-846 9251
Sulfate	1780 mg/L	36.98 meq/L	5 mg/L	SW-846 9036
Major Cation Sum	82.39 meq/L		N/A	Calculation
Major Anion Sum	88.81 meq/L		N/A	Calculation
Cation/Anion Balance	-3.75 % Diff		N/A	Calculation

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

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David N. Poelstra
Laboratory Manager

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11183 SH 30 College Station, Texas 77845

WATER QUALITY REPORT

Client: Navajo Refining Co.

Project: RFI Phase III / Artesia, NM

Sample ID: OCD-8B

Lab ID: 0494W10131/0694G02091

Matrix: Water

Condition: Intact

Report Date: 03/27/95

Receipt Date: 11/10/94

Sample Date: 11/06/94

Parameter	Concentration	PQL	Method
Total Metals			
Total Arsenic	ND*	0.005 mg/L	SW-846 7061A
Total Chromium	ND*	0.02 mg/L	SW-846 6010A
Total Lead	ND*	0.01 mg/L	SW-846 7421
Total Nickel	ND*	0.01 mg/L	SW-846 6010A

Dissolved Metals			
Dissolved Arsenic	ND*	0.005 mg/L	SW-846 7061A
Dissolved Chromium	ND*	0.02 mg/L	SW-846 6010A
Dissolved Lead	ND*	0.01 mg/L	SW-846 7421
Dissolved Nickel	ND*	0.01 mg/L	SW-846 6010A

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

David N Poelstra

David N. Poelstra

Laboratory Manager

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3304 Longmire
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EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project :	RFI Phase III / Artesia, NM	Report Date:	11/14/94
Sample ID:	OCD-8A	Date Sampled:	11/06/94
Laboratory ID:	0694G02092	Date Received:	11/09/94
Sample Matrix:	Water	Date Extracted:	11/14/94
Preservative:	Cool, HCl	Date Analyzed:	11/14/94
Condition:	Intact, pH<2		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	ND	0.005
Toluene	ND	0.005
Ethylbenzene	ND	0.005
m,p-Xylene	ND	0.005
o-Xylene	ND	0.005
Methyl ethyl ketone	ND	0.005
Carbon disulfide	ND	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	100%	86 - 118%
Toluene - d8	99%	88 - 110%
Bromofluorobenzene	101%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

Review

Inter-Mountain Laboratories, Inc.

3304 Longmire
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EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project:	RFI Phase III / Artesia, NM	Report Date:	11/14/94
Sample ID:	OCD - 8A	Date Sampled:	11/06/94
Laboratory ID:	0694G02092	Date Received:	11/09/94
Sample Matrix:	Water	Date Extracted:	11/12/94
Condition:	Intact	Date Analyzed:	11/13/94
Preservative:	Cool		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Acenaphthene	ND	0.010
Acenaphthylene	ND	0.010
Anthracene	ND	0.010
Benzo(a)anthracene	ND	0.010
Benzo(b)fluoranthene	ND	0.010
Benzo(k)fluoranthene	ND	0.010
Benzo(g,h,i)perylene	ND	0.010
Benzo(a)pyrene	ND	0.010
Chrysene	ND	0.010
Dibenz(a,h)anthracene	ND	0.010
Fluoranthene	ND	0.010
Fluorene	ND	0.010
Ideno(1,2,3-cd)pyrene	ND	0.010
Naphthalene	ND	0.010
Phenanthrene	ND	0.010
Pyrene	ND	0.010

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	61%	21 - 110%
Phenol - d5	75%	10 - 110%
Nitrobenzene - d5	67%	35 - 114%
2 - Fluorobiphenyl	75%	43 - 116%
2,4,6 - Tribromophenol	83%	10 - 123%
Terphenyl - d14	77%	33 - 141%

References: Method 3510: Separatory Funnel Liquid-Liquid Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments:

Ramona R. Dennis
Analyst

Ulond M Roy
Review

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WATER QUALITY REPORT

Client: Navajo Refining Co.

Project: RFI Phase III

Sample ID: OCD-8A

Lab ID: 0494W10189/0694G02092

Matrix: Water

Condition: Intact

Report Date: 03/28/95

Receipt Date: 11/10/94

Sample Date: 11/06/94

Parameter	Concentration		PQL	Method
pH (Lab)	7.4	s.u.	0.1	SW-846 9040
Conductivity (Lab)	12200	µmhos/cm	1	SW-846 9050
Total Dissolved Solids (180° C)	9560	mg/L	10	EPA 160.1
Total Alkalinity (as CaCO3)	407	mg/L	1	EPA 310.1
Total Hardness (as CaCO3)	3000	mg/L	1	Calculation
Fluoride	2.7	mg/L	0.1	EPA 340.2

Calcium	634	mg/L	31.64	meq/L	1 mg/L	SW-846 6010A
Magnesium	345	mg/L	28.40	meq/L	1 mg/L	SW-846 6010A
Potassium	9	mg/L	0.24	meq/L	1 mg/L	SW-846 6010A
Sodium	2140	mg/L	93.08	meq/L	1 mg/L	SW-846 6010A
[illegible]rbonate	497	mg/L	8.15	meq/L	1 mg/L	EPA 310.1
Carbonate	ND*		0.00		1 mg/L	EPA 310.1
Chloride	2340	mg/L	65.95	meq/L	1 mg/L	SW-846 9251
Sulfate	3480	mg/L	72.37	meq/L	5 mg/L	SW-846 9036
Major Cation Sum	153.36	meq/L			N/A	Calculation
Major Anion Sum	146.46	meq/L			N/A	Calculation
Cation/Anion Balance	2.30	% Diff			N/A	Calculation

Total Metals				
Total Arsenic	0.022	mg/L	0.005	SW-846 7061A
Total Chromium	0.058	mg/L	0.005	SW-846 7191
Total Lead	0.02	mg/L	0.01	SW-846 7421
Total Nickel	0.11	mg/L	0.05	SW-846 7520

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

[illegible]wed By:

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III
Sample ID: OCD-8A
Lab ID: 0494W10189/0694G02092
Matrix: Water
Condition: Intact

Report Date: 03/28/95
Receipt Date: 11/10/94
Sample Date: 11/06/94

Parameter	Concentration	PQL	Method
Dissolved Aluminum	ND*	0.1 mg/L	SW-846 6010A
Dissolved Antimony	ND*	0.1 mg/L	SW-846 6010A
Dissolved Arsenic	0.019 mg/L	0.005	SW-846 7061A
Dissolved Barium	ND*	0.05 mg/L	SW-846 6010A
Dissolved Beryllium	ND*	0.01 mg/L	SW-846 6010A
Dissolved Boron	0.87 mg/L	0.05	SW-846 6010A
Dissolved Cadmium	0.04 mg/L	0.02	SW-846 6010A
Dissolved Chromium	ND*	0.02 mg/L	SW-846 6010A
Dissolved Cobalt	ND*	0.02 mg/L	SW-846 6010A
Dissolved Copper	ND*	0.01 mg/L	SW-846 6010A
Dissolved Iron	0.50 mg/L	0.05	SW-846 6010A
Dissolved Lead	ND*	0.1 mg/L	SW-846 6010A
Dissolved Manganese	4.55 mg/L	0.02	SW-846 6010A
Dissolved Molybdenum	ND*	0.05 mg/L	SW-846 6010A
Dissolved Nickel	ND*	0.05 mg/L	SW-846 7520
Dissolved Selenium	ND*	0.2 mg/L	SW-846 6010A
Dissolved Silica	10.92 mg/L	0.05	SW-846 6010A
Dissolved Silver	ND*	0.01 mg/L	SW-846 6010A
Dissolved Thallium	ND*	0.2 mg/L	SW-846 6010A
Dissolved Vanadium	0.01 mg/L	0.01	SW-846 6010A
Dissolved Zinc	ND*	0.01 mg/L	SW-846 6010A

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

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CHAIN OF CUSTODY RECORD

Client/Project Name: Navajo

Project Location: Artesia NM

Sampler: (Signature) Brian P. Sullivan

Chain of Custody Tape No.

ANALYSES / PARAMETERS

Sample No./ Identification	Date	Time	Lab Number	Matrix	No. of Containers	VOAs	SVOAs	Metals As Cr Ni Pb	Gen Chem	Remarks
MW 7A	11/6/94	1540		water	6	X	X	X	X	0694G02099
MW 7B	11/6/94	1555		↓	6	X	X	X	X	0694G02100
Pond 3	11/6/94	1630			5	X	X	X	X	0694G02101
Pond 5	11/6/94	1645			2			X	X	0694G02102
OCD-7B	11/7/94	1515			6	X	X	X	X	0694G02103 *
OCD-7A	11/7/94	1645			6	X	X	X	X	0694G02104
Trip Blank						X				0694G02105
Equipment Rinse #4	11/7/94	1405			~~3~~ 1	~~X~~		X		0694G02106
Equipment ~~Rinse~~ BLANK #3	11/7/94	1405			2	X				0694G02134

* Pest & Herb Req. on This sample + NMGW Quality metals

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
Brian P. Sullivan	11/8/94	1430	[illegible] / BB	11/9/94	0900
Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
Relinquished by: (Signature)	Date	Time	Received by laboratory: (Signature)	Date	Time

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☐ 11183 SH 30, College Station, TX 77845, Telephone (409) 776-8945

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Inter-Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project :	RFI Phase III / Artesia, NM	Report Date:	11/14/94
Sample ID:	MW-7A	Date Sampled:	11/06/94
Laboratory ID:	0694G02099	Date Received:	11/09/94
Sample Matrix:	Water	Date Extracted:	11/14/94
Preservative:	Cool, HCl	Date Analyzed:	11/14/94
Condition:	Intact, pH<2		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	ND	0.005
Toluene	ND	0.005
Ethylbenzene	ND	0.005
m,p-Xylene	ND	0.005
o-Xylene	ND	0.005
Methyl ethyl ketone	ND	0.005
Carbon disulfide	ND	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	97%	86 - 118%
Toluene - d8	97%	88 - 110%
Bromofluorobenzene	103%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

Review

Inter-Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project:	RFI Phase III / Artesia, NM	Report Date:	11/14/94
Sample ID:	MW 7A	Date Sampled:	11/06/94
Laboratory ID:	0694G02099	Date Received:	11/09/94
Sample Matrix:	Water	Date Extracted:	11/12/94
Condition:	Intact	Date Analyzed:	11/13/94
Preservative:	Cool		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Acenaphthene	ND	0.010
Acenaphthylene	ND	0.010
Anthracene	ND	0.010
Benzo(a)anthracene	ND	0.010
Benzo(b)fluoranthene	ND	0.010
Benzo(k)fluoranthene	ND	0.010
Benzo(g,h,i)perylene	ND	0.010
Benzo(a)pyrene	ND	0.010
Chrysene	ND	0.010
Dibenz(a,h)anthracene	ND	0.010
Fluoranthene	ND	0.010
Fluorene	ND	0.010
Ideno(1,2,3-cd)pyrene	ND	0.010
Naphthalene	ND	0.010
Phenanthrene	ND	0.010
Pyrene	ND	0.010

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	55%	21 - 110%
Phenol - d5	69%	10 - 110%
Nitrobenzene - d5	64%	35 - 114%
2 - Fluorobiphenyl	66%	43 - 116%
2,4,6 - Tribromophenol	79%	10 - 123%
Terphenyl - d14	76%	33 - 141%

References: Method 3510: Separatory Funnel Liquid-Liquid Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments:

Ramona R. Dennis
Analyst

Lloyd M ...
Review

iml

Inter-Mountain Laboratories, Inc.

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WATER QUALITY REPORT

Client: Navajo Refining Co.

Project: RFI Phase III / Artesia, NM

Sample ID: MW 7A

Lab ID: 0494W10122/0694G02099

Matrix: Water

Condition: Intact

Report Date: 03/27/95

Receipt Date: 11/10/94

Sample Date: 11/06/94

Parameter	Concentration		PQL	Method
pH (Lab)	7.7 s.u.		0.1	SW-846 9040
Conductivity (Lab)	12900 µmhos/cm		1	SW-846 9050
Total Dissolved Solids (180° C)	10200 mg/L		10	EPA 160.1
Total Alkalinity (as CaCO3)	286 mg/L		1	EPA 310.1
Total Hardness (as CaCO3)	2400 mg/L		1	Calculation
Fluoride	7.1 mg/L		0.1	EPA 340.2
Calcium	409 mg/L	20.41 meq/L	1 mg/L	SW-846 6010A
Magnesium	336 mg/L	27.65 meq/L	1 mg/L	SW-846 6010A
Potassium	7 mg/L	0.17 meq/L	1 mg/L	SW-846 6010A
Sodium	2520 mg/L	109.66 meq/L	1 mg/L	SW-846 6010A
Bicarbonate	349 mg/L	5.72 meq/L	1 mg/L	EPA 310.1
Carbonate	ND*	0.00	1 mg/L	EPA 310.1
Chloride	2450 mg/L	68.97 meq/L	1 mg/L	SW-846 9251
Sulfate	3380 mg/L	70.45 meq/L	5 mg/L	SW-846 9036
Major Cation Sum	157.89 meq/L		N/A	Calculation
Major Anion Sum	145.15 meq/L		N/A	Calculation
Cation/Anion Balance	4.20 % Diff		N/A	Calculation

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

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Laboratory Manager

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: MW 7A
Lab ID: 0494W10122/0694G02099
Matrix: Water
Condition: Intact

Report Date: 03/27/95
Receipt Date: 11/10/94
Sample Date: 11/06/94

Parameter	Concentration	PQL	Method
Total Metals			
Total Arsenic	0.097 mg/L	0.005	SW-846 7061A
Total Chromium	0.04 mg/L	0.02	SW-846 6010A
Total Lead	0.02 mg/L	0.01	SW-846 7421
Total Nickel	0.03 mg/L	0.01	SW-846 6010A

Dissolved Metals			
Dissolved Arsenic	0.039 mg/L	0.005	SW-846 7061A
Dissolved Chromium	ND*	0.02 mg/L	SW-846 6010A
Dissolved Lead	ND*	0.01 mg/L	SW-846 7421
Dissolved Nickel	ND*	0.01 mg/L	SW-846 6010A

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

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David N. Poelstra
Laboratory Manager

Inter-Mountain Laboratories, Inc.

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EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client: **NAVAJO REFINING COMPANY**
Project : RFI Phase III / Artesia, NM
Sample ID: MW-7B
Laboratory ID: 0694G02100
Sample Matrix: Water
Preservative: Cool, HCl
Condition: Intact, pH<2

Report Date: 11/14/94
Date Sampled: 11/06/94
Date Received: 11/09/94
Date Extracted: 11/14/94
Date Analyzed: 11/14/94

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	ND	0.005
Toluene	ND	0.005
Ethylbenzene	ND	0.005
m,p-Xylene	ND	0.005
o-Xylene	ND	0.005
Methyl ethyl ketone	ND	0.005
Carbon disulfide	ND	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	104%	86 - 118%
Toluene - d8	95%	88 - 110%
Bromofluorobenzene	95%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

Review

3304 Longmire
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EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project:	RFI Phase III / Artesia, NM	Report Date:	11/14/94
Sample ID:	MW 7B	Date Sampled:	11/06/94
Laboratory ID:	0694G02100	Date Received:	11/09/94
Sample Matrix:	Water	Date Extracted:	11/12/94
Condition:	Intact	Date Analyzed:	11/13/94
Preservative:	Cool		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Acenaphthene	ND	0.010
Acenaphthylene	ND	0.010
Anthracene	ND	0.010
Benzo(a)anthracene	ND	0.010
Benzo(b)fluoranthene	ND	0.010
Benzo(k)fluoranthene	ND	0.010
Benzo(g,h,i)perylene	ND	0.010
Benzo(a)pyrene	ND	0.010
Chrysene	ND	0.010
Dibenz(a,h)anthracene	ND	0.010
Fluoranthene	ND	0.010
Fluorene	ND	0.010
Ideno(1,2,3-cd)pyrene	ND	0.010
Naphthalene	ND	0.010
Phenanthrene	ND	0.010
Pyrene	ND	0.010

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	60%	21 - 110%
Phenol - d5	74%	10 - 110%
Nitrobenzene - d5	68%	35 - 114%
2 - Fluorobiphenyl	71%	43 - 116%
2,4,6 - Tribromophenol	87%	10 - 123%
Terphenyl - d14	84%	33 - 141%

References: Method 3510: Separatory Funnel Liquid-Liquid Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments:

Ramona R. Desmits
Analyst

Wend M Hog
Review

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: MW 7B
Lab ID: 0494W10123/0694G02100
Matrix: Water
Condition: Intact

Report Date: 03/27/95
Receipt Date: 11/10/94
Sample Date: 11/06/94

Parameter	Concentration	PQL	Method
pH (Lab)	7.6 s.u.	0.1	SW-846 9040
Conductivity (Lab)	7190 µmhos/cm	1	SW-846 9050
Total Dissolved Solids (180° C)	5600 mg/L	10	EPA 160.1
Total Alkalinity (as CaCO3)	209 mg/L	1	EPA 310.1
Total Hardness (as CaCO3)	2060 mg/L	1	Calculation
Fluoride	1.1 mg/L	0.1	EPA 340.2

Calcium	512 mg/L	25.55 meq/L	1 mg/L	SW-846 6010A
Magnesium	190 mg/L	15.64 meq/L	1 mg/L	SW-846 6010A
Potassium	8 mg/L	0.19 meq/L	1 mg/L	SW-846 6010A
Sodium	895 mg/L	38.93 meq/L	1 mg/L	SW-846 6010A
Bicarbonate	255 mg/L	4.18 meq/L	1 mg/L	EPA 310.1
Carbonate	ND*	0.00	1 mg/L	EPA 310.1
Chloride	1230 mg/L	34.73 meq/L	1 mg/L	SW-846 9251
Sulfate	2160 mg/L	44.99 meq/L	5 mg/L	SW-846 9036
Major Cation Sum	80.31 meq/L		N/A	Calculation
Major Anion Sum	83.89 meq/L		N/A	Calculation
Cation/Anion Balance	-2.18 % Diff		N/A	Calculation

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

David N Poelstra

David N. Poelstra
Laboratory Manager

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Inter-Mountain Laboratories, Inc.

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11183 SH 30 College Station, Texas 77845

WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: MW 7B
Lab ID: 0494W10123/0694G02100
Matrix: Water
Condition: Intact

Report Date: 03/27/95
Receipt Date: 11/10/94
Sample Date: 11/06/94

Parameter	Concentration	PQL	Method
Total Metals			
Total Arsenic	0.011 mg/L	0.005	SW-846 7061A
Total Chromium	ND*	0.02 mg/L	SW-846 6010A
Total Lead	ND*	0.01 mg/L	SW-846 7421
Total Nickel	ND*	0.01 mg/L	SW-846 6010A

Dissolved Metals			
Dissolved Arsenic	0.007 mg/L	0.005	SW-846 7061A
Dissolved Chromium	ND*	0.02 mg/L	SW-846 6010A
Dissolved Lead	ND*	0.01 mg/L	SW-846 7421
Dissolved Nickel	ND*	0.01 mg/L	SW-846 6010A

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

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3304 Longmire
College Station, Texas 77845

EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client:	NAVAJO REFINING COMPANY		
Project :	RFI Phase III / Artesia, NM	Report Date:	11/15/94
Sample ID:	Pond 3	Date Sampled:	11/06/94
Laboratory ID:	0694G02101	Date Received:	11/09/94
Sample Matrix:	Water	Date Extracted:	11/15/94
Preservative:	Cool, HCl	Date Analyzed:	11/15/94
Condition:	Intact, pH<2		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	ND	0.005
Toluene	ND	0.005
Ethylbenzene	ND	0.005
m,p-Xylene	ND	0.005
o-Xylene	ND	0.005
Methyl ethyl ketone	ND	0.005
Carbon disulfide	ND	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	104%	86 - 118%
Toluene - d8	99%	88 - 110%
Bromofluorobenzene	92%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

Review

Inter-Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project:	RFI Phase III / Artesia, NM	Report Date:	11/18/94
Sample ID:	Pond 3	Date Sampled:	11/06/94
Laboratory ID:	0694G02101	Date Received:	11/09/94
Sample Matrix:	Water	Date Extracted:	11/12/94
Condition:	Intact	Date Analyzed:	11/17/94
Preservative:	Cool		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Acenaphthene	ND	0.020
Acenaphthylene	ND	0.020
Anthracene	ND	0.020
Benzo(a)anthracene	ND	0.020
Benzo(b)fluoranthene	ND	0.020
Benzo(k)fluoranthene	ND	0.020
Benzo(g,h,i)perylene	ND	0.020
Benzo(a)pyrene	ND	0.020
Chrysene	ND	0.020
Dibenz(a,h)anthracene	ND	0.020
Fluoranthene	ND	0.020
Fluorene	ND	0.020
Ideno(1,2,3-cd)pyrene	ND	0.020
Naphthalene	ND	0.020
Phenanthrene	ND	0.020
Pyrene	ND	0.020

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	48%	21 - 110%
Phenol - d5	47%	10 - 110%
Nitrobenzene - d5	43%	35 - 114%
2 - Fluorobiphenyl	55%	43 - 116%
2,4,6 - Tribromophenol	72%	10 - 123%
Terphenyl - d14	76%	33 - 141%

References: Method 3510: Separatory Funnel Liquid-Liquid Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments:

Ramona R. Dennis
Analyst

Wanda M Rog
Review

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WATER QUALITY REPORT

Client: Navajo Refining Co.

Project: RFI Phase III / Artesia, NM

Sample ID: POND 3

Lab ID: 0494W10124/0694G02101

Matrix: Water

Condition: Intact

Report Date: 03/27/95

Receipt Date: 11/10/94

Sample Date: 11/06/94

Parameter	Concentration	PQL	Method
pH (Lab)	7.2 s.u.	0.1	SW-846 9040
Conductivity (Lab)	12600 µmhos/cm	1	SW-846 9050
Total Dissolved Solids (180° C)	8220 mg/L	10	EPA 160.1
Total Alkalinity (as CaCO3)	206 mg/L	1	EPA 310.1
Total Hardness (as CaCO3)	449 mg/L	1	Calculation
Fluoride	158.4 mg/L	0.1	EPA 340.2

Calcium	38 mg/L	1.90 meq/L	1 mg/L	SW-846 6010A
Magnesium	86 mg/L	7.08 meq/L	1 mg/L	SW-846 6010A
Potassium	86 mg/L	2.20 meq/L	1 mg/L	SW-846 6010A
Sodium	2670 mg/L	116.01 meq/L	1 mg/L	SW-846 6010A
Bicarbonate	251 mg/L	4.11 meq/L	1 mg/L	EPA 310.1
Carbonate	ND*	0.00	1 mg/L	EPA 310.1
Chloride	2300 mg/L	64.80 meq/L	1 mg/L	SW-846 9251
Sulfate	2720 mg/L	56.53 meq/L	5 mg/L	SW-846 9036
Major Cation Sum	127.19 meq/L		N/A	Calculation
Major Anion Sum	125.45 meq/L		N/A	Calculation
Cation/Anion Balance	0.69 % Diff		N/A	Calculation

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: POND 3
Lab ID: 0494W10124/0694G02101
Matrix: Water
Condition: Intact

Report Date: 03/27/95
Receipt Date: 11/10/94
Sample Date: 11/06/94

Parameter	Concentration	PQL	Method
Total Metals			
Total Arsenic	0.497 mg/L	0.005	SW-846 7061A
Total Chromium	ND*	0.02 mg/L	SW-846 6010A
Total Lead	ND*	0.01 mg/L	SW-846 7421
Total Nickel	0.03 mg/L	0.01	SW-846 6010A

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: POND 5
Lab ID: 0494W10125/0694G02102
Matrix: Water
Condition: Intact

Report Date: 03/28/95
Receipt Date: 11/10/94
Sample Date: 11/06/94

Parameter	Concentration	PQL	Method
pH (Lab)	7.1 s.u.	0.1	SW-846 9040
Conductivity (Lab)	8030 μmhos/cm	1	SW-846 9050
Total Dissolved Solids (180° C)	4630 mg/L	10	EPA 160.1
Total Alkalinity (as CaCO3)	258 mg/L	1	EPA 310.1
Total Hardness (as CaCO3)	332 mg/L	1	Calculation
Fluoride	126.8 mg/L	0.1	EPA 340.2

Calcium	33 mg/L	1.63 meq/L	1 mg/L	SW-846 6010A
Magnesium	61 mg/L	5.01 meq/L	1 mg/L	SW-846 6010A
Potassium	51 mg/L	1.30 meq/L	1 mg/L	SW-846 6010A
Sodium	1260 mg/L	54.98 meq/L	1 mg/L	SW-846 6010A
Bicarbonate	315 mg/L	5.16 meq/L	1 mg/L	EPA 310.1
Carbonate	ND*	0.00	1 mg/L	EPA 310.1
Chloride	1370 mg/L	38.67 meq/L	1 mg/L	SW-846 9251
Sulfate	958 mg/L	19.95 meq/L	5 mg/L	SW-846 9036
Major Cation Sum	62.92 meq/L		N/A	Calculation
Major Anion Sum	63.78 meq/L		N/A	Calculation
Cation/Anion Balance	-0.68 % Diff		N/A	Calculation

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: POND 5
Lab ID: 0494W10125/0694G02102
Matrix: Water
Condition: Intact

Report Date: 03/27/95
Receipt Date: 11/10/94
Sample Date: 11/06/94

Parameter	Concentration	PQL	Method
Total Metals			
Total Arsenic	0.298 mg/L	0.005	SW-846 7061A
Total Chromium	ND*	0.02 mg/L	SW-846 6010A
Total Lead	ND*	0.01 mg/L	SW-846 7421
Total Nickel	ND*	0.01 mg/L	SW-846 6010A

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

wed By:

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3304 Longmire
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EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project :	RFI Phase III / Artesia, NM	Report Date:	11/15/94
Sample ID:	OCD-7B	Date Sampled:	11/07/94
Laboratory ID:	0694G02103	Date Received:	11/09/94
Sample Matrix:	Water	Date Extracted:	11/15/94
Preservative:	Cool, HCl	Date Analyzed:	11/15/94
Condition:	Intact, pH<2		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	ND	0.005
Toluene	ND	0.005
Ethylbenzene	ND	0.005
m,p-Xylene	ND	0.005
o-Xylene	ND	0.005
Methyl ethyl ketone	ND	0.005
Carbon disulfide	ND	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	99%	86 - 118%
Toluene - d8	98%	88 - 110%
Bromofluorobenzene	99%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

Review

Inter-Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project:	RFI Phase III / Artesia, NM	Report Date:	11/16/94
Sample ID:	OCD - 7B	Date Sampled:	11/07/94
Laboratory ID:	0694G02103	Date Received:	11/09/94
Sample Matrix:	Water	Date Extracted:	11/12/94
Condition:	Intact	Date Analyzed:	11/14/94
Preservative:	Cool		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Acenaphthene	ND	0.010
Acenaphthylene	ND	0.010
Anthracene	ND	0.010
Benzo(a)anthracene	ND	0.010
Benzo(b)fluoranthene	ND	0.010
Benzo(k)fluoranthene	ND	0.010
Benzo(g,h,i)perylene	ND	0.010
Benzo(a)pyrene	ND	0.010
Chrysene	ND	0.010
Dibenz(a,h)anthracene	ND	0.010
Fluoranthene	ND	0.010
Fluorene	ND	0.010
Ideno(1,2,3-cd)pyrene	ND	0.010
Naphthalene	ND	0.010
Phenanthrene	ND	0.010
Pyrene	ND	0.010

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	57%	21 - 110%
Phenol - d5	62%	10 - 110%
Nitrobenzene - d5	56%	35 - 114%
2 - Fluorobiphenyl	56%	43 - 116%
2,4,6 - Tribromophenol	82%	10 - 123%
Terphenyl - d14	72%	33 - 141%

References: Method 3510: Separatory Funnel Liquid-Liquid Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments:

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III
Sample ID: OCD-7B
Lab ID: 0494W10193/0694G02103
Matrix: Water
Condition: Intact

Report Date: 03/28/95
Receipt Date: 11/10/94
Sample Date: 11/07/94

Parameter	Concentration	PQL	Method
pH (Lab)	7.6 s.u.	0.1	SW-846 9040
Conductivity (Lab)	6880 µmhos/cm	1	SW-846 9050
Total Dissolved Solids (180° C)	5190 mg/L	10	EPA 160.1
Total Alkalinity (as CaCO3)	97 mg/L	1	EPA 310.1
Total Hardness (as CaCO3)	2220 mg/L	1	Calculation
Fluoride	1.2 mg/L	0.1	EPA 340.2

Calcium	715 mg/L	35.68 meq/L	1 mg/L	SW-846 6010A
Magnesium	105 mg/L	8.64 meq/L	1 mg/L	SW-846 6010A
Potassium	13 mg/L	0.33 meq/L	1 mg/L	SW-846 6010A
Sodium	824 mg/L	35.84 meq/L	1 mg/L	SW-846 6010A
Bicarbonate	118 mg/L	1.93 meq/L	1 mg/L	EPA 310.1
Carbonate	ND*	0.00	1 mg/L	EPA 310.1
Chloride	1120 mg/L	31.71 meq/L	1 mg/L	SW-846 9251
Sulfate	2060 mg/L	42.87 meq/L	5 mg/L	SW-846 9036
Major Cation Sum	80.49 meq/L		N/A	Calculation
Major Anion Sum	76.52 meq/L		N/A	Calculation
Cation/Anion Balance	2.53 % Diff		N/A	Calculation

Total Metals			
Total Arsenic	ND*	0.005 mg/L	SW-846 7061A
Total Chromium	ND*	0.02 mg/L	SW-846 6010A
Total Lead	ND*	0.01 mg/L	SW-846 7421
Total Nickel	ND*	0.01 mg/L	SW-846 6010A

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III
Sample ID: OCD-7B
Lab ID: 0494W10193/0694G02103
Matrix: Water
Condition: Intact

Report Date: 03/28/95
Receipt Date: 11/10/94
Sample Date: 11/07/94

Parameter	Concentration	PQL	Method
Dissolved Aluminum	ND*	0.1 mg/L	SW-846 6010A
Dissolved Antimony	ND*	0.1 mg/L	SW-846 6010A
Dissolved Arsenic	ND*	0.005 mg/L	SW-846 7061A
Dissolved Barium	ND*	0.05 mg/L	SW-846 6010A
Dissolved Beryllium	ND*	0.01 mg/L	SW-846 6010A
Dissolved Boron	0.55 mg/L	0.05	SW-846 6010A
Dissolved Cadmium	ND*	0.02 mg/L	SW-846 6010A
Dissolved Chromium	ND*	0.02 mg/L	SW-846 6010A
Dissolved Cobalt	ND*	0.02 mg/L	SW-846 6010A
Dissolved Copper	ND*	0.01 mg/L	SW-846 6010A
Dissolved Iron	0.79 mg/L	0.05	SW-846 6010A
Dissolved Lead	ND*	0.1 mg/L	SW-846 6010A
Dissolved Manganese	0.51 mg/L	0.02	SW-846 6010A
Dissolved Molybdenum	ND*	0.05 mg/L	SW-846 6010A
Dissolved Nickel	ND*	0.01 mg/L	SW-846 6010A
Dissolved Selenium	ND*	0.2 mg/L	SW-846 6010A
Dissolved Silica	7.95 mg/L	0.05	SW-846 6010A
Dissolved Silver	ND*	0.01 mg/L	SW-846 6010A
Dissolved Thallium	ND*	0.2 mg/L	SW-846 6010A
Dissolved Vanadium	ND*	0.01 mg/L	SW-846 6010A
Dissolved Zinc	ND*	0.01 mg/L	SW-846 6010A

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

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EPA Method 8141
ORGANOPHOSPHORUS COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project :	RFI Phase III / Artesia, NM	Report Date:	12/12/94
Sample ID:	OCD-7B	Date Sampled:	11/07/94
Laboratory ID:	0694G02103	Date Received:	11/09/94
Sample Matrix:	Water	Date Extracted:	11/14/94
Preservative:	Cool	Date Analyzed:	12/08/94
Condition:	Intact		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Azinphos Methyl	ND	0.0004
Bolstar	ND	0.0004
Chlorpyrifos	ND	0.0004
Coumaphos	ND	0.0008
Demeton	ND	0.0004
Diazinon	ND	0.0004
Dichlorvos	ND	0.0004
Dimethoate	ND	0.002
Disulfoton	ND	0.0004
EPN	ND	0.0004
Ethoprop	ND	0.0004
Fensulfothion	ND	0.002
Fenthion	ND	0.0004
Malathion	ND	0.0004
Merphos	ND	0.0004
Mevinphos	ND	0.002
Monocrotophos	ND	0.002
Naled	ND	0.004
Ethyl Parathion	ND	0.0004
Methyl Parathion	ND	0.0004
Phorate	ND	0.0004
Ronnel	ND	0.0004
Sulfotep	ND	0.0004
Tetrachlorovinphos	ND	0.0004
TEPP	ND	0.0004
Tokuthion	ND	0.0004
Trichloronate	ND	0.0004

ND - Analyte not detected at stated limit of detection

Reference: Method 8141: Organophosphorus Compounds by Gas Chromatography: Capillary Column Technique. Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments:

Inter-Mountain Laboratories, Inc.

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EPA Method 8151
CHLORINATED HERBICIDES

Client:	**NAVAJO REFINING COMPANY**		
Project Name:	RFI Phase III / Artesia, NM	Report Date:	12/09/94
Sample ID:	OCD - 7B	Date Sampled:	11/07/94
Sample Number:	0694G02103	Date Received:	11/09/94
Sample Matrix:	Water	Date Extracted:	11/14/94
Preservative:	Cool	Date Analyzed:	12/06/94
Condition:	Intact		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Dalapon	ND	0.02
3,5-Dichlorobenzoic acid	ND	0.02
4-Nitrophenol	ND	0.02
Dicamba	ND	0.02
MCPP	ND	4
MCPA	ND	4
Dichlorprop	ND	0.02
2,4-D	ND	0.02
Pentachlorophenol	ND	0.02
Chloramben	ND	0.02
2.4.5 - TP	ND	0.02
2,4,5 - T (Silvex)	ND	0.02
2,4 - DB	ND	0.02
Dinoseb	ND	0.02
Bentazon	ND	0.02
Picloram	ND	0.02
DCPA	ND	0.02
Acifluorfen	ND	0.02

ND - Analyte not detected at stated detection limit

Reference: Method 8151: Chlorinated Herbicides
Test Methods for Evaluating Solid Wastes, SW-846, United States Environmental Protection Agency, Final Update I, July 1992.

Ben T Ha
Analyst

Wanda M Rog
Review

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EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project :	RFI Phase III / Artesia, NM	Report Date:	11/15/94
Sample ID:	OCD-7A	Date Sampled:	11/07/94
Laboratory ID:	0694G02104	Date Received:	11/09/94
Sample Matrix:	Water	Date Extracted:	11/15/94
Preservative:	Cool, HCl	Date Analyzed:	11/15/94
Condition:	Intact, pH<2		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	ND	0.005
Toluene	ND	0.005
Ethylbenzene	ND	0.005
m,p-Xylene	ND	0.005
o-Xylene	ND	0.005
Methyl ethyl ketone	ND	0.005
Carbon disulfide	ND	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	100%	86 - 118%
Toluene - d8	98%	88 - 110%
Bromofluorobenzene	97%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

Review

Inter-Mountain Laboratories, Inc.

3304 Longmire
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EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project:	RFI Phase III / Artesia, NM	Report Date:	11/16/94
Sample ID:	OCD - 7A	Date Sampled:	11/07/94
Laboratory ID:	0694G02104	Date Received:	11/09/94
Sample Matrix:	Water	Date Extracted:	11/12/94
Condition:	Intact	Date Analyzed:	11/14/94
Preservative:	Cool		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Acenaphthene	ND	0.010
Acenaphthylene	ND	0.010
Anthracene	ND	0.010
Benzo(a)anthracene	ND	0.010
Benzo(b)fluoranthene	ND	0.010
Benzo(k)fluoranthene	ND	0.010
Benzo(g,h,i)perylene	ND	0.010
Benzo(a)pyrene	ND	0.010
Chrysene	ND	0.010
Dibenz(a,h)anthracene	ND	0.010
Fluoranthene	ND	0.010
Fluorene	ND	0.010
Ideno(1,2,3-cd)pyrene	ND	0.010
Naphthalene	ND	0.010
Phenanthrene	ND	0.010
Pyrene	ND	0.010

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	57%	21 - 110%
Phenol - d5	60%	10 - 110%
Nitrobenzene - d5	57%	35 - 114%
2 - Fluorobiphenyl	64%	43 - 116%
2,4,6 - Tribromophenol	83%	10 - 123%
Terphenyl - d14	76%	33 - 141%

References: Method 3510: Separatory Funnel Liquid-Liquid Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States
Environmental Protection Agency, July 1992.

Comments:

Ramona R. Dennis
Analyst

[signature]
Review

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: OCD-7A
Lab ID: 0494W10127/0694G02104
Matrix: Water
Condition: Intact

Report Date: 03/27/95
Receipt Date: 11/10/94
Sample Date: 11/07/94

Parameter	Concentration	PQL	Method
pH (Lab)	7.2 s.u.	0.1	SW-846 9040
Conductivity (Lab)	10800 µmhos/cm	1	SW-846 9050
Total Dissolved Solids (180° C)	8320 mg/L	10	EPA 160.1
Total Alkalinity (as CaCO3)	526 mg/L	1	EPA 310.1
Total Hardness (as CaCO3)	2150 mg/L	1	Calculation
Fluoride	5.1 mg/L	0.1	EPA 340.2

Calcium	575 mg/L	28.69 meq/L	1 mg/L	SW-846 6010A
Magnesium	173 mg/L	14.24 meq/L	1 mg/L	SW-846 6010A
Potassium	8 mg/L	0.21 meq/L	1 mg/L	SW-846 6010A
Sodium	1960 mg/L	85.12 meq/L	1 mg/L	SW-846 6010A
Bicarbonate	642 mg/L	10.52 meq/L	1 mg/L	EPA 310.1
Carbonate	ND*	0.00	1 mg/L	EPA 310.1
Chloride	2000 mg/L	56.31 meq/L	1 mg/L	SW-846 9251
Sulfate	2920 mg/L	60.84 meq/L	5 mg/L	SW-846 9036
Major Cation Sum	128.26 meq/L		N/A	Calculation
Major Anion Sum	127.66 meq/L		N/A	Calculation
Cation/Anion Balance	0.23 % Diff		N/A	Calculation

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: OCD-7A
Lab ID: 0494W10127/0694G02104
Matrix: Water
Condition: Intact

Report Date: 03/27/95
Receipt Date: 11/10/94
Sample Date: 11/07/94

Parameter	Concentration	PQL	Method
Total Metals			
Total Arsenic	0.149 mg/L	0.005	SW-846 7061A
Total Chromium	ND*	0.02 mg/L	SW-846 6010A
Total Lead	ND*	0.01 mg/L	SW-846 7421
Total Nickel	0.03 mg/L	0.01	SW-846 6010A

Dissolved Metals			
Dissolved Arsenic	0.150 mg/L	0.005	SW-846 7061A
Dissolved Chromium	ND*	0.02 mg/L	SW-846 6010A
Dissolved Lead	ND*	0.01 mg/L	SW-846 7421
Dissolved Nickel	0.02 mg/L	0.01	SW-846 6010A

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

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Laboratory Manager

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EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client: **NAVAJO REFINING COMPANY**
Project : RFI Phase III / Artesia, NM
Sample ID: Trip Blank
Laboratory ID: 0694G02105
Sample Matrix: Water
Preservative: Cool, HCl
Condition: Intact, pH<2

Report Date: 11/15/94
Date Sampled: NA
Date Received: 11/09/94
Date Extracted: 11/15/94
Date Analyzed: 11/15/94

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	ND	0.005
Toluene	ND	0.005
Ethylbenzene	ND	0.005
m,p-Xylene	ND	0.005
o-Xylene	ND	0.005
Methyl ethyl ketone	ND	0.005
Carbon disulfide	ND	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	98%	86 - 118%
Toluene - d8	100%	88 - 110%
Bromofluorobenzene	97%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

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Organics Laboratory
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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: EQUIP BLANK 4
Lab ID: 0494W10213/0694G02106
Matrix: Water
Condition: Intact

Report Date: 03/28/95
Receipt Date: 11/15/94
Sample Date: 11/07/94

Parameter	Concentration	PQL	Method
Total Metals			
Total Arsenic	ND*	0.005 mg/L	SW-846 7061A
Total Chromium	ND*	0.02 mg/L	SW-846 6010A
Total Lead	ND*	0.01 mg/L	SW-846 7421
Total Nickel	ND*	0.01 mg/L	SW-846 6010A

ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

Reviewed By:

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EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project :	RFI Phase III / Artesia, NM	Report Date:	11/15/94
Sample ID:	Equipment Blank #3	Date Sampled:	11/07/94
Laboratory ID:	0694G02134	Date Received:	11/09/94
Sample Matrix:	Water	Date Extracted:	11/15/94
Preservative:	Cool, HCl	Date Analyzed:	11/15/94
Condition:	Intact, pH<2		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	ND	0.005
Toluene	ND	0.005
Ethylbenzene	ND	0.005
m,p-Xylene	ND	0.005
o-Xylene	ND	0.005
Methyl ethyl ketone	ND	0.005
Carbon disulfide	ND	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	99%	86 - 118%
Toluene - d8	99%	88 - 110%
Bromofluorobenzene	94%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

Review

Inter-Mountain Laboratories, Inc.

CHAIN OF CUSTODY RECORD

Client/Project Name	Project Location
Navajo	Artesia NM
Sampler: (Signature)	**Chain of Custody Tape No.**

Sample No./ Identification	Date	Time	Lab Number	Matrix	No. of Containers	VOA	SVOA	Metals As Cr Ni Pb	Gen Chem	Remarks
MW-5B	11/8/94	0920		water ~~0694602094~~	6	✓	✓	✓	✓	0694602094
MW-5A		1010		0694602095	8					plus herb. pest. + NM metals
MW-3		1145		0694602096	8					" " "
Field Duplicate 2		—		0694602097	6					
				~~0694602098~~						
Trip Blank		—		0694602098	1	✓				

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
Brian P. Sullivan	1440	11/8/94	D. [illegible] /36	11/9/94	0900
Relinquished by: (Signature)	**Date**	**Time**	**Received by: (Signature)**	**Date**	**Time**
Relinquished by: (Signature)	**Date**	**Time**	**Received by laboratory: (Signature)**	**Date**	**Time**

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20048

Inter·Mountain Laboratories, Inc.

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EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project:	RFI Phase III / Artesia, NM	Report Date:	11/14/94
Sample ID:	MW 5B	Date Sampled:	11/08/94
Laboratory ID:	0694G02094	Date Received:	11/09/94
Sample Matrix:	Water	Date Extracted:	11/12/94
Condition:	Intact	Date Analyzed:	11/13/94
Preservative:	Cool		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Acenaphthene	ND	0.010
Acenaphthylene	ND	0.010
Anthracene	ND	0.010
Benzo(a)anthracene	ND	0.010
Benzo(b)fluoranthene	ND	0.010
Benzo(k)fluoranthene	ND	0.010
Benzo(g,h,i)perylene	ND	0.010
Benzo(a)pyrene	ND	0.010
Chrysene	ND	0.010
Dibenz(a,h)anthracene	ND	0.010
Fluoranthene	ND	0.010
Fluorene	ND	0.010
Ideno(1,2,3-cd)pyrene	ND	0.010
Naphthalene	ND	0.010
Phenanthrene	ND	0.010
Pyrene	ND	0.010

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	65%	21 - 110%
Phenol - d5	72%	10 - 110%
Nitrobenzene - d5	70%	35 - 114%
2 - Fluorobiphenyl	70%	43 - 116%
2,4,6 - Tribromophenol	73%	10 - 123%
Terphenyl - d14	71%	33 - 141%

References: Method 3510: Separatory Funnel Liquid-Liquid Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments:

Ramona R. Dennis
Analyst

Review

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: MW-5B
Lab ID: 0494W10132/0694G02094
Matrix: Water
Condition: Intact

Report Date: 03/27/95
Receipt Date: 11/10/94
Sample Date: 11/08/94

Parameter	Concentration	PQL	Method
pH (Lab)	7.3 s.u.	0.1	SW-846 9040
Conductivity (Lab)	8750 µmhos/cm	1	SW-846 9050
Total Dissolved Solids (180° C)	6570 mg/L	10	EPA 160.1
Total Alkalinity (as CaCO3)	304 mg/L	1	EPA 310.1
Total Hardness (as CaCO3)	2050 mg/L	1	Calculation
Fluoride	1.4 mg/L	0.1	EPA 340.2

Calcium	543 mg/L	27.10 meq/L	1 mg/L	SW-846 6010A
Magnesium	168 mg/L	13.83 meq/L	1 mg/L	SW-846 6010A
Potassium	7 mg/L	0.17 meq/L	1 mg/L	SW-846 6010A
Sodium	1020 mg/L	44.54 meq/L	1 mg/L	SW-846 6010A
Bicarbonate	371 mg/L	6.08 meq/L	1 mg/L	EPA 310.1
Carbonate	ND*	0.00	1 mg/L	EPA 310.1
Chloride	1720 mg/L	48.58 meq/L	1 mg/L	SW-846 9251
Sulfate	1170 mg/L	24.36 meq/L	5 mg/L	SW-846 9036
Major Cation Sum	85.64 meq/L		N/A	Calculation
Major Anion Sum	79.02 meq/L		N/A	Calculation
Cation/Anion Balance	4.02 % Diff		N/A	Calculation

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

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Laboratory Manager

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: MW-5B
Lab ID: 0494W10132/0694G02094
Matrix: Water
Condition: Intact

Report Date: 03/27/95
Receipt Date: 11/10/94
Sample Date: 11/08/94

Parameter	Concentration	PQL	Method
Total Metals			
Total Arsenic	0.213 mg/L	0.005	SW-846 7061A
Total Chromium	ND*	0.02 mg/L	SW-846 6010A
Total Lead	ND*	0.01 mg/L	SW-846 7421
Total Nickel	ND*	0.01 mg/L	SW-846 6010A

Dissolved Metals			
Dissolved Arsenic	0.178 mg/L	0.005	SW-846 7061A
Dissolved Chromium	ND*	0.02 mg/L	SW-846 6010A
Dissolved Lead	ND*	0.01 mg/L	SW-846 7421
Dissolved Nickel	ND*	0.01 mg/L	SW-846 6010A

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

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Laboratory Manager

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EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project :	RFI Phase III / Artesia, NM	Report Date:	11/15/94
Sample ID:	MW-5A	Date Sampled:	11/08/94
Laboratory ID:	0694G02095	Date Received:	11/09/94
Sample Matrix:	Water	Date Extracted:	11/15/94
Preservative:	Cool, HCl	Date Analyzed:	11/15/94
Condition:	Intact, pH<2		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	ND	0.005
Toluene	ND	0.005
Ethylbenzene	ND	0.005
m,p-Xylene	0.021	0.005
o-Xylene	ND	0.005
Methyl ethyl ketone	ND	0.005
Carbon disulfide	ND	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	98%	86 - 118%
Toluene - d8	99%	88 - 110%
Bromofluorobenzene	100%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

Review

3304 Longmire
College Station, Texas 77845

EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project:	RFI Phase III / Artesia, NM	Report Date:	11/20/94
Sample ID:	MW - 5A	Date Sampled:	11/08/94
Laboratory ID:	0694G02095	Date Received:	11/09/94
Sample Matrix:	Water	Date Extracted:	11/15/94
Condition:	Intact	Date Analyzed:	11/19/94
Preservative:	Cool		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Acenaphthene	ND	0.20
Acenaphthylene	ND	0.20
Anthracene	ND	0.20
Benzo(a)anthracene	ND	0.20
Benzo(b)fluoranthene	ND	0.20
Benzo(k)fluoranthene	ND	0.20
Benzo(g,h,i)perylene	ND	0.20
Benzo(a)pyrene	ND	0.20
Chrysene	ND	0.20
Dibenz(a,h)anthracene	ND	0.20
Fluoranthene	ND	0.20
Fluorene	ND	0.20
Ideno(1,2,3-cd)pyrene	ND	0.20
Naphthalene	ND	0.20
Phenanthrene	ND	0.20
Pyrene	ND	0.20

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	42%	21 - 110%
Phenol - d5	54%	10 - 110%
Nitrobenzene - d5	70%	35 - 114%
2 - Fluorobiphenyl	98%	43 - 116%
2,4,6 - Tribromophenol	61%	10 - 123%
Terphenyl - d14	95%	33 - 141%

References: Method 3510: Separatory Funnel Liquid-Liquid Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States
Environmental Protection Agency, July 1992.

Comments:

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Analyst

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Review

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III
Sample ID: MW-5A
Lab ID: 0494W10186/0694G02095
Matrix: Water
Condition: Intact

Report Date: 03/28/95
Receipt Date: 11/10/94
Sample Date: 11/08/94

Parameter	Concentration		PQL	Method
pH (Lab)	7.0 s.u.		0.1	SW-846 9040
Conductivity (Lab)	17500 µmhos/cm		1	SW-846 9050
Total Dissolved Solids (180° C)	14600 mg/L		10	EPA 160.1
Total Alkalinity (as CaCO3)	390 mg/L		1	EPA 310.1
Total Hardness (as CaCO3)	3750 mg/L		1	Calculation
Fluoride	2.9 mg/L		0.1	EPA 340.2
Calcium	536 mg/L	26.75 meq/L	1 mg/L	SW-846 6010A
Magnesium	587 mg/L	48.31 meq/L	1 mg/L	SW-846 6010A
Potassium	8 mg/L	0.20 meq/L	1 mg/L	SW-846 6010A
Sodium	3370 mg/L	146.54 meq/L	1 mg/L	SW-846 6010A
Bicarbonate	475 mg/L	7.79 meq/L	1 mg/L	EPA 310.1
Carbonate	ND*	0.00	1 mg/L	EPA 310.1
Chloride	3320 mg/L	93.74 meq/L	1 mg/L	SW-846 9251
Sulfate	5350 mg/L	111.35 meq/L	5 mg/L	SW-846 9036
Major Cation Sum	221.80 meq/L		N/A	Calculation
Major Anion Sum	212.88 meq/L		N/A	Calculation
Cation/Anion Balance	2.05 % Diff		N/A	Calculation
Total Metals				
Total Arsenic	0.127 mg/L		0.005	SW-846 7061A
Total Chromium	0.084 mg/L		0.005	SW-846 7191
Total Lead	0.02 mg/L		0.01	SW-846 7421
Total Nickel	0.15 mg/L		0.05	SW-846 7520

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III
Sample ID: MW-5A
Lab ID: 0494W10186/0694G02095
Matrix: Water
Condition: Intact

Report Date: 03/28/95
Receipt Date: 11/10/94
Sample Date: 11/08/94

Parameter	Concentration	PQL	Method
Dissolved Aluminum	ND*	0.1 mg/L	SW-846 6010A
Dissolved Antimony	ND*	0.1 mg/L	SW-846 6010A
Dissolved Arsenic	0.132 mg/L	0.005	SW-846 7061A
Dissolved Barium	ND*	0.05 mg/L	SW-846 6010A
Dissolved Beryllium	ND*	0.01 mg/L	SW-846 6010A
Dissolved Boron	1.00 mg/L	0.05	SW-846 6010A
Dissolved Cadmium	ND*	0.02 mg/L	SW-846 6010A
Dissolved Chromium	ND*	0.02 mg/L	SW-846 6010A
Dissolved Cobalt	ND*	0.02 mg/L	SW-846 6010A
Dissolved Copper	ND*	0.01 mg/L	SW-846 6010A
Dissolved Iron	3.73 mg/L	0.05	SW-846 6010A
Dissolved Lead	ND*	0.1 mg/L	SW-846 6010A
Dissolved Manganese	1.16 mg/L	0.02	SW-846 6010A
Dissolved Molybdenum	ND*	0.05 mg/L	SW-846 6010A
Dissolved Nickel	0.05 mg/L	0.01	SW-846 6010A
Dissolved Selenium	ND*	0.2 mg/L	SW-846 6010A
Dissolved Silica	23.14 mg/L	0.05	SW-846 6010A
Dissolved Silver	ND*	0.01 mg/L	SW-846 6010A
Dissolved Thallium	ND*	0.2 mg/L	SW-846 6010A
Dissolved Vanadium	ND*	0.01 mg/L	SW-846 6010A
Dissolved Zinc	ND*	0.01 mg/L	SW-846 6010A

*ND - *Parameter not detected at stated Practical Quantitation Limit.*

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

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EPA Method 8141
ORGANOPHOSPHORUS COMPOUNDS

Client: **NAVAJO REFINING COMPANY**
Project : RFI Phase III / Artesia, NM
Sample ID: MW-5A
Laboratory ID: 0694G02095
Sample Matrix: Water
Preservative: Cool
Condition: Intact

Report Date: 12/12/94
Date Sampled: 11/08/94
Date Received: 11/09/94
Date Extracted: 11/14/94
Date Analyzed: 12/08/94

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Azinphos Methyl	ND	0.0002
Bolstar	ND	0.0002
Chlorpyrifos	ND	0.0002
Coumaphos	ND	0.0004
Demeton	ND	0.0002
Diazinon	ND	0.0002
Dichlorvos	ND	0.0002
Dimethoate	ND	0.001
Disulfoton	ND	0.0002
EPN	ND	0.0002
Ethoprop	ND	0.0002
Fensulfothion	ND	0.001
Fenthion	ND	0.0002
Malathion	ND	0.0002
Merphos	ND	0.0002
Mevinphos	ND	0.001
Monocrotophos	ND	0.001
Naled	ND	0.002
Ethyl Parathion	ND	0.0002
Methyl Parathion	ND	0.0002
Phorate	ND	0.0002
Ronnel	ND	0.0002
Sulfotep	ND	0.0002
Tetrachlorovinphos	ND	0.0002
TEPP	ND	0.0002
Tokuthion	ND	0.0002
Trichloronate	ND	0.0002

ND - Analyte not detected at stated limit of detection

Reference: Method 8141: Organophosphorus Compounds by Gas Chromatography: Capillary Column Technique. Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments:

Inter-Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8151
CHLORINATED HERBICIDES

Client:	**NAVAJO REFINING COMPANY**		
Project Name:	RFI Phase III / Artesia, NM	Report Date:	12/09/94
Sample ID:	MW - 5A	Date Sampled:	11/08/94
Sample Number:	0694G02095	Date Received:	11/09/94
Sample Matrix:	Water	Date Extracted:	11/14/94
Preservative:	Cool	Date Analyzed:	12/06/94
Condition:	Intact		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Dalapon	ND	0.01
3,5-Dichlorobenzoic acid	ND	0.01
4-Nitrophenol	ND	0.01
Dicamba	ND	0.01
MCPP	ND	1
MCPA	ND	1
Dichlorprop	ND	0.01
2,4-D	ND	0.01
Pentachlorophenol	ND	0.01
Chloramben	ND	0.01
2.4.5 - TP	ND	0.01
2,4,5 - T (Silvex)	ND	0.01
2,4 - DB	ND	0.01
Dinoseb	ND	0.01
Bentazon	ND	0.01
Picloram	ND	0.01
DCPA	ND	0.01
Acifluorfen	ND	0.01

ND - Analyte not detected at stated detection limit

Reference: Method 8151: Chlorinated Herbicides
Test Methods for Evaluating Solid Wastes, SW-846, United States Environmental Protection Agency, Final Update I, July 1992.

Analyst

Review

Inter-Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**			
Project :	RFI Phase III / Artesia, NM		Report Date:	11/15/94
Sample ID:	MW-3		Date Sampled:	11/08/94
Laboratory ID:	0694G02096		Date Received:	11/09/94
Sample Matrix:	Water		Date Extracted:	11/15/94
Preservative:	Cool, HCl		Date Analyzed:	11/15/94
Condition:	Intact, pH<2			

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	ND	0.005
Toluene	ND	0.005
Ethylbenzene	ND	0.005
m,p-Xylene	ND	0.005
o-Xylene	0.006	0.005
Methyl ethyl ketone	ND	0.005
Carbon disulfide	ND	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	99%	86 - 118%
Toluene - d8	101%	88 - 110%
Bromofluorobenzene	97%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

Review

Inter-Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project:	RFI Phase III / Artesia, NM	Report Date:	11/20/94
Sample ID:	MW - 3	Date Sampled:	11/08/94
Laboratory ID:	0694G02096	Date Received:	11/09/94
Sample Matrix:	Water	Date Extracted:	11/15/94
Condition:	Intact	Date Analyzed:	11/19/94
Preservative:	Cool		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Acenaphthene	ND	0.40
Acenaphthylene	ND	0.40
Anthracene	ND	0.40
Benzo(a)anthracene	ND	0.40
Benzo(b)fluoranthene	ND	0.40
Benzo(k)fluoranthene	ND	0.40
Benzo(g,h,i)perylene	ND	0.40
Benzo(a)pyrene	ND	0.40
Chrysene	ND	0.40
Dibenz(a,h)anthracene	ND	0.40
Fluoranthene	ND	0.40
Fluorene	ND	0.40
Ideno(1,2,3-cd)pyrene	ND	0.40
Naphthalene	ND	0.40
Phenanthrene	ND	0.40
Pyrene	ND	0.40

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	48%	21 - 110%
Phenol - d5	40%	10 - 110%
Nitrobenzene - d5	68%	35 - 114%
2 - Fluorobiphenyl	102%	43 - 116%
2,4,6 - Tribromophenol	63%	10 - 123%
Terphenyl - d14	101%	33 - 141%

References: Method 3510: Separatory Funnel Liquid-Liquid Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments:

Ramona R. Dennis
Analyst

Wenda M Reg
Review

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III
Sample ID: MW-3
Lab ID: 0494W10192/0694G02096
Matrix: Water
Condition: Intact

Report Date: 03/28/95
Receipt Date: 11/10/94
Sample Date: 11/05/94

Parameter	Concentration		PQL	Method
pH (Lab)	7.1 s.u.		0.1	SW-846 9040
Conductivity (Lab)	7500 μmhos/cm		1	SW-846 9050
Total Dissolved Solids (180° C)	5970 mg/L		10	EPA 160.1
Total Alkalinity (as CaCO3)	293 mg/L		1	EPA 310.1
Total Hardness (as CaCO3)	2360 mg/L		1	Calculation
Fluoride	2.6 mg/L		0.1	EPA 340.2
Calcium	608 mg/L	30.34 meq/L	1 mg/L	SW-846 6010A
Magnesium	204 mg/L	16.79 meq/L	1 mg/L	SW-846 6010A
Potassium	7 mg/L	0.17 meq/L	1 mg/L	SW-846 6010A
Sodium	983 mg/L	42.76 meq/L	1 mg/L	SW-846 6010A
Bicarbonate	357 mg/L	5.85 meq/L	1 mg/L	EPA 310.1
Carbonate	ND*	0.00	1 mg/L	EPA 310.1
Chloride	1120 mg/L	31.71 meq/L	1 mg/L	SW-846 9251
Sulfate	2290 mg/L	47.59 meq/L	5 mg/L	SW-846 9036
Major Cation Sum	90.06 meq/L		N/A	Calculation
Major Anion Sum	85.16 meq/L		N/A	Calculation
Cation/Anion Balance	2.80 % Diff		N/A	Calculation
Total Metals				
Total Arsenic	0.045 mg/L		0.005	SW-846 7061A
Total Chromium	0.04 mg/L		0.02	SW-846 6010A
Total Lead	ND*		0.01 mg/L	SW-846 7421
Total Nickel	0.04 mg/L		0.01	SW-846 6010A

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

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Laboratory Manager

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III
Sample ID: MW-3
Lab ID: 0494W10192/0694G02096
Matrix: Water
Condition: Intact

Report Date: 03/28/95
Receipt Date: 11/10/94
Sample Date: 11/05/94

Parameter	Concentration	PQL	Method
Dissolved Aluminum	ND*	0.1 mg/L	SW-846 6010A
Dissolved Antimony	ND*	0.1 mg/L	SW-846 6010A
Dissolved Arsenic	0.029 mg/L	0.005	SW-846 7061A
Dissolved Barium	ND*	0.05 mg/L	SW-846 6010A
Dissolved Beryllium	ND*	0.01 mg/L	SW-846 6010A
Dissolved Boron	0.93 mg/L	0.05	SW-846 6010A
Dissolved Cadmium	0.07 mg/L	0.02	SW-846 6010A
Dissolved Chromium	0.02 mg/L	0.02	SW-846 6010A
Dissolved Cobalt	ND*	0.02 mg/L	SW-846 6010A
Dissolved Copper	ND*	0.01 mg/L	SW-846 6010A
Dissolved Iron	1.70 mg/L	0.05	SW-846 6010A
Dissolved Lead	0.11 mg/L	0.1	SW-846 6010A
Dissolved Manganese	2.68 mg/L	0.02	SW-846 6010A
Dissolved Molybdenum	ND*	0.05 mg/L	SW-846 6010A
Dissolved Nickel	ND*	0.05 mg/L	SW-846 7520
Dissolved Selenium	ND*	0.2 mg/L	SW-846 6010A
Dissolved Silica	15.16 mg/L	0.05	SW-846 6010A
Dissolved Silver	ND*	0.01 mg/L	SW-846 6010A
Dissolved Thallium	ND*	0.2 mg/L	SW-846 6010A
Dissolved Vanadium	0.02 mg/L	0.01	SW-846 6010A
Dissolved Zinc	ND*	0.01 mg/L	SW-846 6010A

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

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EPA Method 8141
ORGANOPHOSPHORUS COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project :	RFI Phase III / Artesia, NM	Report Date:	12/12/94
Sample ID:	MW-3	Date Sampled:	11/08/94
Laboratory ID:	0694G02096	Date Received:	11/09/94
Sample Matrix:	Water	Date Extracted:	11/14/94
Preservative:	Cool	Date Analyzed:	12/08/94
Condition:	Intact		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Azinphos Methyl	ND	0.0002
Bolstar	ND	0.0002
Chlorpyrifos	ND	0.0002
Coumaphos	ND	0.0004
Demeton	ND	0.0002
Diazinon	ND	0.0002
Dichlorvos	ND	0.0002
Dimethoate	ND	0.001
Disulfoton	ND	0.0002
EPN	ND	0.0002
Ethoprop	ND	0.0002
Fensulfothion	ND	0.001
Fenthion	ND	0.0002
Malathion	ND	0.0002
Merphos	ND	0.0002
Mevinphos	ND	0.001
Monocrotophos	ND	0.001
Naled	ND	0.002
Ethyl Parathion	ND	0.0002
Methyl Parathion	ND	0.0002
Phorate	ND	0.0002
Ronnel	ND	0.0002
Sulfotep	ND	0.0002
Tetrachlorovinphos	ND	0.0002
TEPP	ND	0.0002
Tokuthion	ND	0.0002
Trichloronate	ND	0.0002

ND - Analyte not detected at stated limit of detection

Reference: Method 8141: Organophosphorus Compounds by Gas Chromatography: Capillary Column Technique. Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments:

Inter·Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8151
CHLORINATED HERBICIDES

Client:	NAVAJO REFINING COMPANY		
Project Name:	RFI Phase III / Artesia, NM	Report Date:	12/09/94
Sample ID:	MW - 3	Date Sampled:	11/08/94
Sample Number:	0694G02096	Date Received:	11/09/94
Sample Matrix:	Water	Date Extracted:	11/14/94
Preservative:	Cool	Date Analyzed:	12/06/94
Condition:	Intact		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Dalapon	ND	0.01
3,5-Dichlorobenzoic acid	ND	0.01
4-Nitrophenol	ND	0.01
Dicamba	ND	0.01
MCPP	ND	1
MCPA	ND	1
Dichlorprop	ND	0.01
2,4-D	ND	0.01
Pentachlorophenol	ND	0.01
Chloramben	ND	0.01
2.4.5 - TP	ND	0.01
2,4,5 - T (Silvex)	ND	0.01
2,4 - DB	ND	0.01
Dinoseb	ND	0.01
Bentazon	ND	0.01
Picloram	ND	0.01
DCPA	ND	0.01
Acifluorfen	ND	0.01

ND - Analyte not detected at stated detection limit

Reference: Method 8151: Chlorinated Herbicides
Test Methods for Evaluating Solid Wastes, SW-846, United States Environmental Protection Agency, Final Update I, July 1992.

Analyst

Review

Inter-Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project :	RFI Phase III / Artesia, NM	Report Date:	11/15/94
Sample ID:	Field Duplicate 2	Date Sampled:	11/08/94
Laboratory ID:	0694G02097	Date Received:	11/09/94
Sample Matrix:	Water	Date Extracted:	11/15/94
Preservative:	Cool, HCl	Date Analyzed:	11/15/94
Condition:	Intact, pH<2		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	ND	0.005
Toluene	ND	0.005
Ethylbenzene	ND	0.005
m,p-Xylene	0.020	0.005
o-Xylene	ND	0.005
Methyl ethyl ketone	ND	0.005
Carbon disulfide	ND	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	107%	86 - 118%
Toluene - d8	95%	88 - 110%
Bromofluorobenzene	105%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

Review

Inter·Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project:	RFI Phase III / Artesia, NM	Report Date:	11/20/94
Sample ID:	Field Duplicate 2	Date Sampled:	11/08/94
Laboratory ID:	0694G02097	Date Received:	11/09/94
Sample Matrix:	Water	Date Extracted:	11/15/94
Condition:	Intact	Date Analyzed:	11/19/94
Preservative:	Cool		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Acenaphthene	ND	0.40
Acenaphthylene	ND	0.40
Anthracene	ND	0.40
Benzo(a)anthracene	ND	0.40
Benzo(b)fluoranthene	ND	0.40
Benzo(k)fluoranthene	ND	0.40
Benzo(g,h,i)perylene	ND	0.40
Benzo(a)pyrene	ND	0.40
Chrysene	ND	0.40
Dibenz(a,h)anthracene	ND	0.40
Fluoranthene	ND	0.40
Fluorene	ND	0.40
Ideno(1,2,3-cd)pyrene	ND	0.40
Naphthalene	ND	0.40
Phenanthrene	ND	0.40
Pyrene	ND	0.40

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	38%	21 - 110%
Phenol - d5	33%	10 - 110%
Nitrobenzene - d5	64%	35 - 114%
2 - Fluorobiphenyl	94%	43 - 116%
2,4,6 - Tribromophenol	53%	10 - 123%
Terphenyl - d14	98%	33 - 141%

References: Method 3510: Separatory Funnel Liquid-Liquid Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments:

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Analyst

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Review

iml **Inter-Mountain Laboratories, Inc.**

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: FIELD DUPLICATE 2
Lab ID: 0494W10134/0694G02097
Matrix: Water
Condition: Intact

Report Date: 03/27/95
Receipt Date: 11/10/94
Sample Date: 11/08/94

Parameter	Concentration	PQL	Method
pH (Lab)	7.3 s.u.	0.1	SW-846 9040
Conductivity (Lab)	17100 µmhos/cm	1	SW-846 9050
Total Dissolved Solids (180° C)	14700 mg/L	10	EPA 160.1
Total Alkalinity (as CaCO3)	388 mg/L	1	EPA 310.1
Total Hardness (as CaCO3)	3660 mg/L	1	Calculation
Fluoride	2.4 mg/L	0.1	EPA 340.2

Calcium	567 mg/L	28.29 meq/L	1 mg/L	SW-846 6010A
Magnesium	546 mg/L	44.94 meq/L	1 mg/L	SW-846 6010A
Potassium	3 mg/L	0.08 meq/L	1 mg/L	SW-846 6010A
Sodium	3120 mg/L	135.67 meq/L	1 mg/L	SW-846 6010A
Bicarbonate	473 mg/L	7.75 meq/L	1 mg/L	EPA 310.1
Carbonate	ND*	0.00	1 mg/L	EPA 310.1
Chloride	3310 mg/L	93.37 meq/L	1 mg/L	SW-846 9251
Sulfate	5400 mg/L	112.49 meq/L	5 mg/L	SW-846 9036
Major Cation Sum	208.98 meq/L		N/A	Calculation
Major Anion Sum	213.62 meq/L		N/A	Calculation
Cation/Anion Balance	-1.10 % Diff		N/A	Calculation

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

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David N. Poelstra
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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: FIELD DUPLICATE 2
Lab ID: 0494W10134/0694G02097
Matrix: Water
Condition: Intact

Report Date: 03/28/95
Receipt Date: 11/10/94
Sample Date: 11/08/94

Parameter	Concentration	PQL	Method
Total Metals			
Total Arsenic	0.129 mg/L	0.005	SW-846 7061A
Total Chromium	0.056 mg/L	0.005	SW-846 7191
Total Lead	0.01 mg/L	0.01	SW-846 7421
Total Nickel	0.11 mg/L	0.05	SW-846 7520
Dissolved Metals			
Dissolved Arsenic	0.122 mg/L	0.005	SW-846 7061A
Dissolved Chromium	ND*	0.02 mg/L	SW-846 6010A
Dissolved Lead	ND*	0.01 mg/L	SW-846 7421
Dissolved Nickel	0.04 mg/L	0.01	SW-846 6010A

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

...wed By:

David N. Poelstra

David N. Poelstra
Laboratory Manager

Inter-Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project :	RFI Phase III / Artesia, NM	Report Date:	11/16/94
Sample ID:	Trip Blank	Date Sampled:	NA
Laboratory ID:	0694G02098	Date Received:	11/09/94
Sample Matrix:	Water	Date Extracted:	11/16/94
Preservative:	Cool, HCl	Date Analyzed:	11/16/94
Condition:	Intact, pH<2		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	ND	0.005
Toluene	ND	0.005
Ethylbenzene	ND	0.005
m,p-Xylene	ND	0.005
o-Xylene	ND	0.005
Methyl ethyl ketone	ND	0.005
Carbon disulfide	ND	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	105%	86 - 118%
Toluene - d8	93%	88 - 110%
Bromofluorobenzene	88%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

Review

Inter-Mountain Laboratories, Inc.

CHAIN OF CUSTODY RECORD

Client/Project Name	Project Location
Navajo	Artesia NM

Sampler: (Signature)	Chain of Custody Tape No.
Brian Sullivan	

Sample No./ Identification	Date	Time	Lab Number	Matrix	No. of Containers	VOA	SVOA	Metals As Cr Pb Ni	Gen. Chem.	Remarks
MW-6B	11/8/94	1555		Water	6	X	X	X	X	0694166 ~~2014~~
Equip. Blank 5		1630			2	X				2108 ~~2012~~
" " 6		1632			1			X		2109 ~~2011~~
MW-6A		1635			6	X	X	X	X	2110 ~~2010~~
MW-15	11/9/94	0856			6	X	X	X	X	2111 ~~2021~~
Pond Windmill		0954			6	X	X	X	X	2112 ~~2022~~
MW-10		1047			6	X	X	X	X	2113 ~~2023~~
Trip Blank					1	X				2114 ~~2024~~

ANALYSES / PARAMETERS

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
FED EX			[illegible signature]	11/10/94	0930
Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
Relinquished by: (Signature)	Date	Time	Received by laboratory: (Signature)	Date	Time

Inter-Mountain Laboratories, Inc.

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☐ 1160 Research Dr., Bozeman, Montana 59715, Telephone (406) 586-8450

☐ 11183 SH 30, College Station, TX 77845, Telephone (409) 776-8945

☐ 3304 Longmire Drive, College Station, TX 77845, Telephone (409) 774-4999

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Organics Laboratory
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EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project :	RFI Phase III / Artesia, NM	Report Date:	11/17/94
Sample ID:	MW-6B	Date Sampled:	11/08/94
Laboratory ID:	0694G02107	Date Received:	11/10/94
Sample Matrix:	Water	Date Extracted:	11/17/94
Preservative:	Cool, HCl	Date Analyzed:	11/17/94
Condition:	Intact, pH<2		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)*
Benzene	ND	0.025
Toluene	ND	0.025
Ethylbenzene	ND	0.025
m,p-Xylene	ND	0.025
o-Xylene	ND	0.025
Methyl ethyl ketone	ND	0.025
Carbon disulfide	ND	0.025

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	100%	86 - 118%
Toluene - d8	103%	88 - 110%
Bromofluorobenzene	98%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.
* - Elevated detection limit to minimize matrix interference.

Analyst

Review

Inter·Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project:	RFI Phase III / Artesia, NM	Report Date:	11/18/94
Sample ID:	MW - 6B	Date Sampled:	11/08/94
Laboratory ID:	0694G02107	Date Received:	11/10/94
Sample Matrix:	Water	Date Extracted:	11/15/94
Condition:	Intact	Date Analyzed:	11/17/94
Preservative:	Cool		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Acenaphthene	ND	0.010
Acenaphthylene	ND	0.010
Anthracene	ND	0.010
Benzo(a)anthracene	ND	0.010
Benzo(b)fluoranthene	ND	0.010
Benzo(k)fluoranthene	ND	0.010
Benzo(g,h,i)perylene	ND	0.010
Benzo(a)pyrene	ND	0.010
Chrysene	ND	0.010
Dibenz(a,h)anthracene	ND	0.010
Fluoranthene	ND	0.010
Fluorene	ND	0.010
Ideno(1,2,3-cd)pyrene	ND	0.010
Naphthalene	ND	0.010
Phenanthrene	ND	0.010
Pyrene	ND	0.010

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	66%	21 - 110%
Phenol - d5	81%	10 - 110%
Nitrobenzene - d5	72%	35 - 114%
2 - Fluorobiphenyl	76%	43 - 116%
2,4,6 - Tribromophenol	85%	10 - 123%
Terphenyl - d14	85%	33 - 141%

References: Method 3510: Separatory Funnel Liquid-Liquid Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments:

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: MW-6B
Lab ID: 0494W10135/0694G02107
Matrix: Water
Condition: Intact

Report Date: 03/27/95
Receipt Date: 11/10/94
Sample Date: 11/08/94

Parameter	Concentration		PQL	Method
pH (Lab)	7.8 s.u.		0.1	SW-846 9040
Conductivity (Lab)	4390 µmhos/cm		1	SW-846 9050
Total Dissolved Solids (180° C)	3190 mg/L		10	EPA 160.1
Total Alkalinity (as CaCO3)	26 mg/L		1	EPA 310.1
Total Hardness (as CaCO3)	1240 mg/L		1	Calculation
Fluoride	0.6 mg/L		0.1	EPA 340.2
Calcium	362 mg/L	18.06 meq/L	1 mg/L	SW-846 6010A
Magnesium	81 mg/L	6.67 meq/L	1 mg/L	SW-846 6010A
Potassium	6 mg/L	0.16 meq/L	1 mg/L	SW-846 6010A
Sodium	520 mg/L	22.62 meq/L	1 mg/L	SW-846 6010A
Bicarbonate	32 mg/L	0.52 meq/L	1 mg/L	EPA 310.1
Carbonate	ND*	0.00	1 mg/L	EPA 310.1
Chloride	803 mg/L	22.65 meq/L	1 mg/L	SW-846 9251
Sulfate	1180 mg/L	24.53 meq/L	5 mg/L	SW-846 9036
Major Cation Sum	47.51 meq/L		N/A	Calculation
Major Anion Sum	47.70 meq/L		N/A	Calculation
Cation/Anion Balance	-0.20 % Diff		N/A	Calculation

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

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Laboratory Manager

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: MW-6B
Lab ID: 0494W10135/0694G02107
Matrix: Water
Condition: Intact

Report Date: 03/27/95
Receipt Date: 11/10/94
Sample Date: 11/08/94

Parameter	Concentration	PQL	Method
Total Metals			
Total Arsenic	0.011 mg/L	0.005	SW-846 7061A
Total Chromium	ND*	0.02 mg/L	SW-846 6010A
Total Lead	ND*	0.01 mg/L	SW-846 7421
Total Nickel	ND*	0.01 mg/L	SW-846 6010A

Dissolved Metals			
Dissolved Arsenic	0.006 mg/L	0.005	SW-846 7061A
Dissolved Chromium	ND*	0.02 mg/L	SW-846 6010A
Dissolved Lead	ND*	0.01 mg/L	SW-846 7421
Dissolved Nickel	ND*	0.01 mg/L	SW-846 6010A

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

David N Poelstra

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Laboratory Manager

Inter-Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINERY COMPANY**		
Project :	RFI Phase III / Artesia, NM	Report Date:	11/17/94
Sample ID:	Equipment Blank 5	Date Sampled:	11/08/94
Laboratory ID:	0694G02108	Date Received:	11/10/94
Sample Matrix:	Water	Date Extracted:	11/17/94
Preservative:	Cool, HCl	Date Analyzed:	11/17/94
Condition:	Intact, pH<2		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	ND	0.005
Toluene	ND	0.005
m,p-Xylene	ND	0.005
o-Xylene	ND	0.005
Methyl ethyl ketone	ND	0.005
Carbon disulfide	ND	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	99%	86 - 118%
Toluene - d8	101%	88 - 110%
Bromofluorobenzene	97%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

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ne (409) 776-8945 FAX (409) 774-4705

Organics Laboratory
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Phone (409) 774-4999 Fax (409) 696-0692

WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: EQUIP BLK 6
Lab ID: 0494W10209/0694G02109
Matrix: Water
Condition: Intact

Report Date: 03/28/95
Receipt Date: 11/10/94
Sample Date: 11/08/94

Parameter	Concentration	PQL	Method
Total Metals			
Total Arsenic	ND*	0.005 mg/L	SW-846 7061A
Total Chromium	ND*	0.02 mg/L	SW-846 6010A
Total Lead	ND*	0.01 mg/L	SW-846 7421
Total Nickel	ND*	0.01 mg/L	SW-846 6010A

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

Reviewed By:

David N Poelstra

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Laboratory Manager

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EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client: **NAVAJO REFINING COMPANY**
Project : RFI Phase III / Artesia, NM
Sample ID: MW-6A
Laboratory ID: 0694G02110
Sample Matrix: Water
Preservative: Cool, HCl
Condition: Intact, pH<2

Report Date: 11/17/94
Date Sampled: 11/08/94
Date Received: 11/10/94
Date Extracted: 11/17/94
Date Analyzed: 11/17/94

Analyte	Concentration (mg/L)	Detection Limit (mg/L)*
Benzene	ND	0.025
Toluene	ND	0.025
Ethylbenzene	ND	0.025
m,p-Xylene	ND	0.025
o-Xylene	ND	0.025
Methyl ethyl ketone	ND	0.025
Carbon disulfide	ND	0.025

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	98%	86 - 118%
Toluene - d8	98%	88 - 110%
Bromofluorobenzene	91%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.
* - Elevated detection limit to minimize matrix interference.

Analyst

Review

Inter-Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project:	RFI Phase III / Artesia, NM	Report Date:	11/20/94
Sample ID:	MW - 6A	Date Sampled:	11/08/94
Laboratory ID:	0694G02110	Date Received:	11/10/94
Sample Matrix:	Water	Date Extracted:	11/15/94
Condition:	Intact	Date Analyzed:	11/20/94
Preservative:	Cool		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Acenaphthene	ND	0.10
Acenaphthylene	ND	0.10
Anthracene	ND	0.10
Benzo(a)anthracene	ND	0.10
Benzo(b)fluoranthene	ND	0.10
Benzo(k)fluoranthene	ND	0.10
Benzo(g,h,i)perylene	ND	0.10
Benzo(a)pyrene	ND	0.10
Chrysene	ND	0.10
Dibenz(a,h)anthracene	ND	0.10
Fluoranthene	ND	0.10
Fluorene	ND	0.10
Ideno(1,2,3-cd)pyrene	ND	0.10
Naphthalene	ND	0.10
Phenanthrene	ND	0.10
Pyrene	ND	0.10

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	57%	21 - 110%
Phenol - d5	63%	10 - 110%
Nitrobenzene - d5	85%	35 - 114%
2 - Fluorobiphenyl	94%	43 - 116%
2,4,6 - Tribromophenol	72%	10 - 123%
Terphenyl - d14	88%	33 - 141%

References: Method 3510: Separatory Funnel Liquid-Liquid Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments:

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WATER QUALITY REPORT

Client: Navajo Refining Co.

Project: RFI Phase III / Artesia, NM

Sample ID: MW-6A

Lab ID: 0494W10136/0694G02110

Matrix: Water

Condition: Intact

Report Date: 03/27/95

Receipt Date: 11/10/94

Sample Date: 11/08/94

Parameter	Concentration	PQL	Method
pH (Lab)	7.5 s.u.	0.1	SW-846 9040
Conductivity (Lab)	4720 µmhos/cm	1	SW-846 9050
Total Dissolved Solids (180° C)	3650 mg/L	10	EPA 160.1
Total Alkalinity (as CaCO3)	144 mg/L	1	EPA 310.1
Total Hardness (as CaCO3)	1360 mg/L	1	Calculation
Fluoride	2.2 mg/L	0.1	EPA 340.2

Calcium	390 mg/L	19.46 meq/L	1 mg/L	SW-846 6010A
Magnesium	94 mg/L	7.74 meq/L	1 mg/L	SW-846 6010A
Potassium	2 mg/L	0.05 meq/L	1 mg/L	SW-846 6010A
Sodium	512 mg/L	22.27 meq/L	1 mg/L	SW-846 6010A
Bicarbonate	175 mg/L	2.87 meq/L	1 mg/L	EPA 310.1
Carbonate	ND*	0.00	1 mg/L	EPA 310.1
Chloride	727 mg/L	20.51 meq/L	1 mg/L	SW-846 9251
Sulfate	1400 mg/L	29.23 meq/L	5 mg/L	SW-846 9036
Major Cation Sum	49.52 meq/L		N/A	Calculation
Major Anion Sum	52.61 meq/L		N/A	Calculation
Cation/Anion Balance	-3.03 % Diff		N/A	Calculation

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: MW-6A
Lab ID: 0494W10136/0694G02110
Matrix: Water
Condition: Intact

Report Date: 03/28/95
Receipt Date: 11/10/94
Sample Date: 11/08/94

Parameter	Concentration	PQL	Method
Total Metals			
Total Arsenic	0.085 mg/L	0.005	SW-846 7061A
Total Chromium	0.062 mg/L	0.005	SW-846 7191
Total Lead	0.02 mg/L	0.01	SW-846 7421
Total Nickel	0.07 mg/L	0.05	SW-846 7520

Dissolved Metals			
Dissolved Arsenic	0.017 mg/L	0.005	SW-846 7061A
Dissolved Chromium	ND*	0.02 mg/L	SW-846 6010A
Dissolved Lead	ND*	0.01 mg/L	SW-846 7421
Dissolved Nickel	0.01 mg/L	0.01	SW-846 6010A

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

David N Poelstra

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Laboratory Manager

Inter-Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project :	RFI Phase III / Artesia, NM	Report Date:	11/18/94
Sample ID:	MW-15	Date Sampled:	11/09/94
Laboratory ID:	0694G02111	Date Received:	11/10/94
Sample Matrix:	Water	Date Extracted:	11/18/94
Preservative:	Cool, HCl	Date Analyzed:	11/18/94
Condition:	Intact, pH<2		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	0.015	0.005
Toluene	ND	0.005
Ethylbenzene	ND	0.005
m,p-Xylene	ND	0.005
o-Xylene	ND	0.005
Methyl ethyl ketone	ND	0.005
Carbon disulfide	ND	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	102%	86 - 118%
Toluene - d8	97%	88 - 110%
Bromofluorobenzene	98%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

Review

Inter-Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project:	RFI Phase III / Artesia, NM	Report Date:	11/18/94
Sample ID:	MW - 15	Date Sampled:	11/09/94
Laboratory ID:	0694G02111	Date Received:	11/10/94
Sample Matrix:	Water	Date Extracted:	11/15/94
Condition:	Intact	Date Analyzed:	11/17/94
Preservative:	Cool		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Acenaphthene	ND	0.010
Acenaphthylene	ND	0.010
Anthracene	ND	0.010
Benzo(a)anthracene	ND	0.010
Benzo(b)fluoranthene	ND	0.010
Benzo(k)fluoranthene	ND	0.010
Benzo(g,h,i)perylene	ND	0.010
Benzo(a)pyrene	ND	0.010
Chrysene	ND	0.010
Dibenz(a,h)anthracene	ND	0.010
Fluoranthene	ND	0.010
Fluorene	ND	0.010
Ideno(1,2,3-cd)pyrene	ND	0.010
Naphthalene	ND	0.010
Phenanthrene	ND	0.010
Pyrene	ND	0.010

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	62%	21 - 110%
Phenol - d5	73%	10 - 110%
Nitrobenzene - d5	67%	35 - 114%
2 - Fluorobiphenyl	72%	43 - 116%
2,4,6 - Tribromophenol	79%	10 - 123%
Terphenyl - d14	76%	33 - 141%

References: Method 3510: Separatory Funnel Liquid-Liquid Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments:

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: MW-15
Lab ID: 0494W10137/0694G02111
Matrix: Water
Condition: Intact

Report Date: 03/27/95
Receipt Date: 11/10/94
Sample Date: 11/09/94

Parameter	Concentration	PQL	Method
pH (Lab)	7.5 s.u.	0.1	SW-846 9040
Conductivity (Lab)	4860 μmhos/cm	1	SW-846 9050
Total Dissolved Solids (180° C)	3660 mg/L	10	EPA 160.1
Total Alkalinity (as CaCO3)	144 mg/L	1	EPA 310.1
Total Hardness (as CaCO3)	1390 mg/L	1	Calculation
Fluoride	1.2 mg/L	0.1	EPA 340.2

Calcium	372 mg/L	18.56 meq/L	1 mg/L	SW-846 6010A
Magnesium	113 mg/L	9.30 meq/L	1 mg/L	SW-846 6010A
Potassium	8 mg/L	0.21 meq/L	1 mg/L	SW-846 6010A
Sodium	519 mg/L	22.57 meq/L	1 mg/L	SW-846 6010A
Bicarbonate	175 mg/L	2.87 meq/L	1 mg/L	EPA 310.1
Carbonate	ND*	0.00	1 mg/L	EPA 310.1
Chloride	743 mg/L	20.96 meq/L	1 mg/L	SW-846 9251
Sulfate	1470 mg/L	30.54 meq/L	5 mg/L	SW-846 9036
Major Cation Sum	50.65 meq/L		N/A	Calculation
Major Anion Sum	54.37 meq/L		N/A	Calculation
Cation/Anion Balance	-3.54 % Diff		N/A	Calculation

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: MW-15
Lab ID: 0494W10137/0694G02111
Matrix: Water
Condition: Intact

Report Date: 03/27/95
Receipt Date: 11/10/94
Sample Date: 11/09/94

Parameter	Concentration	PQL	Method
Total Metals			
Total Arsenic	0.028 mg/L	0.005	SW-846 7061A
Total Chromium	ND*	0.02 mg/L	SW-846 6010A
Total Lead	ND*	0.01 mg/L	SW-846 7421
Total Nickel	0.02 mg/L	0.01	SW-846 6010A

Parameter	Concentration	PQL	Method
Dissolved Metals			
Dissolved Arsenic	0.008 mg/L	0.005	SW-846 7061A
Dissolved Chromium	ND*	0.02 mg/L	SW-846 6010A
Dissolved Lead	ND*	0.01 mg/L	SW-846 7421
Dissolved Nickel	0.02 mg/L	0.01	SW-846 6010A

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference:

SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

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EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project :	RFI Phase III / Artesia, NM	Report Date:	11/18/94
Sample ID:	Pond Windmill	Date Sampled:	11/09/94
Laboratory ID:	0694G02112	Date Received:	11/10/94
Sample Matrix:	Water	Date Extracted:	11/18/94
Preservative:	Cool, HCl	Date Analyzed:	11/18/94
Condition:	Intact, pH<2		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	ND	0.005
Toluene	ND	0.005
Ethylbenzene	ND	0.005
m,p-Xylene	ND	0.005
o-Xylene	ND	0.005
Methyl ethyl ketone	ND	0.005
Carbon disulfide	ND	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	99%	86 - 118%
Toluene - d8	98%	88 - 110%
Bromofluorobenzene	91%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

Review

Inter-Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client:	NAVAJO REFINING COMPANY		
Project:	RFI Phase III / Artesia, NM	Report Date:	11/18/94
Sample ID:	Pond Windmill	Date Sampled:	11/09/94
Laboratory ID:	0694G02112	Date Received:	11/10/94
Sample Matrix:	Water	Date Extracted:	11/15/94
Condition:	Intact	Date Analyzed:	11/17/94
Preservative:	Cool		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Acenaphthene	ND	0.010
Acenaphthylene	ND	0.010
Anthracene	ND	0.010
Benzo(a)anthracene	ND	0.010
Benzo(b)fluoranthene	ND	0.010
Benzo(k)fluoranthene	ND	0.010
Benzo(g,h,i)perylene	ND	0.010
Benzo(a)pyrene	ND	0.010
Chrysene	ND	0.010
Dibenz(a,h)anthracene	ND	0.010
Fluoranthene	ND	0.010
Fluorene	ND	0.010
Ideno(1,2,3-cd)pyrene	ND	0.010
Naphthalene	ND	0.010
Phenanthrene	ND	0.010
Pyrene	ND	0.010

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	51%	21 - 110%
Phenol - d5	56%	10 - 110%
Nitrobenzene - d5	58%	35 - 114%
2 - Fluorobiphenyl	62%	43 - 116%
2,4,6 - Tribromophenol	68%	10 - 123%
Terphenyl - d14	76%	33 - 141%

References: Method 3510: Separatory Funnel Liquid-Liquid Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments:

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Analyst

Wendi M [illegible]
Review

iml

Inter-Mountain Laboratories, Inc.

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11183 SH 30 College Station, Texas 77845

WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: Pond Windmill
Lab ID: 0494W10133/0694G02112
Matrix: Water
Condition: Intact

Report Date: 03/27/95
Receipt Date: 11/10/94
Sample Date: 11/09/94

Parameter	Concentration		PQL	Method
pH (Lab)	7.6 s.u.		0.1	SW-846 9040
Conductivity (Lab)	5870 μmhos/cm		1	SW-846 9050
Total Dissolved Solids (180° C)	4260 mg/L		10	EPA 160.1
Total Alkalinity (as CaCO3)	145 mg/L		1	EPA 310.1
Total Hardness (as CaCO3)	1500 mg/L		1	Calculation
Fluoride	0.9 mg/L		0.1	EPA 340.2
Calcium	330 mg/L	16.47 meq/L	1 mg/L	SW-846 6010A
Magnesium	165 mg/L	13.58 meq/L	1 mg/L	SW-846 6010A
Potassium	3 mg/L	0.09 meq/L	1 mg/L	SW-846 6010A
Sodium	697 mg/L	30.32 meq/L	1 mg/L	SW-846 6010A
Bicarbonate	176 mg/L	2.89 meq/L	1 mg/L	EPA 310.1
Carbonate	ND*	0.00	1 mg/L	EPA 310.1
Chloride	1130 mg/L	31.76 meq/L	1 mg/L	SW-846 9251
Sulfate	1440 mg/L	30.02 meq/L	5 mg/L	SW-846 9036
Major Cation Sum	60.46 meq/L		N/A	Calculation
Major Anion Sum	64.67 meq/L		N/A	Calculation
Cation/Anion Balance	-3.36 % Diff		N/A	Calculation

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

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Laboratory Manager

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: Pond Windmill
Lab ID: 0494W10133/0694G02112
Matrix: Water
Condition: Intact

Report Date: 03/27/95
Receipt Date: 11/10/94
Sample Date: 11/09/94

Parameter	Concentration	PQL	Method
Total Metals			
Total Arsenic	0.017 mg/L	0.005	SW-846 7061A
Total Chromium	ND*	0.02 mg/L	SW-846 6010A
Total Lead	0.02 mg/L	0.01	SW-846 7421
Total Nickel	ND*	0.01 mg/L	SW-846 6010A

Dissolved Metals			
Dissolved Arsenic	ND*	0.005 mg/L	SW-846 7061A
Dissolved Chromium	ND*	0.02 mg/L	SW-846 6010A
Dissolved Lead	ND*	0.01 mg/L	SW-846 7421
Dissolved Nickel	ND*	0.01 mg/L	SW-846 6010A

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

David N Poelstra

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Laboratory Manager

Inter-Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project :	RFI Phase III / Artesia, NM	Report Date:	11/18/94
Sample ID:	MW-10	Date Sampled:	11/09/94
Laboratory ID:	0694G02113	Date Received:	11/10/94
Sample Matrix:	Water	Date Extracted:	11/18/94
Preservative:	Cool, HCl	Date Analyzed:	11/18/94
Condition:	Intact, pH<2		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	ND	0.005
Toluene	ND	0.005
Ethylbenzene	ND	0.005
m,p-Xylene	ND	0.005
o-Xylene	ND	0.005
Methyl ethyl ketone	ND	0.005
Carbon disulfide	ND	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	100%	86 - 118%
Toluene - d8	98%	88 - 110%
Bromofluorobenzene	91%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

Review

3304 Longmire
College Station, Texas 77845

EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project:	RFI Phase III / Artesia, NM	Report Date:	11/20/94
Sample ID:	MW - 10	Date Sampled:	11/09/94
Laboratory ID:	0694G02113	Date Received:	11/10/94
Sample Matrix:	Water	Date Extracted:	11/15/94
Condition:	Intact	Date Analyzed:	11/20/94
Preservative:	Cool		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Acenaphthene	ND	0.10
Acenaphthylene	ND	0.10
Anthracene	ND	0.10
Benzo(a)anthracene	ND	0.10
Benzo(b)fluoranthene	ND	0.10
Benzo(k)fluoranthene	ND	0.10
Benzo(g,h,i)perylene	ND	0.10
Benzo(a)pyrene	ND	0.10
Chrysene	ND	0.10
Dibenz(a,h)anthracene	ND	0.10
Fluoranthene	ND	0.10
Fluorene	ND	0.10
Ideno(1,2,3-cd)pyrene	ND	0.10
Naphthalene	ND	0.10
Phenanthrene	ND	0.10
Pyrene	ND	0.10

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	49%	21 - 110%
Phenol - d5	53%	10 - 110%
Nitrobenzene - d5	50%	35 - 114%
2 - Fluorobiphenyl	65%	43 - 116%
2,4,6 - Tribromophenol	49%	10 - 123%
Terphenyl - d14	69%	33 - 141%

References: Method 3510: Separatory Funnel Liquid-Liquid Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments:

Ramona R. Dennis
Analyst

Review

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: MW-10
Lab ID: 0494W10138/0694G02113
Matrix: Water
Condition: Intact

Report Date: 03/27/95
Receipt Date: 11/10/94
Sample Date: 11/09/94

Parameter	Concentration	PQL	Method
pH (Lab)	7.6 s.u.	0.1	SW-846 9040
Conductivity (Lab)	5960 μmhos/cm	1	SW-846 9050
Total Dissolved Solids (180° C)	4420 mg/L	10	EPA 160.1
Total Alkalinity (as CaCO3)	229 mg/L	1	EPA 310.1
Total Hardness (as CaCO3)	1330 mg/L	1	Calculation
Fluoride	1.0 mg/L	0.1	EPA 340.2

Calcium	395 mg/L	19.71 meq/L	1 mg/L	SW-846 6010A
Magnesium	83 mg/L	6.83 meq/L	1 mg/L	SW-846 6010A
Potassium	4 mg/L	0.09 meq/L	1 mg/L	SW-846 6010A
Sodium	937 mg/L	40.76 meq/L	1 mg/L	SW-846 6010A
Bicarbonate	279 mg/L	4.57 meq/L	1 mg/L	EPA 310.1
Carbonate	ND*	0.00	1 mg/L	EPA 310.1
Chloride	993 mg/L	28.01 meq/L	1 mg/L	SW-846 9251
Sulfate	1570 mg/L	32.71 meq/L	5 mg/L	SW-846 9036
Major Cation Sum	67.39 meq/L		N/A	Calculation
Major Anion Sum	65.30 meq/L		N/A	Calculation
Cation/Anion Balance	1.58 % Diff		N/A	Calculation

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: MW-10
Lab ID: 0494W10138/0694G02113
Matrix: Water
Condition: Intact

Report Date: 03/28/95
Receipt Date: 11/10/94
Sample Date: 11/09/94

Parameter	Concentration	PQL	Method
Total Metals			
Total Arsenic	0.035 mg/L	0.005	SW-846 7061A
Total Chromium	0.107 mg/L	0.005	SW-846 7191
Total Lead	0.09 mg/L	0.01	SW-846 7421
Total Nickel	0.18 mg/L	0.05	SW-846 7520

Dissolved Metals			
Dissolved Arsenic	0.006 mg/L	0.005	SW-846 7061A
Dissolved Chromium	ND*	0.02 mg/L	SW-846 6010A
Dissolved Lead	ND*	0.01 mg/L	SW-846 7421
Dissolved Nickel	ND*	0.01 mg/L	SW-846 6010A

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

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3304 Longmire
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EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project :	RFI Phase III / Artesia, NM	Report Date:	11/18/94
Sample ID:	Trip Blank	Date Sampled:	NA
Laboratory ID:	0694G02114	Date Received:	11/10/94
Sample Matrix:	Water	Date Extracted:	11/18/94
Preservative:	Cool, HCl	Date Analyzed:	11/18/94
Condition:	Intact, pH<2		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	ND	0.005
Toluene	ND	0.005
Ethylbenzene	ND	0.005
m,p-Xylene	ND	0.005
o-Xylene	ND	0.005
Methyl ethyl ketone	ND	0.005
Carbon disulfide	ND	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	98%	86 - 118%
Toluene - d8	99%	88 - 110%
Bromofluorobenzene	91%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

Review

Inter-Mountain Laboratories, Inc.

CHAIN OF CUSTODY RECORD

Client/Project Name	Project Location
Navajo	Artesia NM

Sampler: (Signature) Brian Sullivan

Chain of Custody Tape No.

ANALYSES / PARAMETERS

Sample No./ Identification	Date	Time	Lab Number	Matrix	No. of Containers	VOA	SVOA	Metals As Cr Ni Pb	Gen. Chem.	Remarks
MW-22B	11/9/94	1315		water	6					0694602128
MW-22A		1422								0694602129
MW-18B		1635								0694602130
MW-18A		1650								0694602131
Trip Blank					1	X				0694602132

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
Brian T. Sullivan	11/10/94	1000	Ben T. [illegible]	11/11/94	0932
Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
Relinquished by: (Signature)	Date	Time	Received by laboratory: (Signature)	Date	Time

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☐ 2506 West Main Street, Farmington, NM 87401, Telephone (505) 326-4737

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☐ 11183 SH 30, College Station, TX 77845, Telephone (409) 776-8945

☐ 3304 Longmire Drive, College Station, TX 77845, Telephone (409) 774-4999

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3304 Longmire
College Station, Texas 77845

EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project :	RFI Phase III / Artesia, NM	Report Date:	11/18/94
Sample ID:	MW-22B	Date Sampled:	11/09/94
Laboratory ID:	0694G02128	Date Received:	11/11/94
Sample Matrix:	Water	Date Extracted:	11/18/94
Preservative:	Cool, HCl	Date Analyzed:	11/18/94
Condition:	Intact, pH<2		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	ND	0.005
Toluene	ND	0.005
Ethylbenzene	ND	0.005
m,p-Xylene	ND	0.005
o-Xylene	ND	0.005
Methyl ethyl ketone	ND	0.005
Carbon disulfide	ND	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	100%	86 - 118%
Toluene - d8	100%	88 - 110%
Bromofluorobenzene	99%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

Review

Inter-Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project:	RFI Phase III / Artesia, NM	Report Date:	11/20/94
Sample ID:	MW - 22B	Date Sampled:	11/09/94
Laboratory ID:	0694G02128	Date Received:	11/11/94
Sample Matrix:	Water	Date Extracted:	11/16/94
Condition:	Intact	Date Analyzed:	11/20/94
Preservative:	Cool		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Acenaphthene	ND	0.050
Acenaphthylene	ND	0.050
Anthracene	ND	0.050
Benzo(a)anthracene	ND	0.050
Benzo(b)fluoranthene	ND	0.050
Benzo(k)fluoranthene	ND	0.050
Benzo(g,h,i)perylene	ND	0.050
Benzo(a)pyrene	ND	0.050
Chrysene	ND	0.050
Dibenz(a,h)anthracene	ND	0.050
Fluoranthene	ND	0.050
Fluorene	ND	0.050
Ideno(1,2,3-cd)pyrene	ND	0.050
Naphthalene	ND	0.050
Phenanthrene	ND	0.050
Pyrene	ND	0.050

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	65%	21 - 110%
Phenol - d5	72%	10 - 110%
Nitrobenzene - d5	65%	35 - 114%
2 - Fluorobiphenyl	92%	43 - 116%
2,4,6 - Tribromophenol	67%	10 - 123%
Terphenyl - d14	83%	33 - 141%

References: Method 3510: Separatory Funnel Liquid-Liquid Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments:

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Analyst

[signature]
Review

iml

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WATER QUALITY REPORT

Organics Laboratory
3304 Longmire Drive College Station, Texas 77845
Phone (409) 774-4999 Fax (409) 696-0692

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: MW-22B
Lab ID: 0494W10223/0694GO2128
Matrix: Water
Condition: Intact

Report Date: 03/28/95
Receipt Date: 11/15/94
Sample Date: 11/09/94

Parameter	Concentration		PQL	Method
pH (Lab)	7.6	s.u.	0.1	SW-846 9040
Conductivity (Lab)	6040	mg/L	1	SW-846 9050
Total Dissolved Solids (180° C)	4480	mg/L	10	EPA 160.1
Total Alkalinity (as CaCO3)	163	mg/L	1	EPA 310.1
Total Hardness (as CaCO3)	*1620*	mg/L	*1*	*Calculation*
Fluoride	0.8	mg/L	0.1	EPA 340.2

Calcium	409	mg/L	20.41	meq/L	1 mg/L	SW-846 6010A
Magnesium	145	mg/L	11.93	meq/L	1 mg/L	SW-846 6010A
Potassium	35	mg/L	0.90	meq/L	1 mg/L	SW-846 6010A
Sodium	875	mg/L	38.06	meq/L	1 mg/L	SW-846 6010A
Bicarbonate	199	mg/L	3.26	meq/L	1 mg/L	EPA 310.1
Carbonate	ND*		0.00		1 mg/L	EPA 310.1
Chloride	910	mg/L	25.67	meq/L	1 mg/L	SW-846 9251
Sulfate	1820	mg/L	37.93	meq/L	5 mg/L	SW-846 9036
Major Cation Sum	71.30	meq/L			N/A	Calculation
Major Anion Sum	66.86	meq/L			N/A	Calculation
Cation/Anion Balance	3.21	% Diff			N/A	Calculation

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: MW-22B
Lab ID: 0494W10223/0694GO2128
Matrix: Water
Condition: Intact

Report Date: 03/28/95
Receipt Date: 11/15/94
Sample Date: 11/09/94

Parameter	Concentration	PQL	Method
Total Metals			
Total Arsenic	ND*	0.005 mg/L	SW-846 7061A
Total Chromium	ND*	0.005 mg/L	SW-846 7191
Total Lead	ND*	0.01 mg/L	SW-846 7421
Total Nickel	ND*	0.01 mg/L	SW-846 6010A
Dissolved Metals			
Dissolved Arsenic	ND*	0.005 mg/L	SW-846 7061A
Dissolved Chromium	ND*	0.02 mg/L	SW-846 6010A
Dissolved Lead	ND*	0.01 mg/L	SW-846 7421
Dissolved Nickel	ND*	0.01 mg/L	SW-846 6010A

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

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Laboratory Manager

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EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project :	RFI Phase III / Artesia, NM	Report Date:	11/18/94
Sample ID:	MW-22A	Date Sampled:	11/09/94
Laboratory ID:	0694G02129	Date Received:	11/11/94
Sample Matrix:	Water	Date Extracted:	11/18/94
Preservative:	Cool, HCl	Date Analyzed:	11/18/94
Condition:	Intact, pH<2		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	ND	0.005
Toluene	ND	0.005
Ethylbenzene	ND	0.005
m,p-Xylene	ND	0.005
o-Xylene	ND	0.005
Methyl ethyl ketone	ND	0.005
Carbon disulfide	ND	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	98%	86 - 118%
Toluene - d8	100%	88 - 110%
Bromofluorobenzene	103%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

Review

3304 Longmire
College Station, Texas 77845

EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project:	RFI Phase III / Artesia, NM	Report Date:	11/21/94
Sample ID:	MW - 22A	Date Sampled:	11/09/94
Laboratory ID:	0694G02129	Date Received:	11/11/94
Sample Matrix:	Water	Date Extracted:	11/16/94
Condition:	Intact	Date Analyzed:	11/20/94
Preservative:	Cool		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Acenaphthene	ND	0.050
Acenaphthylene	ND	0.050
Anthracene	ND	0.050
Benzo(a)anthracene	ND	0.050
Benzo(b)fluoranthene	ND	0.050
Benzo(k)fluoranthene	ND	0.050
Benzo(g,h,i)perylene	ND	0.050
Benzo(a)pyrene	ND	0.050
Chrysene	ND	0.050
Dibenz(a,h)anthracene	ND	0.050
Fluoranthene	ND	0.050
Fluorene	ND	0.050
Ideno(1,2,3-cd)pyrene	ND	0.050
Naphthalene	ND	0.050
Phenanthrene	ND	0.050
Pyrene	ND	0.050

ND - *Analyte not detected at stated limit of detection*

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	65%	21 - 110%
Phenol - d5	69%	10 - 110%
Nitrobenzene - d5	75%	35 - 114%
2 - Fluorobiphenyl	81%	43 - 116%
2,4,6 - Tribromophenol	72%	10 - 123%
Terphenyl - d14	82%	33 - 141%

References: Method 3510: Separatory Funnel Liquid-Liquid Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments:

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Inter-Mountain Laboratories, Inc.

Inorganics Laboratory
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Organics Laboratory
3304 Longmire Drive College Station, Texas 77845
Phone (409) 774-4999 Fax (409) 696-0692

WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: MW-22A
Lab ID: 0494W10224/0694G02129
Matrix: Water
Condition: Intact

Report Date: 03/28/95
Receipt Date: 11/15/94
Sample Date: 11/09/94

Parameter	Concentration		PQL	Method
pH (Lab)	7.6	s.u.	0.1	SW-846 9040
Conductivity (Lab)	6760	mg/L	1	SW-846 9050
Total Dissolved Solids (180° C)	4740	mg/L	10	EPA 160.1
Total Alkalinity (as CaCO3)	165	mg/L	1	EPA 310.1
Total Hardness (as CaCO3)	1340	mg/L	1	Calculation
Fluoride	1.1	mg/L	0.1	EPA 340.2

Calcium	374	mg/L	18.66	meq/L	1 mg/L	SW-846 6010A
Magnesium	99	mg/L	8.15	meq/L	1 mg/L	SW-846 6010A
Potassium	6	mg/L	0.15	meq/L	1 mg/L	SW-846 6010A
Sodium	1170	mg/L	51.02	meq/L	1 mg/L	SW-846 6010A
Bicarbonate	201	mg/L	3.29	meq/L	1 mg/L	EPA 310.1
Carbonate	ND*		0.00		1 mg/L	EPA 310.1
Chloride	1170	mg/L	33.09	meq/L	1 mg/L	SW-846 9251
Sulfate	1660	mg/L	34.46	meq/L	5 mg/L	SW-846 9036
Major Cation Sum	77.98	meq/L			N/A	Calculation
Major Anion Sum	70.85	meq/L			N/A	Calculation
Cation/Anion Balance	4.79	% Diff			N/A	Calculation

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

David N Poelstra

David N. Poelstra
Laboratory Manager

iml

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WATER QUALITY REPORT

Organics Laboratory
3304 Longmire Drive College Station, Texas 77845
Phone (409) 774-4999 Fax (409) 696-0692

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: MW-22A
Lab ID: 0494W10224/0694G02129
Matrix: Water
Condition: Intact

Report Date: 03/28/95
Receipt Date: 11/15/94
Sample Date: 11/09/94

Parameter	Concentration	PQL	Method
Total Metals			
Total Arsenic	0.075 mg/L	0.005	SW-846 7061A
Total Chromium	ND*	0.005 mg/L	SW-846 7191
Total Lead	ND*	0.01 mg/L	SW-846 7421
Total Nickel	ND*	0.01 mg/L	SW-846 6010A

Dissolved Metals			
Dissolved Arsenic	0.021 mg/L	0.005	SW-846 7061A
Dissolved Chromium	ND*	0.02 mg/L	SW-846 6010A
Dissolved Lead	ND*	0.01 mg/L	SW-846 7421
Dissolved Nickel	ND*	0.01 mg/L	SW-846 6010A

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

David N. Poelstra

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Laboratory Manager

Inter-Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client: **NAVAJO REFINING COMPANY**
Project : RFI Phase III / Artesia, NM
Sample ID: MW-18B
Laboratory ID: 0694G02130
Sample Matrix: Water
Preservative: Cool, HCl
Condition: Intact, pH<2

Report Date: 11/18/94
Date Sampled: 11/09/94
Date Received: 11/11/94
Date Extracted: 11/18/94
Date Analyzed: 11/18/94

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	ND	0.005
Toluene	ND	0.005
Ethylbenzene	ND	0.005
m,p-Xylene	ND	0.005
o-Xylene	ND	0.005
Methyl ethyl ketone	ND	0.005
Carbon disulfide	ND	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	101%	86 - 118%
Toluene - d8	99%	88 - 110%
Bromofluorobenzene	90%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

Review

Inter-Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project:	RFI Phase III / Artesia, NM	Report Date:	11/21/94
Sample ID:	MW - 18B	Date Sampled:	11/09/94
Laboratory ID:	0694G02130	Date Received:	11/11/94
Sample Matrix:	Water	Date Extracted:	11/16/94
Condition:	Intact	Date Analyzed:	11/20/94
Preservative:	Cool		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Acenaphthene	ND	0.010
Acenaphthylene	ND	0.010
Anthracene	ND	0.010
Benzo(a)anthracene	ND	0.010
Benzo(b)fluoranthene	ND	0.010
Benzo(k)fluoranthene	ND	0.010
Benzo(g,h,i)perylene	ND	0.010
Benzo(a)pyrene	ND	0.010
Chrysene	ND	0.010
Dibenz(a,h)anthracene	ND	0.010
Fluoranthene	ND	0.010
Fluorene	ND	0.010
Ideno(1,2,3-cd)pyrene	ND	0.010
Naphthalene	ND	0.010
Phenanthrene	ND	0.010
Pyrene	ND	0.010

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	58%	21 - 110%
Phenol - d5	62%	10 - 110%
Nitrobenzene - d5	60%	35 - 114%
2 - Fluorobiphenyl	61%	43 - 116%
2,4,6 - Tribromophenol	61%	10 - 123%
Terphenyl - d14	71%	33 - 141%

References: Method 3510: Separatory Funnel Liquid-Liquid Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments:

Ramona R. Dennis
Analyst

[signature]
Review

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WATER QUALITY REPORT

Organics Laboratory
3304 Longmire Drive College Station, Texas 77845
Phone (409) 774-4999 Fax (409) 696-0692

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: MW-18B
Lab ID: 0494W10225/0694G02130
Matrix: Water
Condition: Intact

Report Date: 03/28/95
Receipt Date: 11/15/94
Sample Date: 11/09/94

Parameter	Concentration		PQL	Method
pH (Lab)	7.2 s.u.		0.1	SW-846 9040
Conductivity (Lab)	4680 mg/L		1	SW-846 9050
Total Dissolved Solids (180° C)	3670 mg/L		10	EPA 160.1
Total Alkalinity (as CaCO3)	152 mg/L		1	EPA 310.1
Total Hardness (as CaCO3)	2110 mg/L		1	Calculation
Fluoride	1.0 mg/L		0.1	EPA 340.2

Calcium	576 mg/L	28.74 meq/L	1 mg/L	SW-846 6010A
Magnesium	163 mg/L	13.42 meq/L	1 mg/L	SW-846 6010A
Potassium	4 mg/L	0.11 meq/L	1 mg/L	SW-846 6010A
Sodium	326 mg/L	14.18 meq/L	1 mg/L	SW-846 6010A
Bicarbonate	185 mg/L	3.03 meq/L	1 mg/L	EPA 310.1
Carbonate	ND*	0.00	1 mg/L	EPA 310.1
Chloride	635 mg/L	17.91 meq/L	1 mg/L	SW-846 9251
Sulfate	1590 mg/L	33.17 meq/L	5 mg/L	SW-846 9036
Major Cation Sum	56.45 meq/L		N/A	Calculation
Major Anion Sum	54.12 meq/L		N/A	Calculation
Cation/Anion Balance	2.11 % Diff		N/A	Calculation

***ND - Parameter not detected at stated Practical Quantitation Limit.*

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: MW-18B
Lab ID: 0494W10225/0694G02130
Matrix: Water
Condition: Intact

Report Date: 03/28/95
Receipt Date: 11/15/94
Sample Date: 11/09/94

Parameter	Concentration	PQL	Method
Total Metals			
Total Arsenic	ND*	0.005 mg/L	SW-846 7061A
Total Chromium	ND*	0.005 mg/L	SW-846 7191
Total Lead	ND*	0.01 mg/L	SW-846 7421
Total Nickel	ND*	0.01 mg/L	SW-846 6010A
Dissolved Metals			
Dissolved Arsenic	ND*	0.005 mg/L	SW-846 7061A
Dissolved Chromium	ND*	0.02 mg/L	SW-846 6010A
Dissolved Lead	ND*	0.01 mg/L	SW-846 7421
Dissolved Nickel	ND*	0.01 mg/L	SW-846 6010A

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

David N Poelstra

David N. Poelstra
Laboratory Manager

Inter-Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client: **NAVAJO REFINING COMPANY**
Project : RFI Phase III / Artesia, NM
Sample ID: MW-18A
Laboratory ID: 0694G02131
Sample Matrix: Water
Preservative: Cool, HCl
Condition: Intact, pH<2

Report Date: 11/18/94
Date Sampled: 11/09/94
Date Received: 11/11/94
Date Extracted: 11/18/94
Date Analyzed: 11/18/94

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	ND	0.005
Toluene	ND	0.005
Ethylbenzene	ND	0.005
m,p-Xylene	ND	0.005
o-Xylene	ND	0.005
Methyl ethyl ketone	ND	0.005
Carbon disulfide	ND	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	98%	86 - 118%
Toluene - d8	97%	88 - 110%
Bromofluorobenzene	88%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

Review

Inter-Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project:	RFI Phase III / Artesia, NM	Report Date:	11/21/94
Sample ID:	MW - 18A	Date Sampled:	11/09/94
Laboratory ID:	0694G02131	Date Received:	11/11/94
Sample Matrix:	Water	Date Extracted:	11/16/94
Condition:	Intact	Date Analyzed:	11/20/94
Preservative:	Cool		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Acenaphthene	ND	0.010
Acenaphthylene	ND	0.010
Anthracene	ND	0.010
Benzo(a)anthracene	ND	0.010
Benzo(b)fluoranthene	ND	0.010
Benzo(k)fluoranthene	ND	0.010
Benzo(g,h,i)perylene	ND	0.010
Benzo(a)pyrene	ND	0.010
Chrysene	ND	0.010
Dibenz(a,h)anthracene	ND	0.010
Fluoranthene	ND	0.010
Fluorene	ND	0.010
Ideno(1,2,3-cd)pyrene	ND	0.010
Naphthalene	ND	0.010
Phenanthrene	ND	0.010
Pyrene	ND	0.010

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	53%	21 - 110%
Phenol - d5	53%	10 - 110%
Nitrobenzene - d5	43%	35 - 114%
2 - Fluorobiphenyl	45%	43 - 116%
2,4,6 - Tribromophenol	49%	10 - 123%
Terphenyl - d14	76%	33 - 141%

References: Method 3510: Separatory Funnel Liquid-Liquid Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments:

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: MW-18A
Lab ID: 0494W10226/0694G02131
Matrix: Water
Condition: Intact

Report Date: 03/28/95
Receipt Date: 11/15/94
Sample Date: 11/09/94

Parameter	Concentration		PQL	Method
pH (Lab)	7.3	s.u.	0.1	SW-846 9040
Conductivity (Lab)	23000	mg/L	1	SW-846 9050
Total Dissolved Solids (180° C)	17700	mg/L	10	EPA 160.1
Total Alkalinity (as CaCO3)	328	mg/L	1	EPA 310.1
Total Hardness (as CaCO3)	5760	mg/L	1	Calculation
Fluoride	2.3	mg/L	0.1	EPA 340.2

Calcium	731	mg/L	36.48	meq/L	1 mg/L	SW-846 6010A
Magnesium	956	mg/L	78.68	meq/L	1 mg/L	SW-846 6010A
Potassium	51	mg/L	1.30	meq/L	1 mg/L	SW-846 6010A
Sodium	3980	mg/L	172.99	meq/L	1 mg/L	SW-846 6010A
rbonate	400	mg/L	6.56	meq/L	1 mg/L	EPA 310.1
Carbonate	ND*		0.00		1 mg/L	EPA 310.1
Chloride	5790	mg/L	163.19	meq/L	1 mg/L	SW-846 9251
Sulfate	4880	mg/L	101.54	meq/L	5 mg/L	SW-846 9036
Major Cation Sum	289.45	meq/L			N/A	Calculation
Major Anion Sum	271.29	meq/L			N/A	Calculation
Cation/Anion Balance	3.24	% Diff			N/A	Calculation

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: MW-18A
Lab ID: 0494W10226/0694G02131
Matrix: Water
Condition: Intact

Report Date: 03/28/95
Receipt Date: 11/15/94
Sample Date: 11/09/94

Parameter	Concentration	PQL	Method
Total Metals			
Total Arsenic	ND*	0.005 mg/L	SW-846 7061A
Total Chromium	ND*	0.005 mg/L	SW-846 7191
Total Lead	ND*	0.01 mg/L	SW-846 7421
Total Nickel	ND*	0.01 mg/L	SW-846 6010A

Dissolved Metals			
Dissolved Arsenic	ND*	0.005 mg/L	SW-846 7061A
Dissolved Chromium	ND*	0.02 mg/L	SW-846 6010A
Dissolved Lead	ND*	0.01 mg/L	SW-846 7421
Dissolved Nickel	ND*	0.01 mg/L	SW-846 6010A

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

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Laboratory Manager

3304 Longmire
College Station, Texas 77845

EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project :	RFI Phase III / Artesia, NM	Report Date:	11/18/94
Sample ID:	Trip Blank	Date Sampled:	NA
Laboratory ID:	0694G02132	Date Received:	11/11/94
Sample Matrix:	Water	Date Extracted:	11/18/94
Preservative:	Cool, HCl	Date Analyzed:	11/18/94
Condition:	Intact, pH<2		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	ND	0.005
Toluene	ND	0.005
Ethylbenzene	ND	0.005
m,p-Xylene	ND	0.005
o-Xylene	ND	0.005
Methyl ethyl ketone	ND	0.005
Carbon disulfide	ND	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	98%	86 - 118%
Toluene - d8	96%	88 - 110%
Bromofluorobenzene	87%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

Review

Inter-Mountain Laboratories, Inc.

CHAIN OF CUSTODY RECORD

Client/Project Name	Project Location	
Navajo	Artesia NM	ANALYSES / PARAMETERS
Sampler: (Signature) Brian Sullivan	Chain of Custody Tape No.	

Sample No./ Identification	Date	Time	Lab Number	Matrix	No. of Containers	VOA	SVOA	metals	Gen Chem	Remarks
MW-19	11/10/94	1014	0694G02153	water	6	X	X	X	X	
MW-23		1135	2154	"	6	X	X	X	X	
MW-14		1322	2155	"	6	X	X	X	X	
MW-4		1552	2156	"	8	X	X	X	X	plus herb./pest/ + NMGW Qual metals
Field Duplicate 3			2157	"	8	X	X	X	X	plus herb + pest.
					1	X				
Trip Blk-3			2158							

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
Brian Sullivan	11/12/94	1000	Br... Flat / BG	11/14/94	0715
Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
Relinquished by: (Signature)	Date	Time	Received by laboratory: (Signature)	Date	Time

Inter-Mountain Laboratories, Inc.

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Inter-Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project :	RFI Phase III / Artesia, NM	Report Date:	11/21/94
Sample ID:	MW-19	Date Sampled:	11/10/94
Laboratory ID:	0694G02153	Date Received:	11/14/94
Sample Matrix:	Water	Date Extracted:	11/21/94
Preservative:	Cool, HCl	Date Analyzed:	11/21/94
Condition:	Intact, pH<2		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	ND	0.005
Toluene	ND	0.005
Ethylbenzene	ND	0.005
m,p-Xylene	ND	0.005
o-Xylene	ND	0.005
Methyl ethyl ketone	ND	0.005
Carbon disulfide	ND	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	99%	86 - 118%
Toluene - d8	98%	88 - 110%
Bromofluorobenzene	94%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

Review

Inter-Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project:	RFI Phase III / Artesia, NM	Report Date:	11/21/94
Sample ID:	MW - 19	Date Sampled:	11/10/94
Laboratory ID:	0694G02153	Date Received:	11/14/94
Sample Matrix:	Water	Date Extracted:	11/17/94
Condition:	Intact	Date Analyzed:	11/20/94
Preservative:	Cool		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Acenaphthene	ND	0.020
Acenaphthylene	ND	0.020
Anthracene	ND	0.020
Benzo(a)anthracene	ND	0.020
Benzo(b)fluoranthene	ND	0.020
Benzo(k)fluoranthene	ND	0.020
Benzo(g,h,i)perylene	ND	0.020
Benzo(a)pyrene	ND	0.020
Chrysene	ND	0.020
Dibenz(a,h)anthracene	ND	0.020
Fluoranthene	ND	0.020
Fluorene	ND	0.020
Ideno(1,2,3-cd)pyrene	ND	0.020
Naphthalene	ND	0.020
Phenanthrene	ND	0.020
Pyrene	ND	0.020

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	56%	21 - 110%
Phenol - d5	60%	10 - 110%
Nitrobenzene - d5	51%	35 - 114%
2 - Fluorobiphenyl	59%	43 - 116%
2,4,6 - Tribromophenol	56%	10 - 123%
Terphenyl - d14	72%	33 - 141%

References: Method 3510: Separatory Funnel Liquid-Liquid Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments:

Ramona R. Dennis
Analyst

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11183 SH 30 College Station, Texas 77845

WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: MW-19
Lab ID: 0494W10216/0694G02153
Matrix: Water
Condition: Intact

Report Date: 03/28/95
Receipt Date: 11/15/94
Sample Date: 11/10/94

Parameter	Concentration		PQL	Method
pH (Lab)	7.5	s.u.	0.1	SW-846 9040
Conductivity (Lab)	6990	mg/L	1	SW-846 9050
Total Dissolved Solids (180° C)	5360	mg/L	10	EPA 160.1
Total Alkalinity (as CaCO3)	209	mg/L	1	EPA 310.1
Total Hardness (as CaCO3)	2690	mg/L	1	Calculation
Fluoride	0.9	mg/L	0.1	EPA 340.2

Calcium	720	mg/L	35.93	meq/L	1 mg/L	SW-846 6010A
Magnesium	216	mg/L	17.78	meq/L	1 mg/L	SW-846 6010A
Potassium	11	mg/L	0.28	meq/L	1 mg/L	SW-846 6010A
Sodium	661	mg/L	28.75	meq/L	1 mg/L	SW-846 6010A
Bicarbonate	255	mg/L	4.18	meq/L	1 mg/L	EPA 310.1
Carbonate	ND*		0.00		1 mg/L	EPA 310.1
Chloride	1170	mg/L	32.89	meq/L	1 mg/L	SW-846 9251
Sulfate	2020	mg/L	42.12	meq/L	5 mg/L	SW-846 9036
Major Cation Sum	82.74	meq/L			N/A	Calculation
Major Anion Sum	79.19	meq/L			N/A	Calculation
Cation/Anion Balance	2.19	% Diff			N/A	Calculation

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

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Laboratory Manager

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: MW-19
Lab ID: 0494W10216/0694G02153
Matrix: Water
Condition: Intact

Report Date: 03/28/95
Receipt Date: 11/15/94
Sample Date: 11/10/94

Parameter	Concentration	PQL	Method
Total Metals			
Total Arsenic	0.015 mg/L	0.005	SW-846 7061A
Total Chromium	ND*	0.005 mg/L	SW-846 7191
Total Lead	ND*	0.01 mg/L	SW-846 7421
Total Nickel	ND*	0.01 mg/L	SW-846 6010A

Dissolved Metals			
Dissolved Arsenic	ND*	0.005 mg/L	SW-846 7061A
Dissolved Chromium	ND*	0.02 mg/L	SW-846 6010A
Dissolved Lead	ND*	0.01 mg/L	SW-846 7421
Dissolved Nickel	ND*	0.01 mg/L	SW-846 6010A

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

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3304 Longmire
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EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project :	RFI Phase III / Artesia, NM	Report Date:	11/21/94
Sample ID:	MW-23	Date Sampled:	11/10/94
Laboratory ID:	0694G02154	Date Received:	11/14/94
Sample Matrix:	Water	Date Extracted:	11/21/94
Preservative:	Cool, HCl	Date Analyzed:	11/21/94
Condition:	Intact, pH<2		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	ND	0.005
Toluene	ND	0.005
Ethylbenzene	ND	0.005
m,p-Xylene	ND	0.005
o-Xylene	ND	0.005
Methyl ethyl ketone	ND	0.005
Carbon disulfide	ND	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	99%	86 - 118%
Toluene - d8	96%	88 - 110%
Bromofluorobenzene	89%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

Review

3304 Longmire
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EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project:	RFI Phase III / Artesia, NM	Report Date:	11/21/94
Sample ID:	MW - 23	Date Sampled:	11/10/94
Laboratory ID:	0694G02154	Date Received:	11/14/94
Sample Matrix:	Water	Date Extracted:	11/17/94
Condition:	Intact	Date Analyzed:	11/20/94
Preservative:	Cool		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Acenaphthene	ND	0.010
Acenaphthylene	ND	0.010
Anthracene	ND	0.010
Benzo(a)anthracene	ND	0.010
Benzo(b)fluoranthene	ND	0.010
Benzo(k)fluoranthene	ND	0.010
Benzo(g,h,i)perylene	ND	0.010
Benzo(a)pyrene	ND	0.010
Chrysene	ND	0.010
Dibenz(a,h)anthracene	ND	0.010
Fluoranthene	ND	0.010
Fluorene	ND	0.010
Ideno(1,2,3-cd)pyrene	ND	0.010
Naphthalene	ND	0.010
Phenanthrene	ND	0.010
Pyrene	ND	0.010

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	51%	21 - 110%
Phenol - d5	60%	10 - 110%
Nitrobenzene - d5	62%	35 - 114%
2 - Fluorobiphenyl	61%	43 - 116%
2,4,6 - Tribromophenol	54%	10 - 123%
Terphenyl - d14	68%	33 - 141%

References: Method 3510: Separatory Funnel Liquid-Liquid Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments:

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: MW-23
Lab ID: 0494W10217/0694G02154
Matrix: Water
Condition: Intact

Report Date: 03/28/95
Receipt Date: 11/15/94
Sample Date: 11/10/94

Parameter	Concentration		PQL	Method
pH (Lab)	7.1	s.u.	0.1	SW-846 9040
Conductivity (Lab)	21500	mg/L	1	SW-846 9050
Total Dissolved Solids (180° C)	15600	mg/L	10	EPA 160.1
Total Alkalinity (as CaCO3)	570	mg/L	1	EPA 310.1
Total Hardness (as CaCO3)	4650	mg/L	1	Calculation
Fluoride	0.8	mg/L	0.1	EPA 340.2

Calcium	1033	mg/L	51.55	meq/L	1 mg/L	SW-846 6010A
Magnesium	504	mg/L	41.48	meq/L	1 mg/L	SW-846 6010A
Potassium	15	mg/L	0.38	meq/L	1 mg/L	SW-846 6010A
Sodium	3800	mg/L	165.46	meq/L	1 mg/L	SW-846 6010A
Bicarbonate	695	mg/L	11.39	meq/L	1 mg/L	EPA 310.1
Carbonate	ND*		0.00		1 mg/L	EPA 310.1
Chloride	5560	mg/L	156.87	meq/L	1 mg/L	SW-846 9251
Sulfate	3800	mg/L	79.03	meq/L	5 mg/L	SW-846 9036
Major Cation Sum	258.87	meq/L			N/A	Calculation
Major Anion Sum	247.30	meq/L			N/A	Calculation
Cation/Anion Balance	2.29	% Diff			N/A	Calculation

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: MW-23
Lab ID: 0494W10217/0694G02154
Matrix: Water
Condition: Intact

Report Date: 03/28/95
Receipt Date: 11/15/94
Sample Date: 11/10/94

Parameter	Concentration	PQL	Method
Total Metals			
Total Arsenic	0.034 mg/L	0.005	SW-846 7061A
Total Chromium	ND*	0.005 mg/L	SW-846 7191
Total Lead	ND*	0.01 mg/L	SW-846 7421
Total Nickel	ND*	0.01 mg/L	SW-846 6010A

Dissolved Metals			
Dissolved Arsenic	0.015 mg/L	0.005	SW-846 7061A
Dissolved Chromium	ND*	0.02 mg/L	SW-846 6010A
Dissolved Lead	ND*	0.01 mg/L	SW-846 7421
Dissolved Nickel	ND*	0.01 mg/L	SW-846 6010A

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

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EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project :	RFI Phase III / Artesia, NM	Report Date:	11/21/94
Sample ID:	MW-14	Date Sampled:	11/10/94
Laboratory ID:	0694G02155	Date Received:	11/14/94
Sample Matrix:	Water	Date Extracted:	11/21/94
Preservative:	Cool, HCl	Date Analyzed:	11/21/94
Condition:	Intact, pH<2		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	ND	0.005
Toluene	ND	0.005
Ethylbenzene	ND	0.005
m,p-Xylene	ND	0.005
o-Xylene	ND	0.005
Methyl ethyl ketone	ND	0.005
Carbon disulfide	ND	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	98%	86 - 118%
Toluene - d8	94%	88 - 110%
Bromofluorobenzene	97%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

Review

3304 Longmire
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EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project:	RFI Phase III / Artesia, NM	Report Date:	11/21/94
Sample ID:	MW - 14	Date Sampled:	11/10/94
Laboratory ID:	0694G02155	Date Received:	11/14/94
Sample Matrix:	Water	Date Extracted:	11/17/94
Condition:	Intact	Date Analyzed:	11/20/94
Preservative:	Cool		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Acenaphthene	ND	0.040
Acenaphthylene	ND	0.040
Anthracene	ND	0.040
Benzo(a)anthracene	ND	0.040
Benzo(b)fluoranthene	ND	0.040
Benzo(k)fluoranthene	ND	0.040
Benzo(g,h,i)perylene	ND	0.040
Benzo(a)pyrene	ND	0.040
Chrysene	ND	0.040
Dibenz(a,h)anthracene	ND	0.040
Fluoranthene	ND	0.040
Fluorene	ND	0.040
Ideno(1,2,3-cd)pyrene	ND	0.040
Naphthalene	ND	0.040
Phenanthrene	ND	0.040
Pyrene	ND	0.040

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	50%	21 - 110%
Phenol - d5	63%	10 - 110%
Nitrobenzene - d5	66%	35 - 114%
2 - Fluorobiphenyl	74%	43 - 116%
2,4,6 - Tribromophenol	66%	10 - 123%
Terphenyl - d14	76%	33 - 141%

References: Method 3510: Separatory Funnel Liquid-Liquid Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments:

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: MW-14
Lab ID: 0494W10218/0694G02155
Matrix: Water
Condition: Intact

Report Date: 03/28/95
Receipt Date: 11/15/94
Sample Date: 11/10/94

Parameter	Concentration		PQL	Method
pH (Lab)	7.2	s.u.	0.1	SW-846 9040
Conductivity (Lab)	16800	mg/L	1	SW-846 9050
Total Dissolved Solids (180° C)	12600	mg/L	10	EPA 160.1
Total Alkalinity (as CaCO3)	1100	mg/L	1	EPA 310.1
Total Hardness (as CaCO3)	3760	mg/L	1	Calculation
Fluoride	0.8	mg/L	0.1	EPA 340.2

Calcium	733	mg/L	36.58	meq/L	1 mg/L	SW-846 6010A
Magnesium	469	mg/L	38.60	meq/L	1 mg/L	SW-846 6010A
Potassium	10	mg/L	0.26	meq/L	1 mg/L	SW-846 6010A
Sodium	2960	mg/L	128.71	meq/L	1 mg/L	SW-846 6010A
Bicarbonate	1344	mg/L	22.03	meq/L	1 mg/L	EPA 310.1
Carbonate	ND*		0.00		1 mg/L	EPA 310.1
Chloride	3680	mg/L	103.92	meq/L	1 mg/L	SW-846 9251
Sulfate	3760	mg/L	78.18	meq/L	5 mg/L	SW-846 9036
Major Cation Sum	204.15	meq/L			N/A	Calculation
Major Anion Sum	204.14	meq/L			N/A	Calculation
Cation/Anion Balance	0.00	% Diff			N/A	Calculation

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: MW-14
Lab ID: 0494W10218/0694G02155
Matrix: Water
Condition: Intact

Report Date: 03/28/95
Receipt Date: 11/15/94
Sample Date: 11/10/94

Parameter	Concentration	PQL	Method
Total Metals			
Total Arsenic	0.087 mg/L	0.005	SW-846 7061A
Total Chromium	ND*	0.005 mg/L	SW-846 7191
Total Lead	ND*	0.01 mg/L	SW-846 7421
Total Nickel	ND*	0.01 mg/L	SW-846 6010A

Dissolved Metals			
Dissolved Arsenic	0.040 mg/L	0.005	SW-846 7061A
Dissolved Chromium	ND*	0.02 mg/L	SW-846 6010A
Dissolved Lead	ND*	0.01 mg/L	SW-846 7421
Dissolved Nickel	ND*	0.01 mg/L	SW-846 6010A

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

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EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client: **NAVAJO REFINING COMPANY**
Project : RFI Phase III / Artesia, NM
Sample ID: MW-4
Laboratory ID: 0694G02156
Sample Matrix: Water
Preservative: Cool, HCl
Condition: Intact, pH<2

Report Date: 11/21/94
Date Sampled: 11/10/94
Date Received: 11/14/94
Date Extracted: 11/21/94
Date Analyzed: 11/21/94

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	0.013	0.005
Toluene	0.006	0.005
Ethylbenzene	0.015	0.005
m,p-Xylene	0.006	0.005
o-Xylene	0.022	0.005
Methyl ethyl ketone	ND	0.005
Carbon disulfide	ND	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	98%	86 - 118%
Toluene - d8	99%	88 - 110%
Bromofluorobenzene	103%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

Review

Inter·Mountain Laboratories, Inc.

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EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project:	RFI Phase III / Artesia, NM	Report Date:	11/22/94
Sample ID:	MW - 4	Date Sampled:	11/10/94
Laboratory ID:	0694G02156	Date Received:	11/14/94
Sample Matrix:	Water	Date Extracted:	11/17/94
Condition:	Intact	Date Analyzed:	11/21/94
Preservative:	Cool		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Acenaphthene	ND	0.10
Acenaphthylene	ND	0.10
Anthracene	ND	0.10
Benzo(a)anthracene	ND	0.10
Benzo(b)fluoranthene	ND	0.10
Benzo(k)fluoranthene	ND	0.10
Benzo(g,h,i)perylene	ND	0.10
Benzo(a)pyrene	ND	0.10
Chrysene	ND	0.10
Dibenz(a,h)anthracene	ND	0.10
Fluoranthene	ND	0.10
Fluorene	ND	0.10
Ideno(1,2,3-cd)pyrene	ND	0.10
Naphthalene	ND	0.10
Phenanthrene	ND	0.10
Pyrene	ND	0.10

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	54%	21 - 110%
Phenol - d5	67%	10 - 110%
Nitrobenzene - d5	52%	35 - 114%
2 - Fluorobiphenyl	77%	43 - 116%
2,4,6 - Tribromophenol	57%	10 - 123%
Terphenyl - d14	77%	33 - 141%

References: Method 3510: Separatory Funnel Liquid-Liquid Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments:

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III
Sample ID: MW-4
Lab ID: 0494W10214/0694G02156
Matrix: Water
Condition: Intact

Report Date: 03/28/95
Receipt Date: 11/15/94
Sample Date: 11/10/94

Parameter	Concentration				PQL	Method
pH (Lab)	7.4	s.u.			0.1	SW-846 9040
Conductivity (Lab)	7480	μmhos/cm			1	SW-846 9050
Total Dissolved Solids (180° C)	5410	mg/L			10	EPA 160.1
Total Alkalinity (as CaCO3)	255	mg/L			1	EPA 310.1
Total Hardness (as CaCO3)	1810	mg/L			1	Calculation
Fluoride	1.9	mg/L			0.1	EPA 340.2
Calcium	495	mg/L	24.70	meq/L	1 mg/L	SW-846 6010A
Magnesium	139	mg/L	11.44	meq/L	1 mg/L	SW-846 6010A
Potassium	3	mg/L	0.07	meq/L	1 mg/L	SW-846 6010A
Sodium	1230	mg/L	53.54	meq/L	1 mg/L	SW-846 6010A
Bicarbonate	311	mg/L	5.10	meq/L	1 mg/L	EPA 310.1
Carbonate	ND*		0.00		1 mg/L	EPA 310.1
Chloride	1310	mg/L	36.87	meq/L	1 mg/L	SW-846 9251
Sulfate	2370	mg/L	49.24	meq/L	5 mg/L	SW-846 9036
Major Cation Sum	89.76	meq/L			N/A	Calculation
Major Anion Sum	91.21	meq/L			N/A	Calculation
Cation/Anion Balance	-0.80	% Diff			N/A	Calculation
Total Metals						
Total Arsenic	0.156	mg/L			0.005	SW-846 7061A
Total Chromium	0.090	mg/L			0.005	SW-846 7191
Total Lead	0.07	mg/L			0.01	SW-846 7421
Total Nickel	0.13	mg/L			0.05	SW-846 7520

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III
Sample ID: MW-4
Lab ID: 0494W10214/0694G02156
Matrix: Water
Condition: Intact

Report Date: 03/28/95
Receipt Date: 11/15/94
Sample Date: 11/10/94

Parameter	Concentration	PQL	Method
Dissolved Aluminum	ND*	0.1 mg/L	SW-846 6010A
Dissolved Antimony	ND*	0.1 mg/L	SW-846 6010A
Dissolved Arsenic	0.076 mg/L	0.005	SW-846 7061A
Dissolved Barium	ND*	0.05 mg/L	SW-846 6010A
Dissolved Beryllium	ND*	0.01 mg/L	SW-846 6010A
Dissolved Boron	0.74 mg/L	0.05	SW-846 6010A
Dissolved Cadmium	0.04 mg/L	0.02	SW-846 6010A
Dissolved Chromium	ND*	0.02 mg/L	SW-846 6010A
Dissolved Cobalt	ND*	0.02 mg/L	SW-846 6010A
Dissolved Copper	ND*	0.01 mg/L	SW-846 6010A
Dissolved Iron	2.40 mg/L	0.05	SW-846 6010A
Dissolved Lead	ND*	0.1 mg/L	SW-846 6010A
Dissolved Manganese	2.61 mg/L	0.02	SW-846 6010A
Dissolved Molybdenum	ND*	0.05 mg/L	SW-846 6010A
Dissolved Nickel	ND*	0.05 mg/L	SW-846 7520
Dissolved Selenium	ND*	0.2 mg/L	SW-846 6010A
Dissolved Silica	30.72 mg/L	0.05	SW-846 6010A
Dissolved Silver	ND*	0.01 mg/L	SW-846 6010A
Dissolved Thallium	ND*	0.2 mg/L	SW-846 6010A
Dissolved Vanadium	ND*	0.01 mg/L	SW-846 6010A
Dissolved Zinc	ND*	0.01 mg/L	SW-846 6010A

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

David N Poelstra

David N. Poelstra
Laboratory Manager

Inter-Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8141
ORGANOPHOSPHORUS COMPOUNDS

Client: **NAVAJO REFINING COMPANY**
Project : RFI Phase III / Artesia, NM
Sample ID: MW-4
Laboratory ID: 0694G02156
Sample Matrix: Water
Preservative: Cool
Condition: Intact

Report Date: 12/12/94
Date Sampled: 11/10/94
Date Received: 11/14/94
Date Extracted: 11/17/94
Date Analyzed: 12/08/94

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Azinphos Methyl	ND	0.0002
Bolstar	ND	0.0002
Chlorpyrifos	ND	0.0002
Coumaphos	ND	0.0004
Demeton	ND	0.0002
Diazinon	ND	0.0002
Dichlorvos	ND	0.0002
Dimethoate	ND	0.001
Disulfoton	ND	0.0002
EPN	ND	0.0002
Ethoprop	ND	0.0002
Fensulfothion	ND	0.001
Fenthion	ND	0.0002
Malathion	ND	0.0002
Merphos	ND	0.0002
Mevinphos	ND	0.001
Monocrotophos	ND	0.001
Naled	ND	0.002
Ethyl Parathion	ND	0.0002
Methyl Parathion	ND	0.0002
Phorate	ND	0.0002
Ronnel	ND	0.0002
Sulfotep	ND	0.0002
Tetrachlorovinphos	ND	0.0002
TEPP	ND	0.0002
Tokuthion	ND	0.0002
Trichloronate	ND	0.0002

ND - Analyte not detected at stated limit of detection

Reference: Method 8141: Organophosphorus Compounds by Gas Chromatography: Capillary Column Technique. Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments:

3304 Longmire
College Station, Texas 77845

EPA Method 8151
CHLORINATED HERBICIDES

Client:	**NAVAJO REFINING COMPANY**		
Project Name:	RFI Phase III / Artesia, NM	Report Date:	12/09/94
Sample ID:	MW - 4	Date Sampled:	11/10/94
Sample Number:	0694G02156	Date Received:	11/14/94
Sample Matrix:	Water	Date Extracted:	11/17/94
Preservative:	Cool	Date Analyzed:	12/07/94
Condition:	Intact		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Dalapon	ND	0.01
3,5-Dichlorobenzoic acid	ND	0.01
4-Nitrophenol	ND	0.01
Dicamba	ND	0.01
MCPP	ND	1
MCPA	ND	1
Dichlorprop	ND	0.01
2,4-D	ND	0.01
Pentachlorophenol	ND	0.01
Chloramben	ND	0.01
2.4.5 - TP	ND	0.01
2,4,5 - T (Silvex)	ND	0.01
2,4 - DB	ND	0.01
Dinoseb	ND	0.01
Bentazon	ND	0.01
Picloram	ND	0.01
DCPA	ND	0.01
Acifluorfen	ND	0.01

ND - Analyte not detected at stated detection limit

Reference: Method 8151: Chlorinated Herbicides
Test Methods for Evaluating Solid Wastes, SW-846, United States Environmental Protection Agency, Final Update I, July 1992.

Analyst

Review

3304 Longmire
College Station, Texas 77845

EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project :	RFI Phase III / Artesia, NM	Report Date:	11/22/94
Sample ID:	Field Duplicate 3	Date Sampled:	11/10/94
Laboratory ID:	0694G02157	Date Received:	11/14/94
Sample Matrix:	Water	Date Extracted:	11/22/94
Preservative:	Cool, HCl	Date Analyzed:	11/22/94
Condition:	Intact, pH=8-9		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	0.014	0.005
Toluene	0.006	0.005
Ethylbenzene	0.016	0.005
m,p-Xylene	0.007	0.005
o-Xylene	0.025	0.005
Methyl ethyl ketone	ND	0.005
Carbon disulfide	ND	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	102%	86 - 118%
Toluene - d8	100%	88 - 110%
Bromofluorobenzene	104%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

Review

3304 Longmire
College Station, Texas 77845

EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project:	RFI Phase III / Artesia, NM	Report Date:	11/21/94
Sample ID:	Field Duplicate 3	Date Sampled:	11/10/94
Laboratory ID:	0694G02157	Date Received:	11/14/94
Sample Matrix:	Water	Date Extracted:	11/17/94
Condition:	Intact	Date Analyzed:	11/20/94
Preservative:	Cool		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Acenaphthene	ND	0.10
Acenaphthylene	ND	0.10
Anthracene	ND	0.10
Benzo(a)anthracene	ND	0.10
Benzo(b)fluoranthene	ND	0.10
Benzo(k)fluoranthene	ND	0.10
Benzo(g,h,i)perylene	ND	0.10
Benzo(a)pyrene	ND	0.10
Chrysene	ND	0.10
Dibenz(a,h)anthracene	ND	0.10
Fluoranthene	ND	0.10
Fluorene	ND	0.10
Ideno(1,2,3-cd)pyrene	ND	0.10
Naphthalene	ND	0.10
Phenanthrene	ND	0.10
Pyrene	ND	0.10

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	35%	21 - 110%
Phenol - d5	45%	10 - 110%
Nitrobenzene - d5	41%	35 - 114%
2 - Fluorobiphenyl	55%	43 - 116%
2,4,6 - Tribromophenol	45%	10 - 123%
Terphenyl - d14	59%	33 - 141%

References: Method 3510: Separatory Funnel Liquid-Liquid Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments:

Ramona R. Dennis
Analyst

Review

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11183 SH 30 College Station, Texas 77845

WATER QUALITY REPORT

Client: Navajo Refining Co.

Project: RFI Phase III / Artesia, NM

Sample ID: FIELD DUP #3

Lab ID: 0494W10219/0694G02157

Matrix: Water

Condition: Intact

Report Date: 03/28/95

Receipt Date: 11/15/94

Sample Date: 11/10/94

Parameter	Concentration		PQL	Method
pH (Lab)	7.1	s.u.	0.1	SW-846 9040
Conductivity (Lab)	7690	mg/L	1	SW-846 9050
Total Dissolved Solids (180° C)	5600	mg/L	10	EPA 160.1
Total Alkalinity (as CaCO3)	496	mg/L	1	EPA 310.1
Total Hardness (as CaCO3)	1900	mg/L	1	Calculation
Fluoride	1.7	mg/L	0.1	EPA 340.2

Calcium	502	mg/L	25.05	meq/L	1 mg/L	SW-846 6010A
Magnesium	156	mg/L	12.84	meq/L	1 mg/L	SW-846 6010A
Potassium	5	mg/L	0.12	meq/L	1 mg/L	SW-846 6010A
Sodium	1240	mg/L	53.98	meq/L	1 mg/L	SW-846 6010A
Bicarbonate	605	mg/L	9.92	meq/L	1 mg/L	EPA 310.1
Carbonate	ND*		0.00		1 mg/L	EPA 310.1
Chloride	1390	mg/L	39.15	meq/L	1 mg/L	SW-846 9251
Sulfate	1900	mg/L	39.52	meq/L	5 mg/L	SW-846 9036
Major Cation Sum	91.99	meq/L			N/A	Calculation
Major Anion Sum	88.58	meq/L			N/A	Calculation
Cation/Anion Balance	1.89	% Diff			N/A	Calculation

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

David N. Poelstra

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Laboratory Manager

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11183 SH 30 College Station, Texas 77845

WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: FIELD DUP #3
Lab ID: 0494W10219/0694G02157
Matrix: Water
Condition: Intact

Report Date: 03/28/95
Receipt Date: 11/15/94
Sample Date: 11/10/94

Parameter	Concentration	PQL	Method
Total Metals			
Total Arsenic	0.143 mg/L	0.005	SW-846 7061A
Total Chromium	0.063 mg/L	0.005	SW-846 7191
Total Lead	0.06 mg/L	0.01	SW-846 7421
Total Nickel	0.07 mg/L	0.05	SW-846 7520

Dissolved Metals			
Dissolved Arsenic	0.083 mg/L	0.005	SW-846 7061A
Dissolved Chromium	ND*	0.02 mg/L	SW-846 6010A
Dissolved Lead	ND*	0.01 mg/L	SW-846 7421
Dissolved Nickel	ND*	0.01 mg/L	SW-846 6010A

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

David N Poelstra

David N. Poelstra
Laboratory Manager

Inter-Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8141
ORGANOPHOSPHORUS COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project :	RFI Phase III / Artesia, NM	Report Date:	12/12/94
Sample ID:	Field Duplicate 3	Date Sampled:	11/10/94
Laboratory ID:	0694G02157	Date Received:	11/14/94
Sample Matrix:	Water	Date Extracted:	11/17/94
Preservative:	Cool	Date Analyzed:	12/08/94
Condition:	Intact		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Azinphos Methyl	ND	0.0002
Bolstar	ND	0.0002
Chlorpyrifos	ND	0.0002
Coumaphos	ND	0.0004
Demeton	ND	0.0002
Diazinon	ND	0.0002
Dichlorvos	ND	0.0002
Dimethoate	ND	0.001
Disulfoton	ND	0.0002
EPN	ND	0.0002
Ethoprop	ND	0.0002
Fensulfothion	ND	0.001
Fenthion	ND	0.0002
Malathion	ND	0.0002
Merphos	ND	0.0002
Mevinphos	ND	0.001
Monocrotophos	ND	0.001
Naled	ND	0.002
Ethyl Parathion	ND	0.0002
Methyl Parathion	ND	0.0002
Phorate	ND	0.0002
Ronnel	ND	0.0002
Sulfotep	ND	0.0002
Tetrachlorovinphos	ND	0.0002
TEPP	ND	0.0002
Tokuthion	ND	0.0002
Trichloronate	ND	0.0002

ND - Analyte not detected at stated limit of detection

Reference: Method 8141: Organophosphorus Compounds by Gas Chromatography: Capillary Column Technique. Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments:

Inter-Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8151
CHLORINATED HERBICIDES

Client: NAVAJO REFINING COMPANY
Project Name: RFI Phase III / Artesia, NM
Sample ID: Field Duplicate 3
Sample Number: 0694G02157
Sample Matrix: Water
Preservative: Cool
Condition: Intact

Report Date: 12/09/94
Date Sampled: 11/10/94
Date Received: 11/14/94
Date Extracted: 11/17/94
Date Analyzed: 12/07/94

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Dalapon	ND	0.01
3,5-Dichlorobenzoic acid	ND	0.01
4-Nitrophenol	ND	0.01
Dicamba	ND	0.01
MCPP	ND	1
MCPA	ND	1
Dichlorprop	ND	0.01
2,4-D	ND	0.01
Pentachlorophenol	ND	0.01
Chloramben	ND	0.01
2.4.5 - TP	ND	0.01
2,4,5 - T (Silvex)	ND	0.01
2,4 - DB	ND	0.01
Dinoseb	ND	0.01
Bentazon	ND	0.01
Picloram	ND	0.01
DCPA	ND	0.01
Acifluorfen	ND	0.01

ND - Analyte not detected at stated detection limit

Reference: Method 8151: Chlorinated Herbicides
Test Methods for Evaluating Solid Wastes, SW-846, United States Environmental Protection Agency, Final Update I, July 1992.

Ben L W

Analyst

Wendi M Kog

Review

Inter·Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client: **NAVAJO REFINING COMPANY**
Project : RFI Phase III / Artesia, NM
Sample ID: Trip Blank-3
Laboratory ID: 0694G02158
Sample Matrix: Water
Preservative: Cool, HCl
Condition: Intact, pH<2

Report Date: 11/22/94
Date Sampled: NA
Date Received: 11/14/94
Date Extracted: 11/22/94
Date Analyzed: 11/22/94

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	ND	0.005
Toluene	ND	0.005
Ethylbenzene	ND	0.005
m,p-Xylene	ND	0.005
o-Xylene	ND	0.005
Methyl ethyl ketone	ND	0.005
Carbon disulfide	ND	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	103%	86 - 118%
Toluene - d8	99%	88 - 110%
Bromofluorobenzene	90%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

Review

Inter-Mountain Laboratories, Inc.

CHAIN OF CUSTODY RECORD

Client/Project Name	Project Location
Navajo	Artesia NM

Sampler: (Signature)	Chain of Custody Tape No.
Brian Sullivan	

ANALYSES / PARAMETERS

Sample No./ Identification	Date	Time	Lab Number	Matrix	No. of Containers	VOAs	SVOAs	metals	Gen Chem	Remarks
MW-46	11/11/94	0810	06942159	Water	6	X	X	X	X	
MW-45		0856	2160	water	~~6~~4	X	X	X	X	VOA's Left out / BG
MW-30		1038	2161	"	"	X	X	X	X	
Equipment Blank 7		1117	2162	"	3	X		X		
DAF Unit		1158	2163	"	2	X				
Trickle Filter		1222	2164	"	2	X				
Field Duplicate 4			2165	"	5	X	X	X		
TRIP BLK - 2			2166	"	1	X				

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
Brian Sullivan	1000	11/12/94	Aaron Hart / BG	11/14/94	0915
Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
Relinquished by: (Signature)	Date	Time	Received by laboratory: (Signature)	Date	Time

Inter-Mountain Laboratories, Inc.

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☐ 11183 SH 30, College Station, TX 77845, Telephone (409) 776-8945

☐ 3304 Longmire Drive, College Station, TX 77845, Telephone (409) 774-4999

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Inter-Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project :	RFI Phase III / Artesia, NM	Report Date:	11/22/94
Sample ID:	MW-46	Date Sampled:	11/11/94
Laboratory ID:	0694G02159	Date Received:	11/14/94
Sample Matrix:	Water	Date Extracted:	11/22/94
Preservative:	Cool, HCl	Date Analyzed:	11/22/94
Condition:	Intact, pH<2		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	ND	0.005
Toluene	ND	0.005
Ethylbenzene	ND	0.005
m,p-Xylene	ND	0.005
o-Xylene	ND	0.005
Methyl ethyl ketone	ND	0.005
Carbon disulfide	ND	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	102%	86 - 118%
Toluene - d8	103%	88 - 110%
Bromofluorobenzene	94%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

Review

Inter-Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project:	RFI Phase III / Artesia, NM	Report Date:	11/23/94
Sample ID:	MW - 46	Date Sampled:	11/11/94
Laboratory ID:	0694G02159	Date Received:	11/14/94
Sample Matrix:	Water	Date Extracted:	11/18/94
Condition:	Intact	Date Analyzed:	11/22/94
Preservative:	Cool		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Acenaphthene	ND	0.010
Acenaphthylene	ND	0.010
Anthracene	ND	0.010
Benzo(a)anthracene	ND	0.010
Benzo(b)fluoranthene	ND	0.010
Benzo(k)fluoranthene	ND	0.010
Benzo(g,h,i)perylene	ND	0.010
Benzo(a)pyrene	ND	0.010
Chrysene	ND	0.010
Dibenz(a,h)anthracene	ND	0.010
Fluoranthene	ND	0.010
Fluorene	ND	0.010
Ideno(1,2,3-cd)pyrene	ND	0.010
Naphthalene	ND	0.010
Phenanthrene	ND	0.010
Pyrene	ND	0.010

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	66%	21 - 110%
Phenol - d5	66%	10 - 110%
Nitrobenzene - d5	74%	35 - 114%
2 - Fluorobiphenyl	70%	43 - 116%
2,4,6 - Tribromophenol	77%	10 - 123%
Terphenyl - d14	74%	33 - 141%

References: Method 3510: Separatory Funnel Liquid-Liquid Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments:

Ramona R. Dennis
Analyst

Ulond McRoy
Review

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: MW-46
Lab ID: 0494W10220/0694G02159
Matrix: Water
Condition: Intact

Report Date: 03/28/95
Receipt Date: 11/15/94
Sample Date: 11/11/94

Parameter	Concentration		PQL	Method
pH (Lab)	7.1	s.u.	0.1	SW-846 9040
Conductivity (Lab)	4410	mg/L	1	SW-846 9050
Total Dissolved Solids (180° C)	3880	mg/L	10	EPA 160.1
Total Alkalinity (as CaCO3)	329	mg/L	1	EPA 310.1
Total Hardness (as CaCO3)	2620	mg/L	1	Calculation
Fluoride	2.4	mg/L	0.1	EPA 340.2

Calcium	641	mg/L	31.99	meq/L	1 mg/L	SW-846 6010A
Magnesium	247	mg/L	20.33	meq/L	1 mg/L	SW-846 6010A
Potassium	14	mg/L	0.36	meq/L	1 mg/L	SW-846 6010A
Sodium	205	mg/L	8.92	meq/L	1 mg/L	SW-846 6010A
Bicarbonate	401	mg/L	6.57	meq/L	1 mg/L	EPA 310.1
Carbonate	ND*		0.00		1 mg/L	EPA 310.1
Chloride	369	mg/L	10.41	meq/L	1 mg/L	SW-846 9251
Sulfate	2020	mg/L	42.12	meq/L	5 mg/L	SW-846 9036
Major Cation Sum	61.60	meq/L			N/A	Calculation
Major Anion Sum	59.10	meq/L			N/A	Calculation
Cation/Anion Balance	2.07	% Diff			N/A	Calculation

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

David N Poelstra

David N. Poelstra
Laboratory Manager

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WATER QUALITY REPORT

Organics Laboratory
3304 Longmire Drive College Station, Texas 77845
Phone (409) 774-4999 Fax (409) 696-0692

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: MW-46
Lab ID: 0494W10220/0694G02159
Matrix: Water
Condition: Intact

Report Date: 03/28/95
Receipt Date: 11/15/94
Sample Date: 11/11/94

Parameter	Concentration	PQL	Method
Total Metals			
Total Arsenic	ND*	0.005 mg/L	SW-846 7061A
Total Chromium	ND*	0.005 mg/L	SW-846 7191
Total Lead	0.01 mg/L	0.01	SW-846 7421
Total Nickel	ND*	0.01 mg/L	SW-846 6010A
Dissolved Metals			
Dissolved Arsenic	ND*	0.005 mg/L	SW-846 7061A
Dissolved Chromium	ND*	0.02 mg/L	SW-846 6010A
Dissolved Lead	ND*	0.01 mg/L	SW-846 7421
Dissolved Nickel	ND*	0.01 mg/L	SW-846 6010A

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

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3304 Longmire
College Station, Texas 77845

EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project :	RFI Phase III / Artesia, NM	Report Date:	11/22/94
Sample ID:	MW-45	Date Sampled:	11/11/94
Laboratory ID:	0694G02160	Date Received:	11/15/94
Sample Matrix:	Water	Date Extracted:	11/22/94
Preservative:	Cool, HCl	Date Analyzed:	11/22/94
Condition:	Intact, pH<2		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	ND	0.005
Toluene	ND	0.005
Ethylbenzene	ND	0.005
m,p-Xylene	ND	0.005
o-Xylene	ND	0.005
Methyl ethyl ketone	ND	0.005
Carbon disulfide	ND	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	103%	86 - 118%
Toluene - d8	101%	88 - 110%
Bromofluorobenzene	106%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

Review

Inter·Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project:	RFI Phase III / Artesia, NM	Report Date:	11/22/94
Sample ID:	MW - 45	Date Sampled:	11/11/94
Laboratory ID:	0694G02160	Date Received:	11/14/94
Sample Matrix:	Water	Date Extracted:	11/18/94
Condition:	Intact	Date Analyzed:	11/21/94
Preservative:	Cool		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Acenaphthene	ND	0.020
Acenaphthylene	ND	0.020
Anthracene	ND	0.020
Benzo(a)anthracene	ND	0.020
Benzo(b)fluoranthene	ND	0.020
Benzo(k)fluoranthene	ND	0.020
Benzo(g,h,i)perylene	ND	0.020
Benzo(a)pyrene	ND	0.020
Chrysene	ND	0.020
Dibenz(a,h)anthracene	ND	0.020
Fluoranthene	ND	0.020
Fluorene	ND	0.020
Ideno(1,2,3-cd)pyrene	ND	0.020
Naphthalene	ND	0.020
Phenanthrene	ND	0.020
Pyrene	ND	0.020

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	56%	21 - 110%
Phenol - d5	63%	10 - 110%
Nitrobenzene - d5	70%	35 - 114%
2 - Fluorobiphenyl	71%	43 - 116%
2,4,6 - Tribromophenol	81%	10 - 123%
Terphenyl - d14	86%	33 - 141%

References: Method 3510: Separatory Funnel Liquid-Liquid Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments:

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: MW-45
Lab ID: 0494W10221/0694G02160
Matrix: Water
Condition: Intact

Report Date: 03/28/95
Receipt Date: 11/15/94
Sample Date: 11/11/94

Parameter	Concentration				PQL	Method
pH (Lab)	6.9	s.u.			0.1	SW-846 9040
Conductivity (Lab)	7450	mg/L			1	SW-846 9050
Total Dissolved Solids (180° C)	6590	mg/L			10	EPA 160.1
Total Alkalinity (as $CaCO_3$)	249	mg/L			1	EPA 310.1
Total Hardness (as $CaCO_3$)	4000	mg/L			1	Calculation
Fluoride	2.1	mg/L			0.1	EPA 340.2
Calcium	865	mg/L	43.16	meq/L	1 mg/L	SW-846 6010A
Magnesium	447	mg/L	36.79	meq/L	1 mg/L	SW-846 6010A
Potassium	14	mg/L	0.36	meq/L	1 mg/L	SW-846 6010A
Sodium	463	mg/L	20.14	meq/L	1 mg/L	SW-846 6010A
Bicarbonate	303	mg/L	4.97	meq/L	1 mg/L	EPA 310.1
Carbonate	ND*		0.00		1 mg/L	EPA 310.1
Chloride	939	mg/L	26.49	meq/L	1 mg/L	SW-846 9251
Sulfate	3110	mg/L	64.75	meq/L	5 mg/L	SW-846 9036
Major Cation Sum	100.45	meq/L			N/A	Calculation
Major Anion Sum	96.21	meq/L			N/A	Calculation
Cation/Anion Balance	2.16	% Diff			N/A	Calculation

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: MW-45
Lab ID: 0494W10221/0694G02160
Matrix: Water
Condition: Intact

Report Date: 03/28/95
Receipt Date: 11/15/94
Sample Date: 11/11/94

Parameter	Concentration	PQL	Method
Total Metals			
Total Arsenic	0.022 mg/L	0.005	SW-846 7061A
Total Chromium	0.035 mg/L	0.005	SW-846 7191
Total Lead	0.10 mg/L	0.01	SW-846 7421
Total Nickel	ND*	0.01 mg/L	SW-846 6010A

Dissolved Metals			
Dissolved Arsenic	ND*	0.005 mg/L	SW-846 7061A
Dissolved Chromium	ND*	0.02 mg/L	SW-846 6010A
Dissolved Lead	ND*	0.01 mg/L	SW-846 7421
Dissolved Nickel	ND*	0.01 mg/L	SW-846 6010A

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

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Laboratory Manager

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3304 Longmire
College Station, Texas 77845

EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project :	RFI Phase III / Artesia, NM	Report Date:	11/22/94
Sample ID:	MW-30	Date Sampled:	11/11/94
Laboratory ID:	0694G02161	Date Received:	11/14/94
Sample Matrix:	Water	Date Extracted:	11/22/94
Preservative:	Cool, HCl	Date Analyzed:	11/22/94
Condition:	Intact, pH<2		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	ND	0.005
Toluene	ND	0.005
Ethylbenzene	ND	0.005
m,p-Xylene	ND	0.005
o-Xylene	ND	0.005
Methyl ethyl ketone	ND	0.005
Carbon disulfide	ND	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	100%	86 - 118%
Toluene - d8	99%	88 - 110%
Bromofluorobenzene	107%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

Review

Inter·Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project:	RFI Phase III / Artesia, NM	Report Date:	11/23/94
Sample ID:	MW - 30	Date Sampled:	11/11/94
Laboratory ID:	0694G02161	Date Received:	11/14/94
Sample Matrix:	Water	Date Extracted:	11/18/94
Condition:	Intact	Date Analyzed:	11/22/94
Preservative:	Cool		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Acenaphthene	ND	0.020
Acenaphthylene	ND	0.020
Anthracene	ND	0.020
Benzo(a)anthracene	ND	0.020
Benzo(b)fluoranthene	ND	0.020
Benzo(k)fluoranthene	ND	0.020
Benzo(g,h,i)perylene	ND	0.020
Benzo(a)pyrene	ND	0.020
Chrysene	ND	0.020
Dibenz(a,h)anthracene	ND	0.020
Fluoranthene	ND	0.020
Fluorene	ND	0.020
Ideno(1,2,3-cd)pyrene	ND	0.020
Naphthalene	ND	0.020
Phenanthrene	ND	0.020
Pyrene	ND	0.020

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	57%	21 - 110%
Phenol - d5	64%	10 - 110%
Nitrobenzene - d5	73%	35 - 114%
2 - Fluorobiphenyl	74%	43 - 116%
2,4,6 - Tribromophenol	76%	10 - 123%
Terphenyl - d14	74%	33 - 141%

References: Method 3510: Separatory Funnel Liquid-Liquid Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments:

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: MW-30
Lab ID: 0494W10222/0694G02161
Matrix: Water
Condition: Intact

Report Date: 03/28/95
Receipt Date: 11/15/94
Sample Date: 11/11/94

Parameter	Concentration		PQL	Method
pH (Lab)	7.7	s.u.	0.1	SW-846 9040
Conductivity (Lab)	6080	mg/L	1	SW-846 9050
Total Dissolved Solids (180° C)	4890	mg/L	10	EPA 160.1
Total Alkalinity (as CaCO3)	369	mg/L	1	EPA 310.1
Total Hardness (as CaCO3)	2340	mg/L	1	Calculation
Fluoride	1.5	mg/L	0.1	EPA 340.2

Calcium	467	mg/L	23.30	meq/L	1 mg/L	SW-846 6010A
Magnesium	285	mg/L	23.46	meq/L	1 mg/L	SW-846 6010A
Potassium	3	mg/L	0.08	meq/L	1 mg/L	SW-846 6010A
Sodium	568	mg/L	24.71	meq/L	1 mg/L	SW-846 6010A
Bicarbonate	450	mg/L	7.38	meq/L	1 mg/L	EPA 310.1
Carbonate	ND*		0.00		1 mg/L	EPA 310.1
Chloride	756	mg/L	21.33	meq/L	1 mg/L	SW-846 9251
Sulfate	2090	mg/L	43.56	meq/L	5 mg/L	SW-846 9036
Major Cation Sum	71.55	meq/L			N/A	Calculation
Major Anion Sum	72.26	meq/L			N/A	Calculation
Cation/Anion Balance	-0.49	% Diff			N/A	Calculation

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

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WATER QUALITY REPORT

Organics Laboratory
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Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: MW-30
Lab ID: 0494W10222/0694G02161
Matrix: Water
Condition: Intact

Report Date: 03/28/95
Receipt Date: 11/15/94
Sample Date: 11/11/94

Parameter	Concentration	PQL	Method
Total Metals			
Total Arsenic	0.020 mg/L	0.005	SW-846 7061A
Total Chromium	ND*	0.005 mg/L	SW-846 7191
Total Lead	ND*	0.01 mg/L	SW-846 7421
Total Nickel	0.02 mg/L	0.01	SW-846 6010A

Dissolved Metals			
Dissolved Arsenic	0.018 mg/L	0.005	SW-846 7061A
Dissolved Chromium	ND*	0.02 mg/L	SW-846 6010A
Dissolved Lead	ND*	0.01 mg/L	SW-846 7421
Dissolved Nickel	0.02 mg/L	0.01	SW-846 6010A

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

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3304 Longmire
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EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client: **NAVAJO REFINING COMPANY**
Project : RFI Phase III / Artesia, NM
Sample ID: Equipment Blank 7
Laboratory ID: 0694G02162
Sample Matrix: Water
Preservative: Cool, HCl
Condition: Intact, pH<2

Report Date: 11/22/94
Date Sampled: 11/11/94
Date Received: 11/14/94
Date Extracted: 11/22/94
Date Analyzed: 11/22/94

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	ND	0.005
Toluene	ND	0.005
Ethylbenzene	ND	0.005
m,p-Xylene	ND	0.005
o-Xylene	ND	0.005
Methyl ethyl ketone	ND	0.005
Carbon disulfide	ND	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	102%	86 - 118%
Toluene - d8	100%	88 - 110%
Bromofluorobenzene	99%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

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WATER QUALITY REPORT

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Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: EQUIP BLK 7
Lab ID: 0494W10211/0694G02162
Matrix: Water
Condition: Intact

Report Date: 03/28/95
Receipt Date: 11/15/94
Sample Date: 11/11/94

Parameter	Concentration	PQL	Method
Total Metals			
Total Arsenic	ND*	0.005 mg/L	SW-846 7061A
Total Chromium	ND*	0.02 mg/L	SW-846 6010A
Total Lead	ND*	0.01 mg/L	SW-846 7421
Total Nickel	ND*	0.01 mg/L	SW-846 6010A

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

eviewed By:

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Laboratory Manager

3304 Longmire
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EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project :	RFI Phase III / Artesia, NM	Report Date:	11/22/94
Sample ID:	DAF Unit	Date Sampled:	11/11/94
Laboratory ID:	0694G02163	Date Received:	11/14/94
Sample Matrix:	Water	Date Extracted:	11/22/94
Preservative:	Cool, HCl	Date Analyzed:	11/22/94
Condition:	Intact, pH<2		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	0.036	0.005
Toluene	0.061	0.005
Ethylbenzene	0.021	0.005
m,p-Xylene	0.053	0.005
o-Xylene	0.026	0.005
Methyl ethyl ketone	1.22*	0.05
Carbon disulfide	0.050	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	102%	86 - 118%
Toluene - d8	101%	88 - 110%
Bromofluorobenzene	110%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.
* - Concentration calculated from dilution of the sample.

Analyst

Review

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EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project :	RFI Phase III / Artesia, NM	Report Date:	11/22/94
Sample ID:	Trickle Filter	Date Sampled:	11/11/94
Laboratory ID:	0694G02164	Date Received:	11/14/94
Sample Matrix:	Water	Date Extracted:	11/22/94
Preservative:	Cool, HCl	Date Analyzed:	11/22/94
Condition:	Intact, pH=8-9		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	0.013	0.005
Toluene	0.026	0.005
Ethylbenzene	0.015	0.005
m,p-Xylene	0.040	0.005
o-Xylene	0.024	0.005
Methyl ethyl ketone	1.22*	0.05
Carbon disulfide	ND	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	103%	86 - 118%
Toluene - d8	103%	88 - 110%
Bromofluorobenzene	110%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.
* - Concentration calculated from dilution of the sample.

Analyst

Review

3304 Longmire
College Station, Texas 77845

EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project :	RFI Phase III / Artesia, NM	Report Date:	11/22/94
Sample ID:	Field Duplicate 4	Date Sampled:	11/11/94
Laboratory ID:	0694G02165	Date Received:	11/14/94
Sample Matrix:	Water	Date Extracted:	11/22/94
Preservative:	Cool, HCl	Date Analyzed:	11/22/94
Condition:	Intact, pH<2		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	ND	0.005
Toluene	ND	0.005
Ethylbenzene	ND	0.005
m,p-Xylene	ND	0.005
o-Xylene	ND	0.005
Methyl ethyl ketone	ND	0.005
Carbon disulfide	ND	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	104%	86 - 118%
Toluene - d8	100%	88 - 110%
Bromofluorobenzene	105%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

Review

Inter·Mountain Laboratories, Inc.

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EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project:	RFI Phase III / Artesia, NM	Report Date:	11/23/94
Sample ID:	Field Duplicate 4	Date Sampled:	11/11/94
Laboratory ID:	0694G02165	Date Received:	11/14/94
Sample Matrix:	Water	Date Extracted:	11/18/94
Condition:	Intact	Date Analyzed:	11/22/94
Preservative:	Cool		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Acenaphthene	ND	0.020
Acenaphthylene	ND	0.020
Anthracene	ND	0.020
Benzo(a)anthracene	ND	0.020
Benzo(b)fluoranthene	ND	0.020
Benzo(k)fluoranthene	ND	0.020
Benzo(g,h,i)perylene	ND	0.020
Benzo(a)pyrene	ND	0.020
Chrysene	ND	0.020
Dibenz(a,h)anthracene	ND	0.020
Fluoranthene	ND	0.020
Fluorene	ND	0.020
Ideno(1,2,3-cd)pyrene	ND	0.020
Naphthalene	ND	0.020
Phenanthrene	ND	0.020
Pyrene	ND	0.020

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	62%	21 - 110%
Phenol - d5	61%	10 - 110%
Nitrobenzene - d5	53%	35 - 114%
2 - Fluorobiphenyl	61%	43 - 116%
2,4,6 - Tribromophenol	72%	10 - 123%
Terphenyl - d14	70%	33 - 141%

References: Method 3510: Separatory Funnel Liquid-Liquid Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments:

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Analyst

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: FIELD DUPLICATE 4
Lab ID: 0494W10212/0694G02165
Matrix: Water
Condition: Intact

Report Date: 03/28/95
Receipt Date: 11/15/94
Sample Date: 11/11/94

Parameter	Concentration	PQL	Method
Total Metals			
Total Arsenic	0.018 mg/L	0.005	SW-846 7061A
Total Chromium	0.04 mg/L	0.02	SW-846 6010A
Total Lead	0.07 mg/L	0.01	SW-846 7421
Total Nickel	ND*	0.01 mg/L	SW-846 6010A
Dissolved Metals			
Dissolved Arsenic	ND*	0.005 mg/L	SW-846 7061A
Dissolved Chromium	ND*	0.02 mg/L	SW-846 6010A
Dissolved Lead	ND*	0.01 mg/L	SW-846 7421
Dissolved Nickel	0.02 mg/L	0.01	SW-846 6010A

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

Reviewed By:

David N. Poelstra

David N. Poelstra
Laboratory Manager

Inter-Mountain Laboratories, Inc.

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College Station, Texas 77845

EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project :	RFI Phase III / Artesia, NM	Report Date:	11/23/94
Sample ID:	Trip Blank - 2	Date Sampled:	NA
Laboratory ID:	0694G02166	Date Received:	11/14/94
Sample Matrix:	Water	Date Extracted:	11/23/94
Preservative:	Cool, HCl	Date Analyzed:	11/23/94
Condition:	Intact, pH<2		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	ND	0.005
Toluene	ND	0.005
Ethylbenzene	ND	0.005
m,p-Xylene	ND	0.005
o-Xylene	ND	0.005
Methyl ethyl ketone	ND	0.005
Carbon disulfide	ND	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	100%	86 - 118%
Toluene - d8	101%	88 - 110%
Bromofluorobenzene	87%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

Review

Inter-Mountain Laboratories, Inc.

CHAIN OF CUSTODY RECORD

Client/Project Name: Navajo

Project Location: Artesia NM

Sampler: (Signature) Brian Sullivan

Chain of Custody Tape No.

ANALYSES / PARAMETERS

Sample No./ Identification	Date	Time	Lab Number	Matrix	No. of Containers	VOA	SVOA	metals	Gen Chem	Remarks
TMD-SS1	11/11/94	1330	0694602138	Soil	2		+	+		~~06~~ ~~0694602138~~
TMD-SS2		1340	2139	Soil	2		X	X		~~2139~~
TMD-SS3		1358	2140	Soil	2		X	X		~~2140~~
TMD-SS4		1410	2141	"	~~3~~ 2		X	X		~~2141~~
TMD-SS5		1436	2142	"	"		X	X		~~2142~~
TMD-SS6		1442	2143	"	"		X	X		~~2143~~
NPR-RW-1		1545	2144	Water	5	X	X	X	X	~~2144~~
NPR-SD 1		1610	2145	sediment	3	X	X	X		ld broken ~~2145~~ on arrival replaced
NPR-SD 2		1640	2146	"	"	X	X	X		~~2146~~
NPR-SD 3		1658	2147	"	"	X	X	X		~~2148~~ ~~2147~~
NPR-RW 2		~~17~~08	2148	water	5	X	X	X	X	~~2149~~ ~~2148~~
NPR-SD 4		1710	2149	sediment	3	X	X	X		~~2150~~ ~~2149~~
NPR-SD-Dg.		—	2150	sediment	3	X	X	X		~~2151~~ ~~2150~~
Pond Inlet		1818	2151	water	2	X				~~2152~~ ~~2151~~

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
Brian Sullivan	11/12/94	1000	Baron Flot /sb	11-14/94	0915
Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
Relinquished by: (Signature)	Date	Time	Received by laboratory: (Signature)	Date	Time

Inter-Mountain Laboratories, Inc.

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☐ 11183 SH 30, College Station, TX 77845, Telephone (409) 776-8945

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Inter-Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project:	RFI Phase III / Artesia, NM	Report Date:	11/28/94
Sample ID:	TMD - SS1	Date Sampled:	11/11/94
Laboratory ID:	0694G02138	Date Received:	11/14/94
Sample Matrix:	Soil	Date Extracted:	11/22/94
Condition:	Intact	Date Analyzed:	11/23/94
Preservative:	Cool		

Analyte	Concentration (mg/Kg)	Detection Limit (mg/Kg) *
Acenaphthene	ND	1.8
Acenaphthylene	ND	1.8
Anthracene	ND	1.8
Benzo(a)anthracene	ND	1.8
Benzo(b)fluoranthene	ND	1.8
Benzo(k)fluoranthene	ND	1.8
Benzo(g,h,i)perylene	ND	1.8
Benzo(a)pyrene	ND	1.8
Chrysene	ND	1.8
Dibenz(a,h)anthracene	ND	1.8
Fluoranthene	ND	1.8
Fluorene	ND	1.8
Ideno(1,2,3-cd)pyrene	ND	1.8
Naphthalene	ND	1.8
Phenanthrene	ND	1.8
Pyrene	ND	1.8

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	*D	25 - 121%
Phenol - d5	*D	24 - 113%
Nitrobenzene - d5	*D	23 - 120%
2 - Fluorobiphenyl	*D	30 - 115%
2,4,6 - Tribromophenol	*D	19 - 122%
Terphenyl - d14	*D	18 - 137%

References: Method 3550: Sonication Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: *D - Surrogates diluted out of sample.
* - Elevated detection limit due to matrix interference.

Ramona R. Dennis
Analyst

Review

iml

Inter-Mountain Laboratories, Inc.

Phone (409) 776-8945 FAX (409) 774-4705

11183 SH 30 College Station, Texas 77845

Client: Navajo Refining Co.

Project: RFI Phase III / Artesia, NM

Sample ID: TMD-SS1

Lab ID: 0494H10196

Matrix: Soil

Condition: Intact

Report Date: 12/14/94

Receipt Date: 11/15/94

Sample Date: 11/11/94

Parameter	Concentration	PQL	Method
INORGANIC CHARACTERIZATION			
pH	7.8 s.u.	0.1	SW-846 9045
Electrical Conductivity	7.6 mmhos/cm	0.1	SW-846 9050
Oil & Grease	0.3 percent	0.1	SW-846 9071
3051 DIGESTION TRACE METAL CONCENTRATIONS			
Arsenic	26.7 mg/Kg	0.5	SW-846 7061
Chromium	249 mg/Kg	1	SW-846 6010A
Lead	530 mg/Kg	1	SW-846 7421
Nickel	21 mg/Kg	5	SW-846 6010A
Zinc	199 mg/Kg	1	SW-846 6010A

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

ewed By:

Gary L. Pudge
Director, Soil Laboratory

Inter-Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project:	RFI Phase III / Artesia, NM	Report Date:	11/28/94
Sample ID:	TMD - SS2	Date Sampled:	11/11/94
Laboratory ID:	0694G02139	Date Received:	11/14/94
Sample Matrix:	Soil	Date Extracted:	11/22/94
Condition:	Intact	Date Analyzed:	11/23/94
Preservative:	Cool		

Analyte	Concentration (mg/Kg)	Detection Limit (mg/Kg)
Acenaphthene	ND	30
Acenaphthylene	ND	30
Anthracene	ND	30
Benzo(a)anthracene	ND	30
Benzo(b)fluoranthene	ND	30
Benzo(k)fluoranthene	ND	30
Benzo(g,h,i)perylene	ND	30
Benzo(a)pyrene	ND	30
Chrysene	ND	30
Dibenz(a,h)anthracene	ND	30
Fluoranthene	ND	30
Fluorene	ND	30
Ideno(1,2,3-cd)pyrene	ND	30
Naphthalene	ND	30
Phenanthrene	ND	30
Pyrene	ND	30

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	*D	25 - 121%
Phenol - d5	*D	24 - 113%
Nitrobenzene - d5	*D	23 - 120%
2 - Fluorobiphenyl	*D	30 - 115%
2,4,6 - Tribromophenol	*D	19 - 122%
Terphenyl - d14	*D	18 - 137%

References: Method 3550: Sonication Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: *D - Surrogates diluted out of sample.
* - Elevated detection limit due to matrix interference.

Ramona R. Dennis
Analyst

Ulenda M Kaz
Review

iml

Inter-Mountain Laboratories, Inc.

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11183 SH 30 College Station, Texas 77845

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: TMD-SS2
Lab ID: 0494H10197
Matrix: Soil
Condition: Intact

Report Date: 12/14/94
Receipt Date: 11/15/94
Sample Date: 11/11/94

Parameter	Concentration	PQL	Method
INORGANIC CHARACTERIZATION			
pH	7.7 s.u.	0.1	SW-846 9045
Electrical Conductivity	5.5 mmhos/cm	0.1	SW-846 9050
Oil & Grease	1.9 percent	0.1	SW-846 9071
3051 DIGESTION TRACE METAL CONCENTRATIONS			
Arsenic	11.8 mg/Kg	0.5	SW-846 7061
Chromium	305 mg/Kg	1	SW-846 6010A
Lead	11600 mg/Kg	1	SW-846 7421
Nickel	20 mg/Kg	5	SW-846 6010A
Zinc	203 mg/Kg	1	SW-846 6010A

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

wed By:

Gary L. Pudge
Director, Soil Laboratory

Inter-Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project:	RFI Phase III / Artesia, NM	Report Date:	11/28/94
Sample ID:	TMD - SS3	Date Sampled:	11/11/94
Laboratory ID:	0694G02140	Date Received:	11/14/94
Sample Matrix:	Soil	Date Extracted:	11/22/94
Condition:	Intact	Date Analyzed:	11/23/94
Preservative:	Cool		

Analyte	Concentration (mg/Kg)	Detection Limit (mg/Kg) *
Acenaphthene	ND	30
Acenaphthylene	ND	30
Anthracene	ND	30
Benzo(a)anthracene	ND	30
Benzo(b)fluoranthene	ND	30
Benzo(k)fluoranthene	ND	30
Benzo(g,h,i)perylene	ND	30
Benzo(a)pyrene	ND	30
Chrysene	ND	30
Dibenz(a,h)anthracene	ND	30
Fluoranthene	ND	30
Fluorene	ND	30
Ideno(1,2,3-cd)pyrene	ND	30
Naphthalene	ND	30
Phenanthrene	ND	30
Pyrene	ND	30

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	*D	25 - 121%
Phenol - d5	*D	24 - 113%
Nitrobenzene - d5	*D	23 - 120%
2 - Fluorobiphenyl	*D	30 - 115%
2,4,6 - Tribromophenol	*D	19 - 122%
Terphenyl - d14	*D	18 - 137%

References: Method 3550: Sonication Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: *D - Surrogates diluted out of sample.
* - Elevated detection limit due to matrix interference.

Ramona R. Dennis
Analyst

Wendi M Key
Review

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11183 SH 30 College Station, Texas 77845

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: TMD-SS3
Lab ID: 0494H10198
Matrix: Soil
Condition: Intact

Report Date: 12/14/94
Receipt Date: 11/15/94
Sample Date: 11/11/94

Parameter	Concentration	PQL	Method
INORGANIC CHARACTERIZATION			
pH	7.4 s.u.	0.1	SW-846 9045
Electrical Conductivity	3.8 mmhos/cm	0.1	SW-846 9050
Oil & Grease	11.0 percent	0.1	SW-846 9071

3051 DIGESTION TRACE METAL CONCENTRATIONS			
Arsenic	85.2 mg/Kg	0.5	SW-846 7061
Chromium	639 mg/Kg	1	SW-846 6010A
Lead	1670 mg/Kg	1	SW-846 7421
Nickel	37 mg/Kg	5	SW-846 6010A
Zinc	434 mg/Kg	1	SW-846 6010A

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

ewed By:

Gary L. Pudge
Director, Soil Laboratory

Inter-Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project:	RFI Phase III / Artesia, NM	Report Date:	11/28/94
Sample ID:	TMD - SS4	Date Sampled:	11/11/94
Laboratory ID:	0694G02141	Date Received:	11/14/94
Sample Matrix:	Soil	Date Extracted:	11/22/94
Condition:	Intact	Date Analyzed:	11/23/94
Preservative:	Cool		

Analyte	Concentration (mg/Kg)	Detection Limit (mg/Kg) *
Acenaphthene	ND	40
Acenaphthylene	ND	40
Anthracene	ND	40
Benzo(a)anthracene	ND	40
Benzo(b)fluoranthene	ND	40
Benzo(k)fluoranthene	ND	40
Benzo(g,h,i)perylene	ND	40
Benzo(a)pyrene	ND	40
Chrysene	ND	40
Dibenz(a,h)anthracene	ND	40
Fluoranthene	ND	40
Fluorene	ND	40
Ideno(1,2,3-cd)pyrene	ND	40
Naphthalene	ND	40
Phenanthrene	ND	40
Pyrene	ND	40

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	*D	25 - 121%
Phenol - d5	*D	24 - 113%
Nitrobenzene - d5	*D	23 - 120%
2 - Fluorobiphenyl	*D	30 - 115%
2,4,6 - Tribromophenol	*D	19 - 122%
Terphenyl - d14	*D	18 - 137%

References: Method 3550: Sonication Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: *D - Surrogates diluted out of sample.
* - Elevated detection limit due to matrix interference.

Ramona R. Dennis
Analyst

Wendi M Koz
Review

iml

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11183 SH 30 College Station, Texas 77845

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: TMD-SS4
Lab ID: 0494H10199
Matrix: Soil
Condition: Intact

Report Date: 12/14/94
Receipt Date: 11/15/94
Sample Date: 11/11/94

Parameter	Concentration	PQL	Method
INORGANIC CHARACTERIZATION			
pH	7.5 s.u.	0.1	SW-846 9045
Electrical Conductivity	3.8 mmhos/cm	0.1	SW-846 9050
Oil & Grease	3.7 percent	0.1	SW-846 9071
3051 DIGESTION TRACE METAL CONCENTRATIONS			
Arsenic	23.8 mg/Kg	0.5	SW-846 7061
Chromium	1016 mg/Kg	1	SW-846 6010A
Lead	906 mg/Kg	1	SW-846 7421
Nickel	20 mg/Kg	5	SW-846 6010A
Zinc	320 mg/Kg	1	SW-846 6010A

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

...wed By:

Gary L. Pudge
Director, Soil Laboratory

Inter-Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project:	RFI Phase III / Artesia, NM	Report Date:	11/28/94
Sample ID:	TMD - SS5	Date Sampled:	11/11/94
Laboratory ID:	0694G02142	Date Received:	11/14/94
Sample Matrix:	Soil	Date Extracted:	11/22/94
Condition:	Intact	Date Analyzed:	11/23/94
Preservative:	Cool		

Analyte	Concentration (mg/Kg)	Detection Limit (mg/Kg) *
Acenaphthene	ND	60
Acenaphthylene	ND	60
Anthracene	ND	60
Benzo(a)anthracene	ND	60
Benzo(b)fluoranthene	ND	60
Benzo(k)fluoranthene	ND	60
Benzo(g,h,i)perylene	ND	60
Benzo(a)pyrene	ND	60
Chrysene	ND	60
Dibenz(a,h)anthracene	ND	60
Fluoranthene	ND	60
Fluorene	ND	60
Ideno(1,2,3-cd)pyrene	ND	60
Naphthalene	ND	60
Phenanthrene	ND	60
Pyrene	ND	60

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	*D	25 - 121%
Phenol - d5	*D	24 - 113%
Nitrobenzene - d5	*D	23 - 120%
2 - Fluorobiphenyl	*D	30 - 115%
2,4,6 - Tribromophenol	*D	19 - 122%
Terphenyl - d14	*D	18 - 137%

References: Method 3550: Sonication Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: *D - Surrogates diluted out of sample.
* - Elevated detection limit due to matrix interference.

Ramona R. Dennis
Analyst

Wanda M Kog
Review

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Inter-Mountain Laboratories, Inc.
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11183 SH 30 College Station, Texas 77845

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: TMD-SS5
Lab ID: 0494H10200
Matrix: Soil
Condition: Intact

Report Date: 12/14/94
Receipt Date: 11/15/94
Sample Date: 11/11/94

Parameter	Concentration	PQL	Method
INORGANIC CHARACTERIZATION			
pH	7.8 s.u.	0.1	SW-846 9045
Electrical Conductivity	8.6 mmhos/cm	0.1	SW-846 9050
Oil & Grease	2.5 percent	0.1	SW-846 9071
3051 DIGESTION TRACE METAL CONCENTRATIONS			
Arsenic	21.9 mg/Kg	0.5	SW-846 7061
Chromium	226 mg/Kg	1	SW-846 6010A
Lead	205 mg/Kg	1	SW-846 7421
Nickel	15 mg/Kg	5	SW-846 6010A
Zinc	155 mg/Kg	1	SW-846 6010A

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

Reviewed By:

Gary L. Pudge
Director, Soil Laboratory

3304 Longmire
College Station, Texas 77845

EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project:	RFI Phase III / Artesia, NM	Report Date:	11/28/94
Sample ID:	TMD - SS6	Date Sampled:	11/11/94
Laboratory ID:	0694G02143	Date Received:	11/14/94
Sample Matrix:	Soil	Date Extracted:	11/22/94
Condition:	Intact	Date Analyzed:	11/23/94
Preservative:	Cool		

Analyte	Concentration (mg/Kg)	Detection Limit (mg/Kg) *
Acenaphthene	ND	36
Acenaphthylene	ND	36
Anthracene	ND	36
Benzo(a)anthracene	ND	36
Benzo(b)fluoranthene	ND	36
Benzo(k)fluoranthene	ND	36
Benzo(g,h,i)perylene	ND	36
Benzo(a)pyrene	ND	36
Chrysene	ND	36
Dibenz(a,h)anthracene	ND	36
Fluoranthene	ND	36
Fluorene	ND	36
Ideno(1,2,3-cd)pyrene	ND	36
Naphthalene	ND	36
Phenanthrene	ND	36
Pyrene	ND	36

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	*D	25 - 121%
Phenol - d5	*D	24 - 113%
Nitrobenzene - d5	*D	23 - 120%
2 - Fluorobiphenyl	*D	30 - 115%
2,4,6 - Tribromophenol	*D	19 - 122%
Terphenyl - d14	*D	18 - 137%

References: Method 3550: Sonication Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: *D - Surrogates diluted out of sample.
* - Elevated detection limit due to matrix interference.

Ramona R. Dennis
Analyst

Wendi M Koz
Review

iml

Inter-Mountain Laboratories, Inc.

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11183 SH 30 College Station, Texas 77845

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: TMD-SS6
Lab ID: 0494H10201
Matrix: Soil
Condition: Intact

Report Date: 12/14/94
Receipt Date: 11/15/94
Sample Date: 11/11/94

Parameter	Concentration	PQL	Method
INORGANIC CHARACTERIZATION			
pH	7.7 s.u.	0.1	SW-846 9045
Electrical Conductivity	8.9 mmhos/cm	0.1	SW-846 9050
Oil & Grease	1.9 percent	0.1	SW-846 9071
3051 DIGESTION TRACE METAL CONCENTRATIONS			
Arsenic	14.8 mg/Kg	0.5	SW-846 7061
Chromium	156 mg/Kg	1	SW-846 6010A
Lead	191 mg/Kg	1	SW-846 7421
Nickel	18 mg/Kg	5	SW-846 6010A
Zinc	144 mg/Kg	1	SW-846 6010A

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

Reviewed By:

Gary L. Pudge
Director, Soil Laboratory

Inter·Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client: **NAVAJO REFINING COMPANY**
Project : RFI Phase III / Artesia, NM
Sample ID: NPR-RW-1
Laboratory ID: 0694G02144
Sample Matrix: Water
Preservative: Cool, HCl
Condition: Intact, pH<2

Report Date: 11/23/94
Date Sampled: 11/11/94
Date Received: 11/14/94
Date Extracted: 11/23/94
Date Analyzed: 11/23/94

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	ND	0.005
Toluene	ND	0.005
Ethylbenzene	ND	0.005
m,p-Xylene	ND	0.005
o-Xylene	ND	0.005
Methyl ethyl ketone	ND	0.005
Carbon disulfide	ND	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	101%	86 - 118%
Toluene - d8	101%	88 - 110%
Bromofluorobenzene	100%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

Review

3304 Longmire
College Station, Texas 77845

EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project:	RFI Phase III / Artesia, NM	Report Date:	11/23/94
Sample ID:	NPR - RW - 1	Date Sampled:	11/11/94
Laboratory ID:	0694G02144	Date Received:	11/14/94
Sample Matrix:	Water	Date Extracted:	11/18/94
Condition:	Intact	Date Analyzed:	11/22/94
Preservative:	Cool		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Acenaphthene	ND	0.010
Acenaphthylene	ND	0.010
Anthracene	ND	0.010
Benzo(a)anthracene	ND	0.010
Benzo(b)fluoranthene	ND	0.010
Benzo(k)fluoranthene	ND	0.010
Benzo(g,h,i)perylene	ND	0.010
Benzo(a)pyrene	ND	0.010
Chrysene	ND	0.010
Dibenz(a,h)anthracene	ND	0.010
Fluoranthene	ND	0.010
Fluorene	ND	0.010
Ideno(1,2,3-cd)pyrene	ND	0.010
Naphthalene	ND	0.010
Phenanthrene	ND	0.010
Pyrene	ND	0.010

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	52%	21 - 110%
Phenol - d5	50%	10 - 110%
Nitrobenzene - d5	58%	35 - 114%
2 - Fluorobiphenyl	54%	43 - 116%
2,4,6 - Tribromophenol	61%	10 - 123%
Terphenyl - d14	68%	33 - 141%

References: Method 3510: Separatory Funnel Liquid-Liquid Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments:

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Analyst

Wendi M. Rog
Review

Inter·Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: NPR-RW-1
Lab ID: 0494W10239/0694G02144
Matrix: Water
Condition: Intact

Report Date: 12/13/94
Receipt Date: 11/15/94
Sample Date: 11/11/94

Parameter	Concentration		PQL	Method
pH (Lab)	7.9	s.u.	0.1	SW-846 9040
Conductivity (Lab)	6630	mg/L	1	SW-846 9050
Total Dissolved Solids (180° C)	4580	mg/L	10	EPA 160.1
Total Alkalinity (as CaCO3)	157	mg/L	1	EPA 310.1
Total Hardness (as CaCO3)	2120	mg/L	1	Calculation
Fluoride	0.7	mg/L	0.1	EPA 340.2

Calcium	555	mg/L	27.69	meq/L	1 mg/L	SW-846 6010A
Magnesium	178	mg/L	14.63	meq/L	1 mg/L	SW-846 6010A
Potassium	6	mg/L	0.15	meq/L	1 mg/L	SW-846 6010A
Sodium	696	mg/L	30.28	meq/L	1 mg/L	SW-846 6010A
Bicarbonate	191	mg/L	3.13	meq/L	1 mg/L	EPA 310.1
Carbonate	ND*		0.00		1 mg/L	EPA 310.1
Chloride	1300	mg/L	64.87	meq/L	1 mg/L	SW-846 9251
Sulfate	1510	mg/L	31.41	meq/L	5 mg/L	SW-846 9036
Major Cation Sum	72.76	meq/L			N/A	Calculation
Major Anion Sum	71.24	meq/L			N/A	Calculation
Cation/Anion Balance	1.06	% Diff			N/A	Calculation

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: NPR-RW-1
Lab ID: 0494W10239/0694G02144
Matrix: Water
Condition: Intact

Report Date: 03/28/95
Receipt Date: 11/15/94
Sample Date: 11/11/94

Parameter	Concentration	PQL	Method
Total Metals			
Total Arsenic	ND*	0.005 mg/L	SW-846 7061A
Total Chromium	ND*	0.005 mg/L	SW-846 7191
Total Lead	ND*	0.01 mg/L	SW-846 7421
Total Nickel	ND*	0.01 mg/L	SW-846 6010A

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

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Laboratory Manager

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EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project :	RFI Phase III / Artesia, NM	Report Date:	11/23/94
Sample ID:	NPR-SD-1	Date Sampled:	11/11/94
Laboratory ID:	0694G02145	Date Received:	11/14/94
Sample Matrix:	Soil	Date Extracted:	11/23/94
Preservative:	Cool	Date Analyzed:	11/23/94
Condition:	Intact		

Analyte	Concentration (mg/Kg)	Detection Limit (mg/Kg)
Benzene	ND	0.006
Toluene	ND	0.006
Ethylbenzene	ND	0.006
m,p-Xylene	ND	0.006
o-Xylene	ND	0.006
Methyl ethyl ketone	ND	0.006
Carbon disulfide	ND	0.006

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	98%	80 - 120%
Toluene - d8	100%	81 - 117%
Bromofluorobenzene	78%	74 - 121%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

Review

Inter-Mountain Laboratories, Inc.

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College Station, Texas 77845

EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project:	RFI Phase III / Artesia, NM	Report Date:	11/23/94
Sample ID:	NPR - SD 1	Date Sampled:	11/11/94
Laboratory ID:	0694G02145	Date Received:	11/14/94
Sample Matrix:	Soil	Date Extracted:	11/22/94
Condition:	Intact	Date Analyzed:	11/23/94
Preservative:	Cool		

Analyte	Concentration (mg/Kg)	Detection Limit (mg/Kg)
Acenaphthene	ND	0.4
Acenaphthylene	ND	0.4
Anthracene	ND	0.4
Benzo(a)anthracene	ND	0.4
Benzo(b)fluoranthene	ND	0.4
Benzo(k)fluoranthene	ND	0.4
Benzo(g,h,i)perylene	ND	0.4
Benzo(a)pyrene	ND	0.4
Chrysene	ND	0.4
Dibenz(a,h)anthracene	ND	0.4
Fluoranthene	ND	0.4
Fluorene	ND	0.4
Ideno(1,2,3-cd)pyrene	ND	0.4
Naphthalene	ND	0.4
Phenanthrene	ND	0.4
Pyrene	ND	0.4

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	57%	25 - 121%
Phenol - d5	52%	24 - 113%
Nitrobenzene - d5	61%	23 - 120%
2 - Fluorobiphenyl	64%	30 - 115%
2,4,6 - Tribromophenol	81%	19 - 122%
Terphenyl - d14	80%	18 - 137%

References: Method 3550: Sonication Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments:

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Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: NPR-SD-1
Lab ID: 0494H10202
Matrix: Soil
Condition: Intact

Report Date: 02/15/95
Receipt Date: 11/15/94
Sample Date: 11/11/94

Parameter	Concentration	PQL	Method
INORGANIC CHARACTERIZATION			
pH	8.2 s.u.	0.1	SW-846 9045
3051 DIGESTION TRACE METAL CONCENTRATIONS			
Arsenic	ND*	0.5 mg/Kg	SW-846 7061
Chromium	6 mg/Kg	1	SW-846 6010A
Lead	4 mg/Kg	1	SW-846 7421
Nickel	6 mg/Kg	5	SW-846 6010A

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

Reviewed By:

Gary L. Pudge
Director, Soil Laboratory

Inter-Mountain Laboratories, Inc.

3304 Longmire
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EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project :	RFI Phase III / Artesia, NM	Report Date:	11/23/94
Sample ID:	NPR-SD-2	Date Sampled:	11/11/94
Laboratory ID:	0694G02146	Date Received:	11/14/94
Sample Matrix:	Soil	Date Extracted:	11/23/94
Preservative:	Cool	Date Analyzed:	11/23/94
Condition:	Intact		

Analyte	Concentration (mg/Kg)	Detection Limit (mg/Kg)
Benzene	ND	0.006
Toluene	ND	0.006
Ethylbenzene	ND	0.006
m,p-Xylene	ND	0.006
o-Xylene	ND	0.006
Methyl ethyl ketone	ND	0.006
Carbon disulfide	ND	0.006

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	98%	80 - 120%
Toluene - d8	100%	81 - 117%
Bromofluorobenzene	82%	74 - 121%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

Review

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EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project:	RFI Phase III / Artesia, NM	Report Date:	11/23/94
Sample ID:	NPR - SD 2	Date Sampled:	11/11/94
Laboratory ID:	0694G02146	Date Received:	11/14/94
Sample Matrix:	Soil	Date Extracted:	11/22/94
Condition:	Intact	Date Analyzed:	11/22/94
Preservative:	Cool		

Analyte	Concentration (mg/Kg)	Detection Limit (mg/Kg)
Acenaphthene	ND	0.4
Acenaphthylene	ND	0.4
Anthracene	ND	0.4
Benzo(a)anthracene	ND	0.4
Benzo(b)fluoranthene	ND	0.4
Benzo(k)fluoranthene	ND	0.4
Benzo(g,h,i)perylene	ND	0.4
Benzo(a)pyrene	ND	0.4
Chrysene	ND	0.4
Dibenz(a,h)anthracene	ND	0.4
Fluoranthene	ND	0.4
Fluorene	ND	0.4
Ideno(1,2,3-cd)pyrene	ND	0.4
Naphthalene	ND	0.4
Phenanthrene	ND	0.4
Pyrene	ND	0.4

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	52%	25 - 121%
Phenol - d5	49%	24 - 113%
Nitrobenzene - d5	48%	23 - 120%
2 - Fluorobiphenyl	45%	30 - 115%
2,4,6 - Tribromophenol	47%	19 - 122%
Terphenyl - d14	72%	18 - 137%

References: Method 3550: Sonication Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments:

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Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: NPR-SD-2
Lab ID: 0494H10203
Matrix: Soil
Condition: Intact

Report Date: 12/14/94
Receipt Date: 11/15/94
Sample Date: 11/11/94

Parameter	Concentration	PQL	Method
INORGANIC CHARACTERIZATION			
pH	8.3 s.u.	0.1	SW-846 9045

3051 DIGESTION TRACE METAL CONCENTRATIONS			
Arsenic	NR*	0.5 mg/Kg	SW-846 7061
Chromium	7 mg/Kg	1	SW-846 6010A
Lead	4.00 mg/Kg	1	SW-846 7421
Nickel	7 mg/Kg	5	SW-846 6010A

*NR - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

...ewed By:

Gary L. Pudge
Director, Soil Laboratory

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EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project :	RFI Phase III / Artesia, NM	Report Date:	11/23/94
Sample ID:	NPR-SD-3	Date Sampled:	11/11/94
Laboratory ID:	0694G02147	Date Received:	11/14/94
Sample Matrix:	Soil	Date Extracted:	11/23/94
Preservative:	Cool	Date Analyzed:	11/23/94
Condition:	Intact		

Analyte	Concentration (mg/Kg)	Detection Limit (mg/Kg)
Benzene	ND	0.006
Toluene	ND	0.006
Ethylbenzene	ND	0.006
m,p-Xylene	ND	0.006
o-Xylene	ND	0.006
Methyl ethyl ketone	ND	0.006
Carbon disulfide	ND	0.006

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	97%	80 - 120%
Toluene - d8	101%	81 - 117%
Bromofluorobenzene	89%	74 - 121%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

Review

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College Station, Texas 77845

EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project:	RFI Phase III / Artesia, NM	Report Date:	11/28/94
Sample ID:	NPR - SD3	Date Sampled:	11/11/94
Laboratory ID:	0694G02147	Date Received:	11/14/94
Sample Matrix:	Soil	Date Extracted:	11/22/94
Condition:	Intact	Date Analyzed:	11/23/94
Preservative:	Cool		

Analyte	Concentration (mg/Kg)	Detection Limit (mg/Kg)
Acenaphthene	ND	0.4
Acenaphthylene	ND	0.4
Anthracene	ND	0.4
Benzo(a)anthracene	ND	0.4
Benzo(b)fluoranthene	ND	0.4
Benzo(k)fluoranthene	ND	0.4
Benzo(g,h,i)perylene	ND	0.4
Benzo(a)pyrene	ND	0.4
Chrysene	ND	0.4
Dibenz(a,h)anthracene	ND	0.4
Fluoranthene	ND	0.4
Fluorene	ND	0.4
Ideno(1,2,3-cd)pyrene	ND	0.4
Naphthalene	ND	0.4
Phenanthrene	ND	0.4
Pyrene	ND	0.4

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	46%	25 - 121%
Phenol - d5	45%	24 - 113%
Nitrobenzene - d5	57%	23 - 120%
2 - Fluorobiphenyl	62%	30 - 115%
2,4,6 - Tribromophenol	63%	19 - 122%
Terphenyl - d14	74%	18 - 137%

References: Method 3550: Sonication Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments:

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Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: NPR-SD-3
Lab ID: 0494H10204
Matrix: Soil
Condition: Intact

Report Date: 12/14/94
Receipt Date: 11/15/94
Sample Date: 11/11/94

Parameter	Concentration	PQL	Method
INORGANIC CHARACTERIZATION			
pH	8.2 s.u.	0.1	SW-846 9045

3051 DIGESTION TRACE METAL CONCENTRATIONS			
Arsenic	NR*	0.5 mg/Kg	SW-846 7061
Chromium	6 mg/Kg	1	SW-846 6010A
Lead	2.00 mg/Kg	1	SW-846 7421
Nickel	5 mg/Kg	5	SW-846 6010A

*NR - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

wed By:

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Director, Soil Laboratory

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College Station, Texas 77845

EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project :	RFI Phase III / Artesia, NM	Report Date:	11/23/94
Sample ID:	NPR-RW-2	Date Sampled:	11/11/94
Laboratory ID:	0694G02148	Date Received:	11/14/94
Sample Matrix:	Water	Date Extracted:	11/23/94
Preservative:	Cool, HCl	Date Analyzed:	11/23/94
Condition:	Intact, pH<2		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	ND	0.005
Toluene	ND	0.005
Ethylbenzene	ND	0.005
m,p-Xylene	ND	0.005
o-Xylene	ND	0.005
Methyl ethyl ketone	ND	0.005
Carbon disulfide	ND	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	101%	86 - 118%
Toluene - d8	101%	88 - 110%
Bromofluorobenzene	97%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

Review

3304 Longmire
College Station, Texas 77845

EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project:	RFI Phase III / Artesia, NM	Report Date:	11/23/94
Sample ID:	NPR - RW - 2	Date Sampled:	11/11/94
Laboratory ID:	0694G02148	Date Received:	11/14/94
Sample Matrix:	Water	Date Extracted:	11/18/94
Condition:	Intact	Date Analyzed:	11/22/94
Preservative:	Cool		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Acenaphthene	ND	0.010
Acenaphthylene	ND	0.010
Anthracene	ND	0.010
Benzo(a)anthracene	ND	0.010
Benzo(b)fluoranthene	ND	0.010
Benzo(k)fluoranthene	ND	0.010
Benzo(g,h,i)perylene	ND	0.010
Benzo(a)pyrene	ND	0.010
Chrysene	ND	0.010
Dibenz(a,h)anthracene	ND	0.010
Fluoranthene	ND	0.010
Fluorene	ND	0.010
Ideno(1,2,3-cd)pyrene	ND	0.010
Naphthalene	ND	0.010
Phenanthrene	ND	0.010
Pyrene	ND	0.010

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	61%	21 - 110%
Phenol - d5	58%	10 - 110%
Nitrobenzene - d5	68%	35 - 114%
2 - Fluorobiphenyl	65%	43 - 116%
2,4,6 - Tribromophenol	69%	10 - 123%
Terphenyl - d14	75%	33 - 141%

References: Method 3510: Separatory Funnel Liquid-Liquid Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States *Environmental Protection Agency*, July 1992.

Comments:

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: NPR-RW-2
Lab ID: 0494W10215/0694G02148
Matrix: Water
Condition: Intact

Report Date: 03/28/95
Receipt Date: 11/15/94
Sample Date: 11/11/94

Parameter	Concentration	PQL	Method
pH (Lab)	7.8 s.u.	0.1	SW-846 9040
Conductivity (Lab)	6680 mg/L	1	SW-846 9050
Total Dissolved Solids (180° C)	4610 mg/L	10	EPA 160.1
Total Alkalinity (as CaCO3)	154 mg/L	1	EPA 310.1
Total Hardness (as CaCO3)	2040 mg/L	1	Calculation
Fluoride	0.7 mg/L	0.1	EPA 340.2

Calcium	547 mg/L	27.30 meq/L	1 mg/L	SW-846 6010A
Magnesium	164 mg/L	13.50 meq/L	1 mg/L	SW-846 6010A
Potassium	7 mg/L	0.17 meq/L	1 mg/L	SW-846 6010A
Sodium	696 mg/L	30.27 meq/L	1 mg/L	SW-846 6010A
Bicarbonate	188 mg/L	3.08 meq/L	1 mg/L	EPA 310.1
Carbonate	ND*	0.00	1 mg/L	EPA 310.1
Chloride	1280 mg/L	35.97 meq/L	1 mg/L	SW-846 9251
Sulfate	1460 mg/L	30.44 meq/L	5 mg/L	SW-846 9036
Major Cation Sum	71.24 meq/L		N/A	Calculation
Major Anion Sum	69.49 meq/L		N/A	Calculation
Cation/Anion Balance	1.24 % Diff		N/A	Calculation

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

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WATER QUALITY REPORT

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: NPR-RW-2
Lab ID: 0494W10215/0694G02148
Matrix: Water
Condition: Intact

Report Date: 03/28/95
Receipt Date: 11/15/94
Sample Date: 11/11/94

Parameter	Concentration	PQL	Method
Total Metals			
Total Arsenic	ND*	0.005 mg/L	SW-846 7061A
Total Chromium	ND*	0.005 mg/L	SW-846 7191
Total Lead	ND*	0.01 mg/L	SW-846 7421
Total Nickel	ND*	0.01 mg/L	SW-846 6010A

*ND - Parameter not detected at stated Practical Quantitation Limit.

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

EPA - "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency, EPA 600/4-79-020, Revised March, 1983.

Reviewed By:

David N Poelstra

David N. Poelstra
Laboratory Manager

Inter-Mountain Laboratories, Inc.

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EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project :	RFI Phase III / Artesia, NM	Report Date:	11/23/94
Sample ID:	NPR-SD-4	Date Sampled:	11/11/94
Laboratory ID:	0694G02149	Date Received:	11/14/94
Sample Matrix:	Soil	Date Extracted:	11/23/94
Preservative:	Cool	Date Analyzed:	11/23/94
Condition:	Intact		

Analyte	Concentration (mg/Kg)	Detection Limit (mg/Kg)
Benzene	ND	0.006
Toluene	ND	0.006
Ethylbenzene	ND	0.006
m,p-Xylene	ND	0.006
o-Xylene	ND	0.006
Methyl ethyl ketone	ND	0.006
Carbon disulfide	ND	0.006

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	99%	80 - 120%
Toluene - d8	100%	81 - 117%
Bromofluorobenzene	77%	74 - 121%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

Review

Inter-Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project:	RFI Phase III / Artesia, NM	Report Date:	11/28/94
Sample ID:	NPR - SD4	Date Sampled:	11/11/94
Laboratory ID:	0694G02149	Date Received:	11/14/94
Sample Matrix:	Soil	Date Extracted:	11/22/94
Condition:	Intact	Date Analyzed:	11/23/94
Preservative:	Cool		

Analyte	Concentration (mg/Kg)	Detection Limit (mg/Kg)
Acenaphthene	ND	0.4
Acenaphthylene	ND	0.4
Anthracene	ND	0.4
Benzo(a)anthracene	ND	0.4
Benzo(b)fluoranthene	ND	0.4
Benzo(k)fluoranthene	ND	0.4
Benzo(g,h,i)perylene	ND	0.4
Benzo(a)pyrene	ND	0.4
Chrysene	ND	0.4
Dibenz(a,h)anthracene	ND	0.4
Fluoranthene	ND	0.4
Fluorene	ND	0.4
Ideno(1,2,3-cd)pyrene	ND	0.4
Naphthalene	ND	0.4
Phenanthrene	ND	0.4
Pyrene	ND	0.4

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	43%	25 - 121%
Phenol - d5	40%	24 - 113%
Nitrobenzene - d5	56%	23 - 120%
2 - Fluorobiphenyl	50%	30 - 115%
2,4,6 - Tribromophenol	60%	19 - 122%
Terphenyl - d14	58%	18 - 137%

References: Method 3550: Sonication Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments:

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Analyst

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Review

Inter-Mountain Laboratories, Inc.
Phone (409) 776-8945 FAX (409) 774-4705
11183 SH 30 College Station, Texas 77845

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: NPR-SD-4
Lab ID: 0494H10205
Matrix: Soil
Condition: Intact

Report Date: 12/14/94
Receipt Date: 11/15/94
Sample Date: 11/11/94

Parameter	Concentration	PQL	Method
INORGANIC CHARACTERIZATION			
pH	8.2 s.u.	0.1	SW-846 9045
3051 DIGESTION TRACE METAL CONCENTRATIONS			
Arsenic	5.60 mg/Kg	0.5	SW-846 7061
Chromium	6 mg/Kg	1	SW-846 6010A
Lead	4.00 mg/Kg	1	SW-846 7421
Nickel	5 mg/Kg	5	SW-846 6010A

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

…ewed By:

Gary L. Pudge
Director, Soil Laboratory

Inter-Mountain Laboratories, Inc.

3304 Longmire
College Station, Texas 77845

EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project :	RFI Phase III / Artesia, NM	Report Date:	11/23/94
Sample ID:	NPR-SD-Dup	Date Sampled:	11/11/94
Laboratory ID:	0694G02150	Date Received:	11/14/94
Sample Matrix:	Soil	Date Extracted:	11/23/94
Preservative:	Cool	Date Analyzed:	11/23/94
Condition:	Intact		

Analyte	Concentration (mg/Kg)	Detection Limit (mg/Kg)
Benzene	ND	0.006
Toluene	ND	0.006
Ethylbenzene	ND	0.006
m,p-Xylene	ND	0.006
o-Xylene	ND	0.006
Methyl ethyl ketone	ND	0.006
Carbon disulfide	ND	0.006

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	97%	80 - 120%
Toluene - d8	100%	81 - 117%
Bromofluorobenzene	81%	74 - 121%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.

Analyst

Review

3304 Longmire
College Station, Texas 77845

EPA Method 8270
SEMIVOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project:	RFI Phase III / Artesia, NM	Report Date:	11/28/94
Sample ID:	NPR - SD - DUP	Date Sampled:	11/11/94
Laboratory ID:	0694G02150	Date Received:	11/14/94
Sample Matrix:	Soil	Date Extracted:	11/22/94
Condition:	Intact	Date Analyzed:	11/23/94
Preservative:	Cool		

Analyte	Concentration (mg/Kg)	Detection Limit (mg/Kg)
Acenaphthene	ND	0.4
Acenaphthylene	ND	0.4
Anthracene	ND	0.4
Benzo(a)anthracene	ND	0.4
Benzo(b)fluoranthene	ND	0.4
Benzo(k)fluoranthene	ND	0.4
Benzo(g,h,i)perylene	ND	0.4
Benzo(a)pyrene	ND	0.4
Chrysene	ND	0.4
Dibenz(a,h)anthracene	ND	0.4
Fluoranthene	ND	0.4
Fluorene	ND	0.4
Ideno(1,2,3-cd)pyrene	ND	0.4
Naphthalene	ND	0.4
Phenanthrene	ND	0.4
Pyrene	ND	0.4

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
2 - Fluorophenol	45%	25 - 121%
Phenol - d5	43%	24 - 113%
Nitrobenzene - d5	51%	23 - 120%
2 - Fluorobiphenyl	46%	30 - 115%
2,4,6 - Tribromophenol	60%	19 - 122%
Terphenyl - d14	71%	18 - 137%

References: Method 3550: Sonication Extraction.
Method 8270: Gas Chromatography / Mass Spectrometry for Semivolatile Organics
Test Methods for Evaluating Solid Wastes, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments:

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Analyst

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Review

iml Inter-Mountain Laboratories, Inc.
Phone (409) 776-8945 FAX (409) 774-4705 11183 SH 30 College Station, Texas 77845

Client: Navajo Refining Co.
Project: RFI Phase III / Artesia, NM
Sample ID: NPR-SD-DUP
Lab ID: 0494H10206
Matrix: Soil
Condition: Intact

Report Date: 12/14/94
Receipt Date: 11/15/94
Sample Date: 11/11/94

Parameter	Concentration		PQL	Method
INORGANIC CHARACTERIZATION				
pH	8.2	s.u.	0.1	SW-846 9045
3051 DIGESTION TRACE METAL CONCENTRATIONS				
Arsenic	4.40	mg/Kg	0.5	SW-846 7061
Chromium	6	mg/Kg	1	SW-846 6010A
Lead	4.00	mg/Kg	1	SW-846 7421
Nickel	5	mg/Kg	5	SW-846 6010A

Reference: SW-846 - "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", United States Environmental Protection Agency, Final Update 1, July 1992.

wed By:

Gary L. Pudge
Director, Soil Laboratory

3304 Longmire
College Station, Texas 77845

EPA Method 8240
VOLATILE ORGANIC COMPOUNDS

Client:	**NAVAJO REFINING COMPANY**		
Project :	RFI Phase III / Artesia, NM	Report Date:	11/23/94
Sample ID:	Pond Inlet	Date Sampled:	11/11/94
Laboratory ID:	0694G02151	Date Received:	11/14/94
Sample Matrix:	Water	Date Extracted:	11/23/94
Preservative:	Cool, HCl	Date Analyzed:	11/23/94
Condition:	Intact, pH<2		

Analyte	Concentration (mg/L)	Detection Limit (mg/L)
Benzene	ND	0.005
Toluene	0.018	0.005
Ethylbenzene	0.017	0.005
m,p-Xylene	0.060	0.005
o-Xylene	0.028	0.005
Methyl ethyl ketone	0.90*	0.05
Carbon disulfide	0.066	0.005

ND - Analyte not detected at stated limit of detection

Quality Control:

Surrogate	Percent Recovery	Acceptance Limits
Dibromofluoromethane	99%	86 - 118%
Toluene - d8	101%	88 - 110%
Bromofluorobenzene	87%	86 - 115%

Reference: Method 8240A: Gas Chromatography / Mass Spectrometry for Volatile Organics Test Methods for Evaluating Solid Waste, SW - 846, Final Update I, United States Environmental Protection Agency, July 1992.

Comments: A capillary column is used instead of a packed column as in the reference above.
* - Concentration calculated from dilution of the sample.

Analyst

Review