BENCHMARK
ENVIRONMENTAL CORPORATION

APR

CERTIFICATE OF RECEIPT

The undersigned acknowledges receipt of two copies of the *Ciniza Refinery Land Treatment Unit Post-Closure Application, Part A and Part B,* Volumes I, II, and III, delivered on the 27th of April 1998.

Signature: _____

Printed Name: Stephen Power

Title: Geologist / Giant RCRA Permit Manager

Date: April 27, 1998

Delivered by: Susan Collins, BEC

Date: 4-27-98

4501 Indian School Road N.E., Suite 105 Albuquerque, New Mexico 87110 (505) 262-2694 FAX (505) 262-2698

Table J-1. Solid Waste Management Units

SWMU No.[1]	SWMU Title	Status	Report
1	The Aeration Basin (i)[2]	EPA approval of NFA given in January 1994. Survey plat[3] submitted to EPA. Investigative process complete. Five-year sampling of soil around basin required again in 2001.	Appendix I-1: Aeration Basin - SWMU No. 1 Summary OCD 5-year soil sampling
2	The Evaporation Ponds (ii)	EPA approval of NFA given in January 1994. Investigative process complete. Follow-up monitoring required. Survey plat[3] submitted. Five-year sampling required again in 2001.	Appendix I-2: Evaporation Ponds - SWMU No. 2 Summary March 93 RFI
3	Empty Container Storage Area (v)	EPA approval of NFA given January 1994. Investigative process complete. Survey plat[3] submitted to EPA.	Appendix I-3: Empty Container Storage Area - SWMU No. 3 Summary March 93 RFI
4	Old Burn Pit (viii)	RFI 1990; sampling report identified corrective action. Site capped in 1998. Investigative process complete. Survey plat[3] submitted.	Appendix I-4: Old Burn Pit - SWMU No. 4 Summary
5	Landfill Areas (vii)	VCAP submitted February 1993 and approved in January 1994. Closure plan prepared and certified by PE, 1998.	Appendix I-5: Landfill Areas - SWMU No. 5 Closure Certification March 93 RFI
6	The Tank Farm—Leaded Gasoline Tanks (iii)	VCAP submitted in April 1996. Investigative process complete. Corrective action currently under way. Survey plat[3] submitted.	Appendix I-6: Tank Farm—Leaded Gasoline Tanks - SWMU No. 6 Summary Active
7	Fire Training Area (iv)	VCAP submitted in March 1993, and approved via fax in March 1996. RFI sampling complete. Investigative process complete. Survey plat[3] submitted. Corrective action ongoing.	Appendix I-7: Fire Training Area - SWMU No. 7 Summary Complete to be Submitted
8	The Railroad Rack Lagoon (vi)	VCAP submitted in December 1992, and approved in November 1994. RFI sampling complete. Investigative process complete. Corrective action ongoing. Survey plat[3] submitted.	Appendix I-8: Railroad Rack Lagoon - SWMU No. 8 Summary active
9	The Drainage Ditch Near the Inactive Land Farm (x and xiii)	RFI sampling complete. Report on additional RFI sampling suggested NFA. Investigative process complete. Survey plat[3] submitted to EPA.	Appendix I-9: Drainage Ditch and the Inactive Land Farm - SWMU No. 9 Summary Complete Report ?
10	The Sludge Pits (ix)	VCAP submitted in December 1992, and approved in January 1994. RFI sampling complete. Investigative process complete. Proceed with closure activities. Survey plat[3] submitted.	Appendix I-10: Sludge Pits - SWMU No. 10 Summary Look for Confirming info

Table J-1. Solid Waste Management Units (Continued)

SWMU No.[1]	SWMU Title	Status	Report
11	Secondary Oil Skimmer (xi) (removed)	RFI sampling complete. Report on additional RFI sampling suggested NFA. Investigative process complete. Corrective action ongoing. Survey plat[3] submitted.	Appendix I-11: Secondary Oil Skimmer - SWMU No. 11 Summary Complete to be submitted
12	Contact Wastewater Collection System (CWWCS) (xii)	Investigative process complete. EPA requires inspection every 5 years. Ciniza currently repairing and inspecting system. Will notify NMOCD upon completion.	Appendix I-12: Contact Wastewater Collection System - SWMU No. 12 Summary Talk OCD
13	The Drainage Ditch Between API Evaporation Ponds and ~~Neutralization Tank~~ Evaporation Ponds (xiv) Between the N evap. ponds & S, evap ponds	EPA approval of NFA given in January 1994. Follow-up monitoring required. Survey plat[3] submitted to EPA. Soil sampling collected around drainage ditch required again in 2001.	Appendix I-13: Drainage Ditch Between API Evaporation Ponds and Neutralization Tank Evaporation Ponds - SWMU No. 13 Summary active

[1]Solid Waste Management Unit Numbers as designated in the RCRA Facility Investigation Work Plan (submitted May 1990).

[2]Solid Waste Management Unit Numbers as designated in the HSWA Permit (Section C, Corrective Actions for Continuing Releases, 5.(a)(1). December 1988.

[3]See Figure J-14.

Revision 0

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RCRA
PART A AND PART B
POST-CLOSURE
PERMIT APPLICATION

LAND TREATMENT UNIT
GIANT REFINING COMPANY
CINIZA REFINERY

VOLUME I

UBMITTED TO: NEW MEXICO ENVIRONMENT DEPARTMENT
HAZARDOUS AND RADIOACTIVE MATERIALS BUREAU
P.O. BOX 26110
SANTA FE, NEW MEXICO 87502

ATE SUBMITTED: APRIL 24, 1998

REPARED BY: CINIZA REFINERY
ROUTE 3, BOX 7
GALLUP, NEW MEXICO 87301

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ACRONYMS AND ABBREVIATIONS

%C	percent of completeness
%R	percent recovery
20 NMAC 4.1	Title 20 *New Mexico Administrative Code*, Chapter 4, Part 1
ASO	acid-soluble oil
BFB	4-bromofluorobenzene
BTEX	benzene, toluene, ethyl benzene, and xylene
BTZ	below the treatment zone
CAP	Corrective Action Plan
CEC	carbon exchange capacity
CFR	*Code of Federal Regulations*
Ciniza	Giant Refining Company—Ciniza Refinery
CME	comprehensive monitoring evaluation
C:N:P	carbon:nitrogen:phosphorous
COC	chain of custody
CWWCS	Contact Wastewater Collection System
DMP	detection monitoring plan
DOT	U.S. Department of Transportation
DRO	Range Organics
EDP	early detection plan
EDS	early detection system
EDW	early detection well
EM	Environmental Manager
EPA	U.S. Environmental Protection Agency
FR	*Federal Register*
FRP	facility response plan
Giant	Giant Refining Company
GRO	gasoline range organics
I-40	Interstate-40
LCS	laboratory control sample
LTD	land treatment demonstration
LTU	land treatment unit
MDL	method detection limit
MW	monitoring well
NMAC	*New Mexico Administrative Code*
NMED	New Mexico Environment Department
NMED/HRMB	New Mexico Environment Department/Hazardous and Radioactive Material Bureau
NMOCD	New Mexico Oil Conservation Division
PHC	principal hazardous constituents
PPE	personal protective equipment
PVC	polyvinyl chloride
QA	quality assurance
QA/QC	quality assurance/quality control
QC	quality control
RCRA	Resource Conservation and Recovery Act
RFA	Resource Conservation Recovery Act Facility Assessment
RFI	Resource Conservation Recovery Act Facility Investigation
RPD	relative percent difference

SAL	screening action level
SAP	sampling and analysis plan
SMW	shallow monitoring wells
SOP	standard operating procedure
SVOC	semivolatile organic compound
SWMU	solid waste management unit
TPH	total petroleum hydrocarbons
TEGD	*RCRA Ground Water Monitoring Technical Enforcement Guidance Document* (EPA 1986)
U.S.C.	*United States Code*
UST	underground storage tank
VCAP	Voluntary Corrective Action Plan
VOA	volatile organic analyte
VOC	volatile organic compound
WAP	waste analysis plan
ZOI	zone of incorporation

A.0 INTRODUCTION

This post-closure permit application is submitted to the New Mexico Environment Department (NMED) and the U.S. Environmental Protection Agency (EPA) to meet the requirements of the RCRA; the New Mexico Hazardous Waste Act; and Title 20 *New Mexico Administrative Code*, Chapter 4, Part 1 (20 NMAC 4.1), Subpart IX, §270. This post-closure Part B permit application addresses the Land Treatment Unit (LTU) at Giant Refining Company—Ciniza Refinery (Ciniza) (Permit No. NMD 000333211-2). The information contained in this post-closure application is designed to meet permit application requirements of 20 NMAC 4.1, Subpart IX, 270, and the closure/post-closure requirements of 20 NMAC 4.1, Subpart V, §264.110 to §264.120. Closure and post-closure obligations of 20 NMAC, Subpart V, §264.280 reflect the post-closure permit application focus.

In addition to fulfilling RCRA Part B permit application requirements for the LTU, Ciniza is also including the RCRA Part A permit application, which includes all hazardous waste codes and volumes applied to the LTU from 1988 to 1990. 20 NMAC 4.1, Subpart IX permitting regulations do not distinguish between information requirements for operating permits and post-closure permits. Therefore, this Part B permit application includes facility-level information (20 NMAC 4.1, Subpart IX, §270.14(b)) and unit-specific information (20 NMAC 4.1 and Subpart V, §264.280). All regulatory citations in this application reference 20 NMAC 4.1, which incorporates Title 40 of the *Code of Federal Regulations* (CFR), Parts 260 through 270.

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Form Approved, OMB No. 2050-0034 Expires 9-30-96
GSA No. 0248-EPA-OT

For EPA Regional Use Only

Date Received
Month Day Year

EPA
United States Environmental Protection Agency
Washington, DC 20460

Hazardous Waste Permit Application Part A

(Read the Instructions before starting)

I. Installation's EPA ID Number *(Mark 'X' in the appropriate box)*

[ ] A. First Part A Submission

[XX] B. Part A Amendment # _____

C. Installation's EPA ID Number: NMD003331 1

D. Secondary ID Number *(If applicable)*:

II. Name of Facility

GIANT REFINING COMPANY

III. Facility Location *(Physical address not P.O. Box or Route Number)*

A. Street: INTERSTATE 40

Street *(Continued)*: EXIT 39

City or Town: JAMESTOWN

State: NM

Zip Code: 87347 —

County Code *(If known)*:

County Name: MCKINLEY

B. Land Type *(Enter code)*: P

C. Geographic Location
LATITUDE *(Degrees, Minutes, & Seconds)*: 35 29 02
LONGITUDE *(Degrees, Minutes & Seconds)*: 108 25 04 2

D. Facility Existence Date
Month Day Year: 10 18 1980

IV. Facility Mailing Address

Street or P.O. Box: ROUTE 3 BOX 7

City or Town: GALLUP

State: NM

Zip Code: 87301 —

V. Facility Contact *(Person to be contacted regarding waste activities at facility)*

Name *(Last)*: PAVLICH

(First): DAVID

Job Title: MANAGER H/S/E

Phone Number *(Area Code and Number)*: 505 — 722 — 3833

VI. Facility Contact Address *(See Instructions)*

A. Contact Address
Location [ ] Mailing [XX] Other [ ]

B. Street or P.O. Box:

City or Town:

State:

Zip Code: —

Please print or type with ELITE type (12 characters per inch) in the unshaded areas only

Form Approved, OMB No. 2050-0034 Expires 9-30-96
GSA No. 0248-EPA-OT

EPA I.D. Number *(Enter from page 1)*: NMD000333211

Secondary ID Number *(Enter from page 1)*:

VII. Operator Information *(See Instructions)*

Name of Operator: GIANT REFINING COMPANY CINIZA

Street or P.O. Box: ROUTE 3 BOX 7

City or Town: GALLUP

State: NM

ZIP Code: 87301-

Phone Number *(Area Code and Number)*: 505-722-3833

B. Operator Type: P

C. Change of Operator Indicator: Yes [ ] No [X]

Date Changed: Month Day Year

VIII. Facility Owner *(See Instructions)*

A. Name of Facility's Legal Owner: GIANT INDUSTRIES ARIZONA INC

Street or P.O. Box: 23733 NORTH SCOTTSDALE ROAD

City or Town: SCOTTSDALE

State: AZ

ZIP Code: 85255-

Phone Number *(Area Code and Number)*: 602-585-8888

B. Owner Type: P

C. Change of Owner Indicator: Yes [ ] No [X]

Date Changed: Month Day Year

IX. SIC Codes *(4-digit, in order of significance)*

Primary	(Description)	Secondary	(Description)
2911	Petroleum Refining		
Secondary	(Description)	**Secondary**	(Description)

X. Other Environmental Permits *(See Instructions)*

A. Permit Type *(Enter code)*	B. Permit Number	C. Description
RE	NMD000333211	RCRA Part B Permit
NE	AQP633-M-2	NM Air Quality Permit
	NMR00A172	General NPDES Stormwater
	GW-32	NMOCD Discharge Plan

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GSA No. 0248-EPA-OT

EPA I.D. Number *(Enter from page 1)*

N	M	D	0	0	0	3	3	3	2	1	1

Secondary ID Number *(Enter from page 1)*

XI. Nature of Business *(Provide a brief description)*

The Giant-Ciniza Plant refines crude oil and markets refined petroleum fuel products.

XII. Process Codes and Design Capacities

A. PROCESS CODE - *Enter the code from the list of process codes below that best describes each process to be used at the facility. Thirteen lines are provided for entering codes. If more lines are needed, attach a separate sheet of paper with the additional information. For "other" processes (i.e., D99, S99, T04 and X99), describe the process (including its design capacity) in the space provided in Item XIII.*

B. PROCESS DESIGN CAPACITY - *For each code entered in column A, enter the capacity of the process.*

1. AMOUNT - *Enter the amount. In a case where design capacity is not applicable (such as in a closure/post-closure or enforcement action) enter the total amount of waste for that process.*
2. UNIT OF MEASURE - *For each amount entered in column B(1), enter the code from the list of unit measure codes below that describes the unit of measure used. Only the units of measure that are listed below should be used.*

C. PROCESS TOTAL NUMBER OF UNITS - *Enter the total number of units used with the corresponding process code.*

PROCESS CODE	PROCESS	APPROPRIATE UNITS OF MEASURE FOR PROCESS DESIGN CAPACITY
	Disposal:	
D79	Underground Injection	Gallons; Liters; Gallons Per Day; or Liters Per Day
D80	Landfill	Acre-feet or Hectare-meter
D81	Land Treatment	Acres or Hectares
D82	Ocean Disposal	Gallons Per Day r Liters Per Day
D83	Surface Impoundment	Gallons or Liters
D99	Other Disposal	Any Unit of Measure Listed Below
	Storage:	
S01	Container (Barrel, Drum, Etc.)	Gallons or Liters
S02	Tank	Gallons or Liters
S03	Waste Pile	Cubic Yards or Cubic Meters
S04	Surface Impoundment	Gallons or Liters
S05	Drip Pad	Gallons or Liters
S06	Containment Building-Storage	Cubic Yards or Cubic Meters
S99	Other Storage	Any Unit of Measure Listed Below
	Treatment:	
T01	Tank	Gallons Per Day or Liters Per Day
T02	Surface Impoundment	Gallons Per Day or Liters Per Day
T03	Incinerator	Short Tons Per Hour; Metric Tons Per Hour; Gallons Per Hour; Liters Per Hour; or Btu's Per Hour
T04	Other Treatment	Gallons Per Day; Liters Per Day; Pounds Per Hour; Short Tons Per Hour; Kilograms Per Hour; Metric Tons Per Day; Metric Tons Per Hour; Short Tons Per Day; or Btu's Per Hour
T80	Boiler	Gallons or Liters
T81	Cement Kiln	Gallons Per Day; Liters Per Day; Pounds Per Hour; Short Tons Per Hour; Kilograms Per Hour; Metric Tons Per Day; Metric Tons Per Hour; Short Tons Per Day; or Btu's Per Hour
T82	Lime Kiln	
T83	Aggregate Kiln	
T84	Phosphate Kiln	
T85	Coke Oven	
T86	Blast Furnace	
T87	Smelting, Melting, Or Refining Furnace	Gallons Per Day; Liters Per Day; Pounds Per Hour; Short Tons Per Hour; Kilograms Per Hour; Metric Tons Per Day; Metric Tons Per Hour; Short Tons Per Day; or Btu's Per Hour
T88	Titanium Dioxide Chloride Process Oxidation Reactor	
T89	Methane Reforming Furnace	
T90	Pulping Liquor Recovery Furnace	
T91	Combustion Device Used In The Recovery Of Sulfur Values From Spent Sulfuric Acid	
T92	Halogen Acid Furnaces	
T93	Other Industrial Furnaces Listed In 40 CFR §260.10	
T94	Containment Building-Treatment	Cubic Yards or Cubic Meters
	Miscellaneous (Subpart X):	
X01	Open Burning/Open Detonation	Any Unit of Measure Listed Below
X02	Mechanical Processing	Short Tons Per Hour; Metric Tons Per Hour; Short Tons Per Day; Metric Tons Per Day; Pounds Per Hour; or Kilograms Per Hour
X03	Thermal Unit	Gallons Per Day; Liters Per Day; Pounds Per Hour; Short Tons Per Hour; Kilograms Per Hour; Metric Tons Per Day; Metric Tons Per Hour; Short Tons Per Day; or Btu's Per Hour
X04	Geologic Repository	Cubic Yards or Cubic Meters
X99	Other Subpart X	Any Unit of Measure Listed Below

UNIT OF MEASURE	UNIT OF MEASURE CODE
Gallons	G
Gallons Per Hour	E
Gallons Per Day	U
Liters	L
Liters Per Hour	H
Liters Per Day	V
Short Tons Per Hour	D
Metric Tons Per Hour	W
Short Tons Per Day	N
Metric Tons Per Day	S
Pounds Per Hour	J
Kilograms Per Hour	R
Cubic Yards	Y
Cubic Meters	C
Acres	B
Acre-feet	A
Hectares	Q
Hectare-meter	F
Btu's Per Hour	I

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Secondary ID Number (Enter from page 1):

XII. Process Codes and Design Capabilities (Continued)

EXAMPLE FOR COMPLETING ITEM XII (Shown in line number X-1 below): A facility has a storage tank, which can hold 533,788 gallons.

Line Number		A. Process Code (From list above)			B. PROCESS DESIGN CAPACITY 1. Amount (Specify)	2. Unit Of Measure (Enter code)	C. Process Total Number Of Units	For Official Use Only
X	1	S	0	2	5 3 3 7 8 8	G	0 0 1	
	1	D	8	1	15 .0	B	001	
	2				.			
	3				.			
	4				.			
	5				.			
	6				.			
	7				.			
	8				.			
	9				.			
1	0				.			
1	1				.			
1	2				.			
1	3				.			

NOTE: If you need to list more than 13 process codes, attach an additional sheet(s) with the information in the same format as above. Number the lines sequentially, taking into account any lines that will be used for "other" processes (i.e., D99, S99, T04 and X99) in Item XIII.

XIII. Other Processes (Follow instructions from Item XII for D99, S99, T04 and X99 process codes)

Line Number (Enter #s in seq w/XII)		A. Process Code (From list above)			B. PROCESS DESIGN CAPACITY 1. Amount (Specify)	2. Unit Of Measure (Enter code)	C. Process Total Number Of Units	D. Description Of Process
X	1	T	0	4				In-situ Vitrification
	1							
	2							
	3							
	4							

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EPA I.D. Number *(Enter from page 1)*

N	M	D	0	0	0	3	3	3	2	1	1

Secondary ID Number *(Enter from page 1)*

XIV. Description of Hazardous Wastes

A. EPA HAZARDOUS WASTE NUMBER - *Enter the four-digit number from 40 CFR, Part 261 Subpart D of each listed hazardous waste you will handle. For hazardous wastes which are not listed in 40 CFR, Part 261 Subpart D, enter the four-digit number(s) from 40 CFR, Part 261 Subpart C that describes the characteristics and/or the toxic contaminants of those hazardous wastes.*

B. ESTIMATED ANNUAL QUANTITY - *For each listed waste entered in column A estimate the quantity of that waste that will be handled on an annual basis. For each characteristic or toxic contaminant entered in column A estimate the total annual quantity of all the non-listed waste(s) that will be handled which possess that characteristic or contaminant.*

C UNIT OF MEASURE - *For each quantity entered in column B enter the unit of measure code. Units of measure which must be used and the appropriate codes are:*

ENGLISH UNIT OF MEASURE	CODE	METRIC UNIT OF MEASURE	CODE
POUNDS	P	KILOGRAMS	K
TONS	T	METRIC TONS	M

If facility records use any other unit of measure for quantity, the units of measure must be converted into one of the required units of measure taking into account the appropriate density or specific gravity of the waste.

D. PROCESSES

1. PROCESS CODES:

For listed hazardous waste: For each listed hazardous waste entered in column A select the code(s) from the list of process codes contained in Item XII A. on page 3 to indicate how the waste will be stored, treated, and/or disposed of at the facility.

For non-listed hazardous waste: For each characteristic or toxic contaminant entered in column A, select the code(s) from the list of process codes contained in Item XII A. on page 3 to indicate all the processes that will be used to store, treat, and/or dispose of all the non-listed hazardous wastes that possess that characteristic or toxic contaminant.

NOTE: THREE SPACES ARE PROVIDED FOR ENTERING PROCESS CODES. IF MORE ARE NEEDED:

1. *Enter the first two as described above.*
2. *Enter "000" in the extreme right box of item XIV-D(1).*
3. *Enter in the space provided on page 7, Item XIV-E, the line number and the additional code(s).*

2. PROCESS DESCRIPTION: *If a code is not listed for a process that will be used, describe the process in the space provided on the form (D.(2)).*

NOTE: HAZARDOUS WASTES DESCRIBED BY MORE THAN ONE EPA HAZARDOUS WASTE NUMBER - Hazardous wastes that can be described by more than one EPA Hazardous Waste Number shall be described on the form as follows:

1. *Select one of the EPA Hazardous Waste Numbers and enter it in column A. On the same line complete columns B, C and D by estimating the total annual quantity of the waste and describing all the processes to be used to treat, store, and/or dispose of the waste.*
2. *In column A of the next line enter the other EPA Hazardous Waste Number that can be used to describe the waste. In column D(2) on that line enter "Included with above" and make no other entries on that line.*
3. *Repeat step 2 for each EPA Hazardous Waste Number that can be used to describe the hazardous waste.*

EXAMPLE FOR COMPLETING ITEM XIV (shown in line numbers X-1, X-2, X-3, and X-4 below) - A facility will treat and dispose of an estimated 900 pounds per year of chrome shavings from leather tanning and finishing operation. In addition, the facility will treat and dispose of three non-listed wastes. Two wastes are corrosive only and there will be an estimated 200 pounds per year of each waste. The other waste is corrosive and ignitable and there will be an estimated 100 pounds per year of that waste. Treatment will be in an incinerator and disposal will be in a landfill.

Line Number		A. EPA HAZARD WASTE NO. (Enter code)				B. ESTIMATED ANNUAL QUANTITY OF WASTE	C. UNIT OF MEASURE (Enter code)	D. PROCESS (1) PROCESS CODES (Enter code)									D. PROCESS (2) PROCESS DESCRIPTION (If a code is not entered in D(1))
X	1	K	0	5	4	900	P	T	0	3	D	8	0				
X	2	D	0	0	2	400	P	T	0	3	D	8	0				
X	3	D	0	0	1	100	P	T	0	3	D	8	0				
X	4	D	0	0	2												Included With Above

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Secondary ID Number (Enter from page 1):

XIV. Description of Hazardous Wastes (Continued)

Line Number	A. EPA HAZARDOUS WASTE NO. (Enter code)	B. ESTIMATED ANNUAL QUANTITY OF WASTE	C. UNIT OF MEASURE (Enter code)	D. PROCESSES (1) PROCESS CODES (Enter code)	D. PROCESSES (2) PROCESS DESCRIPTION (If a code is not entered in D(1))
1	D001	45.0	T	D81	
2	K049	228.0	T	D81	
3	K050	6.0	T	D81	
4	K051	2325.0	T	D81	
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
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32					
33					

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GSA No. 0248-EPA-OT

EPA I.D. Number (Enter from page 1)	Secondary ID Number (Enter from page 1)
N M D 0 0 0 3 3 3 2 1 1	

XV. Map

Attach to this application a topographic map, or other equivalent map, of the area extending to at least one mile beyond property boundaries. The map must show the outline of the facility, the location of each of its existing and proposed intake and discharge structures, each of its hazardous waste treatment, storage, or disposal facilities, and each well where it injects fluids underground. Include all springs, rivers and other surface water bodies in this map area. See instructions for precise requirements. Att. A

XVI. Facility Drawing

All existing facilities must include a scale drawing of the facility (see instructions for more detail). Att. B

XVII. Photographs

All existing facilities must include photographs (aerial or ground-level) that clearly delineate all existing structures; existing storage, treatment and disposal areas; and sites of future storage, treatment or disposal areas (see instructions for more detail). Att. C

XVIII. Certification(s)

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 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.

Owner Signature LEROY CROW SENIOR VICE PRESIDENT, OPERATIONS	Date Signed April 22, 1998
Name and Official Title (Type or print)	
Owner Signature	Date Signed
Name and Official Title (Type or print)	
Operator Signature	Date Signed
Name and Official Title (Type or print)	
Operator Signature	Date Signed
Name and Official Title (Type or print)	

XIX. Comments

This Part A permit application applies only to the post-closure of the land treatment unit at the Giant-Ciniza Refinery.

The volumes of waste entered in XIV B are the total volumes applied to the land treatment unit from 1987 to 1990.

Note: Mail completed form to the appropriate EPA Regional or State Office. (Refer to instructions for more information)

Attachment A

Ciniza Refinery Topographic Map

TO VIEW THE MAP AND/OR MAPS WITH THIS DOCUMENT, PLEASE CALL THE HAZARDOUS WASTE BUREAU AT 505-476-6000 TO MAKE AN APPOINTMENT

Attachment C

LTU Photos

LTU Vehicle Fence and Evaporation Pond No. 12 (Facing North)

LTU (Facing Southwest)

B.0 FACILITY DESCRIPTION

The information provided in this section is submitted in accordance with the applicable requirements of 20 NMAC 4.1, Subpart IX, §270.14(b)(1), §270.14(b)(11), and §270.14(b)(19). This section includes a general description of the Ciniza , a description of the LTU, and facility location information for compliance with the topographic map, land use, seismic standard, floodplain, and traffic pattern requirements.

B.1 General Description [20 NMAC 4.1, Subpart IX, §270.14(b)(1)]

Ciniza is a crude oil refining facility located in McKinley County, New Mexico, at Township 15 North, Range 15 West, Sections 28 and 33, the northern one-third of Section 4 of the New Mexico coordinate system. Ciniza's mailing address is Route 3, Box 7, Gallup, New Mexico, 87301, and the physical address is Interstate-40 (I-40), Exit 39, Jamestown, New Mexico, 87347. Ciniza is just north of I-40 and approximately 17 miles east of Gallup, New Mexico.

Ciniza Refinery, originally owned by El Paso Natural Gas Company was constructed in 1957. The refinery was purchased by Shell Oil Company and operated by Shell until 1982. Ciniza was then purchased by Giant Refining Company (Giant). Giant Industries Arizona, Incorporated, the parent of Giant, is headquartered in Scottsdale, Arizona.

Current Ciniza operations include production of multiple grades of unleaded gasoline, two grades of jet fuel, kerosene, diesel, residual fuel, butane, and propane. The refinery is supported by a tank farm. The refinery facility is detailed on Figure B-1. The majority of the refinery sales occur at a marketing terminal located at the Ciniza Refinery and operated by Giant.

B.2 Description of the Land Treatment Unit [20 NMAC 4.1, Subpart IX, §270.14(b)(1)]

The LTU is located within the Ciniza property boundary. The primary purpose of the LTU is the degradation, transformation, or immobilization of hazardous wastes using microbial activity and soil characteristics. The LTU is approximately 1,500 ft northwest of the refinery process area and is above the 100-year floodplain, as shown on Figures B-2 and B-3. The LTU consists of three 480-ft x 240-ft sections located immediately east of Evaporation Pond 12B. Each section is diked and contains 2.6 acres (1.0 hectare) of available treatment surface. The top 12 in. of soil (the zone of incorporation [ZOI]) was plowed and disked to encourage aerobic microbial activity and improved chemical reaction rates. During post-closure maintenance activities, soil nutrients will be applied, as necessary. Ciniza Hazardous Waste Facility Permit specified the design, capacity of, and conditional

limits for the LTU during the operational phase of the LTU. During the post-closure period, no hazardous waste, nonhazardous waste, refinery waste, or other material will be applied to the LTU.

B.3 Topographic Maps [20 NMAC 4.1, Subpart IX, §270.14(b)(19)]

The maps identified in this section demonstrate compliance with 20 NMAC 4.1, Subpart IX, §270.14(b)(19). All maps clearly show a map scale, date, and north arrow.

B.3.1 Legal Boundaries and Access Control [20 NMAC 4.1, Subpart IX, §§270.14(b)(19)(vii) and (viii)]

The topographic map of the Ciniza Refinery (Figure B-4) shows the legal boundaries of Ciniza Refinery, access control features (e.g., fences, gates), and location of the LTU. The topographic map shows a distance of 1,000 ft from the LTU perimeter.

B.3.2 Surface Waters and Wells [20 NMAC 4.1, Subpart IX, §270.14(b)(19)(iii) and (ix)]

Surface waters and wells are shown on Figure B-3. Floodplain information is provided in Section B.5. In the event of a 100-year flood, water is diverted away from the LTU via surrounding berms, grading, and natural topography.

B.3.3 Surrounding Land Uses [20 NMAC 4.1, Subpart IX, §270.14(b)(19)(iv)]

Ciniza, located in McKinley County, is in a remote, undeveloped, and sparsely populated area. The surrounding land use (as shown on Figure B-1) is cattle and sheep grazing at a density of less than six cattle or 30 sheep per section. Most of McKinley County is rural, as are adjoining portions of neighboring counties.

Ciniza maintains residences for several employees approximately 0.5 mile south of the refinery process area. A truck stop is located within one mile south-southwest of the process area at an I-40 exit. A rural residential area, with a density of eight to 10 residents per square mile, is about 1.5 miles southwest of the refinery. A railroad is within two miles to the north; the small community of Iyanbito is within three miles to the northwest; the Fort Wingate Military Reservation is within six miles to the west; the Cibola National Forest is within two miles to the southwest; and a highway rest area is within 1 mile at the I-40 exit to the south. The largest residential community near the refinery is Gallup, New Mexico, which is 17 miles away.

B.3.4 Wind Rose [20 NMAC 4.1, Subpart IX, §270.14(b)(19)(v)]

Wind rose data for Gallup, New Mexico (17 miles west of the Ciniza Refinery) is shown on Figure B-5. Surface winds at Ciniza vary throughout the year. Wind speeds are strongest from March through May and are weakest in November. The strongest winds are generally west-southwest. Winds from March to October decrease linearly in average speed from 50 to 10 mph.

B.3.5 Structures [20 NMAC 4.1, Subpart IX, §§270.14(b)(19)(x) and (xi)]

Runoff control systems, barriers for drainage or flood control, access and internal roads, storm systems, and fire control facilities are shown on Figures B-1, B-2, and B-3, respectively.

B.4 Seismic Standard [20 NMAC 4.1, Subpart IX, §§270.14(b)(11)(i) and (ii)]

McKinley County, New Mexico, is not listed in Appendix VI of Part 264. Compliance with the seismic standard need not be demonstrated.

B.5 Floodplain Standard [20 NMAC 4.1, Subpart IX, §270.14(b)(11)(iii) and §270.14(b)(19)(ii)]

In accordance with 20 NMAC 4.1, Subpart IX, §270.14(b)(11)(iii), the 100-year floodplain is shown on Figure B-3. The LTU lies outside the 100-year floodplain boundary.

Figure B-3 shows the drainage areas and 100-year floodplain relative to Ciniza and the LTU. The drainage area, which flows northwest of the LTU, includes 6,965 acres south of I-40 draining through Four Mile Canyon. Existing drainage control structures at I-40 are three 10 ft x 12 ft concrete box culverts and one 6 ft x 7 ft concrete box culvert. The 100-year peak flow at these points (Tables B-1, B-2, and B-3) totals 3,175 cfs, as shown on Figure B-3. After passing east of Ciniza, the drainage turns west (bounded on the north by the railroad bed) and flows past the refinery at 3,607 cfs. Existing drainage channels can contain the 100-year event within the areas delineated on Figure B-3. The 100-year floodplain is approximately 300 ft south of the railroad track and is adjacent to the northeast end of the Ciniza landing strip. Tables B-1, B-2, and B-3 provide additional detailed floodplain information.

Approximately 2,572 acres drain 1,800 ft to the southwest of Ciniza. These flows originate south of I-40 and peak at 700 cfs for the 100-year event. Existing drainage control structures for Ciniza roads and the evaporation ponds divert the 100-year flows away from the refinery, as shown on Figure B-3. Table B-4 provides additional floodplain information for this drainage area.

B.6 Traffic [20 NMAC 4.1, Subpart IX, §270.14(b)(10)]

Ciniza roads are asphalt-paved, with the exception of the section starting from the sewerage lagoon west to the LTU. During post-closure, an estimated 52 trips per year by vehicle are expected for LTU maintenance and monitoring. The LTU is in an isolated area and only those personnel involved with the maintenance and monitoring activities will have access to the LTU. Vehicle access to the LTU requires entry through the refinery process area. The location of the roads leading from the process area to the LTU traffic control stop signs and gates are shown on Figure B-6. Figure B-6 also shows the landing strip for the pipeline area, which serves as the emergency landing strip.

Table B-1. Peak Discharge and Runoff Calculation Sheet No. 1

Reference:	Chapter 2 - Engineering Field Manual for Conservation Practices: USDA, Soil Conservation Service
Location:	Area NW, Four Mile Canyon, Ciniza, New Mexico
Soil and Cover:	Subarea I, B/C soil, 75-percent cover, good condition, ponderosa pine
Date:	December 15, 1983
Purpose:	100-year floodplain at Ciniza Refinery

Drainage Area:	A	=	5,071 ac
Length:	L	=	20,000 ft
Elevation Differences:	H	=	900 ft
Runoff Curve Number:	CN	=	58
Time of Concentration:	T_c	=	8.82 hours
Rainfall, 24-hour at 100 year:	P_{24}	=	2.8 in.
Direct Runoff	Q	=	0.3 in.
Distribution Curve No:	DC	=	70
Runoff Rate:	R	=	0.84 cfs/ac-in.
Peak Discharge, q = A x Q x R		=	1,280 cfs
Runoff Volume, v = A x Q/12		=	127 ac-ft

Delta H Engineering, Ltd., 1983.

Table B-2. Peak Discharge and Runoff Calculation Sheet No. 2

Reference:	Chapter 2 - Engineering Field Manual for Conservation Practices: USDA, Soil Conservation Service
Location:	Area NW, Four Mile Canyon, Ciniza, New Mexico
Soil and Cover:	Subarea II, B/C soil, 50-percent cover, mountain brush and juniper grass
Date:	December 15, 1983
Purpose:	100-year floodplain at Ciniza Refinery

Drainage Area:	A	=	1,894 ac
Length:	L	=	17,000 ft
Elevation Differences:	H	=	200 ft
Runoff Curve Number:	CN	=	65
Time of Concentration:	T_c	=	1.3 hours
Rainfall, 24-hour at 100 year:	P_{24}	=	2.8 in.
Direct Runoff	Q	=	0.4 in.
Distribution Curve No:	DC	=	70
Runoff Rate:	R	=	0.55 cfs/ac-in.
Peak Discharge, q = A x Q x R		=	1,895 cfs
Runoff Volume, v = A x Q/12		=	3,175 ac-ft[a]

Delta H Engineering, Ltd., 1983.

[a]Calculations indicate approximate number as 63 ac-ft, Benchmark 1998.

Table B-3. Peak Discharge and Runoff Calculation Sheet No. 3

Reference:	Chapter 2 - Engineering Field Manual for Conservation Practices: USDA, Soil Conservation Service
Location:	Area NW, Four Mile Canyon, Ciniza, New Mexico
Soil and Cover:	Subarea III, B/C soil, 50-percent cover, herbaceous and mountain brush
Date:	December 15, 1983
Purpose:	100-year floodplain at Ciniza Refinery

Drainage Area:	A	=	1,028 ac
Length:	L	=	14,000 ft
Elevation Differences:	H	=	2,500 ft
Runoff Curve Number:	CN	=	70
Time of Concentration:	T_c	=	0.95 hour
Rainfall, 24-hour at 100 year:	P_{24}	=	2.8 in.
Direct Runoff	Q	=	0.60 in.
Distribution Curve No:	DC	=	70
Runoff Rate:	R	=	0.70 cfs/ac-in.
Peak Discharge, q = A x Q x R		=	432 cfs
Runoff Volume, v = A x Q/12		=	51.4 ac-ft

Delta H Engineering, Ltd., 1983.

Table B-4. Peak Discharge and Runoff Calculation Sheet No. 4

Reference:	Chapter 2 - Engineering Field Manual for Conservation Practices: USDA, Soil Conservation Service
Location:	Area SW, immediately west of Fourmile Canyon, Ciniza, New Mexico
Soil and Cover:	B/C soil, 60-percent Ponderosa Pine, 40-percent mountain brush
Date:	December 15, 1983
Purpose:	100-year floodplain at Ciniza Refinery

Drainage Area:	A	=	2,572 ac
Length:	L	=	22,000 ft
Elevation Differences:	H	=	690 ft
Runoff Curve Number:	CN	=	64
Time of Concentration:	T_c	=	1.0 hour
Rainfall, 24-hour at 100 year:	P_{24}	=	2.8 in.
Direct Runoff	Q	=	0.4 in.
Distribution Curve No:	DC	=	70
Runoff Rate:	R	=	0.68 cfs/ac-in.
Peak Discharge, q = A x Q x R		=	700 cfs
Runoff Volume, v = A x Q/12		=	86 ac-ft

Delta H Engineering, Ltd., 1983.

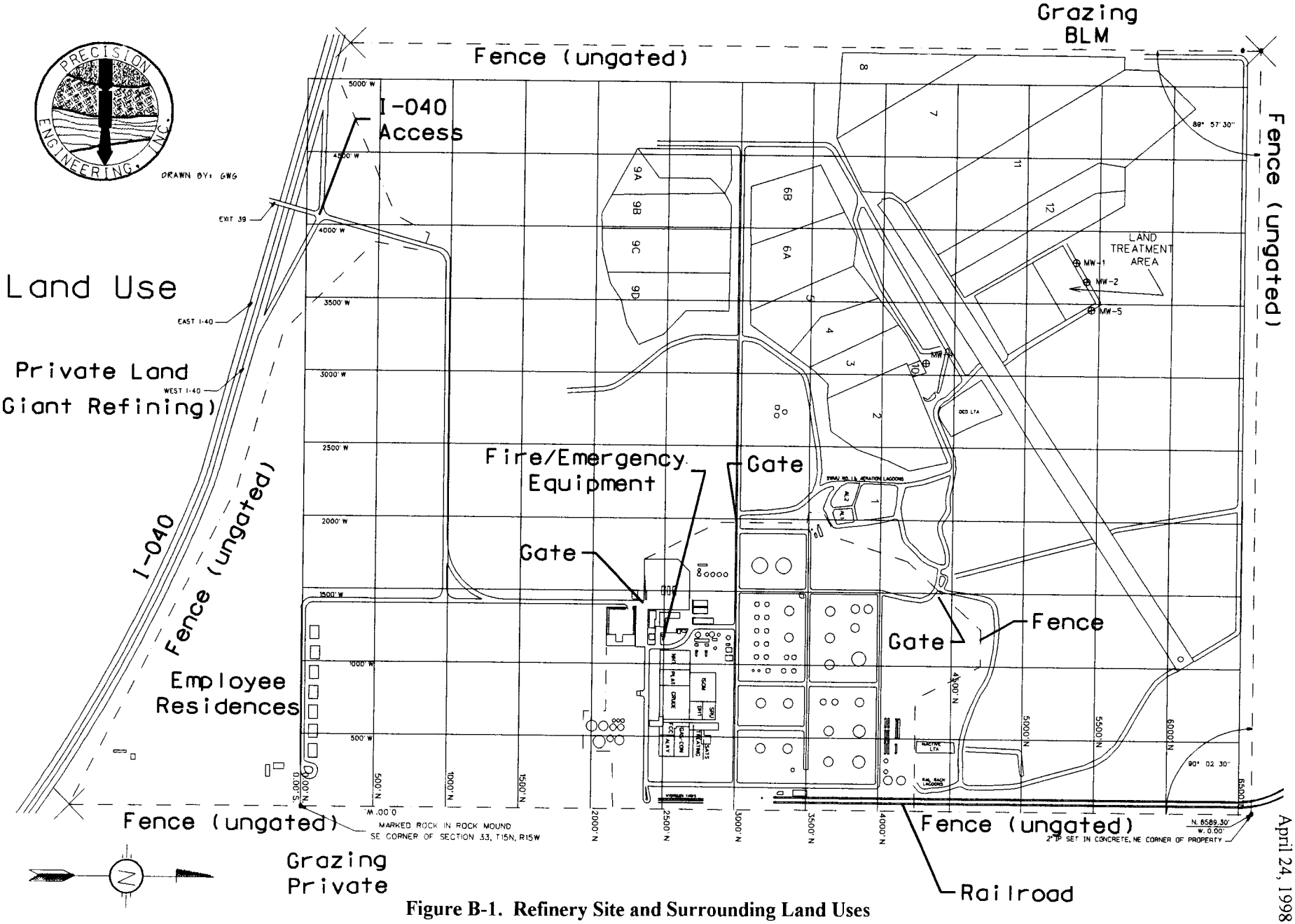


Figure B-1. Refinery Site and Surrounding Land Uses

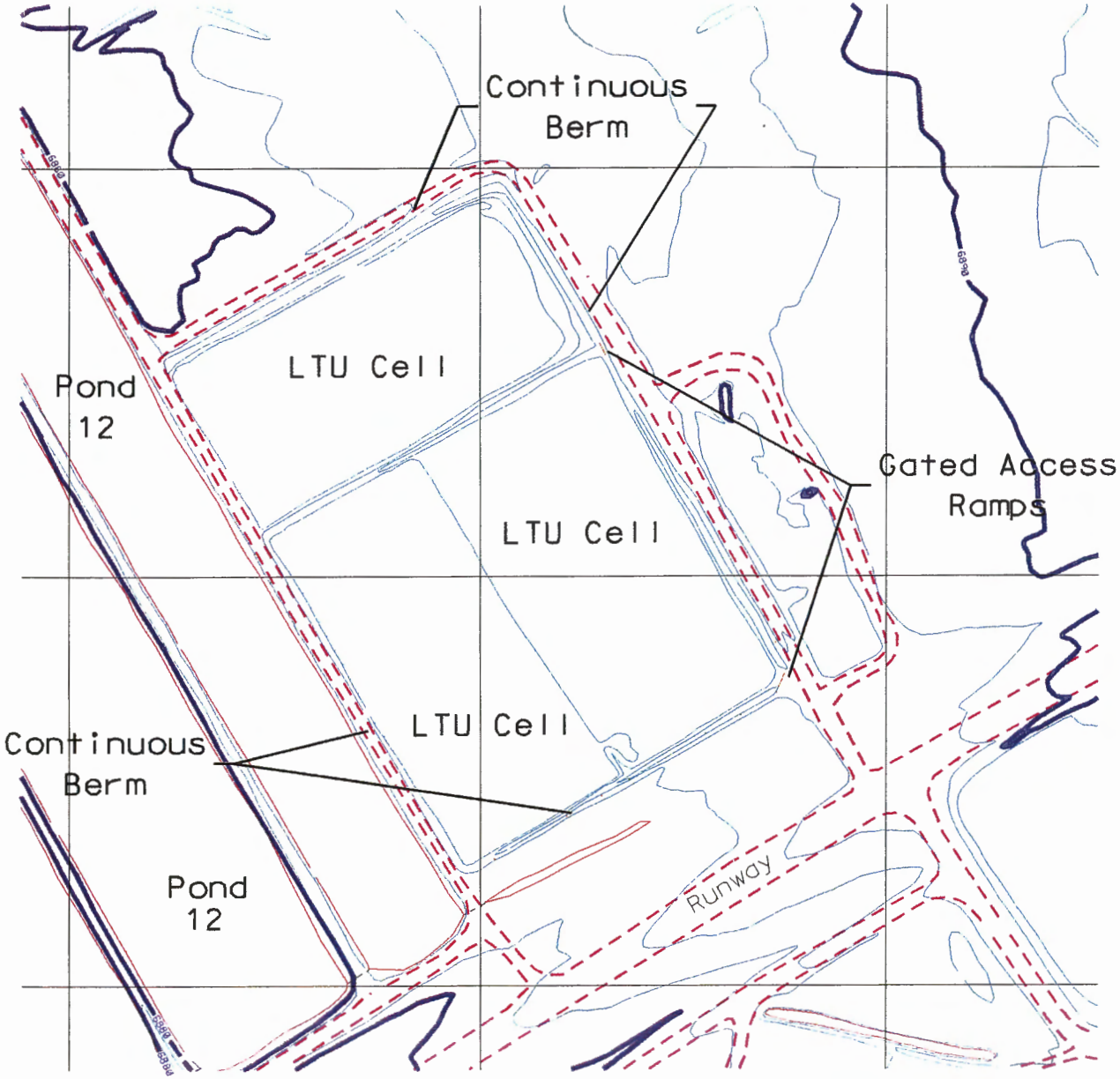


Figure B-2
LTU Close Up
NTS

— Roads

N

Figure B-2. Ciniza Land Treatment Unit

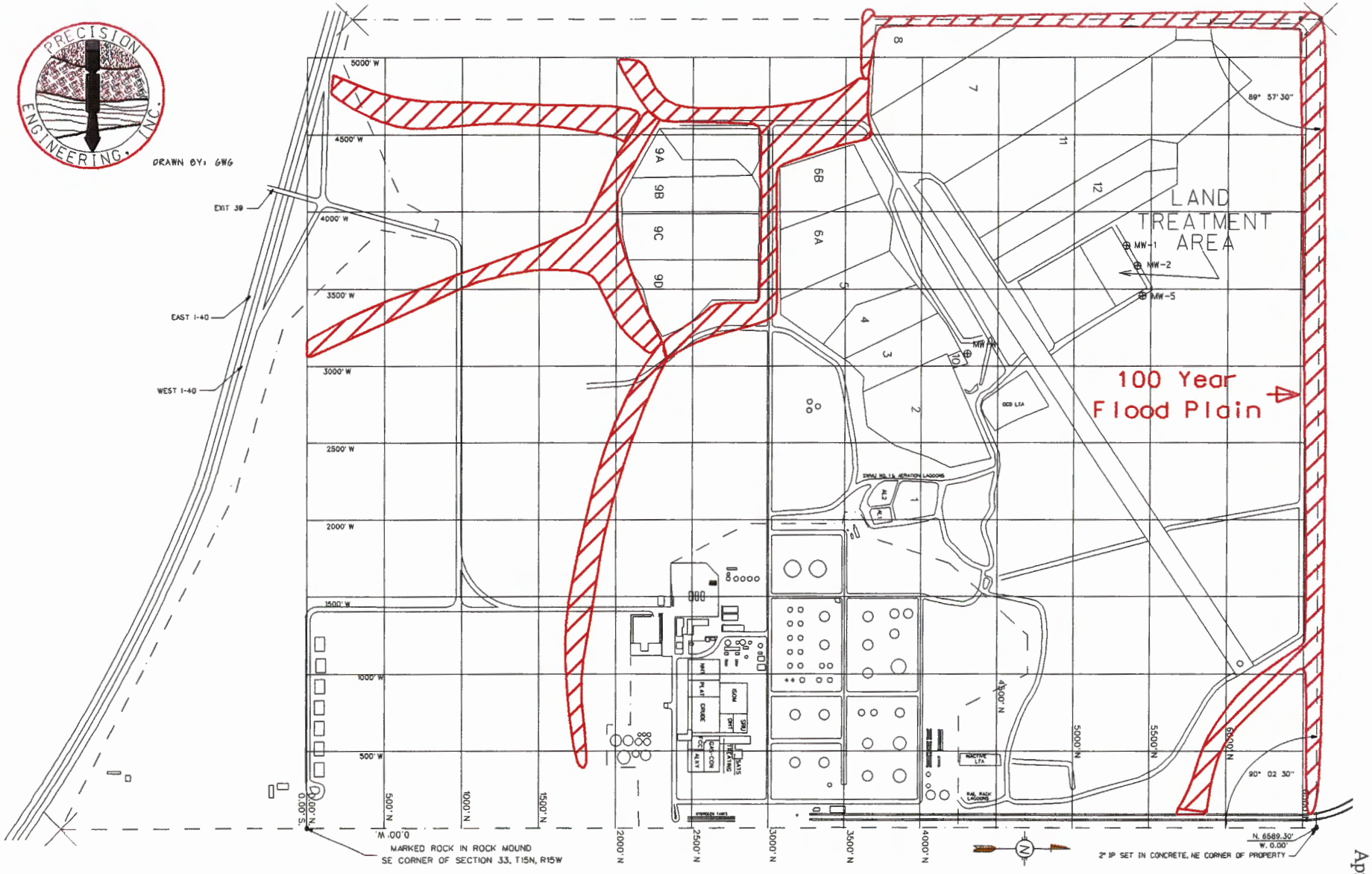
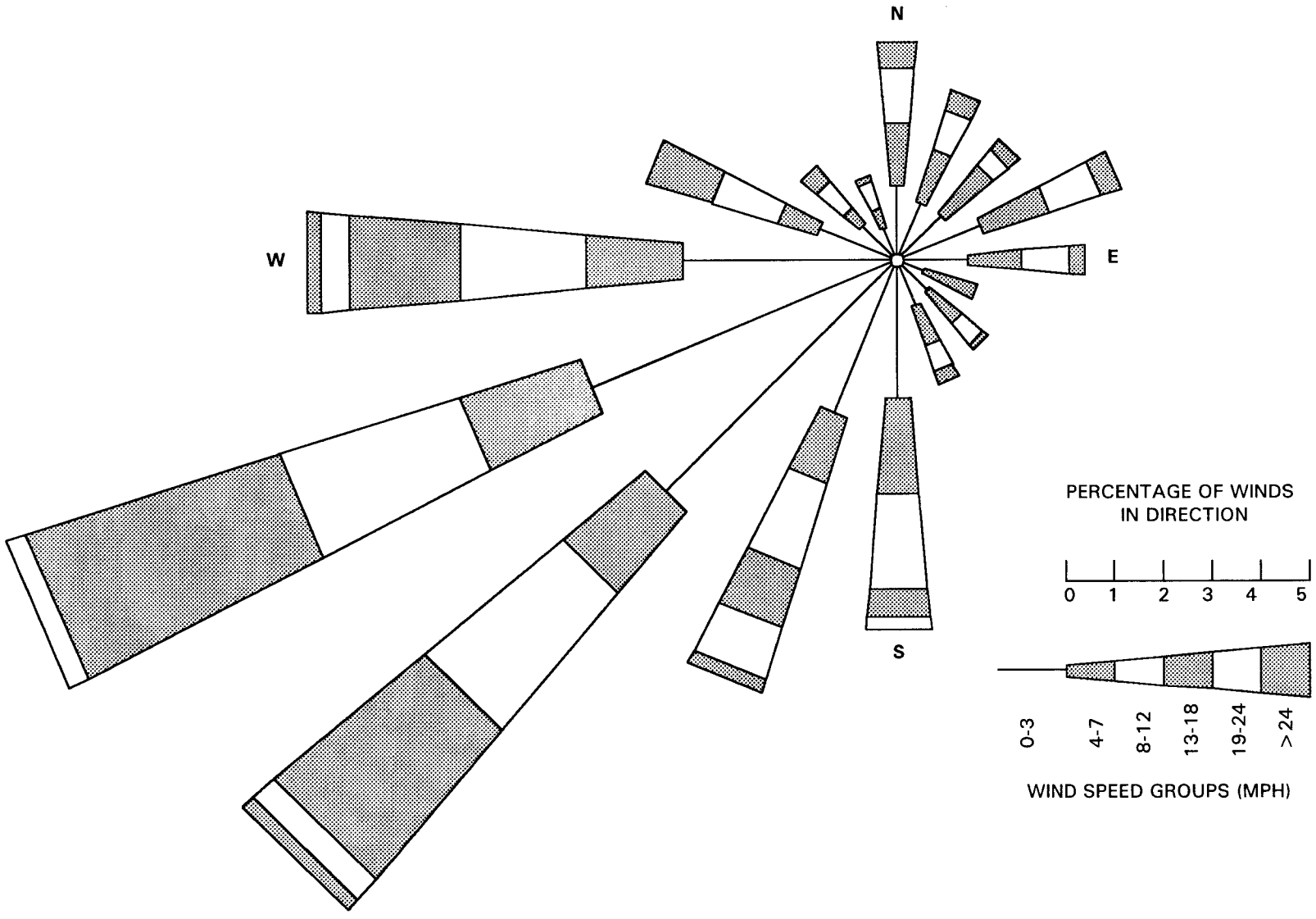


Figure B-3a. 100-Year/Floodplain and Surface Waters and Wells



SOURCE: CLIMATOLOGICAL SUMMARY FOR GALLUP, N.M. DEPARTMENT OF COMMERCE 1972

Figure B-5. Wind Rose

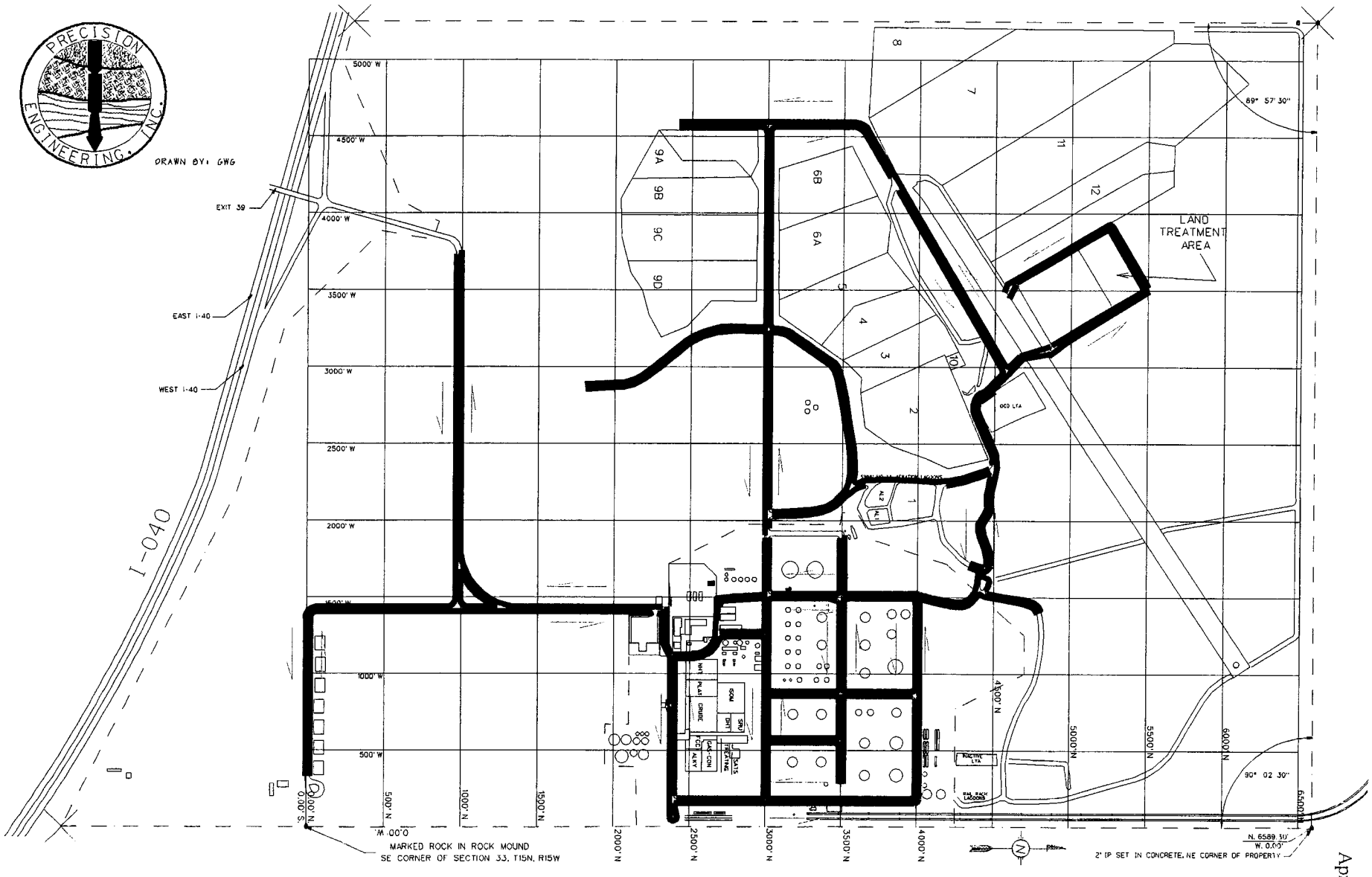


Figure B-6. Traffic Patterns

C.0 WASTE CHARACTERISTICS

The information provided in this section is submitted in accordance with the applicable requirements of 20 NMAC 4.1, Subpart V, §264.13, and Subpart IX, §270.14(b)(2).

C.1 Chemical and Physical Properties [20 NMAC 4.1, Subpart V, §264.13(a), and Subpart IX, §270.14(b)(2)]

Ciniza applied refinery sludges carrying the EPA hazardous waste numbers D001, D007, K049, K050, K051, and K052 to the LTU in accordance with Ciniza's Hazardous Waste Facility Permit until November 8, 1990. During this time of hazardous waste application, Ciniza treated approximately 2,600 tons of hazardous waste at the LTU. The refinery sludges treated at the LTU were viscous oil-water-solid mixtures. Appendix A describes the chemical and physical properties of the hazardous waste streams treated at the LTU. Ciniza maintains laboratory reports detailing the chemical and physical analyses of representative samples of the wastes.

D.0 LAND TREATMENT UNIT PROGRAM HISTORY

Giant owns and operates the Ciniza Refinery in McKinley County, New Mexico. Ciniza was constructed in 1957, by the El Paso Natural Gas Company, was sold in 1964, and sold again in 1982, to the present owner, Giant Industries, Inc. Ciniza produces fuel products from crude oil. Various hydrocarbon liquids are stored on-site in tanks and distributed throughout the refinery via an extensive piping system. Various wastes are generated during Ciniza operations. Ciniza established the LTU for the degradation, transformation, or immobilization of hazardous wastes generated at Ciniza. The LTU utilized microbial activity and soil characteristics to treat hazardous constituents in the waste. The LTU is approximately 1,500 ft northwest of the refinery process area and consists of three 480-ft x 240-ft sections, as shown on Figure B-1. The LTU received hazardous wastes from October 10, 1980, to November 8, 1990. The LTU received nonhazardous waste between 1990 and 1993. Waste has not been added to the LTU since 1993.

Ciniza established the LTU for the degradation, transformation, or immobilization of hazardous wastes generated at the Ciniza Refinery. The history of the LTU is summarized in Table D-1. Table D-2 lists the ZOI sample event results from 1993 – 1999. Background sample results are detailed on Table D-3; Figures D-1 and D-2 identify sample locations in the vicinity of the LTU and the sampling grid-random number system.

Historical LTU information and data extracted from existing permit applications, operating permits, operating records, and other source documents are provided as Appendix C. The inclusion of this appendix does not imply that historical information and data have been verified.

Table D-1. LTU History at Ciniza Refinery

Date	Event
August 1980	Ciniza notified EPA that it was a generator and operator of a hazardous waste management facility.
October 10, 1980	Ciniza begins application of hazardous wastes to the LTU.
November 1980	Ciniza submitted a Part A permit application as an "existing facility."
November 1980 through February 1988	Ciniza operated the LTU under interim status.
December 1983	Ciniza submitted a Part B permit application.
April 1985	Ciniza submitted a land treatment demonstration (LTD) plan and application for a two-phase LTD permit.
February 9, 1987	EPA issued Ciniza a short-term LTD permit (NMD000333211-1).
November 4, 1988	The state issued Ciniza a Hazardous Waste Facility Permit (NMD000333211-2).
November 8, 1990	Ciniza ceased application of hazardous wastes to the LTU.
1990 to 1993	Ciniza applied nonhazardous wastes to the LTU.
October 10, 1980 to Present	Ciniza has maintained the LTU and has conducted soil and groundwater monitoring.

Table D-2a. Ciniza ZOI Analytical Results, 1993 – 1999

Year 1999

Fall 1999						
Sample ID[a]	pH	%TOC[b]	Total P[c]	TKN[d]	O&G[e]	Units
ZOI-1-055-101999	7.5	1.40	190	210	710	mg/kg
ZOI-1-193-101999	8.1	0.38	140	300	580	mg/kg
ZOI-2-055-101999	7.7	2.20	260	600	4400	mg/kg
ZOI-3-160-101999	8.1	0.37	210	260	180	mg/kg

Bi-Monthly Fall 1999						
Sample ID[a]	pH	%TOC[b]	Total P[c]	TKN[d]	O&G[e]	Units
ZOI-1-160-100799					5700	mg/kg
ZOI-1-198-100799					390	mg/kg
ZOI-2-084-100799					2600	mg/kg
ZOI-3-158-100799					360	mg/kg

Spring 1999						
Sample ID[a]	pH	%TOC[b]	Total P[c]	TKN[d]	O&G[e]	Units
ZOI-1-040-051899	7.6	2.8	0.1	730	6600	mg/kg
ZOI-1-098-051899	7.2	2.6	0.3	500	4900	mg/kg
ZOI-1-143-051899	7.9	5.5	0.2	230	10000	mg/kg
ZOI-2-040-051899	7.1	5.8	0.2	700	18000	mg/kg
ZOI-2-041-051899	8.1	3.2	0.2	540	4500	mg/kg
ZOI-2-107-051899	7.5	3.4	0.2	510	7000	mg/kg
ZOI-3-038-051899	6.6	1.7	0.1	500	3500	mg/kg
ZOI-3-097-051899	8.0	0.5	0.5	190	900	mg/kg
ZOI-3-135-051899	8.8	0.3	0.2	320	ND	mg/kg
ZOI-3-152-051899	8.4	0.4	0.2	300	ND	mg/kg

[a] Sample Number Identification:
(1) Zone of Incorporation – upper 12-in. of soil
(2) LTU Cell 1, 2, or 3
(3) Grid Cell Number – between 1-200
(4) Data Sample Number
[b] TOC = Total Organic Carbon
[c] Total P = Total Phosphorus
[d] TKN = Total Kjeldahl Nitrogen
[e] O&G = Oil and Grease

Table D-2a. Ciniza ZOI Analytical Results, 1993 – 1999 (Continued)

Year 1998

Fall 1998						
Sample ID[a]	pH	%TOC[b]	Total P[c]	TKN[d]	O&G[e]	Units
ZOI-1-127-011499	8.6	0.3	120	190	ND	mg/kg
ZOI-1-142-011499	8.0	0.4	130	190	ND	mg/kg
ZOI-2-113-011499	8.7	0.5	140	220	ND	mg/kg
ZOI-3-056-011499	8.8	0.4	150	220	ND	mg/kg

Bi-Monthly Summer 1998						
Sample ID[a]	pH	%TOC[b]	Total P[c]	TKN[d]	O&G[e]	Units
ZOI-1-176-060598					210	mg/kg
ZOI-2-014-060598					9200	mg/kg
ZOI-2-070-060598					470	mg/kg
ZOI-3-058-060598					400	mg/kg

Spring 1998						
Sample ID[a]	pH	%TOC[b]	Total P[c]	TKN[d]	O&G[e]	Units
ZOI-1-174-042398	8.5	0.5	230	220	120	mg/kg
ZOI-2-186-042398	8.5	0.3	190	160	ND	mg/kg
ZOI-3-036-042398	7.9	0.7	230	350	220	mg/kg
ZOI-3-119-042398	8.4	0.5	250	280	80	mg/kg

[a] Sample Number Identification:
(1) Zone of Incorporation – upper 12-in. of soil
(2) LTU Cell 1, 2, or 3
(3) Grid Cell Number – between 1-200
(4) Data Sample Number
[b] TOC = Total Organic Carbon
[c] Total P = Total Phosphorus
[d] TKN = Total Kjeldahl Nitrogen
[e] O&G = Oil and Grease

Table D-2a. Ciniza ZOI Analytical Results, 1993 – 1999 (Continued)

Year 1997

Fall 1997						
Sample ID[a]	pH	%TOC[b]	Total P[c]	TKN[d]	O&G[e]	Units
ZOI-1-039-111197	7.8	0.5	270	150	120	mg/kg
ZOI-1-163-111197	8.1	0.6	220	280	55	mg/kg
ZOI-2-114-111197	8.2	0.2	190	130	74	mg/kg
ZOI-3-153-111197	8.5	0.4	280	190	74	mg/kg

Bi-Monthly Fall 1997						
Sample ID[a]	pH	%TOC[b]	Total P[c]	TKN[d]	O&G[e]	Units
ZOI-1-075-091097	8.7	0.7				mg/kg
ZOI-2-198-091097	8.6	0.4				mg/kg
ZOI-3-064-091097	8.6	0.8				mg/kg
ZOI-3-142-091097	8.5	0.7				mg/kg

Bi-Monthly Summer 1997						
Sample ID[a]	pH	%TOC[b]	Total P[c]	TKN[d]	O&G[e]	Units
ZOI-1-068-052797	7.8	0.5			50	mg/kg
ZOI-2-037-052797	7.8	0.4			110	mg/kg
ZOI-3-079-052797	7.5	1.0			ND	mg/kg
ZOI-3-093-052797	7.6	1.0			80	mg/kg

Spring 1997						
Sample ID[a]	pH	%TOC[b]	Total P[c]	TKN[d]	O&G[e]	Units
ZOI-1-140-050297	7.7	<1	267	313		mg/kg
ZOI-2-068-050297	7.7	<1	139	470		mg/kg
ZOI-2-073-050297	7.7	<1	81	359		mg/kg
ZOI-3-066-050297	7.7	<1	99	455		mg/kg

[a] Sample Number Identification:
(1) Zone of Incorporation – upper 12-in. of soil
(2) LTU Cell 1, 2, or 3
(3) Grid Cell Number – between 1-200
(4) Data Sample Number
[b] TOC = Total Organic Carbon
[c] Total P = Total Phosphorus
[d] TKN = Total Kjeldahl Nitrogen
[e] O&G = Oil and Grease

Table D-2a. Ciniza ZOI Analytical Results, 1993 – 1999 (Continued)

Year 1996

Fall 1996						
Sample ID[a]	pH	%TOC[b]	Total P[c]	TKN[d]	O&G[e]	Units
ZOI-1-089-021897	7.5	0.01	0.1	400	ND	mg/kg
ZOI-2-168-021897	7.7	0.01	0.2	300	ND	mg/kg
ZOI-3-027-021897	7.8	0.01	0.2	400	ND	mg/kg
ZOI-3-186-021897	7.7	0.01	0.3	400	ND	mg/kg

Bi-Monthly Fall 1996						
Sample ID[a]	pH	%TOC[b]	Total P[c]	TKN[d]	O&G[e]	Units
ZOI-1-082-090396					138	mg/kg
ZOI-2-033-090396					29	mg/kg
ZOI-2-165-090396					ND	mg/kg
ZOI-3-088-090396					ND	mg/kg

Summer 1996						
Sample ID[a]	pH	%TOC[b]	Total P[c]	TKN[d]	O&G[e]	Units
ZOI-1-073-061196					ND	mg/kg
ZOI-2-075-061196					ND	mg/kg
ZOI-2-120-061196					ND	mg/kg
ZOI-3-148-061196					ND	mg/kg

Spring 1996 Special Sampling						
Sample ID[a]	pH	%TOC[b]	Total P[c]	TKN[d]	O&G[e]	Units
ZOI-1-014-040296					3930	mg/kg
ZOI-1-091-040196					2940	mg/kg
ZOI-1-104-040196		container broken in transit to lab				mg/kg
ZOI-1-178-040296					6900	mg/kg
ZOI-2-050-040196					4850	mg/kg
ZOI-2-078-040196					13400	mg/kg
ZOI-2-081-040196					3640	mg/kg
ZOI-2-132-040296					4760	mg/kg
ZOI-3-090-040296					164	mg/kg
ZOI-3-092-040296					ND	mg/kg
ZOI-3-163-040296					ND	mg/kg
ZOI-3-198-040296					ND	mg/kg

[a] Sample Number Identification:
(1) Zone of Incorporation – upper 12-in. of soil
(2) LTU Cell 1, 2, or 3
(3) Grid Cell Number – between 1-200
(4) Data Sample Number
[b] TOC = Total Organic Carbon
[c] Total P = Total Phosphorus
[d] TKN = Total Kjeldahl Nitrogen
[e] O&G = Oil and Grease

Table D-2a. Ciniza ZOI Analytical Results, 1993 – 1999 (Continued)

Year 1995

Sample ID[a]	pH	%TOC[b]	Total P[c]	TKN[d]	O&G[e]	Units
Fall 1995						
ZOI-1-088-111595	7.7		360	470	88000	mg/kg
ZOI-2-114-111595	7.7		350	710	75000	mg/kg
ZOI-3-043-111595	8.3		220	510	14000	mg/kg
ZOI-3-134-111595	8.6		230	290	100	mg/kg

Sample ID[a]	pH	%TOC[b]	Total P[c]	TKN[d]	O&G[e]	Units
Bi-Monthly Fall 1995						
ZOI-1-118-083195					6590	mg/kg
ZOI-2-008-083195					10800	mg/kg
ZOI-2-178-083195					3950	mg/kg
ZOI-3-145-083195					17	mg/kg

Sample ID[a]	pH	%TOC[b]	Total P[c]	TKN[d]	O&G[e]	Units
Bi-Monthly Summer 1995						
ZOI1-038-062995					5830	mg/kg
ZOI-1-085-062995					9720	mg/kg
ZOI-2-117-062995					7390	mg/kg
ZOI-3-065-062995					2870	mg/kg

Sample ID[a]	pH	%TOC[b]	Total P[c]	TKN[d]	O&G[e]	Units
Spring 1995						
ZOI-1-015-042895	6.0		301	1330	18000	mg/kg
ZOI-1-186-042895	7.5		297	666	14000	mg/kg
ZOI-2-064-042895	7.5		334	775	9400	mg/kg
ZOI-3-099-042895	10.1		410	49	6340	mg/kg

[a] Sample Number Identification:
(1) Zone of Incorporation – upper 12-in. of soil
(2) LTU Cell 1, 2, or 3
(3) Grid Cell Number – between 1-200
(4) Data Sample Number
[b] TOC = Total Organic Carbon
[c] Total P = Total Phosphorus
[d] TKN = Total Kjeldahl Nitrogen
[e] O&G = Oil and Grease

Table D-2a. Ciniza ZOI Analytical Results, 1993 – 1999 (Continued)

Year 1994

Bi-Monthly Fall 1994

Sample ID[a]	pH	%TOC[b]	Total P[c]	TKN[d]	O&G[e]	Units
ZOI-1-089-080494					32000	mg/kg
ZOI-1-069-080494					16000	mg/kg
ZOI-2-132-080494					16000	mg/kg
ZOI-3-122-080494					60000	mg/kg

Bi-Monthly Summer 1994

Sample ID[a]	pH	%TOC[b]	Total P[c]	TKN[d]	O&G[e]	Units
ZOI-1-056-061694					21000	mg/kg
ZOI-1-149-061694					22000	mg/kg
ZOI-2-097-061694					19000	mg/kg
ZOI-3-126-061694					2100	mg/kg

Spring 1994

Sample ID[a]	pH	%TOC[b]	Total P[c]	NO2/NO3 N	O&G[e]	Units
ZOI-1-174-052394	7.8	1.3	270	8	70	mg/kg
ZOI-2-061-052394	7.7	5.8	310	7	65	mg/kg
ZOI-2-147-052394	7.3	4.5	330	13	ND	mg/kg
ZOI-3-153-052394	7.9	2.1	270	25	160	mg/kg

[a] Sample Number Identification:
(1) Zone of Incorporation – upper 12-in. of soil
(2) LTU Cell 1, 2, or 3
(3) Grid Cell Number – between 1-200
(4) Data Sample Number
[b] TOC = Total Organic Carbon
[c] Total P = Total Phosphorus
[d] TKN = Total Kjeldahl Nitrogen
[e] O&G = Oil and Grease

Table D-2a. Ciniza ZOI Analytical Results, 1993 – 1999 (Continued)

Year 1993

Bi-Monthly Fall 1993

Sample ID[a]	pH	%TOC[b]	Total P[c]	TKN[d]	O&G[e]	Units
ZOI-1-147-092193					9300	mg/kg
ZOI-2-025-092193					9400	mg/kg
ZOI-2-124-092193					20000	mg/kg
ZOI-3-022-092193					2600	mg/kg

Fall 1993

Sample ID[a]	pH	%TOC[b]	Total P[c]	TKN[d]	O&G[e]	Units
ZOI-1-179-080293					11000	mg/kg
ZOI-2-032-080293					29000	mg/kg
ZOI-2-136-080293					28000	mg/kg
ZOI-3-089-080293					1500	mg/kg

Spring 1993

Sample ID[a]	pH	%TOC[b]	Total P[c]	N	O&G[e]	Units
ZOI-1-039-060293	7.3		200	1700	15000	mg/kg
ZOI-2-027-060293	7.2		210	1700	17000	mg/kg
ZOI-2-062-060293	8.1		245	1000	15000	mg/kg
ZOI-3-015-060293	7.8		160	820	180	mg/kg

[a] Sample Number Identification:
(1) Zone of Incorporation – upper 12-in. of soil
(2) LTU Cell 1, 2, or 3
(3) Grid Cell Number – between 1-200
(4) Data Sample Number
[b] TOC = Total Organic Carbon
[c] Total P = Total Phosphorus
[d] TKN = Total Kjeldahl Nitrogen
[e] O&G = Oil and Grease

Table D-2b. Ciniza BTZ Analytical Results, 1993 – 1999

Year 1999

Sample ID[a]	pH	% TOC[b]	% Moisture	Vols (8021)	Semi Vols (8270)	Units
			Fall 1999			
BTZ-1-055-101999	8.0	0.3	lab error -	ND	ND	ug/kg
BTZ-1-193-101999	8.1	0.3	did not perform	ND	ND	ug/kg
BTZ-2-055-101999	8.8	0.1	requested	ND	ND	ug/kg
BTZ-3-160-101999	8.2	0.3	analyses	ND	ND	ug/kg

Sample ID[a]	pH	% TOC[b]	% Moisture	Vols (8021)	Semi Vols (8270)	Units
			Spring 1999			
BTZ-1-040-051899	8.4	0.2	12	ND	ND	ug/kg
BTZ-1-098-051899	8.4	0.3	13	ND	ND	ug/kg
BTZ-1-143-051899	8.5	0.4	12	ND	ND	ug/kg
BTZ-2-040-051899	8.1	0.3	15	ND	ND	ug/kg
BTZ-20-41-051899	8.1	0.3	13	ND	ND	ug/kg
BTZ-2-107-051899	8.4	0.2	13	ND	ND	ug/kg
BTZ-3-038-051899	8.4	0.3	16	ND	ND	ug/kg
BTZ-3-097-051899	8.6	0.2	13	ND	ND	ug/kg
BTZ-3-135-051899	8.4	0.4	14	ND	ND	ug/kg
BTZ-3-152-051899	8.9	0.1	10	ND	ND	ug/kg

[a] Sample Number Identification:
(1) Below Treatment Zone = BTZ
(2) LTU Cell 1, 2, or 3
(3) Grid Cell Number - between 1-200
(4) Data Sample Number

[b] TOC = Total Organic Carbon

Table D-2b. Ciniza BTZ Analytical Results, 1993 – 1999 (Continued)

Year 1998

Fall 1998						
Sample ID[a]	pH	% TOC[b]	% Moisture	Vols (8021)	Semi Vols (8270)	Units
BTZ-1-127-011499	8.9	0.3	13	ND	ND	ug/kg
BTZ-1-142-011499	8.8	0.2	10	ND	ND	ug/kg
BTZ-2-113-011499	8.9	0.6	6	ND	ND	ug/kg
BTZ-3-056-011499	8.3	0.3	5	ND	ND	ug/kg

Summer 1998						
Sample ID[a]	pH	% TOC[b]	% Moisture	Vols (8020)	Semi Vols (8270)	Units
BTZ-1-058-061798				ND	ND	ug/kg
BTZ-1-189-061798				ND	ND	ug/kg
BTZ-2-089-061798				ND	ND	ug/kg
BTZ-3-047-061798				ND	ND	ug/kg

Spring 1998						
Sample ID[a]	pH	% TOC[b]	% Moisture	Vols (8020)	Semi Vols (8270)	Units
BTZ-1-174-042398	8.4	0.4	12	ND	ND	ug/kg
BTZ-2-186-042398	8.6	0.4	13	ND	ND	ug/kg
BTZ-3-036-042398	8.5	0.4	19	ND	ND	ug/kg
BTZ-3-119-042398	8.7	0.4	14	ND	ND	ug/kg

[a] Sample Number Identification:
(1) Below Treatment Zone = BTZ
(2) LTU Cell 1, 2, or 3
(3) Grid Cell Number – between 1-200
(4) Data Sample Number

[b] TOC = Total Organic Carbon

Table D-2b. Ciniza BTZ Analytical Results, 1993 — 1999 (Continued)

Year 1997

			Fall 1997			
Sample ID[a]	**pH**	**% TOC[b]**	**% Moisture**	**Vols (8020)**	**Semi Vols (8270)**	**Units**
BTZ-1-039-111197	8.1	0.4	12	ND		ug/kg
BTZ-1-163-111197	8.6	0.1	8	ND		ug/kg
BTZ-2-114-111197	8.5	0.5	15	ND		ug/kg
BTZ-3-153-111197	8.5	0.4	11	ND		ug/kg

			Spring 1997			
Sample ID[a]	**pH**	**% TOC[b]**	**% Moisture**	**Vols (8020)**	**Semi Vols (8270)**	**Units**
BTZ-1-140-050297	7.8	<1	10.7	ND	ND	ug/kg
BTZ-2-068-050297	7.8	<1	14.3	ND	ND	ug/kg
BTZ-2-073-050297	7.8	<1	12.9	ND	ND	ug/kg
BTZ-3-066-050297	7.8	<1	11.8	ND	ND	ug/kg

			Fall 1997			
Sample ID[a]	**pH**	**% TOC[b]**	**% Moisture**	**Vols (8020)**	**Semi Vols (8270)**	**Units**
BTZ-1-039-111197	8.1	0.4	12	ND		ug/kg
BTZ-1-163-111197	8.6	0.1	8	ND		ug/kg
BTZ-2-114-111197	8.5	0.5	15	ND		ug/kg
BTZ-3-153-111197	8.5	0.4	11	ND		ug/kg

			Spring 1997			
Sample ID[a]	**pH**	**% TOC[b]**	**% Moisture**	**Vols (8020)**	**Semi Vols (8270)**	**Units**
BTZ-1-140-050297	7.8	<1	10.7	ND	ND	ug/kg
BTZ-2-068-050297	7.8	<1	14.3	ND	ND	ug/kg
BTZ-2-073-050297	7.8	<1	12.9	ND	ND	ug/kg
BTZ-3-066-050297	7.8	<1	11.8	ND	ND	ug/kg

[a] Sample Number Identification:
(1) Below Treatment Zone = BTZ
(2) LTU Cell 1, 2, or 3
(3) Grid Cell Number – between 1-200
(4) Data Sample Number

[b] TOC = Total Organic Carbon

Table D-2b. Ciniza BTZ Analytical Results, 1993 – 1999 (Continued)

Year 1996

Fall 1996						
Sample ID[a]	pH	% TOC[b]	% Moisture	Vols (8020)	Semi Vols (8270)	Units
BTZ-1-089-021897	7.6	0.01	13.0	ND	ND	ug/kg
BTZ-2-168-021897	7.6	0.01	13.8	ND	ND	ug/kg
BTZ-3-027-021897	7.8	0.01	18.9	ND	ND	ug/kg
BTZ-3-186-021897	7.9	0.01	11.5	ND	ND	ug/kg

Summer 1996						
Sample ID[a]	pH	% TOC[b]	% Moisture	Vols (8020)	Semi Vols (8270)	Units
BTZ-1-073-061196	8.1	0.3	11.5	ND	ND	ug/kg
BTZ-2-075-061196	8.0	0.2	13.9	ND	ND	ug/kg
BTZ-2-120-061196	7.8	0.2	15.4	ND	ND	ug/kg
BTZ-3-148-061196	8.1	0.2	13.8	ND	ND	ug/kg

Spring 1996 Special Sampling						
Sample ID[a]	pH	% TOC[b]	% Moisture	Vols (8020)	Semi Vols (8270)	Units
BTZ-1-014-040296		0.4		ND	ND	ug/kg
BTZ-1-091-040196		0.4		ND	ND	ug/kg
BTZ-1-104-040196		0.5		ND	ND	ug/kg
BTZ-1-178-040296		0.3		ND	ND	ug/kg
BTZ-2-050-040196		0.3		ND	ND	ug/kg
BTZ-2-078-040196		0.4		ND	ND	ug/kg
BTZ-2-081-040196		0.2		ND	ND	ug/kg
BTZ-2-132-040296		0.4		ND	ND	ug/kg
BTZ-3-090-040296		0.3		ND	ND	ug/kg
BTZ-3-092-040296		0.3		ND	ND	ug/kg
BTZ-3-163-040296		0.3		ND	ND	ug/kg
BTZ-3-198-040296		0.3		ND	ND	ug/kg

[a] Sample Number Identification:
(1) Below Treatment Zone = BTZ
(2) LTU Cell 1, 2, or 3
(3) Grid Cell Number – between 1-200
(4) Data Sample Number

[b] TOC = Total Organic Carbon

Table D-2b. Ciniza BTZ Analytical Results, 1993 – 1999 (Continued)

Year 1995

Sample ID[a]	pH	% TOC[b]	% Moisture	Vols (8020)	Semi Vols (8270)	Units
			Fall 1995			
BTZ-1-088-111595	9.5		13	ND	ND	ug/kg
BTZ-2-114-111595	9.1		15	ND	ND	ug/kg
BTZ-3-043-111595	9.6		10	ND	ND	ug/kg
BTZ-3-134-111595	9.2		13	ND	ND	ug/kg

Sample ID[a]	pH	% TOC[b]	% Moisture	Vols (8020)	Semi Vols (8270)	Units
			Spring 1995			
BTZ-1-015-042895	8.2		14.8	ND	ND	ug/kg
BTZ-1-186-042895	8.3		14.0	ND	ND	ug/kg
BTZ-2-064-042895	8.0		16.4	ND	ND	ug/kg
BTZ-3-099-042895	7.0		17.5	ND	ND	ug/kg

[a] Sample Number Identification:
(1) Below Treatment Zone = BTZ
(2) LTU Cell 1, 2, or 3
(3) Grid Cell Number – between 1-200
(4) Data Sample Number

[b] TOC = Total Organic Carbon

Table D-2b. Ciniza BTZ Analytical Results, 1993 – 1999 (Continued)

Year 1994

			Spring 1994			
Sample ID[a]	**pH**	**% TOC[b]**	**% Moisture**	**Vols (8020)**	**Semi Vols (8270)**	**Units**
BTZ-1-174-052394	8.8	0.4	14	ND	ND	ug/kg
BTZ-2-081-052394	9.0	0.3	12	ND	ND	ug/kg
BTZ-2-147-052394	9.2	0.3	13	ND	ND	ug/kg
BTZ-3-143-052394	9.5	0.3	9	ND	ND	ug/kg

[a] Sample Number Identification:
(1) Below Treatment Zone = BTZ
(2) LTU Cell 1, 2, or 3
(3) Grid Cell Number – between 1-200
(4) Data Sample Number

[b] TOC = Total Organic Carbon

Table D-2b. Ciniza BTZ Analytical Results, 1993 – 1999 (Continued)

Year 1993

			Fall 1993			
Sample ID[a]	**pH**	**% TOC[b]**	**% Moisture**	**Vols (8020)**	**Semi Vols (8270)**	**Units**
BTZ-1-180-080393	8.3		14.8	ND	ND	ug/kg
BTZ-2-115-080393	8.4		15.1	ND	ND	ug/kg
BTZ-2-023-080393	7.9		17.8	ND	ND	ug/kg
BTZ-3-088-080393	9.2		3.2	ND	ND	ug/kg

[a] Sample Number Identification:
(1) Below Treatment Zone = BTZ
(2) LTU Cell 1, 2, or 3
(3) Grid Cell Number – between 1-200
(4) Data Sample Number

[b] TOC = Total Organic Carbon

Table D-2c. Ciniza LTU Characterization Studies, 1996 – 1999

Year 1999 RCRA Metals

	Spring 1999												
Sample ID[a]	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Lead	Nickel	Selenium	Vanadium	Mercury	Units
ZOI-1-040-051899	ND	ND	290	ND	ND	190	7.1	40	28	ND	30	1	mg/kg
ZOI-1-098-051899	ND	ND	210	1.1	ND	15	5.7	11	13	ND	19	ND	mg/kg
ZOI-1-143-051899	ND	ND	240	1	ND	9.2	ND	9.1	10	ND	13	ND	mg/kg
ZOI-2-040-051899	ND	20.0	710	ND	ND	200	9.7	87	54	ND	40	13	mg/kg
ZOI-2-041-051899	1.2	10.0	550	ND	ND	310	8.2	54	32	3.3	35	8.4	mg/kg
ZOI-2-107-051899	ND	7.5	350	ND	0.8	220	6.2	40	24	ND	21	1.6	mg/kg
ZOI-3-038-051899	ND	3.9	340	ND	ND	190	5.1	21	11	ND	16	0.9	mg/kg
ZOI-3-097-051899	ND	1.6	360	1.4	ND	24	7	12	14	ND	30	ND	mg/kg
ZOI-3-135-051899	ND	1.3	330	1.6	ND	23	8.2	14	17	ND	36	ND	mg/kg
ZOI-3-152-051899	ND	1.5	350	1.5	ND	8.5	5.3	10	11	ND	17	ND	mg/kg

[a] Sample Number Identification:
(1) Zone of Incorporation
(2) LTU Cell 1, 2, or 3
(3) Grid Cell Number – between 1-200
(4) Data Sample Number

Table D-2c. Ciniza LTU Characterization Studies, 1996 – 1999 (Continued)

Year 1999 RCRA Metals

	Spring 1999												
Sample ID[a]	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Lead	Nickel	Selenium	Vanadium	Mercury	Units
3'-1-040-051899	16	ND	180	1.1	ND	9.5	4.1	11	9.4	ND	16	ND	mg/kg
3'-1-098-051899	ND	ND	140	ND	ND	7	ND	7.9	7	ND	12	ND	mg/kg
3'-1-143-051899	ND	ND	240	ND	ND	14	5.7	10	13	ND	20	ND	mg/kg
3'-2-040-051899	ND	1.2	310	1.3	ND	7.4	4.9	9.6	9.4	ND	14	ND	mg/kg
3'-2-041-051899	ND	1.3	290	1.7	ND	18	7	13	15	ND	28	ND	mg/kg
3'-2-107-051899	ND	ND	290	ND	ND	9.4	4.3	11	9.4	ND	15	ND	mg/kg
3'-3-038-051899	ND	1.5	200	1.4	ND	8.9	5	11	9.8	ND	18	ND	mg/kg
3'-3-097-051899	ND	1.6	300	1.8	ND	27	8.8	13	19	ND	40	ND	mg/kg
3'-3-135-051899	ND	1.7	360	1.5	ND	24	8.4	12	18	ND	36	ND	mg/kg
3'-3-152-051899	ND	1.4	370	1.4	ND	17	7	11	15	ND	27	ND	mg/kg

[a] Sample Number Identification:
(1) Treatment Zone
(2) LTU Cell 1, 2, or 3
(3) Grid Cell Number – between 1-200
(4) Data Sample Number

Table D-2c. Ciniza LTU Characterization Studies, 1996 – 1999 (Continued)

Year 1999 RCRA Metals

	Spring 1999												
Sample ID[a]	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Lead	Nickel	Selenium	Vanadium	Mercury	Units
BTZ-1-040-051899	ND	ND	210	ND	ND	12	5.2	8.9	13	ND	20	ND	mg/kg
BTZ-1-098-051899	ND	ND	210	1.1	ND	15	5.7	11	13	ND	19	ND	mg/kg
BTZ-1-143-051899	ND	ND	240	1	ND	9.2	ND	9.1	10	n	13	n	mg/kg
BTZ-2-040-051899	ND	1.4	260	1.5	ND	17	6.9	12	15	ND	27	0.2	mg/kg
BTZ-2-041-051899	ND	1.8	270	1.4	ND	18	7.1	12	15	ND	30	ND	mg/kg
BTZ-2-107-051899	ND	ND	230	1.1	ND	12	5.1	10	12	ND	19	ND	mg/kg
BTZ-3-038-051899	ND	2.4	300	1.4	ND	25	8.6	12	20	ND	43	ND	mg/kg
BTZ-3-097-051899	ND	1.6	330	1.2	ND	10	5.3	9.1	11	ND	22	ND	mg/kg
BTZ-3-135-051899	ND	1.4	330	1.6	ND	6.2	4.1	10	7.8	ND	16	ND	mg/kg
BTZ-3-152-051899	ND	1.1	430	ND	ND	7.8	4.7	8.5	8.8	ND	18	ND	mg/kg

[a] Sample Number Identification:
(1) Below Treatment Zone
(2) LTU Cell 1, 2, or 3
(3) Grid Cell Number – between 1-200
(4) Data Sample Number

Table D-2c. Ciniza LTU Characterization Studies, 1996 – 1999 (Continued)

Year 1998 **RCRA Metals, Volatiles, and Semi-Volatiles**

Summer 1998

Sample ID	Silver	Arsenic	Barium	Mercury	Cadmium	Chromium	Lead	Selenium	Vols 8021	Semi Vols 8270	Units
[a]ZOI-1-058-061798	ND	ND	210	ND	ND	9	6	ND	ND	ND	mg/kg
ZOI-1-189-061798	ND	ND	180	ND	ND	9	ND	ND	ND	ND	mg/kg
ZOI-2-089-061798	ND	ND	230	ND	ND	10	ND	ND	ND	ND	mg/kg
ZOI-3-047-061798	ND	ND	280	ND	ND	10	8	ND	ND	ND	mg/kg
[b]2'-1-058-061798	ND	ND	160	ND	ND	10	6	ND	ND	ND	mg/kg
2'-1-189-061798	ND	ND	310	ND	ND	9	5	ND	ND	ND	mg/kg
2'-2-089-061798	ND	ND	240	ND	ND	9	6	ND	ND	ND	mg/kg
2'-3-047-061798	ND	ND	360	ND	ND	11	7	ND	ND	ND	mg/kg
4'-1-058-061798	ND	ND	170	ND	ND	8	8	ND	ND	ND	mg/kg
4'-1-189-061798	ND	ND	280	ND	ND	8	6	ND	ND	ND	mg/kg
4'-2-089-061798	ND	ND	200	ND	0.5	11	8	ND	ND	ND	mg/kg
4'-3-047-061798	ND	ND	270	ND	ND	12	6	ND	ND	ND	mg/kg
[c]BTZ-1-058-061798	ND	ND	210	ND	ND	12	7	ND	ND	ND	mg/kg
BTZ-1-189-061798	ND	ND	180	ND	ND	12	ND	ND	ND	ND	mg/kg
BTZ-2-089-061798	ND	ND	160	ND	ND	11	6	ND	ND	ND	mg/kg
BTZ-3-047-061798	ND	ND	240	ND	ND	12	7	ND	ND	ND	mg/kg

[a] Sample Number Identification:
(1) Zone of Incorporation
(2) LTU Cell 1, 2, or 3
(3) Grid Cell Number – between 1-200
(4) Data Sample Number

[b] Sample Number Identification:
(1) Treatment Zone
(2) LTU Cell 1, 2, or 3
(3) Grid Cell Number – between 1-200
(4) Data Sample Number

[c] Sample Number Identification:
(1) Below Treatment Zone
(2) LTU Cell 1, 2, or 3
(3) Grid Cell Number – between 1-200
(4) Data Sample Number

Table D-2c. Ciniza LTU Characterization Studies, 1996 – 1999 (Continued)

Year 1998 RCRA Metals, Volatiles, and Semi-Volatiles

Sample ID	Silver	Arsenic	Barium	Mercury	Cadmium	Chromium	Lead	Selenium	Vols 8021	Semi Vols 8270	Units
					Spring 1998						
[a]ZOI-1-174-042398	ND	ND	190	ND	ND	10	6	ND	ND	ND	mg/kg
ZOI-2-186-042398	ND	ND	350	ND	ND	16	7	ND	ND	ND	mg/kg
ZOI-3-036-042398	ND	ND	340	0.1	ND	30	9	ND	ND	ND	mg/kg
ZOI-3-119-042398	ND	ND	280	ND	ND	12	8	ND	ND	ND	mg/kg
[b]2'-1-174-042398	ND	ND	450	ND	ND	10	ND	ND	ND	ND	mg/kg
2'-2-186-042398	ND	ND	240	ND	ND	10	ND	ND	ND	ND	mg/kg
2'-3-036-042398	ND	ND	310	ND	ND	10	6	ND	ND	ND	mg/kg
2'-3-119-042398	ND	ND	240	ND	ND	13	5	ND	ND	ND	mg/kg
4'-1-174-042398	ND	ND	350	ND	ND	9	7	ND	ND	ND	mg/kg
4'-2-186-042398	ND	ND	220	ND	ND	11	5	10	ND	ND	mg/kg
4'-3-036-042398	ND	ND	240	ND	ND	10	ND	ND	ND	ND	mg/kg
4'-3-119-042398	ND	ND	310	ND	ND	11	6	ND	ND	ND	mg/kg
[c]BTZ-1-174-042398	ND	ND	340	ND	ND	9	8	ND	ND	ND	mg/kg
BTZ-2-186-042398	ND	ND	270	0.1	6	12	6	ND	ND	ND	mg/kg
BTZ-3-036-042398	ND	ND	240	ND	ND	12	6	ND	ND	ND	mg/kg
BTZ-3-119-042398	ND	ND	270	ND	ND	13	7	ND	ND	ND	mg/kg

[a] Sample Number Identification:
(1) Zone of Incorporation
(2) LTU Cell 1, 2, or 3
(3) Grid Cell Number – between 1-200
(4) Data Sample Number

[b] Sample Number Identification:
(1) Treatment Zone
(2) LTU Cell 1, 2, or 3
(3) Grid Cell Number – between 1-200
(4) Data Sample Number

[c] Sample Number Identification:
(1) Below Treatment Zone
(2) LTU Cell 1, 2, or 3
(3) Grid Cell Number – between 1-200
(4) Data Sample Number

Table D-2c. Ciniza LTU Characterization Studies, 1996 – 1999 (Continued)

Year 1997 RCRA Metals

Fall 1997

Sample ID[a]	Silver	Arsenic	Barium	Cadmium	Chromium	Lead	Selenium	Mercury	Units
ZOI-1-075-091097	ND	ND	270	ND	13	7	ND	ND	mg/kg
ZOI-2-198-091097	ND	ND	250	ND	7	8	ND	0.3	mg/kg
ZOI-3-064-091097	ND	ND	320	ND	8	9	ND	ND	mg/kg
ZOI-3-142-091097	ND	ND	270	ND	8	9	ND	ND	mg/kg

Summer 1997

Sample ID[a]	Silver	Arsenic	Barium	Cadmium	Chromium	Lead	Selenium	Mercury	Units
ZOI-1-068-052797	ND	0.8	360	ND	9	12	ND	ND	mg/kg
ZOI-2-037-052797	ND	0.8	310	0.1	8	9	ND	0.1	mg/kg
ZOI-3-079-052797	ND	ND	280	0.1	28	15	ND	0.2	mg/kg
ZOI-3-093-052797	ND	ND	290	0.1	31	13	ND	0.5	mg/kg

[a] Sample Number Identification:
(1) Below Treatment Zone
(2) LTU Cell 1, 2, or 3
(3) Grid Cell Number – between 1-200
(4) Data Sample Number

Table D-2c. Ciniza LTU Characterization Studies, 1996 – 1999 (Continued)

Year 1996 RCRA Metals

Summer 1996

Sample ID[a]	Silver	Arsenic	Barium	Cadmium	Chromium	Lead	Selenium	Mercury	Units
ZOI-1-073-061196	ND	0.4	191	ND	11	6.3	ND	ND	mg/kg
ZOI-2-075-061196	0.8	0.6	227	ND	10	8.4	ND	ND	mg/kg
ZOI-2-120-061196	ND	0.5	305	ND	10	6.9	ND	ND	mg/kg
ZOI-3-148-061196	1.7	0.5	140	ND	14	6.9	ND	ND	mg/kg

Spring 1996 Special Sampling

Sample ID[b]	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Lead	Nickel	Selenium	Vanadium	Mercury	Units
BTZ-1-014-040296	ND	0.4	271	1.2	ND	14.8	5.8	10	11.5	ND	18.5	ND	mg/kg
BTZ-1-091-040196	ND	0.4	301	0.9	ND	10.6	4.6	6.5	8.3	ND	17	ND	mg/kg
BTZ-1-104-040196	ND	0.5	265	1.3	ND	16.4	6.5	9.6	12.5	ND	20.7	ND	mg/kg
BTZ-1-178-040296	ND	0.5	266	0.9	ND	13.7	6.2	9.4	11.9	ND	19.8	ND	mg/kg
BTZ-2-050-040196	ND	0.6	240	1.3	ND	15.7	6	9.2	12.3	ND	19.1	ND	mg/kg
BTZ-2-078-040196	ND	0.6	260	1.3	ND	20.5	7.5	10.4	15.1	ND	26.8	ND	mg/kg
BTZ-2-081-040196	ND	0.4	253	1.3	ND	17.1	6.8	9.7	12.8	ND	20.5	ND	mg/kg
BTZ-2-132-040296	ND	0.5	268	1.3	ND	18.7	5.9	8.8	12.3	ND	22.1	ND	mg/kg
BTZ-3-090-040296	ND	1.1	337	0.9	ND	21.8	7.7	8	17.1	ND	29.5	ND	mg/kg
BTZ-3-092-040296	ND	0.7	392	1.3	ND	16.8	6.6	9	13.3	ND	23	ND	mg/kg
BTZ-3-163-040296	ND	0.7	247	1.3	ND	19.5	7.8	9	15.1	ND	27.3	ND	mg/kg
BTZ-3-198-040296	ND	0.5	243	1.3	ND	16.2	5.6	9.2	12	ND	19.2	ND	mg/kg

[a] Sample Number Identification:
(1) Zone of Incorporation
(2) LTU Cell 1, 2, or 3
(3) Grid Cell Number – between 1-200
(4) Data Sample Number

[b] Sample Number Identification:
(1) Below Treatment Zone
(2) LTU Cell 1, 2, or 3
(3) Grid Cell Number – between 1-200
(4) Data Sample Number

Table D-3. Background Sample Event May 18, 1997 – Results

Sample Number	Parameter	Silver	Arsenic	Barium	Cadmium	Chromium	Mercury	Lead	Selenium
	Reporting Limit	1	5	1	0.5	1	0.02	5	10
	Units	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
705350-01		ND	ND	240	ND	8	ND	7	ND
705350-02		ND	ND	240	ND	13	ND	8	ND
705350-03		ND	ND	310	ND	13	ND	10	ND
705350-04		ND	ND	240	ND	13	ND	7	ND

Note: SW-846-6010 and 7471 RCRA Metals and Mercury

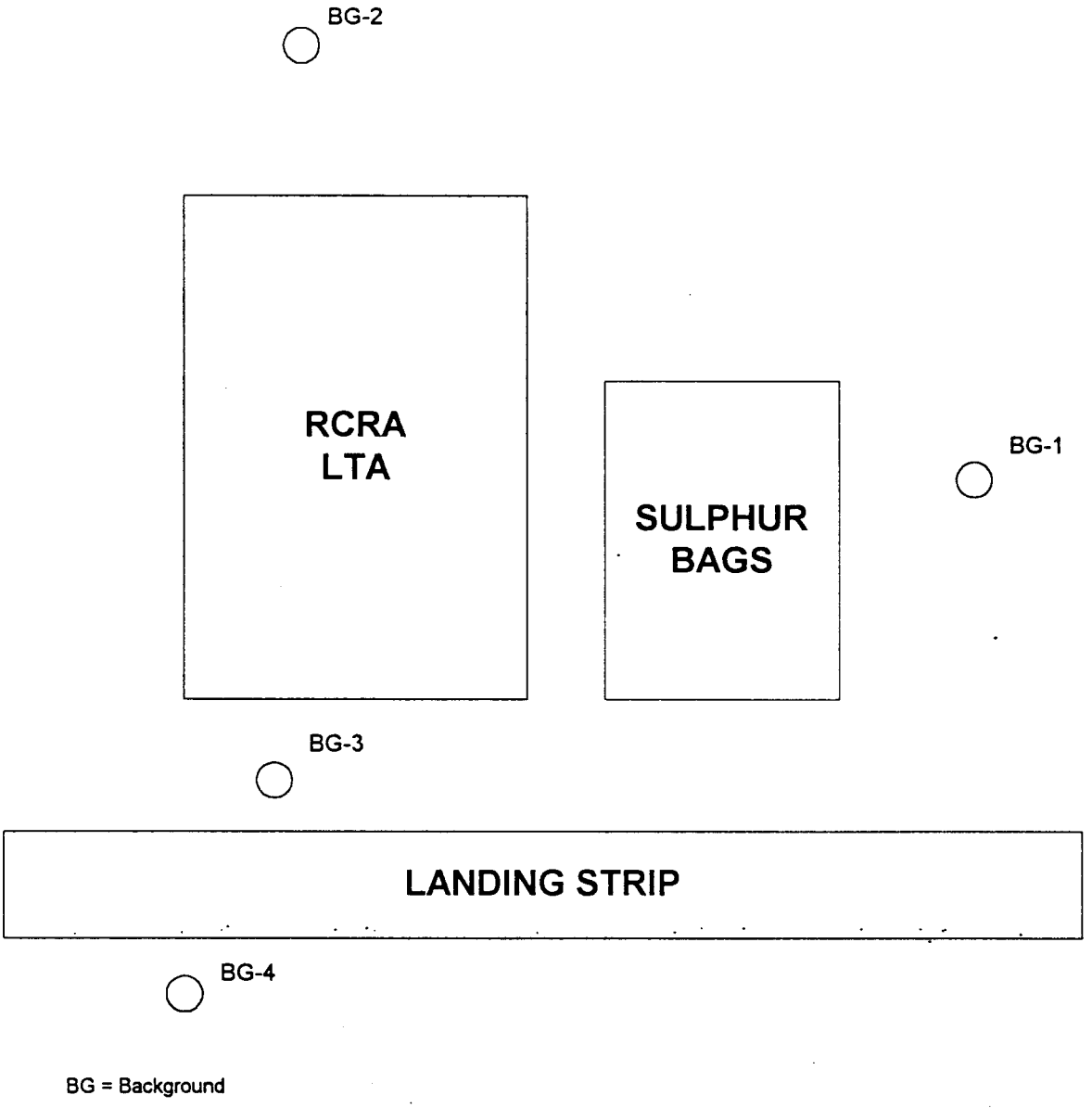


Figure D-1. Background Sample Event May 18, 1997 – Locations

Figure D-2. Sampling Grid – Random Number System

Sampling Points - Cell #1

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

Sampling Points - Cell #2

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

Sampling Points - Cell #3

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

E.0 POST-CLOSURE MONITORING

Ciniza Refinery has established a post-closure monitoring program in accordance with requirements of 20 NMAC 4.1, Subpart IX, §270.14(c) and §270.20(b)(3). Ciniza is committed to protecting human health and the environment and therefore proposes a post-closure monitoring program that consists of two monitoring sequences: early detection monitoring in the unsaturated zone, and detection monitoring in the groundwater at the point of compliance. The two monitoring sequences, detailed in Appendix E, Post-Closure Monitoring Plan, ensure that data obtained during all post-closure monitoring activities are scientifically defensible and support regulatory compliance.

Early detection monitoring will detect whether any migration of hazardous constituents from the treatment zone has occurred and to ensure that hazardous constituents within the treatment zone have been successfully treated. The number and depth of samples have been selected to adequately detect potential migration of hazardous constituents and determine successful treatment, degradation, transformation, and immobilization in the treatment zone. The details for early detection monitoring are provided in Appendix E, Post-Closure Monitoring Plan, and are summarized in Section E.1.

Detection monitoring comprises the monitoring program required at 20 NMAC 4.1, Subpart V, 264, Subpart F for the uppermost Sonsela aquifer. The purpose of the detection monitoring is to determine existing conditions of groundwater quality and quantity around the LTU. The number and depth of samples and analytical methods have been selected to effectively monitor the saturated zones beneath the LTU. The detection monitoring, designed to monitor the Sonsela aquifer, is provided in Appendix E, Post-Closure Monitoring Plan, and is summarized in Section E.2.

E.1 Early Detection Monitoring [20 NMAC 4.1, Subpart V, §264.278 and Subpart IX, §270.20(b)]

Ciniza will sample and analyze during the post-closure care period to meet the requirements of 20 NMAC 4.1, Subpart V, §264.278 and Subpart IX, §270.20(b). The early detection monitoring includes sampling soil in the ZOI, the treatment zone, and groundwater in the Chinle slope wash. The early detection monitoring will yield samples that provide a reliable measurement of the quality of the soil and groundwater beneath the treatment zone.

Selection of analytical parameters, i.e., the modified Skinner List including total petroleum hydrocarbons (TPH) as gasoline range organics (GRO) and diesel range organics (DRO), and principal hazardous constituents (PHCs), is based on the hazardous constituents expected to be present in the waste and their associated degradation

products. The modified Skinner List is a subset of 40 CFR 261 Appendix VIII constituents and identifies the specific hazardous constituents of concern that typically may be found in refinery waste. NMED established PHCs for the LTU in the Ciniza Hazardous Waste Facility Permit. PHCs are hazardous constituents contained in waste applied to the LTU. NMED determined these PHCs most difficult to treat, considering the combined effects of degradation, transformation, and immobilization. Ciniza will analyze samples for hazardous constituents from the modified Skinner List including TPH as GRO and DRO, and PHCs, collectively referred to as the modified Skinner List.

The sampling schedule (Figure E-1) for the ZOI, treatment zone, and Chinle slope wash provides a sampling frequency based on maximum protection of human health and the environment, while minimizing disruption of the LTU and underlying sediments. Ciniza will analyze samples for organics and metals identified on the modified Skinner List. The sampling schedule is described for each zone in the following subsections.

E.1.1 Zone of Incorporation Sampling

Ciniza will sample the ZOI (upper 12 in. of the treatment zone) to confirm treatment and to ensure that hazardous constituents within the treatment zone have been successfully treated. Ciniza will obtain soil samples following the protocols in Appendix E, Post-Closure Monitoring Plan, which identifies procedures for obtaining soil samples, determining sampling locations, decontaminating equipment, and chain of custody (COC); analytical parameters; analytical procedures; and quality assurance/quality control (QA/QC) requirements.

E.1.1.1 Sampling Frequency and Analytical Parameters. Characterization of the ZOI was completed in 1999 during a special sampling event. The ZOI was characterized for both organics and metals identified on the modified Skinner List (Tables E-1A through E-1D); Tables E-2A through E-2D list the results for this sample event. During the post-closure care period, the ZOI will be sampled three times, with minimum disruption of the vegetative cover.

- Events 1, 2, and 3: The three post-closure sampling events will take place in the ninth year, 19th year, and 30th year, respectively, of post-closure care. Analytical parameters selected for Events 1, 2, and 3 are both organics and metals identified in the modified Skinner List.

- Organics	Modified Skinner List (including TPH as GRO and DRO	Tables E-1A and E-1B
- Metals	Modified Skinner List	Tables E-1C and E-1D

The sampling frequency for organics and metals during post-closure care period is detailed on Figure E-1. This schedule assumes the early sampling events demonstrate no statistically significant increase for any analytes in the ZOI.

If sample results from any sampling event indicate a statistically significant increase in hazardous constituents as defined in 40 CFR 264.278 and § 264.97(h), then sampling frequency may be modified after consultation with NMED. If a statistically significant increase is indicated and confirmed following protocol established in Appendix E, Post-Closure Monitoring Plan, appropriate notification to NMED will be provided and a permit modification may be required for further characterization of the ZOI. The characterization, if required, will include all organics and metals in the modified Skinner List including TPH as GRO and DRO. Confirmation may also trigger a special sampling and analysis event of the Chinle slope wash. This special sampling event, if necessary, will provide additional information on hazardous constituents present and potential migration out of the ZOI.

E.1.2 Treatment Zone Sampling

Ciniza will sample the treatment zone following the protocols in Appendix E, Post-Closure Monitoring Plan. The Post-Closure Monitoring Plan identifies procedures for obtaining soil samples, determining sampling locations, decontaminating equipment, and COC; analytical parameters; analytical procedures; and QA/QC requirements.

Initial characterization of the treatment zone was conducted in a 1999 special sampling event (Tables E-2A through E-2D). The zones were characterized for both organics and metals identified in the modified Skinner List (Tables E-1A through E-1D).

The treatment zone sampling frequency is parallel to the frequency of ZOI sampling. The treatment zone will be sampled within the ninth year, 19th year, and 30th year of post-closure care. The samples will be analyzed for both organics and metals in the modified Skinner List plus TPH as GRO and DRO. The sampling schedule is detailed on Figure E-1.

If a statistically significant increase is indicated and confirmed following protocol established in the Post-Closure Monitoring Plan, appropriate notification to NMED will be provided and a permit modification may be required for further characterization of the treatment zone. The characterization, if required, will include all organics and metals in the modified Skinner List plus TPH as GRO and DRO. Confirmation may also trigger a special sampling and analysis event of the Chinle slope wash. This special sampling event will provide additional information on hazardous constituents present and potential migration out of the treatment zone.

E.1.3 Chinle Slope Wash Sampling

Beneath the LTU, a water-bearing unit known as the Chinle slope wash lies on top of, but is not part of, the Chinle formation. This water-bearing unit is located above the Chinle formation, and consequently, is located above the Sonsela aquifer (Figure I-1 demonstrates this stratigraphic sequence). The Sonsela is the geologic unit that meets the regulatory definition of the uppermost aquifer that must be monitored in accordance with 20 NMAC 4.1, Subpart V, 264. Although the Chinle slope wash does **not** meet the regulatory definition of an aquifer that must be monitored, as part of early detection monitoring, Ciniza will sample groundwater from the Chinle slope wash to be protective of human health and the environment.

The Chinle slope wash will be sampled using one downgradient stainless steel, shallow monitoring well (SMW)-4. The Post-Closure Monitoring Plan identifies procedures for obtaining groundwater samples from SMW-4, decontaminating equipment, and COC; analytical parameters; analytical procedures; and QA/QC requirements. If SMW-4 is dry, this observance will be reported for that sampling event and no further sampling will be conducted until the next scheduled sampling event.

E.1.3.1 Background Determination. Background values for Chinle slope wash samples are not established. Detection of any constituents from Tables E-1A through E-1D, above regulatory limits, may generate additional sampling after consultation with NMED.

E.1.3.2 Sampling Frequency. The Chinle slope wash will be sampled annually for three years. After year three, the Chinle slope wash will be sampled biennially up to and including year nine of the post-closure care period; then the Chinle slope wash will be sampled in years 19 and 30 of post-closure care period. The samples will be analyzed for the organics noted in the modified Skinner List (Tables E-1A and E-1B).

If a statistically significant increase is indicated and verified following protocol established in the Post-Closure Monitoring Plan, Ciniza will submit the required notification to the NMED, and a permit modification of the sampling schedule may be required to further characterize the release. Prior to submitting a modification request, Ciniza may demonstrate that the release is from a source other than the LTU or is from errors in sampling, analysis, or data evaluation. Any modification request will address compliance monitoring requirements and will consist of an approach that is tailored to the specific qualities of the release (e.g., location, depth, concentration, media, constituent identified, migration characteristics expected).

E.2 Detection Monitoring [20 NMAC 4.1, Subpart V, §264.97 and §264.98 and Subpart IX, §270.14(c)]
Ciniza will conduct detection monitoring during the post-closure care period in accordance with the requirements of 20 NMAC 4.1, Subpart V, §264.97 and §264.98 and Subpart IX, §270.14(c). The detection monitoring will yield samples that represent the quality of hydraulically upgradient groundwater in the Sonsela that could not be affected by LTU operations and samples that represent the quality of downgradient groundwater passing the point of compliance (defined in Section E.2.2).

E.2.1 Contaminant Plume Description [20 NMAC 4.1, Subpart IX, §270.14(c)(4)]
Ciniza has routinely monitored the Sonsela aquifer as well as the vadose zone above the Chinle formation in accordance with the Ciniza Hazardous Waste Facility Permit throughout the life of the LTU. This monitoring has at no time indicated that a plume of contamination has migrated from the treatment zone; therefore, the requirements of 20 NMAC 4.1, Subpart IX, §270.14(c)(4) do not apply.

E.2.2 Description of Wells [20 NMAC 4.1, Subpart V, §264.97(a), (b), and (c); §264.98(b); and Subpart IX, §270.14(c)(5)]
20 NMAC 4.1, Subpart V, §264.97 requires that the quality of the groundwater passing the point of compliance in the uppermost aquifer be monitored. 20 NMAC 4.1, Subpart V, §264.95 defines the point of compliance as a vertical surface located at the hydraulically downgradient limit of the waste management unit that extends down into the uppermost aquifer underlying the unit. The uppermost aquifer beneath the LTU is the Sonsela, which is a confined aquifer that generally flows to the north/northeast under the LTU. Ciniza maintains four groundwater monitoring wells (MWs) at the LTU.

Pursuant to 20 NMAC Subpart V, §264.97, Ciniza measured background conditions in the Sonsela by sampling groundwater from MW-4, which is completed in the same region of the Sonsela as MW-1, MW-2, and MW-5. MW-4 is located upgradient from the LTU. Water that passes beneath the LTU in the Sonsela is sampled from MW-1, MW-2, and MW-5, which are located on the downgradient edge of the LTU. MW-1, MW-2, and MW-5 are completed in the uppermost aquifer (i.e., Sonsela) at the point of compliance.

E.2.3 Sampling and Analysis Procedures [20 NMAC 4.1, Subpart V, §264.97(d), (e), and (f) and §264.98(d), (e), and (f); and Subpart IX, §270.14(c)(5) and §270.14(c)(6)(iv)]
Ciniza obtains groundwater samples following the protocols in the Post-Closure Monitoring Plan. The Post-Closure Monitoring Plan identifies procedures for obtaining groundwater samples, decontaminating equipment, and COC; analytical parameters; analytical procedures; and QA/QC requirements. These procedures have been designed to ensure that monitoring results provide a reliable indication of groundwater quality below the LTU.

Ciniza will determine groundwater elevations in MWs prior to well evacuation each time the groundwater is sampled. Ciniza will determine the groundwater surface elevation using the electric tape method or other acceptable method prior to obtaining samples. Using the groundwater surface elevation data, Ciniza will determine the groundwater flow rate and the direction of flow in the Sonsela aquifer at least annually to ensure that the monitoring system location is adequate.

The Sonsela aquifer will be sampled annually for three years. After year three, the Sonsela aquifer will be sampled biennially up to and including year nine of the post-closure care period; then the aquifer will be sampled in years 19 and 30 of post-closure care period. The samples will be analyzed for both organics and metals in the modified Skinner List provided in Tables E-1A through E-1D.

If Sonsela sampling results indicate that there is statistically significant increase of hazardous constituents in the Sonsela aquifer, notification of the increase will be provided to the NMED in writing within seven days of that determination. At that time, Ciniza will sample MW-1, MW-2, MW-4, and MW-5, to determine whether constituents in Appendix VIII of 20 NMAC 4.1, Subpart V, 264 are present and in what concentrations. Within one month after determination and notification to NMED, Ciniza will resample these MWs and repeat the analysis for any compounds previously detected. Prior to submitting a modification request, Ciniza may demonstrate that the release is from a source other than the LTU or is from errors in sampling, analysis, or data evaluation. If confirmation sampling verifies Appendix VIII constituents, Ciniza will, within 90 days, submit an application to the NMED to establish a compliance monitoring program for the LTU using the detected compounds as a basis for the compliance monitoring program.

E.2.4 Indicator Parameters, Waste Constituents, Reaction Products to be Monitored [20 NMAC 4.1, Subpart V, §264.98(a) and Subpart IX, §270.14(c)(6)(i)]

Selection of analytical parameters is based on the hazardous constituents expected to be present in the waste and their associated degradation products. Expected hazardous constituents were identified from the modified Skinner List and PHCs (collectively referred to as the modified Skinner List). PHCs are those identified on the Ciniza Hazardous Waste Facility Permit and the modified Skinner List is a subset of 40 CFR 261 Appendix VIII constituents and identifies the specific hazardous constituents of concern that typically may be found in refinery waste. The analytical parameters for detection monitoring are listed in Tables E-1A through E-1D.

E.2.5 Background Groundwater Quality and Concentration Values [20 NMAC 4.1, Subpart V, §264.97(a)(1) and (g), §264.98(g); and Subpart IX, §270.14(c)(6)(iii)]

Background groundwater quality values were established for the LTU during the Land Treatment Demonstration; however, MW-4 will continue to be sampled at the same interval as the other MWs to continuously monitor any changes in background water quality. To ensure that sampling and analytical quality control (QC) is verified, analytical results for the upgradient well (MW-4) will be compared to downgradient wells (MW-1, MW-2, and MW-5). Statistical methods will be employed to determine whether fluctuation in results represent impacts from the LTU or reflect variances in sampling and analytical procedure, natural groundwater fluctuation, or other non-LTU influences. A summary of the statistical methods used is provided in Section E.2.6.

E.2.6 Statistical Procedures [20 NMAC 4.1, Subpart V, §264.97(h) and §264.97 (i)(1), (5), and (6)]

20 NMAC 4.1, Subpart V, §264.97(h) requires that groundwater monitoring data be evaluated using statistical analysis. Ciniza has evaluated groundwater monitoring data using Cochran's approximation to the Behrens-Fisher Student's T-test for its existing groundwater monitoring program. Ciniza plans to continue using this methodology to evaluate groundwater monitoring data during the post-closure care period. Details about the methodology used for the detection monitoring is included as Appendix E, the Post-Closure Monitoring Plan.

E.2.7 Notification and Reporting [20 NMAC 4.1, Subpart V, §264.97 (j) and §264.98 (g)]

Pursuant to the requirements of 20 NMAC 4.1, Subpart V, §264.97(j), Ciniza will submit a groundwater monitoring report annually to the NMED for review.

Table E-1A. Modified Skinner List 8260 Volatile Organics and PHCs[a]

Parameter	EPA Method SW-846	Description	Containers	Preservative	Holding Time/Days	Liquid Reporting[c] Limit (□g/L)	Soil Reporting[c] Limit (mg/kg)
Benzene	8260	GC/MS	G	4°C	14	5	0.67
2-Butanone (MEK)	8260	GC/MS	G	4°C	14	1900	7000
Carbon Disulfide	8260	GC/MS	G	4°C	14	1000	350
Chlorobenzene	8260	GC/MS	G	4°C	14	39	54
Chloroform	8260	GC/MS	G	4°C	14	0.16	0.24
Chloromethane	8260	GC/MS	G	4°C	14	1.5	1.2
1,1 Dichloroethane	8260	GC/MS	G	4°C	14	25	580
1,2 Dichloroethane	8260	GC/MS	G	4°C	14	5	0.34
1,1 Dichloroethene	8260	GC/MS	G	4°C	14	5.0	0.053
trans-1,2-Dichloroethene	8260	GC/MS	G	4°C	14	100	63
1,4-Dioxane	8260	GC/MS	G	4°C	14	6.1	44
Ethylbenzene[a]	8260	GC/MS	G	4°C	14	700	230
Methylene Chloride	8260	GC/MS	G	4°C	14	4.3	8.6
Styrene	8260	GC/MS	G	4°C	14	100	1700
1,1,2,2-Tetrachloroethane[b]	8260	GC/MS	G	4°C	14	0.055	0.37
Tetrachloroethene[b]	8260	GC/MS	G	4°C	14	5	4.9
Toluene	8260	GC/MS	G	4°C	14	1000	1000
1,1,1-Trichloroethane	8260	GC/MS	G	4°C	14	60	200
Trichloroethene	8260	GC/MS	G	4°C	14	5	2.7
Total Xylene[a, d]	8260	GC/MS	G	4°C	14	10,000	860
Ethylene Dibromide[b]	8260	GC/MS	G	4°C	14	0.1	0.005
Acetone	8260	GC/MS	G	4°C	14	610	1500

[a]Principal hazardous constituent identified in Ciniza Hazardous Waste Facility Permit.
[b]Additional constituents.
[c]Based on EPA Region 6, Human Health Medium-Specific Screening Levels (1999) and NM WQCC Regulations (1996). Analytical detection limits are required to be lower than reporting limits.
[d]Regulatory limits for individual isomers combined into a 'total' limit for these compounds.

mg/kg = milligrams per kilogram
μg/L = microgram per liter
G = glass with Teflon-lined lid
GC/MS = gas chromatography/mass spectrometry

Table E-1B. Modified Skinner List 8270 Semivolatile Organics Including TPH and PHCs[a]

Parameter	EPA Method SW-846	Description	Container	Preservative	Holding Time/Days	Liquid Reporting Limit (µg/L)[c]	Soil Reporting Limit (mg/kg)[c]
Anthracene	8270	GC/MS	G	4°C	14	1800	16000
Acenaphthene	8270	GC/MS	G	4°C	14	370	2800
Benzo(a)Anthracene	8270	GC/MS	G	4°C	14	0.09	0.62
Benzo(b)Fluoranthene	8270	GC/MS	G	4°C	14	0.09	0.62
Benzo(k)Fluoranthene	8270	GC/MS	G	4°C	14	0.9	6.2
Benzo(a)Pyrene[a]	8270	GC/MS	G	4°C	14	0.0007	0.062
Butyl Benzyl Phthalate	8270	GC/MS	G	4°C	14	7300	240
Chrysene[a]	8270	GC/MS	G	4°C	14	9.2	62
Diethyl Phthalate	8270	GC/MS	G	4°C	14	29000	49000
7,12-Dimethylbenz(a)-Anthracene	8270	GC/MS	G	4°C	14	[e]	[e]
Dimethyl Phthalate	8270	GC/MS	G	4°C	14	370000	100000
Di-n-Octyl Phthalate	8270	GC/MS	G	4°C	14	730	1200
Fluoranthene	8270	GC/MS	G	4°C	14	1500	2300
Fluorene	8270	GC/MS	G	4°C	14	240	2000
Indeno(1,2,3-cd)Pyrene	8270	GC/MS	G	4°C	14	0.09	0.62
2-Methylnaphthalene[a]	8270	GC/MS	G	4°C	14	30	660
2-Methylphenol (Cresol)	8270	GC/MS	G	4°C	14	1800	3000
3/4-Methylphenol (Cresol)	8270	GC/MS	G	4°C	14	1980	3300
Naphthalene[g]	8270	GC/MS	G	4°C	14	30	55
Nitrobenzene	8270	GC/MS	G	4°C	14	3.4	17
4-Nitrophenol	8270	GC/MS	G	4°C	14	2300	3800
Phenanthrene[a]	8270	GC/MS	G	4°C	14	[e]	[e]
Pyrene[a]	8270	GC/MS	G	4°C	14	180	1700
Pyridine	8270	GC/MS	G	4°C	14	37	61
Quinoline	8270	GC/MS	G	4°C	14	0.0056	0.04
Benzenethiole	8270	GC/MS	G	4°C	14	[e]	[e]
Phenol	8270	GC/MS	G	4°C	14	5	36000
Bis(2-Ethylhexyl)phthalate[b]	8270	GC/MS	G	4°C	14	6.0	35
Dibenz(a,j)acridine[b]	8270	GC/MS	G	4°C	14	[e]	[e]
Dibenz(a,h)-anthracene	8270	GC/MS	G	4°C	14	0.0092	0.062
Dichlorobenzene[b, f]	8270	GC/MS	G	4°C	14	675	410
Methyl Naphthalene	8270	GC/MS	G	4°C	14	30	[e]
2,4-Dimethylphenol	8270	GC/MS	G	4°C	14	730	1200
2,4-Dinitrotoluene	8270	GC/MS	G	4°C	14	73	120

Table E-1B. Modified Skinner List 8270 Semivolatile Organics Including TPH and PHCs[a] (Continued)

Parameter	EPA Method SW-846	Description	Container	Preservative	Holding Time/Days	Liquid Reporting Limit (µg/L)[c]	Soil Reporting Limit (mg/kg)[c]
2,4-Dinitrophenol[b]	8270	GC/MS	G	4°C	14	73	120
Benzo(j)Fluoranthene	8270	GC/MS	G	4°C	14	[e]	[e]
2-Chlorophenol	8270	GC/MS	G	4°C	14	30	61
2,4,6-Trichlorophenol	8270	GC/MS	G	4°C	14	6.1	44
Di-n-Butyl Phthalate	8270	GC/MS	G	4°C	14	3700	6100
Benzyl Alcohol[b]	8270	GC/MS	G	4°C	14	11000	18000
Methyl Chrysene	8270	GC/MS	G	4°C	14	[e]	[e]
Total Cresol[a, f]	8270	GC/MS	G	4°C	14	3780	6300
TPH[h]	8015m	GS	G	4°C	7	—	1000

[a]Principal hazardous constituent identified in Ciniza Hazardous Waste Facility Permit.
[b]Additional constituents.
[c]Based on EPA Region 6, Human Health Medium-Specific Screening Levels (1999) and NM WQCC Regulations (1996). Analytical detection limits are required to be lower than reporting limits.
[e]No regulatory limit provided. Laboratory detection limit will be used.
[f]Regulatory limits for individual isomers combined into a 'total' limit for these compounds.
[g]Total naphthalene plus monomethylnaphthalenes regulatory limit is < 30µg/L for aqueous samples.
[h]Total Petroleum Hydrocarbon as Gasoline Range Organics and Diesel Range Organics

µg/L = microgram per liter
mg/kg = milligram per kilogram
G = glass with Teflon-lined lid
GC/MS = gas chromatography/mass spectrometry
GC = gas chromatography

Table E-1C. Modified Skinner List Metals and PHCs[a]

Parameter	EPA Method SW-846	Description	Container	Preservative [b]	Holding Time/Days	Aqueous Reporting Limit (µg/L)[c]	Soil Reporting Limit (mg/kg)[c]
Antimony	7060(aq), 6010	GFAA/ICP	P or G	4°C	180	6.0	31
Arsenic	6010	ICP-AES	P or G	4°C	180	50	22
Barium	6010	ICP-AES	P or G	4°C	180	2000	5400
Beryllium	6010	ICP-AES	P or G	4°C	180	4.0	150
Cadmium	6010	ICP-AES	P or G	4°C	180	5.0	39
Chromium[a]	6010	ICP-AES	P or G	4°C	180	50	210
Cobalt	6010	ICP-AES	P or G	4°C	180	50	3400
Lead[a]	6010	ICP-AES	P or G	4°C	180	15	400
Nickel	6010	ICP-AES	P or G	4°C	180	100	1600
Selenium	6010	ICP-AES	P or G	4°C	180	50	390
Silver	6010	ICP-AES	P or G	4°C	180	50	390
Vanadium	6010	ICP-AES	P or G	4°C	180	260	550
Zinc	6010	ICP-AES	P or G	4°C	180	10000	23000

[a]Principal hazardous constituent identified in Ciniza Hazardous Waste Facility Permit.
[b]Aqueous samples are field acidified to pH < 2 with HNO_3 and must not be refrigerated. Non-aqueous samples are cooled to 4°C.
[c]Based on EPA Region 6, Human Health Medium-Specific Screening Levels (1999) and NM WQCC Regulations (1996). Analytical detection limits are required to be lower than reporting limits.

µg/l = microgram per liter
mg/kg = milligram per kilogram
ICP-AES = Inductively Coupled Plasma - Atomic Emission Spectroscopy
G = glass
P = linear polyethylene, polypropylene, or Teflon

Table E-1D. Mercury[a] and Cyanide

Parameter	EPA Method SW-846	Description	Container	Preservative	Holding Time/Days	Aqueous Reporting Limit (µg/L)[c]	Soil Reporting Limit (mg/kg)[c]
Mercury[a]	7470/7471	CVAA	P or G	4°C[b]	28	2.0	23.
Cyanide	335.3/ 9010, 9014	Colorimetry	P or G	4°C[d]	14	200	1200

[a]Principal hazardous constituent identified in Ciniza Hazardous Waste Facility Permit.

[b]Aqueous samples are field acidified to pH < 2 with HNO_3 and must not be refrigerated. Non-aqueous samples are cooled to 4°C.

[c]Based on EPA Region 6, Human Health Medium-Specific Screening Levels and NM WQCC Regulations (1996). Analytical detection limits are required to be lower than reporting limits.

[d]Aqueous samples are field adjusted to pH >12 with NaOH and refrigerated. Non-aqueous samples are cooled to 4°C.

µg/l = microgram per liter
mg/kg = milligram per kilogram
CVAA = cold vapor atomic absorption
G = glass
P = linear polyethylene, polypropylene, or Teflon

Table E-2A. Inorganic Parameters – ZOI, Treatment Zone, BTZ – 1999

Sample Number	Analyte / Reporting Limit / Units	pH	Total Phosphorus	Oil & Grease	Total Organic Carbon	Total Kjeldahl Nitrogen
	Reporting Limit	NA	0.025	50	0.05	50
	Units	pH units	mg/Kg	mg/Kg	%	mg/Kg
ZOI-3-38-051899		6.60	0.06	3500	1.7	500
3FT-3-38-051899		*	*	*	*	*
BTZ-3-38-051899		8.35	*	*	0.27	*
ZOI-3-97-051899		8.01	0.54	900	0.50	190
3FT-3-97-051899		*	*	*	*	*
BTZ-3-97-051899		8.57	*	*	0.18	*
ZOI-3-135-051899		8.48	0.24	<50	0.26	320
3FT-3-135-051899		*	*	*	*	*
BTZ-3-135-051899		8.41	*	*	0.32	*
ZOI-3-152-051899		8.40	0.19	<50	0.36	300
3FT-3-152-051899		*	*	*	*	*
BTZ-3-152-051899		8.93	*	*	0.14	*
ZOI-2-40-051899		7.09	0.24	18000	5.8	700
3FT-2-40-051899		*	*	*	*	*
BTZ-2-40-051899		8.05	*	*	0.31	*
ZOI-2-41-051899		8.09	0.2	4500	3.2	540
3FT-2-41-051899		*	*	*	*	*
BTZ-2-41-051899		8.10	*	*	0.31	*
ZOI-2-107-051899		7.47	0.17	7000	3.4	510
3FT-2-107-051899		*	*	*	*	*
BTZ-2-107-051899		8.40	*	*	0.22	*
ZOI-1-40-051899		7.61	0.13	6600	2.8	730
3FT-1-40-051899		*	*	*	*	*
BTZ-1-40-051899		8.39	*	*	0.22	*

Table E-2A. Inorganic Parameters – ZOI, Treatment Zone, BTZ – 1999 (Continued)

	Analyte	pH	Total Phosphorus	Oil & Grease	Total Organic Carbon	Total Kjeldahl Nitrogen
	Reporting Limit	NA	0.025	50	0.05	50
Sample Number	Units	pH units	mg/Kg	mg/Kg	%	mg/Kg
ZOI-1-98-051899		7.20	0.27	4900	2.6	500
3FT-1-98-051899		*	*	*	*	*
BTZ-1-98-051899		8.42	*	*	0.29	*
ZOI-1-143-051899		7.90	0.18	10000	5.5	230
3FT-1-143-051899		*	*	*	*	*
BTZ-1-143-051899		8.54	*	*	0.37	*

NOTE:

* Analysis not required

Table E-2B. ICP 6010 Metals and Mercury – ZOI, Treatment Zone, BTZ – 1999

Sample Number	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Lead	Nickel	Selenium	Vanadium	Mercury
ZOI-3-38-051899	<1.2	3.9	340	<1.2	<1.2	190	5.1	21	11	<1.2	16	<0.1
3FT-3-38-051899	<1.2	1.5	200	1.4	<1.2	8.9	5	11	9.8	<1.2	18	<0.1
BTZ-3-38-051899	<1.2	2.4	300	1.4	<1.2	25	8.6	12	20	<1.2	43	<0.1
ZOI-3-97-051899	<1.2	1.6	360	1.4	<1.2	24	7	12	14	<1.2	30	<0.1
3FT-3-97-051899	<1.2	1.6	310	1.8	<1.2	27	8.8	13	19	<1.2	40	<0.1
BTZ-3-97-051899	<1.1	1.6	330	1.2	<1.1	10	5.3	9.1	11	<1.1	22	<0.1
ZOI-3-135-051899	3.8	17	3400	11	<1.2	130	63	120	130	<1.2	220	<0.1
3FT-3-135-051899	<1.1	1.7	360	1.5	<1.1	24	8.4	12	18	<1.1	36	<0.1
BTZ-3-135-051899	<1.2	1.4	330	1.6	<1.2	6.2	4.1	10	7.6	<1.2	16	<0.1
ZOI-3-152-051899	<1.2	1.5	350	1.5	<1.2	8.5	5.3	10	11	<1.2	17	<0.1
3FT-3-152-051899	<1.1	1.4	370	1.4	<1.1	17	7	11	15	<1.1	27	<0.1
BTZ-3-152-051899	<1.1	1.1	430	<1.1	<1.1	7.8	4.7	8.5	8.8	<1.1	18	<0.1
ER-POST CELL 1-98-0518-99	<0.01	<0.01	<0.01	0.004	0.004	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.002
ZOI-2-40-051899	<1.1	20	710	<1.1	<1.1	200	9.7	87	54	<1.1	40	13
3FT-2-40-051899	<1.2	1.2	310	1.3	<1.2	7.4	4.9	9.6	9.4	<1.2	14	<0.1
BTZ-2-40-051899	<1.2	1.4	260	1.5	<1.2	17	6.9	12	15	<1.2	27	0.18
ZOI-2-41-051899	1.2	10	550	<1.2	<1.2	310	8.2	54	32	3.3	35	8.4
3FT-2-41-051899	<1.2	13	290	1.7	<1.2	18	7	13	15	<1.2	28	<0.1
BTZ-2-41-051899	<1.1	1.8	270	1.4	<1.1	18	7.1	12	15	<1.1	30	<0.1
ZOI-2-107-051899	<2.5	7.5	350	<1	0.78	220	6.2	40	24	<2.5	21	1.6

Table E-2B. ICP 6010 Metals and Mercury – ZOI, Treatment Zone, BTZ – 1999 (Continued)

Sample Number	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Lead	Nickel	Selenium	Vanadium	Mercury
3FT-2-107-051899	<2.5	<2.5	290	<1	<0.5	9.4	4.3	11	9.4	<2.5	15	<0.1
BTZ-2-107-051899	<2.5	<2.5	230	1.1	<0.5	12	5.1	10	12	<2.5	19	<0.1
ZOI-1-40-051899	<2.5	<2.5	290	<1	<0.5	190	7.1	40	28	<2.5	30	0.13
3FT-1-40-051899	16	<2.5	180	1.1	<0.5	9.5	4.1	11	9.4	<2.5	16	<0.1
BTZ-1-40-051899	<2.5	<2.5	210	<1	<0.5	12	5.2	8.9	13	<2.5	20	<0.1
ZOI-1-98-051899	<2.5	<2.5	1100	<1	<0.5	58	6.6	18	13	<2.5	13	2
3FT-1-98-051899	<2.5	<2.5	140	<1	<0.5	7	<2.5	7.9	7	<2.5	12	<0.1
BTZ-1-98-051899	<2.5	<2.5	210	1.1	<0.5	15	5.7	11	13	<2.5	19	<0.1
ZOI-1-143-051899	<2.5	14	350	<1	<0.5	140	5.7	53	39	<2.5	35	1.4
3FT-1-143-051899	<2.5	<2.5	240	<1	<0.5	14	5.7	10	13	<2.5	20	<0.1
BTZ-1-143-051899	<2.5	<2.5	240	1	<0.5	9.2	<2.5	9.1	10	<2.5	13	<0.1

NOTES:

Units are mg/Kg (ER-POST CELL-1-98-0518-99 units are µg/L).
Results are reported on a dry weight basis.

Table E-2C. Volatile Analysis by SW-846 Method 8260 – ZOI, Treatment Zone, BTZ – 1999

Sample Number	Chloromethane	Acetone	1,1-Dichloroethene	Methylene Chloride	1,4-Dioxane	1,1-Dichloroethane	Trans-1,2-Dichloroethene	2-Butanone	Carbon Disulfide	Chloroform	1,2-Dichloroethane	1,1,1-Trichloroethane	Benzene	Trichloroethane	Toluene	1,2-Dibromoethane	Tetrachloroethene	Chlorobenzene	Ethylbenzene	o-Xylene	m&p-Xylenes	Styrene	1,1,2,2-Tetrachloroethane	% Moisture
ZOI-3-38-051899	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	21
3FT-3-38-051899	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	21
BTZ-3-38-051899	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18
ZOI-3-97-051899	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18
3FT-3-97-051899	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	27
BTZ-3-97-051899	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14
ZOI-3-135-051899	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16
3FT-3-135-051899	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14
BTZ-3-135-051899	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16
TRIP BLANK COOLER 1[a]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ZOI-3-152-051899	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16
3FT-3-152-051899	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14
BTZ-3-152-051899	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10
ER-POST CELL 1-98-0518-99[a]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ZOI-2-40-051899	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	17
3FT-2-40-051899	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9

Table E-2C. Volatile Analysis by SW-846 Method 8260 – ZOI, Treatment Zone, BTZ – 1999 (Continued)

Sample Number	Chloromethane	Acetone	1,1-Dichloroethene	Methylene Chloride	1,4-Dioxane	1,1-Dichloroethane	Trans-1,2-Dichloroethene	2-Butanone	Carbon Disulfide	Chloroform	1,2-Dichloroethane	1,1,1-Trichloroethane	Benzene	Trichloroethane	Toluene	1,2-Dibromoethane	Tetrachloroethene	Chlorobenzene	Ethylbenzene	o-Xylene	m&p-Xylenes	Styrene	1,1,2,2-Tetrachloroethane	% Moisture
BTZ-2-40-051899	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16
ZOI-2-41-051899	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16
3FT-2-41-051899	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20
BTZ-2-41-051899	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16
ZOI-2-107-051899	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18
3FT-2-107-051899	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20
BTZ-2-107-051899	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15
TRIP BLANK 2[a]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ZOI-1-40-051899	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20
3FT-1-40-051899	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20
BTZ-1-40-051899	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14
ZOI-1-98-051899	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18
3FT-1-98-051899	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14
BTZ-1-98-051899	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15
ZOI-1-143-051899	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	19

Table E-2C. Volatile Analysis by SW-846 Method 8260 – ZOI, Treatment Zone, BTZ – 1999 (Continued)

Sample Number	Chloromethane	Acetone	1,1-Dichloroethene	Methylene Chloride	1,4-Dioxane	1,1-Dichloroethane	Trans-1,2-Dichloroethene	2-Butanone	Carbon Disulfide	Chloroform	1,2-Dichloroethane	1,1,1-Trichloroethane	Benzene	Trichloroethane	Toluene	1,2-Dibromoethane	Tetrachloroethene	Chlorobenzene	Ethylbenzene	o-Xylene	m&p-Xylenes	Styrene	1,1,2,2-Tetrachloroethane	% Moisture
3FT-1-143-051899	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	17
BTZ-1-143-051899	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13

[a] Aqueous sample

NOTES:

- Not detected above Reporting Limit

Reporting Limit varies with sample % moisture.

Reporting Limit maximum for soil samples was 0.07 mg/Kg for all analytes except 1,4 Dioxane (6.3 mg/Kg) and 2-Butanone (0.6 mg/Kg).

Reporting Limit for aqueous samples was 1.0 µg/L for all analytes except 1,4 Dioxane (100 µg/L) and Acetone and 2-Butanone (10 µg/L).

Table E-2D. Semivolatile Analysis by SW-846 Method 8270B – ZOI, Treatment Zone, BTZ – 1999

Analyte	ZOI-3-38-051899	3FT-3-38-051899	BTZ-3-38-051899	ZOI-3-97-051899	3FT-3-97-051899	BTZ-3-97-051899	ZOI-3-135-051899	3FT-3-135-051899	BTZ-3-135-051899	ZOI-3-152-051899	3FT-3-152-051899	BTZ-3-152-051899	ER-POST CELL 1-98-0518-99	ZOI-2-40-051899	3FT-2-40-051899	BTZ-2-40-051899	ZOI-2-41-051899	3FT-2-41-051899	BTZ-2-41-051899	ZOI-2-107-051899	3FT-2-107-051899	BTZ-2-107-051899	ZOI-1-40-051899	3FT-1-40-051899	BTZ-1-40-051899	ZOI-1-98-051899	3FT-1-98-051899	BTZ-1-98-051899	ZOI-1-143-051899	3FT-1-143-051899	BTZ-1-143-051899
1,2-Dichlorobenzene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1,3-Dichlorobenzene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1,4-Dichlorobenzene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Methylnaphthalene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.76	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2,4,6-Trichlorophenol	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2,4-Dimethylphenol	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2,4-Dinitrophenol	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Chlorophenol	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Methylnaphthalene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Methylphenol	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3&4-Methylphenol	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Methylcholanthrene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Nitrophenol	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6-Methyl Chrysene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7.43	-	-
7,12-Dimethylbenz(a) anthracene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.18	-	-
Anthracene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(a)pyrene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.5	-	-

Table E-2D. Semivolatile Analysis by SW-846 Method 8270B – ZOI, Treatment Zone, BTZ – 1999 (Continued)

Analyte	ZOI-3-38-051899	3FT-3-38-051899	BTZ-3-38-051899	ZOI-3-97-051899	3FT-3-97-051899	BTZ-3-97-051899	ZOI-3-135-051899	3FT-3-135-051899	BTZ-3-135-051899	ZOI-3-152-051899	3FT-3-152-051899	BTZ-3-152-051899	ER-POST CELL 1-98-0518-99	ZOI-2-40-051899	3FT-2-40-051899	BTZ-2-40-051899	ZOI-2-41-051899	3FT-2-41-051899	BTZ-2-41-051899	ZOI-2-107-051899	3FT-2-107-051899	BTZ-2-107-051899	ZOI-1-40-051899	3FT-1-40-051899	BTZ-1-40-051899	ZOI-1-98-051899	3FT-1-98-051899	BTZ-1-98-051899	ZOI-1-143-051899	3FT-1-143-051899	BTZ-1-143-051899
Benzo(b)&(j)fluoranthene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.44	-	-
Benz(k)fluoranthene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzyl alcohol	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Butyl benzyl phthalate	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chrysene	2.33	-	-	-	-	-	-	-	-	-	-	-	-	3.13	-	-	-	-	-	-	-	-	2.31	-	-	3.39	-	-	-	-	-
Di-n-butyl phthalate	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Di-n-octyl phthalate	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)acridine	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,j)acridine	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Diethyl phthalate	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dimethyl phthalate	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fluoranthene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Indene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Naphthalene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.32	-	-	-	-	-	-	-	-	-	-	-	5.38	-	-

Table E-2D. Semivolatile Analysis by SW-846 Method 8270B – ZOI, Treatment Zone, BTZ – 1999 (Continued)

Analyte	ZOI-3-38-051899	3FT-3-38-051899	BTZ-3-38-051899	ZOI-3-97-051899	3FT-3-97-051899	BTZ-3-97-051899	ZOI-3-135-051899	3FT-3-135-051899	BTZ-3-135-051899	ZOI-3-152-051899	3FT-3-152-051899	BTZ-3-152-051899	ER-POST CELL 1-98-0518-99	ZOI-2-40-051899	3FT-2-40-051899	BTZ-2-40-051899	ZOI-2-41-051899	3FT-2-41-051899	BTZ-2-41-051899	ZOI-2-107-051899	3FT-2-107-051899	BTZ-2-107-051899	ZOI-1-40-051899	3FT-1-40-051899	BTZ-1-40-051899	ZOI-1-98-051899	3FT-1-98-051899	BTZ-1-98-051899	ZOI-1-143-051899	3FT-1-143-051899	BTZ-1-143-051899
Phenol	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyrene	0.62	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.63	-	-
Pyridine	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Quinoline	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
% Moisture	16	19	16	16	16	13	14	13	14	15	13	10	-	9	17	15	16	18	13	16	19	13	21	18	12	16	13	13	17	16	12

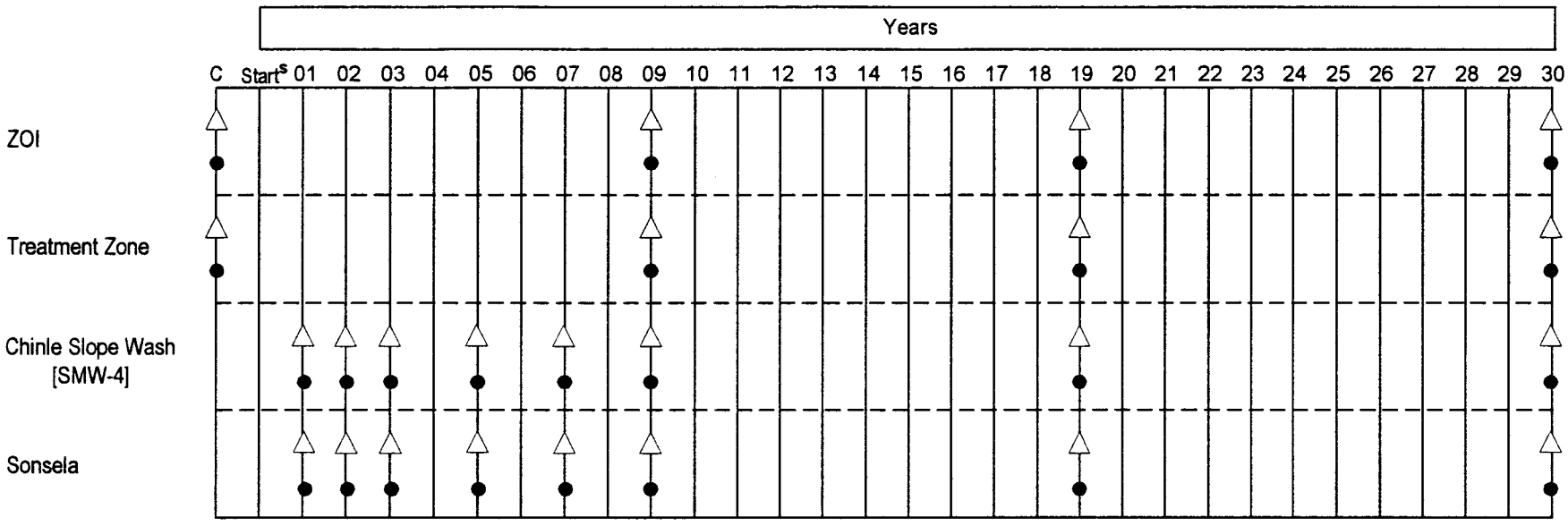
NOTES:

Units are mg/Kg.

- Not detected at reporting limit.

Reporting limit varies with dilution and % moisture: 0.38-4.23 mg/Kg for 2,4-Dinitrophenol, 4-Nitrophenol, and Benzyl alcohol, 0.186-2.11 mg/Kg for all other compounds.

Sample ER-POST-1-98-0518-99 is aqueous. Reporting limits are 10 µg/L for 2,4-Dinitrophenol and 4-Nitrophenol, and 5 µg/L for all other compounds reported.



△ = Modified Skinner List - Metals

● = Modified Skinner List - Organics

s = Begin sample activities within 90 days of post-closure permit issuance

C = May 1999 special sample event

Figure E-1. LTU Post-Closure Sampling Schedule

F.0 PROCEDURES TO PREVENT HAZARDS

This section describes procedures to prevent hazards at the Ciniza LTU in accordance with the applicable requirements of 20 NMAC 4.1 Subpart V, §264.14, §264.15, and §264.31; and Subpart IX, §270.14(b)(8). The LTU is designed and will be operated during the post-closure period to minimize the possibility of fire, explosion, or unplanned releases of hazardous constituents to any environmental medium that could potentially harm human health and the environment. Information on the procedures to prevent hazards at the LTU is provided for the following subject areas:

- Security procedures and equipment [20 NMAC 4.1, Subpart IX, §270.14(b)(4) and §20 NMAC 4.1, Subpart V, §264.14]; and access control [20 NMAC 4.1, Subpart IX, §270.14(b)(19)(viii)]
- Preparedness and prevention requirements [20 NMAC 4.1, Subpart V, Part 264, Subpart C]
- Procedures, structures, and equipment for preventing hazards [20 NMAC 4.1, Subpart IX, §270.14(b)(8)]

F.1 Security [20 NMAC 4.1, Subpart V, §264.14; 20 NMAC 4.1, Subpart IX, §270.14(b)(4)]

Ciniza prevents the unknowing entry and minimizes the possibility of unauthorized entry of persons or livestock onto the LTU through access controls to the refinery property. The refinery property boundary is fenced with a 4-ft- high, three-strand, barbed wire fence. The refinery process area is fenced with an 8-ft-high chain-link fence, and the access gate to the process area is watched 24 hours per day. Vehicle access to the LTU requires entry through the process area. The gate guard limits access to authorized personnel. The rail access into the refinery through the north boundary fence is locked closed and opened only for the scheduled switch engine. Signs legible from a distance of 25 ft are posted around the perimeter of the LTU and bear the legend "Danger - Unauthorized Personnel Keep Out" in English, Spanish, and Navajo. Eight signs are visible from all angles of approach. In accordance with 20 NMAC 4.1, Subpart IX, §270.14(b)(19)(viii), the location of the security fence along the refinery property boundary and access gate are shown on Figure B-1.

F.2 Inspection Plan [20 NMAC 4.1, Subpart V, §264.15 and Subpart IX, §270.14(b)(5)]

The Ciniza Environmental Manager (EM) will assign and train personnel to inspect the LTU on a regular schedule to identify problems or potential problems and correct them before they cause harm to human health or the environment. Table F-1 summarizes the inspection schedule and frequencies and identifies components inspected and potential problems. Inspection frequencies may be increased at the discretion of the Ciniza Refinery EM.

F.2.1 Weekly Inspections

Each week and following every major precipitation event, the inspector inspects the LTU for water accumulation, odors, soil condition, wind dispersion, dike condition, and warning sign condition. No record is kept of these inspections unless repairs are required. The inspector issues a work order request for any needed repairs. Work order requests are tracked by the Scheduling and Maintenance Department and then submitted to the Ciniza EM for signature. The inspector also inspects the LTU monitoring equipment, gates, and fences. The inspector enters the following inspection information in the LTU logbook:

- Inspection date
- Name of person inspecting the LTU
- Observations
- Date and nature of repairs or remedial action taken

Inspection activities during post-closure care ensure early detection of structural defects. The dikes are inspected to ensure that integrity is maintained to effectively control storm water runoff and runon. The LTU is inspected for evidence of wind erosion after windstorms. A checklist used to document each inspection is provided on Figure F-1. The dikes will be maintained at the minimum height of 2 ft above the surface of the LTU and with 2:1 side slopes to ensure that each dike has sufficient capacity to control runoff during the post-closure care period. If the integrity of the dikes is compromised, the Ciniza EM will see that corrective action is taken promptly.

The Ciniza EM maintains inspection logs and work orders for all LTU inspections, except those inspections conducted on safety, communication, and emergency equipment (which are maintained by the Safety Department). All inspection records and work orders are maintained for at least three years following the date of inspection or latest remedial action as a result of an inspection.

F.3 Preventive Procedures, Structures, and Equipment [20 NMAC 4.1, Subpart IX, §270.14(b)(8)]

The design and operation of the LTU meets the requirements of 20 NMAC 4.1, Subpart IX, §270.14(b)(8) to prevent runoff from the LTU, prevent contamination of water supplies, mitigate the effects of equipment and power failure, prevent undue exposure of personnel to hazardous waste, and prevent releases to the atmosphere. This section describes the procedures, structures, and equipment used to prevent hazards at the LTU during the post-closure care period.

F.3.1 Unloading Operations

Ciniza will not apply hazardous wastes to the LTU during the post-closure care period. No unloading operations will be performed at the LTU; thus, no hazardous waste spills can occur.

F.3.2 Runoff Prevention

The structures used at the LTU and refinery process area to prevent runoff from the LTU to other areas of the Ciniza or environment are described in this section, as required by 20 NMAC 4.1, Subpart IX, §270.14(b)(8)(ii).

As discussed in Section B.0, the LTU does not lie within a 100-year floodplain. No major surface water bodies are within 10 miles of the site, and the nearest river, the Puerco River, is approximately one mile north. Protection from flooding or ponding caused by probable maximum precipitation events is provided by diverting water away from the LTU by a system of dikes, berms, and swales (Figure B-3). Additionally, grade elevations of roads are designed so that storm water will not collect on the site under the most severe conditions.

Flood control structures, such as dikes and berms are inspected (Section F.2). During LTU inspections, the structures are checked to ensure that no wind or rain erosion or animal-caused damage has caused the system to fail. Further, the areas around the LTU are also inspected to ensure that they are free of vegetation, debris, or other items that would impede the water diversion. Experience with the LTU during the operational phase has shown that weekly structural inspections are adequate for the climate and soil conditions at Ciniza. However, inspections are also conducted after a significant storm event.

F.3.3 Water Supplies

Application of hazardous waste to the LTU ceased in 1990. Because the hazardous waste applied to the LTU during permitted operations has been degraded or immobilized, the risk to groundwater and/or water supplies is minimal. The geological, hydrological, and climatological features of the LTU (Section I), along with the procedures, structures, and equipment used during the operation phase activities, demonstrate that hazardous waste will not come in contact with the Sonsela aquifer. It is unlikely that any contaminated groundwater can migrate from the treatment zone of the LTU to the accessible environment, including water supplies, during the post-closure care period. Ciniza will monitor the Sonsela aquifer during the post-closure care period, as described in Section E.0 and Appendix E, the Post-Closure Monitoring Plan, to further protect this water body.

F.3.4 Equipment Failure and Power Outages

LTU activities will be limited to applying fertilizer as necessary, and sampling, as detailed in Section E.0, Post-Closure Monitoring. If equipment fails, it will be repaired or replaced before continuing operations requiring the

failed equipment. A power outage would have no effect on LTU activities as the monitoring and maintenance activities are performed during daylight hours.

F.3.5 Personal Protective Equipment

Ciniza personnel responsible for LTU activities will use personal protective equipment (PPE) to protect themselves from the hazards in the work place under normal conditions. PPE and emergency equipment will also be used under unusual hazardous conditions. During post-closure care, PPE required for personnel involved with LTU activities may include protective coveralls, sturdy shoes, and protective shoe coverings, depending on the activities being conducted.

Emergency equipment will be maintained at Ciniza so that personnel and emergency response personnel can protect themselves and respond appropriately to an incident at the LTU. PPE and emergency equipment supplies are stored in the refinery process area. The location of PPE and emergency equipment is listed in Section G.0. The locations of fire extinguishers and communication systems are shown on Figure B-1. All personnel who may be required to use PPE and emergency equipment to respond to a LTU incident are trained to use this equipment.

F.3.6 Releases to Atmosphere [20 NMAC 4.1, Subpart IX, §270.14(b)(8)(vi)]

Because the ZOI depth is 12 in. and a vegetative cover will be applied during closure activities, releases of hazardous constituents to the atmosphere cannot occur.

Table F-1. Inspection Schedule

Area	Specific Items	Type of Problems	Frequency
LTU	General conditions	Water accumulations Odors Soil coloration changes Wind dispersion Site level, needs plowing	Weekly After each major storm event
	Dikes/Berms	Erosion Evidence of runon	Weekly After each major storm event
	Signs	Condition and legibility	Weekly
	Water wells	Caps in place Damage to surface casing Protection barriers in place	Weekly
Security	Fence	Gate properly locked	In operation continually—failures immediately reported
Communication System	Telephones Radio	Audibility	In operation continually—failures immediately reported
	Fire whistle	Audibility	Monthly whistle check
	Emergency generator	Ease of start Lubrication Power generation	Monthly by boiler operator/ Safety Department

Land Treatment Unit Inspection Checklist

LTU Surface

Condition:	Water Standing?	☐ Yes ☐ No
	Wet or Dry?	☐ Yes ☐ No
	Odor?	☐ Yes ☐ No
	Erosion?	☐ Yes ☐ No
	Is vegetation growing?	☐ Yes ☐ No

Monitoring Wells

Condition:

Caps and Locks:

Dikes/Berms

Condition:	Water Standing?	☐ Yes ☐ No
	Wet or Dry?	☐ Yes ☐ No

Vehicle, Fence, and Locks

Condition:

Signs (8)

Condition:	In place?	☐ Yes ☐ No
	Legible?	☐ Yes ☐ No

Repairs Needed

Time of day: _____ ☐ AM ☐ PM Date: _____

Name of Inspector: _____

Repairs Completed

Signature: _____ Date: _____

Figure F-1. Land Treatment Unit Inspection Checklist

G.0 CONTINGENCY PLAN

This section presents general contingency measures for the Ciniza LTU during the post-closure care period. This contingency plan is intended to meet the requirements specified in 20 NMAC 4.1, Subpart V, "Contingency Plan and Emergency Procedures," for RCRA facilities. This plan is consistent with the Ciniza Emergency Procedures Manual; the manual is updated and maintained by the Ciniza Health and Safety Department. The provisions of this contingency plan will be carried out immediately whenever there is a fire, explosion, or sudden event in the refinery process area that could threaten human health or the environment due to effects at the LTU.

G.1 General Information [20 NMAC 4.1, Subpart IX, §270.14(b)(7)]

Ciniza's distance from other emergency response agencies requires that Ciniza provide its own emergency first response resources. The remote location (see Section B.1) hinders immediate notification and interaction with other emergency response agencies. Implementation of the contingency plan is not anticipated because post-closure care activities are limited to monitoring and maintenance.

G.2 Emergency Coordinator [20 NMAC 4.1, Subpart V, §264.52(d) and §264.55, and Subpart IX, §270.14(b)(7)]

Ciniza is staffed 24 hours per day, 365 days per year. The Ciniza facility manager has delegated the authority and responsibility for administering and implementing Ciniza's emergency response activities to the emergency coordinator. The emergency coordinator is responsible for coordinating all emergency responses at the refinery and the LTU. The safety manager is the primary emergency coordinator. On weekends, the weekend duty person is the initial emergency coordinator. When the primary emergency coordinator cannot be reached, persons on the weekend staff duty list serve as alternates. A qualified emergency coordinator can always be reached by contacting the Ciniza gate and/or control room. The control room is staffed 24 hours per day. A list of emergency coordinators is provided in Table G-1.

G.3 Contingency Plan Implementation [20 NMAC 4.1, Subpart V, §264.51 and §264.273; and Subpart IX, §270.14(b)(7)]

Ciniza will implement the contingency plan described in this section in accordance with 20 NMAC 4.1, Subpart IX, §270.14(b)(7). An emergency at the LTU during the post-closure care period is very unlikely. Danger to the environment from the LTU is also minimal. Hazardous waste application to the LTU ceased in 1990, and nonhazardous waste application ceased in 1993. Waste applied during this time has undergone degradation, transformation, and immobilization within the treatment zone. Additionally, low precipitation, extremely low

permeability of the native clay layer, addition of topsoil and a vegetative cover, and the depth to the uppermost potential aquifer all minimize any danger to the environment.

Personnel maintaining the LTU wear appropriate PPE. The Ciniza Emergency Procedures Manual, designed to handle more serious refinery operations emergencies, will be followed should an emergency arise during LTU maintenance activities.

The decision to implement this contingency plan depends upon whether an imminent or actual incident involving a release of hazardous waste to the environment from the LTU area could threaten human health or the environment. The emergency coordinator uses the following guidelines to determine whether to implement the contingency plan.

G.3.1 Fire and Explosions

Fires or explosions and the potential resultant releases of refinery waste and runoff of high volumes of water to the LTU area may result in a threat to human health and the environment. Implementation of this contingency plan is required whenever a sudden release cannot be contained in the refinery process area or threat to human health or the environment exists as a result of a fire or explosion.

If a fire or explosion occurs at Ciniza, it will be controlled as described in the Ciniza Emergency Procedures Manual. In fighting a fire, potentially contaminated runoff from a fire or explosion will be managed by water containment controls in the refinery area, if possible. The existing berm around the perimeter of the LTU provides further protection from water runon due to either a fire or explosion. Water drainage is shown on Figures B-3 and B-4.

All Ciniza personnel are trained to fight fires. At a minimum, the refinery is staffed to immediately make available a fire brigade. The emergency coordinator can institute a call-out procedure to provide more personnel as needed.

Ciniza maintains its own firefighting force and equipment, medical transportation equipment, and first-aid medical supplies at the refinery. The fire fighters attend firefighting school at Texas A & M University and conduct regular fire fighting training at Ciniza. The fire fighting equipment and fire suppression systems are owned, operated, and maintained on site by Ciniza. The fire control equipment and fire suppression systems are described in Section G.5.

G.3.2 Spills

During the post-closure care period, no hazardous wastes will be managed at the LTU; therefore, no spills will occur. Should precipitation accumulate and threaten to overflow the containment berm (see Figure B-2), the contingency plan will be implemented. During the post-closure care period, surface runoff will be controlled by the existing berm around the perimeter of the LTU and by the addition of topsoil and a vegetative cover directly on top of the LTU. The berm should contain over twice the annual rainfall for the area (11 in.) in volume, assuming the average berm height of 2.0 ft and approximately 7.8 acres of surface area. According to the National Oceanic and Atmospheric Administration Atlas No. 2, *Precipitation Frequency Atlas for the Western United States*, the 24-hour, 100-year storm event is 2.7 in. for the Gallup, New Mexico, area. The berm meets requirements to control precipitation runoff from the LTU during a 24-hour, 25-year storm event in accordance with 20 NMAC 4.1, Subpart V, §264.273.

G.3.3 Unplanned Nonsudden Release

Nonsudden releases include those incidents that, if uncontrolled, impact the environment over a long period of time. In the unlikely event that drought or other unplanned event inhibits vegetative growth, performance will be corrected by applying fertilizer as necessary, and/or water addition. Ciniza will coordinate any necessary changes to the procedures for LTU maintenance and monitoring with the NMED.

G.4 Emergency Actions [20 NMAC 4.1, Subpart V, §264.52(d) and Subpart IX, §270.14(b)(7)]

Immediately upon discovery of an imminent or actual emergency (other than fire), the emergency coordinator will be notified. In case of fire, personnel who first discover the fire will notify the boiler house by two-way radio or phone. The boiler house operator will manually operate the refinery whistle and will sound two 5-second blasts and announce the location of the fire on the two-way radio. The emergency coordinator will report to the fire site.

Upon notification of an emergency, the emergency coordinator will perform the following:

- Proceed directly to the site
- Assess the nature of the incident
- Based on the guidelines in Section G.3, determine whether to implement the contingency plan

Upon deciding to implement the contingency plan, the emergency coordinator will perform the following:

a. Notify required response personnel by telephone or refinery radio for any incident other than fire. In case of fire, the emergency coordinator confirms that the fire chief is aware of any special hazards associated with refinery wastes.

b. Notify NMED (505) 827-9329 and the National Response Center (800) 424-8802.

c. Warns the remaining refinery personnel of imminent or actual hazards using the refinery radio.

d. Identify the character, exact source, amount, and extent of contamination either by surface flow or aerial dispersion based on review of LTU records or, if necessary, by chemical analysis.

e. Assess the hazards to the environment and human health.

f. Determine whether evacuation of the local area is advisable.

g. Advise the response personnel as needed to minimize personnel exposure to hazards and expedite control.

Upon control of the incident, the emergency coordinator will perform the following:

a. Arrange for site cleanup.

b. Provide for treating, storing, or disposing of recovered wastes, contaminated soil, or contaminated surface waters.

c. Provide for decontamination of equipment as needed.

d. Conduct testing, as needed, to verify successful cleanup.

e. Within 15 days of any incident involving the LTU, submit the reporting form described in Section G.8 to the NMED.

G.5 Emergency Equipment [20 NMAC 4.1, Subpart V, §264.52(e) and Subpart IX, §270.14(b)(7)]

Ciniza maintains emergency equipment to respond to emergencies in accordance with 20 NMAC 4.1, Subpart V, §264.52(e). Locations of fire and emergency equipment are shown on Figure G-1. The Ciniza Emergency Procedures Manual provides additional information on fire equipment. The major emergency equipment is listed in Table G-2.

G.6 Coordination Agreements [20 NMAC 4.1, Subpart V, §264.52(c) and §264.37, and Subpart IX, §270.14(b)(7)]

Table G-3 lists the organizations that the Ciniza emergency coordinator could contact in an emergency and gives a brief definition of the coordination agreement. Ciniza provides a copy of the contingency plan to all coordinating organizations. Coordination is maintained with Rehoboth McKinley Christian Hospital staff to ensure that they are aware of treating special problems associated with refinery emergencies. The Gallup Fire Department, Thoreau Volunteer Fire Department, and Whispering Cedars Volunteer Fire Department have had general refinery fire fighting training.

Ciniza attempts to handle emergencies internally and maintains fire fighting equipment, fire fighting crews, and an ambulance. Fire fighting crews receive on-site training through drills and instruction and off-site training in fire schools specializing in training for refinery fire fighting.

G.7 Evacuation Plan [20 NMAC 4.1, Subpart V, §264.52(f) and Subpart IX, §270.14(b)(7)]

The refinery gate is staffed around the clock. In an emergency, access of nonrefinery personnel is prohibited. The refinery gate is equipped with outside line emergency access. No foreseeable incidents involving the LTU will result in evacuation of the refinery or surrounding area. However, evacuation as described below may result in the event of a major, uncontrolled refinery fire.

G.7.1 Visitors

Visitors are signed in at the front office. Unescorted visitors are not allowed in the refinery operating area. In an emergency, visitors are instructed to return to the front office, where they are accounted for against the sign-in register. Should evacuation be necessary, visitors are instructed to leave via the access road to I-40 and to gather at the designated muster area.

G.7.2 Contractors

Contractors are logged in and out at the front office for each entry and departure. Contractors are given safety instructions during their first visit to the refinery and they are required to report to the front office during emergencies and are warned of such by the refinery fire whistle. Should evacuation be necessary, contractors are instructed to leave via the access road to I-40 and to gather at the designated muster area.

G.7.3 Employees

All employees are assigned specific duties during emergencies and form the emergency response crews. Each crew leader has a radio and is responsible for communicating with team members. Should evacuation be necessary, notification to employees is made via radio and the refinery whistle. On the order to evacuate, the employees report to the access road at I-40 for head count and further instructions.

G.7.4 Local Citizens

Due to the rural nature and remote location of the site, it is doubtful that evacuation of citizens will be required. The nearest nonrefinery residence is more than one mile south-southwest, the second nearest is approximately 2.5 miles northwest. Should evacuation be deemed necessary, the refinery management will contact the county sheriff to provide assistance.

G.8 Required Reports [20 NMAC 4.1, Subpart V, §264.56(j) and Subpart IX, §270.14(b)(7)]

Any emergency that requires implementing the contingency plan will be reported in writing within 15 days to NMED.

Table G-1. Emergency Coordinator[a]

Emergency Coordinator	Ciniza Telephone	Home Telephone	Home Address
This information will be supplied to NMED at the time of certification pursuant to NMAC 4.1, Subpart V, §264.52(d)			

[a]To ensure immediate response, the Emergency Coordinator may be reached at (505) 722-3833, 24 hours a day.

Table G.2 Emergency Equipment

Quantity	Item	Location	Description
1	Ambulance equipped with first-aid equipment	Fire House	The ambulance is a 3/4-ton van capable of carrying three injured individuals, is radio-equipped to allow communication with the refinery, and is equipped with first aid equipment, including oxygen and burn treatment materials.
1	National Aer-O-Foam Fire Truck	Fire House	The fire truck can be used as a water pumper, a foam pumper, or in combination to deliver simultaneous water and foam streams, and is capable of cross-country operation. The rated capacity of the water pump is 1,000 gpm at 150 psi from draft. Capacities and pressures may be increased when water is supplied from hydrants. The fire truck is capable of drafting from static water sources (such as the evaporation ponds) and can supply up to six discharge hoses. The fire truck carries a tank containing 1,000 gal. of XL 3% foam, 1,000 ft of 3-in. fire hose and 500 ft of 1-1/2-in. fire hose as well as other miscellaneous fire fighting equipment.
1	Pierce Attack Pumper Fire Truck	Fire House	The fire truck is a water and/or foam pumper with a rated capacity of 500 gpm at 150 psi from draft. The truck carries a tank containing 50 gal. of A.F.F.F. foam, a second tank containing 250 gal. of water, 700 ft of 3-in. hose, miscellaneous fire fighting equipment, and a cab-mounted monitor. The fire truck is a rural 4-wheel drive capable of cross-country operation.
1	Fire Water Storage and Distribution Hydrant System	See Figure G-1	Primary fire water storage is located in two tanks: the 5,000 gal. fire water tank (Z86-T1) and the 5,000 gal. raw water tank (Z91-T1), located near the boiler house. These tanks are directly fed by three artesian wells. The Waukeshaw natural gas driven fire water pump and the steam driven fire water pump draw from the artesian wells and discharge to the hydrant system. The No. 2 pond holds an estimated 1.5 million gal. The diesel fire water pump draws from Pond No. 2 and discharges to the hydrant system. The hydrant system includes not only fire water supply hydrants, but also turret monitors, steamers, hose reels, fog nozzles, foamite air chambers and foamite air foam aspirators. The locations of this equipment are shown on Figure G-1.

Table G.2 Emergency Equipment (Continued)

Quantity	Item	Location	Description
1	Diesel-Driven Pond Fire Water Pump	No. 2 Evaporation Pond	This pump can deliver 1,300 gpm and takes suction from the pond and discharges to the hydrant system.
1	Waukesha Natural Gas Engine Fire Water Pump	Boiler House	This pump can deliver 1,000 gpm and takes suction on the raw water and fire water tanks discharging to the hydrant system.
1	Steam Turbine Driven Fire Water Pump	Boiler House	This pump can deliver 1,000 gpm and takes suction from the raw water and fire water storage tank discharging to the hydrant system.
21 12 14 82 45 7	5# CO_2 Fire Extinguishers 10# Foray Fire Extinguishers 15# CO_2 Fire Extinguishers 20# Purple K Fire Extinguishers 30# Purple K Fire Extinguishers 150# Purple K Fire Extinguishers	Facility Wide	The distribution of fire extinguishers throughout the refinery allows rapid response and control of small fires. Refinery vehicles and vacuum trucks are also equipped with fire extinguishers.
11	30 minute Scott Air Packs	Facility Wide	The air packs allow operator response prior to arrival of the fire truck and should they be needed for escape. Two additional air packs are located on the Aer-O-Foam fire truck.
1,000 ft	Additional Fire Hose	Fire House	A major portion of this hose is kept on a trailer to facilitate movement. Additionally, approximately 1,500 ft of fire hose is maintained at key locations in the process area.
1,000 gal. 300 gal	Spare XL 3% Foam A.F.F.F. Foam	Fire House	
2	Proximity Fire Entry Suits	Fire Truck	
3	Hazardous Environment Enclosed Breathing Suits	Fire House	
	Miscellaneous First Aid Equipment	Facility Wide	
	Miscellaneous Fire Fighting Equipment	Facility Wide	

Table G-3. Response Groups and Agencies Available to Ciniza for Guidance and/or Emergency Assistance

Response Group	Telephone Number	Agreement
Ciniza Response Group - Field Emergency Crew		
Incident Commander	Notified by 2-way radio	Provides emergency site evaluation. Notifies shift fire crew. Specifies protective clothing and equipment. Provides support for any emergency incident and decontamination of responders and response equipment.
Fire Crews	Notified by 2-way radio	Provides a first response team to any emergency incident, as directed by the incident commander.
Environmental Staff	(505) 722-3833	Provides guidance on environmental problems and emergency site evaluation. Determines if field monitoring is necessary. Provides guidance on regulatory requirements. Conducts any field surveys to determine spread of contamination and adequacy of cleanup.
Local Agencies		
Gallup Fire Department	911	Provides emergency response fire fighting personnel and equipment, as needed.
Gallup Ambulance	911	Provides ambulance service, as needed.
Thoreau Fire/Ambulance	(505) 862-7440	Dispatches fire fighting personnel and equipment, as needed.
Whispering Cedars Fire Department	(505) 863-6871	Dispatches fire fighting personnel and equipment, as needed.
Local Emergency Planning Committee - August Martin	(505) 488-5684	Provides local emergency response planning.
McKinley County Sheriff's Office	(505) 863-3132	Provides assistance in isolating the refinery, controlling traffic in an emergency, and evacuating local residents.
State Agencies		
State Police Department	(505) 863-9353	Provides assistance in isolating the refinery, controlling traffic in an emergency, and evacuating local residents.
New Mexico Department of Public Safety - Hazardous Materials Emergency Response (8 hours/day)	(505) 827-9226	Provides guidance on hazardous materials and support to determine nature and extent of chemical contamination.
NMED/HRMB Santa Fe Office Mobile	 (505) 827-1557 (505) 827-9329	Notify NMED/HRMB if a hazardous waste release, fire, or explosion could threaten human health or the environment outside the facility.
National Response Center	(800) 424-8802	Notify NRC immediately if a hazardous waste release, fire, or explosion could threaten human health or the environment outside the facility.

Table G-3. Response Groups and Agencies Available to Ciniza for Guidance and/or Emergency Assistance (Continued)

Response Group	Telephone Number	Agreement
Miscellaneous Assistance		
Rehoboth McKinley County Hospital	(505) 863-7000	Provides medical services. Provides and maintains the emergency room.
FAA Emergency Weather Information	(505) 722-4308	Provides information on meteorological condition.
Allied Chemical	(201) 455-2000 (504) 383-5222 (315) 487-4990	Provides specific HF chemical emergency information.
CHEM-TREC (MSDS information)	(800) 424-9300	Provides specific chemical information.
UNICEM Local District	(505) 327-7775 (303) 466-7027	Provides specific chemical emergency information.

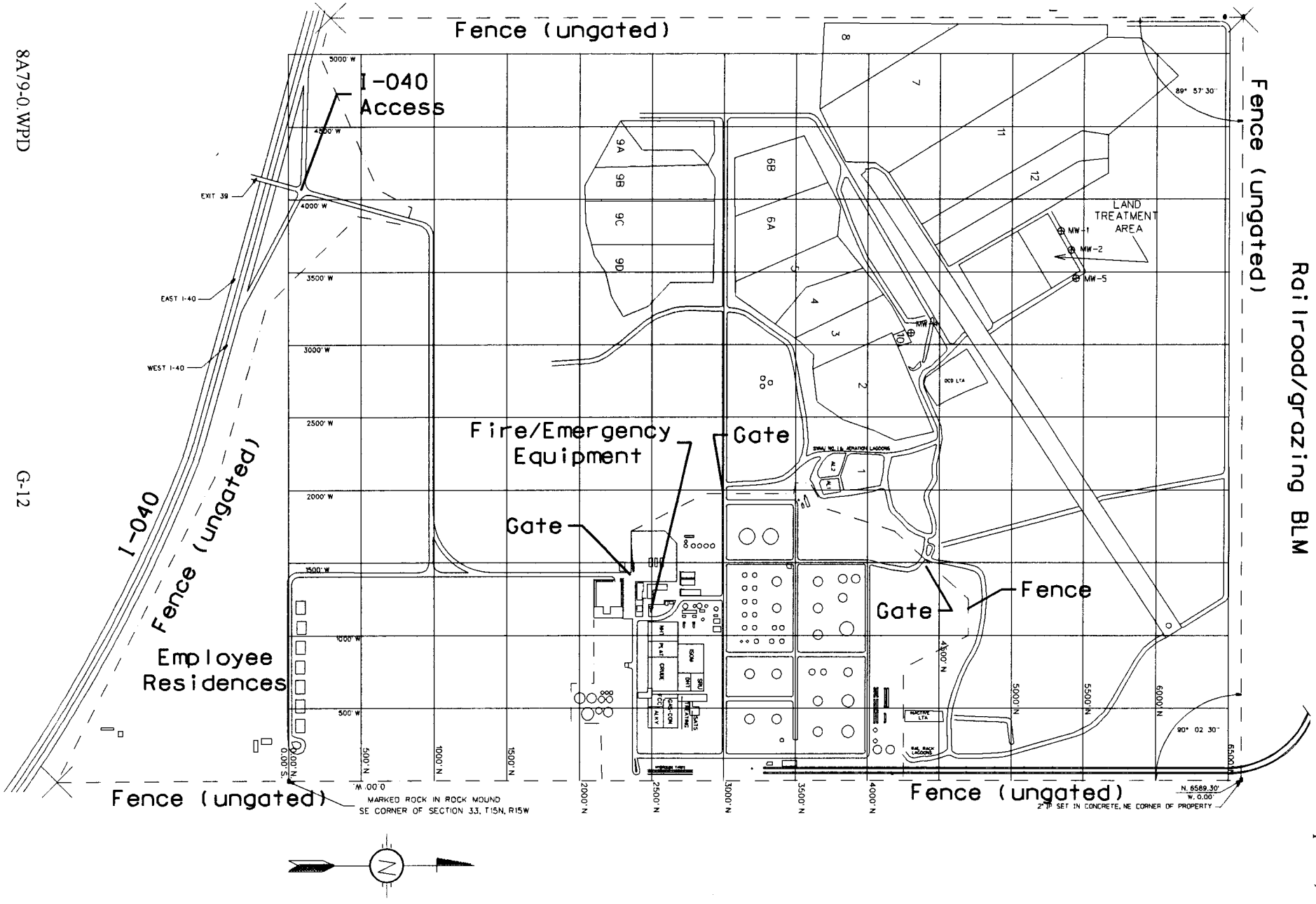


Figure G-1. Locations of Fire and Emergency Equipment

H.0 PERSONNEL TRAINING

This section describes the personnel training program for Ciniza during the LTU post-closure care period. Training requirements are specified in 20 NMAC 4.1, Subpart V, §264.16, and 20 NMAC 4.1, Subpart IX, §270.14(b)(12). The primary objective of the training program is to prepare personnel to operate and maintain safely those areas managing hazardous waste in accordance with 20 NMAC 4.1, Subpart V, Part 264. The degree of training varies with job duties. However, all personnel who may work at the Ciniza LTU receive an introduction to hazardous waste management regulations. This section includes a general description of the Ciniza's personnel training program.

H.1 Training Content, Frequency, and Techniques [20 NMAC 4.1, Subpart IX, §270.14(b)(12) and 20 NMAC 4.1, Subpart V, §264.16(a),(b),(c), (d) and (e)]

Ciniza's training program consists of classroom instruction or on-the-job training. The Lab/Dispatching and Operations Department managers train individual employees on specific duties. Environmental Department personnel that are trained in hazardous waste management procedures conduct RCRA training. The Safety Department conducts first aid and fire fighting training. Specific safety procedures are described in the Safe Work Procedures Manual.

Personnel responsible for post-closure care activities are trained to maintain and inspect the LTU, perform or oversee groundwater and unsaturated zone monitoring activities, and perform sampling and/or analysis. Personnel responsible for post-closure care activities will also be trained in decontamination activities, wear appropriate PPE specified by the Ciniza EM, and follow good hygiene practices.

H.1.1 Implementation of Training Program [20 NMAC 4.1, Subpart V, §264.16(b) and (c)]

New employees or newly assigned employees receive initial training within six months of assignment to post-closure care activities and review training annually. All personnel, excluding administrative office personnel, are trained in their RCRA-related duties and the Contingency Plan (Section G.0). The Environmental Department conducts RCRA training during the semiannual facility safety training sessions. Departmental training is supervised by the applicable manager on a recurring basis and consists of the following:

- All personnel, excluding administrative office personnel, receive initial and semiannual training.
- Laboratory personnel receive laboratory training.
- Operation/Maintenance personnel receive maintenance training.

H.1.2 Emergency Response Training [20 NMAC 4.1, Subpart V, §264.16(a)(3) and (c)]

To ensure maximum protection of life and property and to mitigate the consequence of an emergency situation affecting the LTU, Ciniza personnel involved with emergency response receive training in process area emergency procedures. Additionally, all Ciniza personnel are trained in fire fighting and emergency response, as described in Section G.0, "Contingency Plan." Periodic emergency drills and exercises are used at Ciniza to familiarize workers with emergency procedures.

If called upon by the Ciniza emergency coordinator, additional emergency response personnel may assist at the scene of a refinery emergency. These professionals are trained in their specialties (e.g., heavy equipment operation, hazardous material cleanups, traffic control, and security). At all times during an emergency, these workers are under the supervision of the Ciniza emergency coordinator. The Contingency Plan (Section G.0) provides a more detailed discussion of emergency procedures, personnel, and equipment.

In addition, personnel responsible for post-closure care activities are trained on spill response and Occupational Safety and Health Administration emergency response provisions.

H.2 Training Records [20 NMAC 4.1, Subpart V, §264.16(d) and (e)]

RCRA training records are maintained at the departmental and administrative level. Ciniza Environmental Department staff maintain job titles and job descriptions of employees responsible for LTU activities.

I.0 GENERAL CLOSURE AND POST-CLOSURE REQUIREMENTS

I.1 General Closure and Post-Closure Requirements [20 NMAC 4.1, Subpart V, §264.110 through §264.120]

I.1.1 Applicability of Closure and Post-Closure [20 NMAC 4.1, Subpart V, §264.110 through §264.120]
This plan describes the activities necessary to complete *final closure* of the Ciniza's LTU (NMD 000333211-2). *Final closure* refers to all closure activities such that hazardous waste management activities under Part 264 are no longer conducted. *Final closure* is complete at the end of the post-closure care period.

The LTU is the only hazardous waste management unit located at Ciniza that is subject to the closure requirements of 20 NMAC 4.1, Subpart V, 264, Subpart G. Closure of the LTU constitutes *final closure* of the Ciniza's hazardous waste management activities at the LTU subject to 20 NMAC 4.1, Subparts V and IX, as defined in 20 NMAC 4.1, Subpart I, §260.10.

Final closure performance standards are included in Section I.2. The information contained in this plan is designed to meet permit application requirements of 20 NMAC 4.1, Subpart IX, §270.14(b)(13), and the closure/post-closure requirements of 20 NMAC 4.1, Subpart V, §264, §264.110 through §264.120. Unit-specific closure and post-closure obligations of 20 NMAC 4.1, Subpart V, §264.280 reflect the *final closure* plan's focus.

I.1.2 Site Description [20 NMAC 4.1, Subpart V, §264.112]
Ciniza is a crude oil refining facility located in McKinley County, New Mexico, at Township 15 North, Range 15 West, Sections 28 and 33. The refinery is just north of I-40 and approximately 17 miles east of Gallup, New Mexico.

Ciniza, originally owned by El Paso Natural Gas Company, was constructed in 1957. The refinery was purchased by Shell Oil Company (Shell) in 1964, and operated by Shell until 1982. The refinery was then purchased by Giant. Giant Industries Arizona, Incorporated, the parent of Giant, is headquartered in Scottsdale, Arizona.

I.1.3 Land Treatment Unit Description [20 NMAC 4.1, Subpart V, §264.112]
The Ciniza site map is shown on Figure B-1. The LTU is located within the refinery property boundary. The primary purpose of the LTU was the degradation, transformation, or immobilization of hazardous wastes using microbial activity and soil characteristics. The LTU is approximately 1,500 ft northwest of the refinery process area and is above the 100-year floodplain, as shown on Figure B-3. The LTU consists of three 480-ft x 240-ft sections located immediately east of Evaporation Pond 12B. Each section is diked and contains 2.6 acres (1.0 hectare) of available treatment surface. The top 12 in. of soil was plowed and disked to encourage aerobic microbial activity and improve chemical reaction rates. During

treatment, soil nutrients were applied as necessary to maintain the optimum carbon:nitrogen:phosphorous (C:N:P) ratio of 50:2:1. The LTU received hazardous wastes from October 10, 1980, to November 8, 1990, with treatment confined to the upper 12 in. of natural soil (zone of incorporation). Waste management activities for the treatment program are based on the land treatment demonstration (Land Treatment Demonstration 1988) conducted by Ciniza in order to design the operating treatment parameters. Design capacity and conditional limits of the LTU include a treatment zone depth not greater than 5 ft from the original soil surface, and a maximum treatment zone depth at least 3 ft above the seasonal high water table (20 NMAC 4.1, Subpart V, §264.271(c)(1) and §264.271(c)(2).

I.1.4 Hydrogeology [20 NMAC 4.1, Subpart V, §264.112]

A detailed description of the geologic conditions beneath the LTU is provided as Attachment I-1 of this post-closure plan. The interpretation of geologic conditions is derived from the data of past investigations as well as logs from borings and well installations. Subsurface data in the LTU area have been digitized and modeled as surfaces based on general environments of deposition. The results of modeling indicate a complex subsurface below the LTU. The modeling results are presented graphically in Section Maps 1, 3, 4, and 5, as well as Profiles 1-1', 3-3', and 6-6' of Figure I-1.

I.1.5 Surrounding Land Use [20 NMAC 4.1, Subpart V, §264.112]

Ciniza, located in McKinley County, is situated in a remote, undeveloped, and sparsely populated area. The surrounding land use is cattle and sheep grazing at a density of less than six cattle or 30 sheep per section. Most of McKinley County is rural, as are adjoining portions of neighboring counties.

The refinery maintains residences for several employees 0.5 mile south of the refinery process area. A truckstop is approximately 1 mile south-southwest of the process area near the I-40 exit. A rural residential area, with a density of eight to 10 residents per square mile, is approximately 1.5 miles southwest of the refinery. A railroad is within 2 miles to the north, the small community of Iyanbito is within 3 miles to the northwest, the Fort Wingate Military Reservation is within 6 miles to the west, the Cibola National Forest is within 2 miles to the southwest, and a highway rest area is within 1 mile at the I-40 exit to the south. The largest residential community near the refinery is Gallup, New Mexico, which is 17 miles away, west of the refinery.

I.1.6 Description of Waste [20 NMAC 4.1, Subpart V, §264.112]

Ciniza received its Hazardous Waste Facility Permit (NMEID 1988) and has conducted activities since that date in accordance with its permit. The LTU is permitted to treat refinery sludges carrying the EPA hazardous waste numbers D001, D007, K049, K050, K051, and K052. Application of hazardous waste to the LTU ceased on November 8, 1990. Approximately 2,600 tons of hazardous waste were treated at the LTU during its operating life as described in more detail in Appendix D.

The refinery sludges treated at the LTU were viscous oil-water-solids mixtures. Table I-1 summarizes the wastes applied to the LTU. Records of waste inventory and analysis, as well as the operational logbook documenting any activity within the LTU, will be maintained at Ciniza until closure of the LTU, as required by 20 NMAC 4.1, Subpart V, §264.73(b) and §264.119.

Hazardous wastes currently generated at Ciniza are managed according to 20 NMAC 4.1, Subpart III, §262.34. These wastes are shipped off-site to approved treatment, storage, and disposal facilities for treatment and disposal. No hazardous wastes are stored for more than 90 days pursuant to 20 NMAC 4.1, Subpart III, §262.34.

I.1.7 Ancillary Equipment [20 NMAC 4.1, Subpart V, §264.112]

The equipment used to manage waste and soil at the LTU during *final closure* activities may include, but are not limited to, a tractor, disc and harrow, backhoe, dump truck, and road grader. This equipment, as well as contaminated PPE, will be decontaminated during closure as necessary to meet closure performance standards required by 20 NMAC 4.1, Subpart V, §264.114. Decontamination procedures are described in Section I.5.4.

I.2 Final Closure Performance Standard

I.2.1 Final Closure of the Land Treatment Unit [20 NMAC 4.1, Subpart V, §264.111]

The LTU will be closed to meet the following closure and post-closure performance standards:

- Minimize the need for further maintenance.
- Control, minimize, or eliminate, to the extent necessary to protect human health and the environment, the post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated runoff, or hazardous waste decomposition products to the ground, surface waters, or atmosphere.
- Comply with the final closure requirements of 20 NMAC 4.1, Subpart V, §264.110 through §264.115 (which concern closure) and §264.116 through §264.120 (which concern post-closure care), and the requirements of 20 NMAC 4.1, Subpart V, §264.280 for the closure and post-closure of land treatment units.

I.2.2 Criteria to Meet *Final Closure* Standards [20 NMAC 4.1, Subpart V, §264.280]

These performance standards will be met by conducting the following activities throughout the closure and post-closure care period: 1) maintaining the runon and runoff systems of the LTU; 2) controlling wind dispersal of hazardous waste; 3) continuing unsaturated zone monitoring; 4) maintaining the groundwater monitoring system; 5) establishing and maintaining a vegetative cover over the closed LTU; and 6) decontaminating, as necessary, equipment that comes into contact with hazardous waste and waste residues. Details of *final closure* criteria and support activities are described in Sections I.4 through I.6.

I.3 Administrative Requirements

I.3.1 Final Closure: Schedule for Closure and Post-Closure Care Period [20 NMAC 4.1, Subpart V, §264.112(b)(6), §264.117, and §264.118(b)]

Final closure activities will be conducted in accordance with the approved post-closure care permit as required at 20 NMAC 4.1, Subpart V, §264.112(a), §264.112(b), §264.118(a), and §264.118(b). Table I-2A provides the *final closure* schedule of activities through the closure and post-closure care period. Table I-2B provides final vegetative cover activities to be conducted during closure and post-closure care period. Ciniza will conduct post-closure monitoring and reporting activities for the LTU for 30 years after initial post-closure permit issuance by the Secretary of the NMED or as established in an approved permit modification. Maintenance and monitoring of waste containment systems will be implemented for the same time period. Post-closure property use will not be allowed which could disturb the final cover or the monitoring, containment, or security systems, except as provided by 20 NMAC 4.1, Subpart V, §264.117(b) and §264.117(c), and as approved in a permit modification.

I.3.2 Amendments of the Final Closure Plan [20 NMAC 4.1, Subpart V, §264.112(c) and §264.118(d)]

If final closure activities cannot be completed at the LTU in accordance with the approved schedule, Ciniza will notify the Secretary of the NMED in accordance with the extension requirements cited in 20 NMAC 4.1, Subpart V, §264.112(c) and §264.112(d), and in accordance with the time periods of 20 NMAC 4.1, Subpart V, §264.112(3) and §264.118(d)(3). Ciniza will submit a written notification of request for a permit modification to authorize change in the final closure plan. The modification request will describe the proposed change in operation or LTU design. A copy of the amended permit will be submitted with each notification or request. Ciniza will submit a written request for a permit modification to authorize a change in the approved plan if either of the following occur:

- Changes in operating plans or LTU design affecting the final closure plan
- Unexpected events that require modification of the approved closure/post-closure schedule

A copy of the approved post-closure care permit and any approved revisions will be maintained at:

Ciniza Refinery
Route 3, Box 7
Gallup, New Mexico 87301
Telephone (505) 722-3833

I.3.3 Amendments Requested [20 NMAC 4.1, Subpart V, §264.112(c)(4) and §264.118(d)(4)]

If the Secretary of the NMED requests a modification of the final closure plan under the conditions described in 20 NMAC 4.1, Subpart X, §264.112(c) and §264.118(d), a plan modified in accordance with the request will be submitted within 30 days of notification of the request.

I.3.4 Closure Certification [20 NMAC 4.1, Subpart V, §264.115]

Within 60 days after completion of final closure activities, Ciniza will submit to the Secretary of the NMED, via certified mail, a certification that the unit has been closed in accordance with the specifications of the approved closure plan. The certification will be attested to by a registered independent professional engineer or qualified independent soil scientist and will be signed by the appropriate Ciniza official in accordance with 20 NMAC 4.1, Subpart V, §264.115. Documentation supporting the certification will be furnished to the Secretary of the NMED with the original certification. A copy of the certification and supporting documentation will be maintained by Ciniza in accordance with 20 NMAC 4.1, Subpart V, §264.115.

I.3.5 Survey Plat [20 NMAC 4.1, Subpart V, §264.116]

No later than the submission of final closure certification of the LTU, Ciniza will submit a survey plat to the local land use authority at the McKinley County Courthouse indicating the location and dimensions of the LTU with respect to permanently surveyed benchmarks. Ciniza will also submit a copy of the survey plat to the Secretary of the NMED on the date that certification of final closure is submitted. The plat will be prepared and certified as described in Section I.3.4. A note will be included with the plat to state Ciniza's obligation to restrict disturbance of the LTU.

I.3.6 Certification of Completion of Post-Closure Care [20 NMAC 4.1, Subpart V, §264.120]

Within 60 days after completion of the post-closure care period established under 20 NMAC 4.1, Subpart V, §264.117 or §264.280(d), Ciniza will submit to the Secretary of the NMED, by registered mail, a certification that the post-closure care for the LTU was performed according to the approved post-closure permit.

I.3.7 Post-Closure Notice [20 NMAC 4.1, Subpart V, §264.115]

Within 60 days of certification of *final closure* as described in Sections 3.4 and 3.5, Ciniza will: 1) submit a record of the type, location, and quantity of hazardous wastes disposed of in the LTU to the local zoning authority at the McKinley County Courthouse and to the NMED Secretary; and 2) record a notation on the property deed that:

i. The land was used to manage hazardous waste;

ii. Its use is restricted under 20 NMAC 4.1, Subpart V, Subpart G regulations; and

iii. The survey plot described in Section 3.5 and the record of the type, location, and quantity of hazardous waste disposed in the LTU have been filed with the local zoning authority and the Secretary of the NMED.

Ciniza will submit the certification and a copy of the property deed containing the notation to the NMED Secretary as required by 20 NMAC 4.1, Subpart V, §264.119(b)(2) within 60 days of *final closure* certification.

I.3.8 Financial and Liability Requirements [20 NMAC 4.1, Subpart V, §264.140]

Financial assurance for closure and post-closure will be maintained in accordance with 20 NMAC 4.1, Subpart V, §264.142, §264.143(i), § 264.144 and §264.145(i). Table I-3 provides final closure estimates for the LTU. Financial assurance ensures 20 NMAC 4.1, Subpart V, 264, Subpart G compliance through the end of the post-closure care period. A copy of the financial assurance demonstration document is provided as Appendix H.

I.4 Monitoring Maintenance and Reporting

I.4.1 Activities Required [20 NMAC 4.1, Subpart V, §264.280 and §264.112]

Maintenance and monitoring activities will continue through the end of the post-closure care period. Sections I.4.2 and I.4.3 describe maintenance and monitoring activities respectively, in support of final closure performance standards. The designed activities exhibit a commitment to sound hazardous waste management at the LTU. Focused activities are dedicated to control, minimize, or eliminate post-closure escape of constituents from the LTU, as described below.

I.4.1.1 Maintenance Activities

- Provide and maintain surface soil conditions capable of maintaining growth of a low-maintenance vegetative cover on the LTU.
- Inspect and maintain the surface water runon and runoff systems.
- Provide necessary control for wind dispersal of hazardous waste particulate matter.
- Continue compliance with food-chain crops prohibitions.

I.4.1.2 Monitoring Activities. Ciniza will continue soil-core and groundwater monitoring programs that supply reliable subsurface data for tracking performance of the LTU constituent containment integrity. Monitoring activities will continue through the end of the post-closure care period.

I.4.2 Description of Maintenance Activities

I.4.2.1 Plant Growth Soil Conditions. LTU soil conditioning activities in the near term, during closure activities, are to establish a vegetative cover to stabilize the 6 in. clean soil cover over the LTU. Ciniza will conduct final surface soil tests and apply appropriate amendments, as necessary, and topsoil to the LTU. Inspections will determine maintenance activities necessary to continue optimum soil conditions for plant growth after initial soil conditioning operations. The closure schedule (Table I-2) lists the timing of these activities.

I.4.2.2 Control of Runon and Runoff [20 NM,AC 4.1, Subpart V, §264.280(c)(3) and §264.280(c)(4)]
Maintenance of a berm surrounding the LTU effectively controls runoff, preventing potential contamination of adjacent surface water and surface water channels. Ciniza will level the LTU surface as necessary to prevent ponding of rainfall water. The climate of western New Mexico is classified as continental semiarid. The capacity of the berm is sufficient to contain the volume of rain water from the estimated 24-hour, 100-year storm event (2.7 in.) (see Section G.3.2). Likewise, the berm system prevents runon. Low rainfall rates and the generally flat surface terrain minimize runon potential as well. Ciniza will routinely inspect runon and runoff controls and make any repairs that are necessary to ensure the integrity of the systems.

I.4.2.3 Control of Wind Dispersal [20 NMAC 4.1, Subpart V, §264.280(c)(5)]. Potential releases of airborne particulate matter by windstorms will be controlled by the addition of a topsoil layer on the LTU. During the winter months (November through March) snow cover and frozen ground effectively inhibit wind erosion. Vegetative cover growth, when properly dense, will control particulate lift from the soil-atmosphere interface through decreased turbulent air flow. Soil moisture supplemented by irrigation, if necessary, will also be a temporary means to control wind dispersal from any bare areas of the vegetative cover. Routine inspections scheduled for the post-closure period will evaluate the cover system's ability to control wind erosion and initiate any necessary remedies.

I.4.2.4 Compliance with Food Chain Crop Restrictions [20 NMAC 4.1, Subpart V, §264.280(a)(6)]. Ciniza will not allow the cultivation of food-chain crops on the closed LTU, except for the scientific testing of such cultivation with the intent of providing data only or with the intent of plowing under such a crop for mulch to enhance top soil growth conditions of the final cover (with approval of the Secretary of the NMED). In accordance with 20 NMAC 4.1, Subpart V, §264.276(b)(2)(iv), the appropriate Notice of Deed will be filed with McKinley County, New Mexico, to notify future property owners of the LTU location and the food-chain crop restriction.

I.4.3 Description of Monitoring Activities

I.4.3.1 Clay Unit. Immobility of constituents within the treatment zone are demonstrated by permeability data collected from soils in the LTU documented in the Land Treatment Demonstration Engineering Report (Appendix D). Low permeability and other soil properties make the unit an effective barrier for restricting constituent migration.

Planned monitoring activities at various subsurface depths will collect data to verify that the clay layer's effectiveness is maintained throughout the post-closure care period. This monitoring system is the early detection monitoring, which includes the sampling of the ZOI, treatment zone, and Chinle slope wash.

I.4.3.2 Zone of Incorporation and Treatment Zone Soil-Core Monitoring. Ciniza will continue a soil-core monitoring program to collect analytical data from soils in the ZOI and treatment zone at appropriate depths, locations, and numbers of samples to provide adequate detection of any statistically significant constituent concentrations in these zones. Ciniza will conduct post-closure monitoring in accordance with 20 NMAC 4.1, Subpart V, §264.280 and will use consistent procedures for sample collection, preservation, and shipment; analytical methods; and chain-of-custody control.

If significant concentrations are confirmed, appropriate seven day notification to New Mexico Environment Department/ Hazardous and Radioactive Materials Bureau (NMED/HRMB) will be provided and a permit modification request may be required for further characterization of these zones. Ciniza will conduct additional sampling, as necessary, to confirm the presence or absence of the indicated constituent and to ensure that additional constituents that are present in the location of the release area are characterized.

I.4.3.3 Chinle Slope Wash Monitoring. Sampling and analysis of the Chinle slope wash supplements the above-described (Section I.4.3.2) soil-core monitoring program. The combination of ZOI and treatment zone soil-core monitoring and Chinle slope wash monitoring provides ample means to maintain and monitor the LTU integrity in the post-closure care period. Sampling frequency is described in Figure E-1.

I.4.3.4 Groundwater Detection Monitoring Program. The groundwater detection monitoring program established for the Sonsela aquifer (the uppermost aquifer) consists of program elements to meet 20 NMAC 4.1, Subpart V, Section 264, Subpart F requirements and will be conducted through the post-closure care period. No hazardous constituents have been identified in the Sonsela aquifer during the operating life of the LTU. Releases are not expected to be detected because of the physical and chemical properties of the remaining contaminants and due to the site's geologic characteristics. Artesian qualities of the Sonsela demonstrate geological confining layers that isolate this water supply from potential surface recharge in the Ciniza vicinity. These confining shale layers minimize any surface source potential migration that could impact water quality. Nonetheless, the groundwater detection monitoring program contains provisions for

responding to constituents present in the uppermost aquifer. Response for indicated constituents would be confirmation sampling to verify the presence of the indicated constituents. If constituents are confirmed, the program describes the appropriate NMED notification, preparation of a compliance monitoring program and work plan preparation and subsequent implementation of an approved compliance monitoring program.

I.4.3.5 Administrative Amendments for Monitoring Activities. *Final closure* activities for the LTU are designed to meet all regulatory requirements as they relate to the LTU. Section I.3.2 contains procedures for responding to circumstances that require administrative modifications of the final closure plan. Monitoring activities are designed to collect reliable data that will support future decisions on any modifications needed in the monitoring programs. Ciniza will maintain and monitor control systems and programs to ensure that performance standards are preserved. Activities are based on the historical data and records obtained during the operating permit term and are designed for current data needs.

I.5 Site Control Measures

I.5.1 Security [20 NMAC 4.1, Subpart V, §264.117(b)]

Restricted access to authorized personnel and warning signs will effectively safeguard against potential contaminant exposure during the closure and post-closure care period. These restrictions minimize unknowing exposure possibilities. Figure I-2 shows the LTU, location of the refinery fence, and warning signs. Security measures are described further in Section F.1.

I.5.2 Control of Release to Hazardous Constituents to Groundwater [20 NMAC 4.1, Subpart V, §264.112(b)(5)]

Ciniza will continue the groundwater detection monitoring program of the Sonsela aquifer through the post-closure care period, as described in Appendix E, the Post-Closure Monitoring Plan. Other post-closure care monitoring includes the Chinle slope wash and soil-core monitoring as described in Section E.0 and detailed in the Post-Closure Monitoring Plan. The EDW is SMW-4, and detection MWs include MW-1, MW-2, MW-4, and MW-5. Sample collection and analysis of organics and metals from the modified Skinner List and principal hazardous constituents (PHCs) (collectively referred to as the modified Skinner List) are proposed for providing a reliable indication of the presence of hazardous constituents in the uppermost aquifer. Analytes and sample frequency are detailed in Section E.0 and Appendix E, the Post-Closure Monitoring Plan.

I.5.3 Required Personal Protective Equipment [20 NMAC 4.1, Subpart V, §264.112(b)(4)]

Before beginning any field activities, the Ciniza Team Leader will inspect the LTU to determine the PPE and monitoring requirements for the subject activity. The level of PPE required will depend primarily upon environmental factors (wind, precipitation, temperature), field conditions (e.g., soil moisture), and type of activity being conducted. Personnel involved

in *final closure* activities will be trained in decontamination activities, wear appropriate PPE as specified by the closure coordinator, and follow good hygiene practices to protect themselves from potential exposure to hazardous waste and residues. After use, contaminated PPE will be decontaminated and managed in accordance with 20 NMAC 4.1, Subpart V, §264.114. Typical PPE is described in Section F.3.5.

I.5.4 Equipment Decontamination [20 NMAC 4.1, Subpart V, §264.112(b)(4)]

Decontamination activities are proposed to meet the *final closure* performance standard of controlling, minimizing, or eliminating potential escape of an exposure to hazardous constituents by contaminated equipment and structures. All contaminated equipment, structures, and soils will be properly disposed of or decontaminated according to 20 NMAC 4.1, Subpart V, §264.114. Any hazardous waste generated during *final closure* activities will be managed in compliance with the facility's generator status and as described in this application.

The Post-Closure Monitoring Plan describes measures for preventing sampling and drilling equipment cross contamination during sampling events and measures for decontaminating items after use. Contaminated PPE will be disposed off-site at an approved facility. Items slated for reuse will be scrubbed with biodegradable soap and potable water, triple rinsed in clean water, then wiped dry with a clean towel, and inspected before being properly stored for reuse. Items will again be inspected before each use.

Larger equipment (see Section I.1.7) that is used in *final closure* activities will be moved onto an impermeable synthetic liner for decontamination. The liner will be designed, constructed, and installed to contain the wash water generated by the decontamination process, and to provide sufficient load-bearing capacity for the equipment. Activities will be conducted at the inner perimeter of the LTU so recontamination is prevented as equipment exit the site. Decontamination includes scraping, brushing, or otherwise removing soil that may be clustered on equipment. The outer surface and undercarriage will be washed with potable water and scrubbed with biodegradable soap as necessary to remove remaining residues. Items will be inspected and allowed to air dry before removal from the decontamination area. Wash waters will either be allowed to evaporate or be properly processed through the plant wastewater treatment system. The liner will be properly disposed after use.

I.5.5 Final Cover [20 NMAC 4.1, Subpart V, §264.280(c)(1)]

Maintaining surface soil conditions that foster ample coverage of a vegetative growth are additional measures planned to meet the closure performance standard. The *final closure* schedule (Table I-2) shows how closure and post-closure activities are coordinated. Activities included in vegetative cover maintenance are: inspection, testing soils, amending soils as necessary, planting, irrigating, if necessary, and cultivating young seedlings. Adjustments may be made as indicated by routine inspections of vegetative growth.

The LTU surface is not toxic to the final vegetative cover, the LTU soil surface will be prepared and amended as necessary for seeding. At least a 6-in. topsoil cover will be applied for plant growth.

The LTU surface will be graded as necessary to eliminate local depressions and elevations and provide a flat even expanse. A level surface minimizes the ponding of precipitation and irrigation water, controlling uneven water percolation into the soil. Uniform water distribution promotes optimum nutrient distribution and enhances growth of the vegetative cover.

After considering the appropriate seeding time and making the evaluations noted, Ciniza will determine the appropriate time to seed. There may be a lag time between evaluation and actual seeding in order to take advantage of seasonal weather patterns. Optimal seeding time should occur during the fall or spring immediately following evaluation. When the correct seeding time is reached, the LTU surface will be tilled as necessary to destroy any existing vegetation that may detrimentally compete with the selected plant species and to create a favorable soil density. Native plant varieties that spread naturally have been evaluated to determine whether their presence compromises performance of the vegetative cover. The County Agriculture Agent or other certified professional have been consulted for characteristics of species in question. It is possible that field tests might be performed to provide preliminary information about final selection of a particular seed mixture regarding the ability to germinate and develop in soil conditions of the LTU. The following three factors must be considered for seeding:

1. Seeding Method—Broadcasting or drilling the seeds are the principal preferred methods. Broadcasting, followed by disking, provides the best soil-seed contact for establishing seedlings.
2. Seeding Rate—The suggested seeding rate will be 12 lbs/acre to provide adequate density of vegetative cover.
3. Seeding Depth—Seeding depth will be 0.25 to 0.50 in..

Table I-4 includes the species of grasses to be sown. These grasses are known to thrive locally. They share the characteristics of rapid germination and spread; resistance to fire, insects, and diseases; depth of root system to prevent erosion; vegetative thickness to minimize percolation; and low maintenance. The final vegetative cover will be capable of maintaining growth without extensive maintenance as required by 20 NMAC 4.1, Subpart V, §264.280(c)(2).

Table I-1. Approved Waste Streams Applied to the Land Treatment Unit

EPA Hazardous Waste No.	Waste Description	Annual Application Limit (tons)
D001	Ignitable materials	50
D007	Cooling Water Filter Sludge	5
K049	Slop Oil Emulsion Sludge	200
K050	Heat Exchanger Bundle Cleaning Sludge	15
K051	API Separator Sludge	1,000
K052	Tank Bottoms (Leaded)	5

Table I-2A. Schedule and Vegetative Cover Activities During Closure

Closure Schedule

An estimated 180 days will be required to accomplish closure procedures and reporting requirements. The year of closure of the Land Treatment Units is 2000. Closure will observe the schedule provided below.

Activity	Milestone Date[d]
Notify the NMED	- 90 days
Begin vegetative cover activities	Day 30
Submit certification report to NMED	Day 60

Vegetative Cover Activities During Closure

Activity	Milestone Date[a]
Microtox soil test[b], if necessary	Day 0[c]
Receive and evaluate test results	Day 30
Soil Amendments, if necessary	Day 60
Determine seeding time[a]	Day 60
Prepare LTU	Day 90
• Level surface	
• Add topsoil layer	
• Irrigate as necessary	
Low Maintenance Vegetation	Day 120
• Seeding	1-2 years[d]
• Irrigate as necessary to establish cover system	

[a]Completion dates are dependent on weather conditions and optimal seeding times. NMED will be notified if weather conditions delay listed activities. Under such circumstances, Ciniza will negotiate the closure schedule with NMED.

[b]Microtox or other soil chemical tests may be conducted as needed. Consult with professional agronomist as needed.

[c]Day 0 = within 90 days after post-closure permit issuance (Approval of Closure Plan), weather dependent.

[d]Time dependent on seed germination and vegetation maturity.

Table I-2B. *Final Closure*: Closure and Post-Closure Schedule of Activities

Day 0[1]

Activity	Years																													
	1	2	3	4	5	6	7	8	9								19													30
Sample and Analysis																														
ZOI									•								•													•
Treatment Zone									•								•													•
Chinle Slope Wash	•	•	•		•		•		•								•													•
Sonsela Aquifer	•	•	•		•		•		•								•													•
Inspection and Maintenance[2] (See Table F-1 for detailed schedule)	- - -

Table I-3. *Final Closure* Cost Estimate

Activity	Material	Cost Frequency (over 30 years)	Estimated Cost
Sample by Zone			
ZOI	4 samples at $1,450	3	$ 17,400
Treatment Zone	4 samples at $1,450	3	$ 17,400
Chinle Slope Wash	1 samples at $1,650	8	$ 13,200
Sonsela Aquifer	4 samples at $1,650	8	$ 52,800
Sample QC	25% of $100,800		$ 25,200
Mobilization			
ZOI and Treatment Zone	3 events at $1,000/event		$ 3,000
Chinle Slope Wash and Sonsela	8 events at $2,000/event		$ 16,000
Field Technician	$10,000		$ 10,000
Microtox	$300 per test	9	$ 2,700
Soil Amendments	352,000 ft^2 at 0.02/ft^2		$ 7,040
Establish Vegetative Cover			
Top Soil	7.8 acres at $2000/acre		$ 15,600
Level LTU	7.8 acres at $950/acre		$ 7,410
Plant Seed	7.8 acres at $750/acre		$ 5,850
Water	1140 Mgal. at $1/Mgal.		$ 1,140
Routine Inspection, Maintenance and Repair			
Site Inspection	Weekly inspection		$ 6,000
Security Device	$100 annually		$ 3,000
Runon/Runoff	$1,000 annually to maintain perimeter berm		$ 30,000
Prepare Certification			
• Certify LTU Closure	120 hours at $125/hour		$ 15,000
Notice in Deed	6 hours at $150/hour		$ 900
• Certify Final Closure	120 hours at $125/hour		$ 15,000
Notice in Deed	6 hours at $150/hour		$ 900
Total Task			$265,540
Indirect Costs	20% Closure and Post-Closure Cost		$ 53,108
Ciniza Overhead			$ 26,554
Contingency			$ 26,554
TOTAL			**$371,756**

Mgal. = million gallons
ZOI = Zone of Incorporation

Table I-4. Revegetation Seed Mixture

Seed Type	Pls/Ac[a]
Blue Grama, *Bouteloua gracilis* "Lovington"	2
Sideoats Grama, *Bouteloua curipendula* "El Reno"	4
Buffalo Grass, *Buchloeda tyloides* "Texoka"	5
Alkali Sacaton, *Sporbolus airoides*	0.5

[a]Pounds of pure live seed per acre.

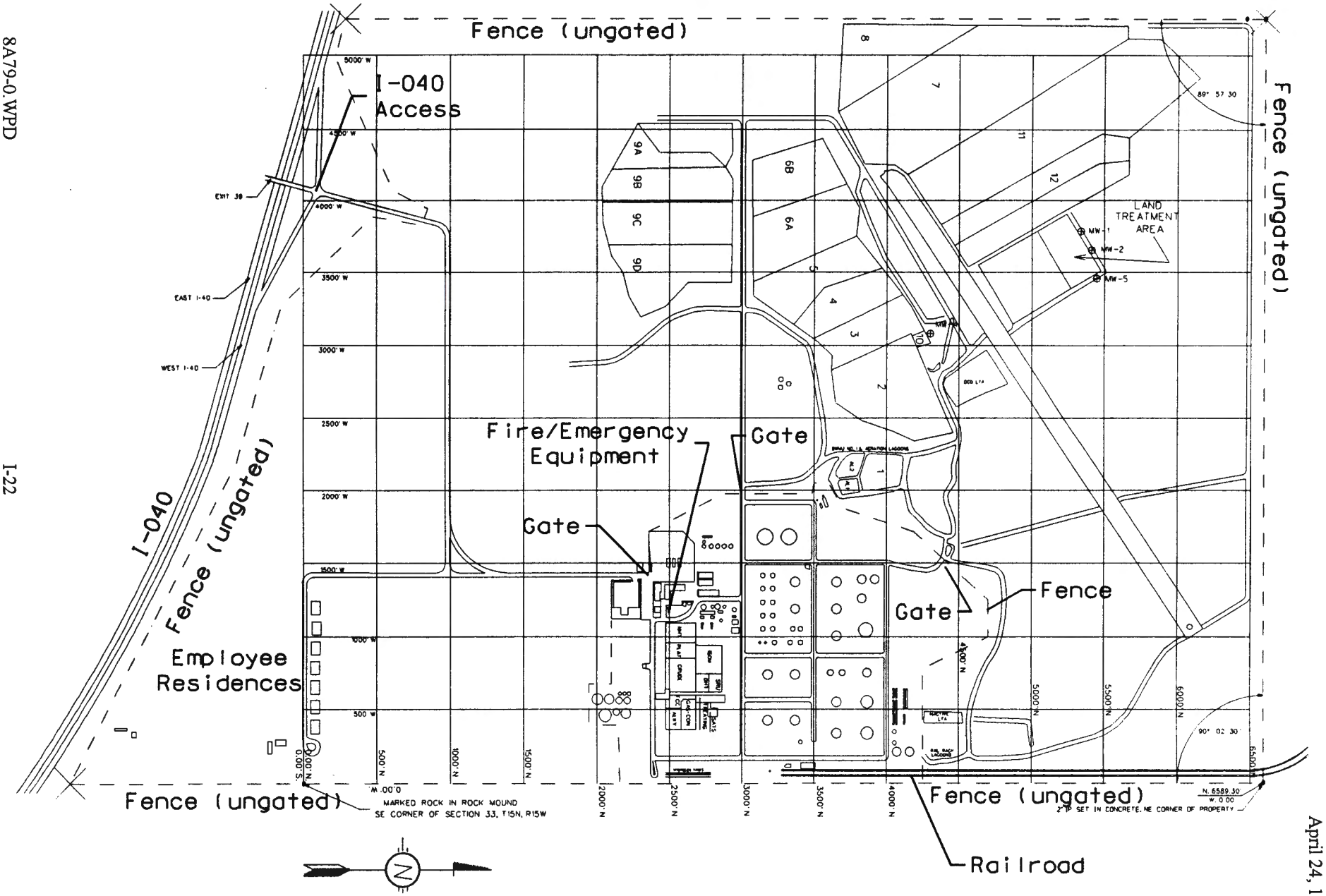


Figure I-2a. LTU, Location of Fence, and Warning Signs

Fence

Warning Signs

Figure I-2b. LTU, Location of Fence, and Warning Signs Detail Photos

Attachment I-1

Geologic Conditions Beneath the LTU

PRECISION ENGINEERING, INC.
P.O. BOX 422 • LAS CRUCES, NM 88004
Ph: (505) 523-7674
FAX: (505) 523-7248 • E-mail: werpei@aol.com

June 8, 1996

Mr. Ed Horst
Giant Refining Company
Ciniza Refinery
Route 3, Box 7
Gallup, New Mexico 87301

Re: LTA Subsurface Conditions

Dear Ed,

Attached is our summary of the geologic conditions at the Land Treatment Area. As you are aware our interpretation of the conditions was derived from all previous drilling that has been performed at the site as well as our work over the course of the past six years.

We would like to express our thanks to you and the rest of the Giant environmental staff. Without your assistance and professional cooperation in accumulating past data, our interpretations of the ground conditions would not have been possible.

If you have any questions or comments concerning our interpretations plese do not hesitate calling. We will be happy to discuss the matter with any project related personnel.

Sincerely,
Precision Engineering, Inc.

William H. Kingsley, P.E.

INTRODUCTION

The intent of this report is to provide a summary of stratigraphic conditions at the Land Treatment Area located in the northwest portion of the Ciniza Refinery property. The interpretations made are derived from the data of past investigations in the area as well as logs from borings and well installations performed by Precision Engineering, Inc. in the area of the refinery as well surface studies we have made on surrounding properties. All subsurface data in the area has been digitized and modeled as surfaces based on general environments of deposition.

HISTORICAL INTERPRETATIONS

Past reports indicate the entire site is, in essence, a part of a highly weathered section of the Chinle Formation. An unconsolidated sandy stringer within this highly weathered shale formation was known to be water bearing. This unconsolidated sand was named the Ciniza Sand and is consistently referred to in reports after 1985. The nomenclature is local only and is not a documented bed name within the Chinle Formation. Some reports refer to the "Ciniza Sand" as a sandstone, however, it has never been shown to have any degree of cementation. Below the "Ciniza Sand" is a sandstone bed that lies within unweathered shale. This sandstone bed is known as the Sonsela Sandstone which is a documented unit name within the Chinle Formation. The bed is water bearing and represents a potential aquifer in the Ciniza area and is being used as an aquifer in the Bluewater area.

The Ciniza Sand was interpreted to vary in thickness below the Land Treatment Area. The zone was also thought to pinch out completely to the west and reach a maximum thickness of approximately five (5) feet in the south central portion of the Treatment Area.

The SMW well series was placed to monitor water quality in the "Ciniza Sand" since some water was encountered in the sands. The wells vary substantially in depth ranging from approximately forty six (46) feet at SMW-1 to seventy four (74) feet at SMW-5. Formation dip was used to explain the differences in depth initially, although it was later thought there may be two beds comprising the "Ciniza Sand".

The MW well series monitors the water from the Sonsela Sandstone. These wells range in depth from approximately one hundred twenty (120) to one hundred twenty seven (127) feet in depth.

CURRENT STRATIGRAPHIC INTERPRETATION

During the course of various subsurface investigations at the refinery site, including the Land Treatment Unit, inconsistencies were noted in the logs of early investigations and the findings of more recent studies. One major inconsistency noted was that the depth to unweathered shale greatly varied from the OW series wells to all other findings. It was also noted that the upper fifty (50) to sixty (60) feet of sediments in the Land Treatment Unit did not match what should have been encountered in a weathered shale section of the Chinle Formation. As a result of the inconsistencies, the Land Treatment Area was modeled based on all borings that have been drilled in the area in an effort to accurately define the stratigraphy.

The results of the modeling show a much more complex subsurface environment than had originally been assumed. The upper fifty (50) to sixty (60) feet of sediments are not weathered in place sediments of the Chinle Formation. Although the sediments have a Chinle Formation parent material, the time of deposition is believed to be much later. Although not dated, the structure of the soils suggests a relatively recent fluvial environment of deposition. Charcoal is abundant in sandy sediments and occasionally encountered in the clay sediments. Some

carbonate accumulation can be noted in the soils. No evidence of cementation of the sediments has been observed. It is believed dating would place the age of the sediments in the range of a few thousand years to a few tens of thousands of years - much younger than the Chinle Formation.

To a depth of approximately ten (10) feet the entire Land Treatment Area is comprised of a high density, high plasticity clay. Below the ten (10) foot depth and within the fluvial materials comprising the upper fifty (50) to sixty (60) feet of the valley floor below the Land Treatment Area is a sandy zone that extends roughly from the ten (10) foot depth to approximately the thirty to forty (40) foot depth. Grossly speaking the sandy unit can be subdivided in to two smaller units. The upper unit is about ten (10) feet thick and the lower unit is about ten (10) to fifteen (15) feet thick. On the south end of the Land Treatment Area the units are separated by a clay zone on the order of five (5) to ten (10) feet in thickness. On the north end of the treatment area the two zones become indistinguishable and appear as a single unit. Whether or not the upper or lower unit pinches out is not fully understood, however, it is suspected the upper unit thins and blends with the lower unit. It should be noted that the sandy zone is best described as interbedded very fine sands, silts and clays that should be expected to hydraulically interconnect. On the south end of the Treatment Area the lower sandy zone is water bearing below approximately the thirty (30) foot depth. To the north no water is encountered in this zone. The approximate extent of water in this zone may be represented by a line extending from the southwest corner of the Area to the northeast corner. Wells SMW-1, 2, and 3 derive their water from this zone. This zone is the original "Ciniza Sand" referred to in earlier work. This sandy zone represents channel deposition believed to be the result of infilling from the ancestral Rio Puerco or, more likely, derived from the Four Mile Canyon drainage system to the east of the Ciniza Refinery property. The channels of this zone trend roughly from northeast to southwest.

Below the sandy zone is a thick clay bed. The bed represents a very low energy environment likely as a result of flood plain deposits of the ancestral Rio Puerco. The clays are hard, high plasticity, moist to wet (but not water bearing) and brown to reddish brown. Occasionally sample specimens show evidence of mud cracks indicating a wetted then dry environment after the initial deposition. No free water has ever been detected in this zone.

Immediately below the clay zone is another sand bed. The sand may or may not contain gravel made up of subrounded sandstone fragments, petrified wood, and rounded to subrounded multi-colored chert fragments one to two inches in greatest dimension In some areas this bed is composed only of fine sand. The sands are red to brown. The bed thickness ranges from three (3) inches to one foot or more. Some logs indicate this zone up to three (3) feet in thickness, although records at Precision Engineering, Inc. only show these thicknesses apparent south and east of the Land Treatment Area. The significance of this bed is two fold. First, in all locations where this zone has been penetrated it has been water bearing. Secondly, it always lies immediately above shale or sandy shale of the upper portion of the Petrified Forest Member of the Chinle Formation. Water from this zone has never been shown to penetrate more than a few inches into the Chinle Formation. The shales below the zone are typically damp to dry; more often than not they are dry. This bed most likely represents alluvial deposition on the ancient exposed Chinle surface. It is felt this bed, at least in the refinery property area, may be used as a marker to represent the boundary between younger valley infilling and true Chinle Formation shales below.

Significantly, the thin sand bed described above is derived from a different environment of deposition. Hydraulic connection to the upper fluvial sands has, as yet, not been demonstrated and the two zones may not connect. Shallow Monitoring Wells (SMW) 4, 5, and 6 produce out of this zone. This bed has also been referred to as "Ciniza Sand" in earlier reports.

Shales and sandy shales of the Chinle formation lie below the valley fill materials. Approximately, thirty (30) to fifty (50) feet of shale lies between the valley fill and the Sonsela Sandstone bed that lies within the Chinle Formation. The sandstone is on the order of ten (10) to thirty (30) feet in thickness. The Sonsela Sandstone is water bearing at the refinery site and as stated earlier meets the definition of a potential aquifer.

The lower boundary of the Sonsela Sandstone is the extent of the modeling on this site. It is known from deep well logs that the Chinle Formation is on the order of seven hundred fifty (750) feet in thickness where deeper, established aquifers are encountered.

SUMMARY

To summarize the current model of the stratigraphic section below the Land Treatment Area, a typical section through the area would be as follows:

The upper ten (10) feet of the site would be comprised of a dense dry to damp clay of high plasticity overlying two sequences of channel sands and silts separated by a clay zone on the order of five (5) to ten (10) feet in thickness. The channel sands would be expected to be on the order of ten (10) to fifteen (15) feet in thickness each. The channel sands are actually interbedded sands, silts, and clays. Below the thirty (30) foot depth in the southern part of the LTA the sandy zone is water bearing. In the northern part the zones are not water bearing. A fifteen (15) to twenty (20) foot thick section of clay is encountered next. The clay is hard, highly plastic, not water bearing, and may show shrinkage cracking structure. Below this, a thin water bearing sand, gravel, or, sandy gravel composed of aggregates of mixed sources is encountered next and represents alluviation from the higher areas to the south into the valley. Below is generally unweathered shale for thirty (30) feet. The top of the shale should be encountered at an average of sixty (60) feet below the surface but may be as shallow as fifty (50) feet to the south and as deep as seventy (70) feet to the north. The water bearing Sonsela Sandstone is then encountered and should be from ten (10) to thirty (30) feet in thickness.

Attachment I-2

EPA's *Human Health Media-Specific Screening Levels*

EPA REGION 6- HUMAN HEALTH MEDIUM-SPECIFIC SCREENING LEVELS

Basis: C=carcinogenic effects
N=non-carcinogenic effects
sat= soil saturation concentration
max= maximum concentration

Contaminant	CAS No.	MCL or Action Level	Risk-Based Screening Levels										Soil Screening Level- Transfers from Soil to: Ground water (DAF=1)
			Soil (ingestion, inhalation, with and without dermal exposure routes)						Ambient Air (Residential Scenario)		Tap Water (Residential Scenario: Ingestion & Inhalation)		
			Residential		Residential w/o dermal		Industrial		Industrial w/o dermal				
		ug/l	mg/kg		mg/kg		mg/kg		mg/kg		ug/m3		ug/l		mg/kg
Acetaldehyde	75-07-0		9.3E+00	C	9.7E+00	C	2.1E+01	C	2.3E+01	C	8.7E-01	C	1.5E+00	C	
Acetochlor	34256-82-1		1.2E+03	N	1.6E+03	N	1.2E+04	N	4.1E+04	N	7.3E+01	N	7.3E+02	N	
Acetone	67-64-1		1.5E+03	N	1.6E+03	N	5.8E+03	N	6.2E+03	N	3.7E+02	N	6.1E+02	N	8.0E-01
Acetonitrile	75-05-8		6.2E+02	N	6.2E+02	N	2.0E+03	N	2.0E+03	N	6.2E+01	N			
Acetophenone	98-86-2		5.0E-01	N	5.0E-01	N	1.6E+00	N	1.6E+00	N	2.1E-02	N	4.2E-02	N	
Acrolein	107-02-8		1.0E-01	N	1.0E-01	N	3.4E-01	N	3.4E-01	N	2.1E-02	N	4.2E-02	N	
Acrylamide	79-06-1		1.1E-01	C	1.4E-01	C	3.8E-01	C	1.3E+00	C	1.5E-03	C	1.5E-02	C	
Acrylic acid	79-10-7		2.9E+04	N	3.7E+04	N	1.0E+05	max	1.0E+05	max	1.0E+00	N	1.8E+04	N	
Acrylonitrile	107-13-1		2.0E-01	C	2.1E-01	C	4.6E-01	C	5.2E-01	C	2.8E-02	C	3.9E-02	C	
Alachlor	15972-60-8	2.0E+00	6.0E+00	C	8.0E+00	C	2.2E+01	C	7.1E+01	C	8.4E-02	C	8.4E-01	C	
Alar	1596-84-5		9.1E+03	N	1.2E+04	N	9.3E+04	N	1.0E+05	max	5.5E+02	N	5.5E+03	N	
Aldicarb	116-06-3	7.0E+00	6.1E+01	N	7.8E+01	N	6.2E+02	N	2.0E+03	N	3.7E+00	N	3.7E+01	N	
Aldicarb sulfone	1646-88-4	7.0E+00	6.1E+01	N	7.8E+01	N	6.2E+02	N	2.0E+03	N	3.7E+00	N	3.7E+01	N	
Aldrin	309-00-2		2.8E-02	C	3.8E-02	C	1.0E-01	C	3.4E-01	C	3.9E-04	C	4.0E-03	C	5.9E+02
Allyl chloride	107-05-1		3.0E+03	N	3.9E+03	N	3.1E+04	N	9.7E+04	N	1.0E+00	N	1.8E+03	N	
Aluminum	7429-90-5		7.8E+04	N	7.8E+04	N	1.0E+05	max	1.0E+05	max			3.7E+04	N	
Amdro	67485-29-4		1.8E+01	N	2.3E+01	N	1.9E+02	N	6.1E+02	N	1.1E+00	N	1.1E+01	N	
4-Aminopyridine	504-24-5		1.2E+00	N	1.6E+00	N	1.2E+01	N	4.1E+01	N	7.3E-02	N	7.3E-01	N	
Ammonia	7664-41-7										1.0E+02	N			
Aniline	62-53-3		8.5E+01	C	1.1E+02	C	3.1E+02	C	1.0E+03	C	1.0E+00	N	1.2E+01	C	
Antimony and compounds	7440-36-0	6.0E+00	3.1E+01	N	3.1E+01	N	8.2E+02	N	8.2E+02	N			1.5E+01	N	3.0E-01
Antimony pentoxide	1314-60-9		3.9E+01	N	3.9E+01	N	1.0E+03	N	1.0E+03	N			1.8E+01	N	
Antimony tetroxide	1332-81-6		3.1E+01	N	3.1E+01	N	8.2E+02	N	8.2E+02	N			1.5E+01	N	
Antimony trioxide	1309-64-4		3.1E+01	N	3.1E+01	N	8.2E+02	N	8.2E+02	N			1.5E+01	N	
Arsenic (noncancer endpoint)	7440-38-2	5.0E+01	2.2E+01	N	2.3E+01	N	3.6E+02	N	6.1E+02	N					
Arsenic (cancer endpoint)	7440-38-2		3.9E-01	C	4.3E-01	C	2.3E+00	C	3.8E+00	C	4.5E-04	C	4.5E-02	C	1.0E+00

EPA REGION 6- HUMAN HEALTH MEDIUM-SPECIFIC SCREENING LEVELS

Basis: C=carcinogenic effects
N=non-carcinogenic effects
sat= soil saturation concentration
max= maximum concentration

Contaminant	CAS No.	MCL or Action Level	Risk-Based Screening Levels										Soil Screening Level- Transfers from Soil to: Ground water (DAF=1)
			Soil (ingestion, inhalation, with and without dermal exposure routes)				Ambient Air (Residential Scenario)		Tap Water (Residential Scenario: Ingestion & Inhalation)				
			Residential		Residential w/o dermal		Industrial		Industrial w/o dermal				
		ug/l	mg/kg		mg/kg		mg/kg		mg/kg		ug/m3		ug/l		mg/kg
Arsine	7784-42-1										5.2E-02	N			
Assure	76578-12-6		5.5E+02	N	7.0E+02	N	5.6E+03	N	1.8E+04	N	3.3E+01	N	3.3E+02	N	
Atrazine	1912-24-9	3.0E+00	2.2E+00	C	2.9E+00	C	7.9E+00	C	2.6E+01	C	3.1E-02	C	3.0E-01	C	
Azobenzene	103-33-3		4.4E+00	C	5.8E+00	C	1.6E+01	C	5.2E+01	C	6.2E-02	C	6.1E-01	C	
Barium and compounds	7440-39-3	2.0E+03	5.4E+03	N	5.4E+03	N	1.0E+05	max	1.0E+05	max	5.2E-01	N	2.6E+03	N	8.2E+01
Baygon	114-26-1		2.4E+02	N	3.1E+02	N	2.5E+03	N	8.2E+03	N	1.5E+01	N	1.5E+02	N	
Baythroid	68359-37-5		1.5E+03	N	2.0E+03	N	1.6E+04	N	5.1E+04	N	9.1E+01	N	9.1E+02	N	
Bentazon	25057-89-0		1.8E+03	N	2.3E+03	N	1.9E+04	N	6.1E+04	N	1.1E+02	N	1.1E+03	N	
Benzaldehyde	100-52-7		6.1E+03	N	7.8E+03	N	6.2E+04	N	1.0E+05	max	3.7E+02	N	3.7E+03	N	
Benzene	71-43-2	5.0E+00	6.7E-01	C	6.8E-01	C	1.4E+00	C	1.5E+00	C	2.5E-01	C	4.2E-01	C	2.0E-03
Benzidine	92-87-5		2.1E-03	C	2.8E-03	C	7.6E-03	C	2.5E-02	C	2.9E-05	C	2.9E-04	C	
Benzoic acid	65-85-0		1.0E+05	max	1.0E+05	max	1.0E+05	max	1.0E+05	max	1.5E+04	N	1.5E+05	N	2.0E+01
Benzyl alcohol	100-51-6		1.8E+04	N	2.3E+04	N	1.0E+05	max	1.0E+05	max	1.1E+03	N	1.1E+04	N	
Benzyl chloride	100-44-7		8.3E-01	C	8.9E-01	C	2.0E+00	C	2.3E+00	C	4.0E-02	C	6.6E-02	C	
Beryllium and compounds	7440-41-7	4.0E+00	1.5E+02	N	1.5E+02	N	2.2E+03	C	2.2E+03	C	8.0E-04	C	7.3E+01	N	3.0E+00
1,1-Biphenyl	92-52-4		2.5E+03	N	3.0E+03	N	1.8E+04	N	3.0E+04	N	1.8E+02	N	3.0E+02	N	
Bis(2-chloroethyl)ether	111-44-4		1.9E-01	C	2.1E-01	C	4.9E-01	C	6.2E-01	C	5.8E-03	C	9.8E-03	C	2.0E-05
Bis(2-chloroisopropyl)ether	39638-32-9		2.6E+00	C	2.9E+00	C	6.6E+00	C	8.1E+00	C	1.9E-01	C	2.7E-01	C	
Bis(chloromethyl)ether	542-88-1		1.9E-04	C	1.9E-04	C	4.2E-04	C	4.4E-04	C	3.1E-05	C	5.2E-05	C	
Bis(2-ethylhexyl)phthalate (DEHP)	117-81-7	6.0E+00	3.5E+01	C	4.6E+01	C	1.2E+02	C	4.1E+02	C	4.8E-01	C	4.8E+00	C	
Boron	7440-42-8		5.5E+03	N	7.0E+03	N	5.6E+04	N	1.0E+05	max	2.1E+01	N	3.3E+03	N	
Boron trifluoride	7637-07-2		1.0E+05	max	1.0E+05	max	1.0E+05	max	1.0E+05	max	7.3E-01	N			
Bromobenzene	108-86-1		2.8E+01	N	2.8E+01	N	9.2E+01	N	9.3E+01	N	1.0E+01	N	2.0E+01	N	
Bromodichloromethane	75-27-4		9.9E-01	C	1.0E+00	C	2.2E+00	C	2.4E+00	C	1.1E-01	C	1.8E-01	C	3.0E-02
Bromoform	75-25-2		6.1E+01	C	8.1E+01	C	2.2E+02	C	7.2E+02	C	1.7E+00	C	8.5E+00	C	4.0E-02

E. A REGION 6- HUMAN HEALTH MEDIUM-SPECIFIC SCREENING LEVELS

Basis: C=carcinogenic effects
N=non-carcinogenic effects
sat= soil saturation concentration
max= maximum concentration

Contaminant	CAS No.	MCL or Action Level	Risk-Based Screening Levels												Soil Screening Level- Transfers from Soil to: Ground water (DAF=1)
			Soil (ingestion, inhalation, with and without dermal exposure routes)								Ambient Air (Residential Scenario)		Tap Water (Residential Scenario: Ingestion & Inhalation)		
			Residential		Residential w/o dermal		Industrial		Industrial w/o dermal						
		ug/l	mg/kg		mg/kg		mg/kg		mg/kg		ug/m3		ug/l		mg/kg
(tribromomethane)															
Bromomethane	74-83-9		3.9E+00	N	3.9E+00	N	1.3E+01	N	1.3E+01	N	5.2E+00	N	8.7E+00	N	1.0E-02
Bromophos	2104-96-3		3.0E+02	N	3.9E+02	N	3.1E+03	N	1.0E+04	N	1.8E+01	N	1.8E+02	N	
Bromoxynil	1689-84-5		1.2E+03	N	1.6E+03	N	1.2E+04	N	4.1E+04	N	7.3E+01	N	7.3E+02	N	
1,3-Butadiene	106-99-0		6.5E-03	C	6.5E-03	C	1.4E-02	C	1.4E-02	C	6.9E-03	C	1.1E-02	C	
1-Butanol	71-36-3		6.1E+03	N	7.8E+03	N	6.2E+04	N	1.0E+05	max	3.7E+02	N	3.7E+03	N	9.0E-01
Butylate	2008-41-5		3.0E+03	N	3.9E+03	N	3.1E+04	N	1.0E+05	max	1.8E+02	N	1.8E+03	N	
n-Butylbenzene	104-51-8		1.4E+02	N	1.4E+02	N	2.4E+02	sat	2.4E+02	sat	3.7E+01	N	6.1E+01	N	
sec-Butylbenzene	135-9-88		1.1E+02	N	1.1E+02	N	2.2E+02	sat	2.2E+02	sat	3.7E+01	N	6.1E+01	N	
tert-Butylbenzene	104-5-18		1.3E+02	N	1.3E+02	N	3.9E+02	sat	3.9E+02	sat	3.7E+01	N	6.1E+01	N	
Butyl benzyl phthalate	85-68-7		2.4E+02	sat	2.4E+02	sat	2.4E+02	sat	2.4E+02	sat	7.3E+02	N	7.3E+03	N	8.1E+02
Cadmium and compounds	7440-43-9	5.0E+00	3.9E+01	N	3.9E+01	N	1.0E+03	N	1.0E+03	N	1.1E-03	C	1.8E+01	N	4.0E-01
Caprolactam	105-60-2		3.0E+04	N	3.9E+04	N	1.0E+05	max	1.0E+05	max	1.8E+03	N	1.8E+04	N	
Captan	133-06-2		1.4E+02	C	1.8E+02	C	5.0E+02	C	1.6E+03	C	1.9E+00	C	1.9E+01	C	
Carbaryl	63-25-2		6.1E+03	N	7.8E+03	N	6.2E+04	N	1.0E+05	max	4.0E+02	N	3.7E+03	N	
Carbazole	86-74-8		2.4E+01	C	3.2E+01	C	8.7E+01	C	2.9E+02	C	3.4E-01	C	3.4E+00	C	3.0E-02
Carbofuran	1563-66-2	4.0E+01	3.0E+02	N	3.9E+02	N	3.1E+03	N	1.0E+04	N	1.8E+01	N	1.8E+02	N	
Carbon disulfide	75-15-0		3.5E+02	N	3.6E+02	N	7.2E+02	sat	7.2E+02	sat	7.3E+02	N	1.0E+03	N	2.0E+00
Carbon tetrachloride	56-23-5	5.0E+00	2.4E-01	C	2.4E-01	C	5.2E-01	C	5.3E-01	C	1.3E-01	C	1.7E-01	C	3.0E-03
Carbosulfan	55285-14-8		6.1E+02	N	7.8E+02	N	6.2E+03	N	2.0E+04	N	3.7E+01	N	3.7E+02	N	
Chloral	302-17-0		1.2E+02	N	1.6E+02	N	1.2E+03	N	4.1E+03	N	7.3E+00	N	7.3E+01	N	
Chloranil	118-75-2		1.2E+00	C	1.6E+00	C	4.3E+00	C	1.4E+01	C	1.7E-02	C	1.7E-01	C	
Chlordane	57-74-9	2.0E+00	1.6E+00	C	1.8E+00	C	8.6E+00	C	1.6E+01	C	1.9E-02	C	1.9E-01	C	5.0E-01
Chlorine	7782-50-5		7.8E+03	N	7.8E+03	N	1.0E+05	max	1.0E+05	max			3.7E+03	N	
Chlorine dioxide	10049-04-4										2.1E-01	N			
Chloroacetic acid	79-11-8		1.2E+02	N	1.6E+02	N	1.2E+03	N	4.1E+03	N	7.3E+00	N	7.3E+01	N	
4-Chloroaniline	106-47-8		2.4E+02	N	3.1E+02	N	2.5E+03	N	8.2E+03	N	1.5E+01	N	1.5E+02	N	3.0E-02

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Contaminant	CAS No.	MCL or Action Level	Risk-Based Screening Levels												Soil Screening Level- Transfers from Soil to: Ground water (DAF=1)
			Soil (ingestion, inhalation, with and without dermal exposure routes)								Ambient Air (Residential Scenario)		Tap Water (Residential Scenario: Ingestion & Inhalation)		
			Residential		Residential w/o dermal		Industrial		Industrial w/o dermal						
		ug/l	mg/kg		mg/kg		mg/kg		mg/kg		ug/m3		ug/l		mg/kg
Chlorobenzene	108-90-7		5.4E+01	N	5.5E+01	N	1.8E+02	N	1.8E+02	N	2.1E+01	N	3.9E+01	N	7.0E-02
Chlorobenzilate	510-15-6		1.8E+00	C	2.4E+00	C	6.5E+00	C	2.1E+01	C	2.5E-02	C	2.5E-01	C	
p-Chlorobenzoic acid	74-11-3		1.2E+04	N	1.6E+04	N	1.0E+05	max	1.0E+05	max	7.3E+02	N	7.3E+03	N	
4-Chlorobenzotrifluoride	98-56-6		1.2E+03	N	1.6E+03	N	1.2E+04	N	4.1E+04	N	7.3E+01	N	7.3E+02	N	
2-Chloro-1,3-butadiene	126-99-8		3.6E+00	N	3.6E+00	N	1.2E+01	N	1.2E+01	N	7.3E+00	N	1.4E+01	N	
1-Chlorobutane	109-69-3		4.8E+02	sat	4.8E+02	sat	4.8E+02	sat	4.8E+02	sat	1.5E+03	N	2.4E+03	N	
1-Chloro-1,1-difluoroethane	75-68-3		3.4E+02	sat	3.4E+02	sat	3.4E+02	sat	3.4E+02	sat	5.2E+04	N	8.7E+04	N	
Chlorodifluoromethane	75-45-6		3.4E+02	sat	3.4E+02	sat	3.4E+02	sat	3.4E+02	sat	5.1E+04	N	8.5E+04	N	
2-Chloroethyl vinyl ether	110-75-8														
Chloroform	67-66-3		2.4E-01	C	2.4E-01	C	5.2E-01	C	5.2E-01	C	8.4E-02	C	1.6E-01	C	3.0E-02
Chloromethane	74-87-3		1.2E+00	C	1.2E+00	C	2.6E+00	C	2.7E+00	C	1.1E+00	C	1.5E+00	C	
4-Chloro-2-methylaniline	95-69-2		8.3E-01	C	1.1E+00	C	3.0E+00	C	9.9E+00	C	1.2E-02	C	1.2E-01	C	
beta-Chloronaphthalene	91-58-7		3.3E+03	N	3.9E+03	N	2.0E+04	N	2.7E+04	N	2.9E+02	N	4.9E+02	N	
o-Chloronitrobenzene	88-73-3		1.3E+01	C	1.5E+01	C	3.7E+01	C	5.9E+01	C	2.7E-01	C	4.5E-01	C	
p-Chloronitrobenzene	100-00-5		1.7E+01	C	2.0E+01	C	4.9E+01	C	7.6E+01	C	3.7E-01	C	6.2E-01	C	
2-Chlorophenol	95-57-8		6.1E+01	N	6.4E+01	N	2.3E+02	N	2.4E+02	N	1.8E+01	N	3.0E+01	N	2.0E-01
2-Chloropropane	75-29-6		1.7E+02	N	1.7E+02	N	5.8E+02	N	6.0E+02	N	1.0E+02	N	1.7E+02	N	
o-Chlorotoluene	95-49-8		1.5E+02	N	1.6E+02	N	5.1E+02	sat	5.1E+02	sat	7.3E+01	N	1.2E+02	N	
Chlorpyrifos	2921-88-2		1.8E+02	N	2.3E+02	N	1.9E+03	N	6.1E+03	N	1.1E+01	N	1.1E+02	N	
Chlorpyrifos-methyl	5598-13-0		6.1E+02	N	7.8E+02	N	6.2E+03	N	2.0E+04	N	3.7E+01	N	3.7E+02	N	
Chromium III	16065-83-1	1.0E+02	1.0E+05	max	1.0E+05	max	1.0E+05	max	1.0E+05	max			5.5E+04	N	
Total Chromium (1/6 ratio Cr VI/Cr III)	18540-29-9	1.0E+02	2.1E+02	C	2.1E+02	C	4.5E+02	C	4.5E+02	C	1.6E-04	C			2.0E+00
Chromium VI	7440-47-3	1.0E+02	3.0E+01	C	3.0E+01	C	6.4E+01	C	6.4E+01	C	2.3E-05	C	1.8E+02	N	2.0E+00
Cobalt	7440-48-4		3.4E+03	N	3.4E+03	N	2.9E+04	N	2.9E+04	N	2.1E-02	N	2.2E+03	N	
Coke Oven Emissions	8007-45-2				4.1E+03	C			8.7E+03	C	3.1E-03	C			

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Contaminant	CAS No.	MCL or Action Level	Risk-Based Screening Levels										Soil Screening Level- Transfers from Soil to: Ground water (DAF=1)
			Soil (ingestion, inhalation, with and without dermal exposure routes)						Ambient Air (Residential Scenario)		Tap Water (Residential Scenario: Ingestion & Inhalation)		
			Residential		Residential w/o dermal		Industrial		Industrial w/o dermal				
		ug/l	mg/kg		mg/kg		mg/kg		mg/kg		ug/m3		ug/l		mg/kg
Copper and compounds	7440-50-8	1.3E+03	2.9E+03	N	2.9E+03	N	7.6E+04	N	7.6E+04	N			1.4E+03	N	
Crotonaldehyde	123-73-9		5.3E-03	C	5.3E-03	C	1.1E-02	C	1.1E-02	C	3.5E-03	C	5.9E-03	C	
Cumene (isopropylbenzene)	98-82-8		1.6E+02	N	1.6E+02	N	5.2E+02	N	5.2E+02	N	4.0E+02	N	6.6E+02	N	
Cyanazine	21725-46-2		5.8E-01	C	7.6E-01	C	2.1E+00	C	6.8E+00	C	8.0E-03	C	8.0E-02	C	
Cyanides	n/a														
Barium cyanide	542-62-1		6.1E+03	N	7.8E+03	N	6.2E+04	N	1.0E+05	max			3.7E+03	N	
Calcium cyanide	592-01-8		2.4E+03	N	3.1E+03	N	2.5E+04	N	8.2E+04	N			1.5E+03	N	
Copper cyanide	544-92-3		3.0E+02	N	3.9E+02	N	3.1E+03	N	1.0E+04	N			1.8E+02	N	
Cyanogen	460-19-5		2.4E+03	N	3.1E+03	N	2.5E+04	N	8.2E+04	N					
Cyanogen bromide	506-68-3		5.5E+03	N	7.0E+03	N	5.6E+04	N	1.0E+05	max			3.3E+03	N	
Cyanogen chloride	506-77-4		3.0E+03	N	3.9E+03	N	3.1E+04	N	1.0E+05	max			1.8E+03	N	
Free cyanide	57-12-5	2.0E+02	1.2E+03	N	1.6E+03	N	1.2E+04	N	4.1E+04	N			7.3E+02	N	2.0E+00
Hydrogen cyanide	74-90-8		1.1E+01	N	1.1E+01	N	3.5E+01	N	3.5E+01	N	3.1E+00	N	6.2E+00	N	
Potassium cyanide	151-50-8		3.0E+03	N	3.9E+03	N	3.1E+04	N	1.0E+05	max			1.8E+03	N	
Potassium silver cyanide	506-61-6		1.2E+04	N	1.6E+04	N	1.0E+05	max	1.0E+05	max			7.3E+03	N	
Silver cyanide	506-64-9		6.1E+03	N	7.8E+03	N	6.2E+04	N	1.0E+05	max			3.7E+03	N	
Sodium cyanide	143-33-9		2.4E+03	N	3.1E+03	N	2.5E+04	N	8.2E+04	N			1.5E+03	N	
Zinc cyanide	557-21-1		3.0E+03	N	3.9E+03	N	3.1E+04	N	1.0E+05	max			1.8E+03	N	
Cyclohexanone	108-94-1		1.0E+05	max	1.0E+05	max	1.0E+05	max	1.0E+05	max	1.8E+04	N	1.8E+05	N	
Cyhalothrin/Karate	68085-85-8		3.0E+02	N	3.9E+02	N	3.1E+03	N	1.0E+04	N	1.8E+01	N	1.8E+02	N	
Cypermethrin	52315-07-8		6.1E+02	N	7.8E+02	N	6.2E+03	N	2.0E+04	N	3.7E+01	N	3.7E+02	N	
Dacthal	1861-32-1		6.1E+02	N	7.8E+02	N	6.2E+03	N	2.0E+04	N	3.7E+01	N	3.7E+02	N	
Dalapon	75-99-0	2.0E+02	1.8E+03	N	2.3E+03	N	1.9E+04	N	6.1E+04	N	1.1E+02	N	1.1E+03	N	
DDD	72-54-8		2.4E+00	C	2.7E+00	C	1.4E+01	C	2.4E+01	C	2.8E-02	C	2.8E-01	C	8.0E-01
DDE	72-55-9		1.7E+00	C	1.9E+00	C	1.0E+01	C	1.7E+01	C	2.0E-02	C	2.0E-01	C	3.0E+00
DDT	50-29-3		1.7E+00	C	1.9E+00	C	1.0E+01	C	1.7E+01	C	2.0E-02	C	2.0E-01	C	2.0E+00

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Contaminant	CAS No.	MCL or Action Level	Risk-Based Screening Levels										Soil Screening Level- Transfers from Soil to: Ground water (DAF=1)
			Soil (ingestion, inhalation, with and without dermal exposure routes)						Ambient Air (Residential Scenario)		Tap Water (Residential Scenario: Ingestion & Inhalation)		
			Residential		Residential w/o dermal		Industrial		Industrial w/o dermal				
		ug/l	mg/kg		mg/kg		mg/kg		mg/kg		ug/m3		ug/l		mg/kg
Diazinon	333-41-5		5.5E+01	N	7.0E+01	N	5.6E+02	N	1.8E+03	N	3.3E+00	N	3.3E+01	N	
Dibenzofuran	132-64-9		2.3E+02	N	2.9E+02	N	2.1E+03	N	5.1E+03	N	1.5E+01	N	2.4E+01	N	
1,4-Dibromobenzene	106-37-6		6.1E+02	N	7.8E+02	N	6.2E+03	N	2.0E+04	N	3.7E+01	N	3.7E+02	N	
Dibromochloromethane	124-48-1		9.7E-01	C	1.0E+00	C	2.2E+00	C	2.4E+00	C	8.0E-02	C	1.3E-01	C	2.0E-02
1,2-Dibromo-3-chloropropane	96-12-8		3.4E-01	C	4.5E-01	C	1.2E+00	C	4.0E+00	C	2.1E-01	N	4.8E-02	C	
1,2-Dibromoethane	106-93-4		5.3E-03	C	6.9E-03	C	1.8E-02	C	4.8E-02	C	8.7E-03	C	7.6E-04	C	
Dibutyl phthalate	84-74-2		6.1E+03	N	7.8E+03	N	6.2E+04	N	1.0E+05	max	3.7E+02	N	3.7E+03	N	2.7E+02
Dicamba	1918-00-9		1.8E+03	N	2.3E+03	N	1.9E+04	N	6.1E+04	N	1.1E+02	N	1.1E+03	N	
1,2-Dichlorobenzene	95-50-1		3.7E+02	sat	3.7E+02	sat	3.7E+02	sat	3.7E+02	sat	2.1E+02	N	3.7E+02	N	9.0E-01
1,3-Dichlorobenzene	541-73-1	6.0E+02	4.1E+01	N	4.1E+01	N	1.4E+02	N	1.4E+02	N	8.4E+00	N	1.7E+01	N	
1,4-Dichlorobenzene	106-46-7	7.5E+01	3.1E+00	C	3.2E+00	C	7.0E+00	C	7.5E+00	C	2.8E-01	C	4.7E-01	C	1.0E-01
3,3-Dichlorobenzidine	91-94-1		1.1E+00	C	1.4E+00	C	3.9E+00	C	1.3E+01	C	1.5E-02	C	1.5E-01	C	3.0E-04
1,4-Dichloro-2-butene	764-41-0		7.6E-03	C	7.9E-03	C	1.7E-02	C	1.8E-02	C	7.2E-04	C	1.2E-03	C	
Dichlorodifluoromethane	75-71-8		9.4E+01	N	9.4E+01	N	3.1E+02	N	3.1E+02	N	2.1E+02	N	3.9E+02	N	
1,1-Dichloroethane	75-34-3		5.8E+02	N	5.9E+02	N	2.0E+03	N	2.1E+03	N	5.2E+02	N	8.1E+02	N	1.0E+00
1,2-Dichloroethane (EDC)	107-06-2	5.0E+00	3.4E-01	C	3.5E-01	C	7.5E-01	C	7.7E-01	C	7.4E-02	C	1.2E-01	C	1.0E-03
1,1-Dichloroethylene	75-35-4	7.0E+00	5.3E-02	C	5.4E-02	C	1.2E-01	C	1.2E-01	C	3.8E-02	C	4.6E-02	C	3.0E-03
1,2-Dichloroethylene (cis)	156-59-2	7.0E+01	4.2E+01	N	4.3E+01	N	1.5E+02	N	1.5E+02	N	3.7E+01	N	6.1E+01	N	2.0E-02
1,2-Dichloroethylene (trans)	156-60-5	1.0E+02	6.3E+01	N	6.3E+01	N	2.1E+02	N	2.1E+02	N	7.3E+01	N	1.2E+02	N	3.0E-02
2,4-Dichlorophenol	120-83-2		1.8E+02	N	2.3E+02	N	1.9E+03	N	6.1E+03	N	1.1E+01	N	1.1E+02	N	5.0E-02
4-(2,4-Dichlorophenoxy)butyric Acid (2,4-DB)	94-82-6	7.0E+01	4.9E+02	N	6.3E+02	N	5.0E+03	N	1.6E+04	N	2.9E+01	N	2.9E+02	N	
2,4-Dichlorophenoxyacetic Acid (2,4-D)	94-75-7		6.8E+02	N	7.8E+02	N	9.6E+03	N	2.0E+04	N	3.7E+01	N	3.7E+02	N	

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			Soil (ingestion, inhalation, with and without dermal exposure routes)								Ambient Air (Residential Scenario)		Tap Water (Residential Scenario: Ingestion & Inhalation)		
			Residential		Residential w/o dermal		Industrial		Industrial w/o dermal						
		ug/l	mg/kg		mg/kg		mg/kg		mg/kg		ug/m3		ug/l		mg/kg
1,2-Dichloropropane	78-87-5	5.0E+00	3.5E-01	C	3.5E-01	C	7.5E-01	C	7.7E-01	C	9.9E-02	C	1.6E-01	C	1.0E-03
1,3-Dichloropropene	542-75-6		8.2E-02	C	8.2E-02	C	1.8E-01	C	1.8E-01	C	5.2E-02	C	8.1E-02	C	2.0E-04
2,3-Dichloropropanol	616-23-9		1.8E+02	N	2.3E+02	N	1.9E+03	N	6.1E+03	N	1.1E+01	N	1.1E+02	N	
Dichlorvos	62-73-7		1.7E+00	C	2.2E+00	C	6.0E+00	C	2.0E+01	C	2.3E-02	C	2.3E-01	C	
Dicofol	115-32-2		1.1E+00	C	1.5E+00	C	4.0E+00	C	1.3E+01	C	1.5E-02	C	1.5E-01	C	
Dicyclopentadiene	77-73-6		5.5E-01	N	5.5E-01	N	1.8E+00	N	1.8E+00	N	2.1E-01	N	4.2E-01	N	
Dieldrin	60-57-1		3.0E-02	C	4.0E-02	C	1.1E-01	C	3.6E-01	C	4.2E-04	C	4.2E-03	C	2.0E-04
Diethylene glycol, monobutyl ether	112-34-5		3.5E+02	N	4.5E+02	N	3.6E+03	N	1.2E+04	N	2.1E+01	N	2.1E+02	N	
Diethylene glycol, monoethyl ether	111-90-0		1.0E+05	max	1.0E+05	max	1.0E+05	max	1.0E+05	max	7.3E+03	N	7.3E+04	N	
Di(2-ethylhexyl)adipate	103-23-1	4.0E+02	4.0E+02	C	5.3E+02	C	1.5E+03	C	4.8E+03	C	5.6E+00	C	5.6E+01	C	
Diethyl phthalate	84-66-2		4.9E+04	N	6.3E+04	N	1.0E+05	max	1.0E+05	max	2.9E+03	N	2.9E+04	N	
Diethylstilbestrol	56-53-1		1.0E-04	C	1.4E-04	C	3.7E-04	C	1.2E-03	C	1.4E-06	C	1.4E-05	C	
Difenzoquat (Avenge)	43222-48-6		4.9E+03	N	6.3E+03	N	5.0E+04	N	1.0E+05	max	2.9E+02	N	2.9E+03	N	
1,1-Difluoroethane	75-37-6		1.0E+05	max	1.0E+05	max	1.0E+05	max	1.0E+05	max	4.2E+04	N	6.9E+04	N	
Diisopropyl methylphosphonate	1445-75-6		4.9E+03	N	6.3E+03	N	5.0E+04	N	1.0E+05	max	2.9E+02	N	2.9E+03	N	
3,3'-Dimethoxybenzidine	119-90-4		3.5E+01	C	4.6E+01	C	1.2E+02	C	4.1E+02	C	4.8E-01	C	4.8E+00	C	
Dimethylamine	124-40-3		6.4E-02	N	6.7E-02	N	2.4E-01	N	2.5E-01	N	2.1E-02	N	3.5E-02	N	
N-N-Dimethylaniline	121-69-7		1.2E+02	N	1.6E+02	N	1.2E+03	N	4.1E+03	N	7.3E+00	N	7.3E+01	N	
2,4-Dimethylaniline	95-68-1		6.4E-01	C	8.5E-01	C	2.3E+00	C	7.6E+00	C	9.0E-03	C	9.0E-02	C	
2,4-Dimethylaniline hydrochloride	21436-96-4		8.3E-01	C	1.1E+00	C	3.0E+00	C	9.9E+00	C	1.2E-02	C	1.2E-01	C	
3,3'-Dimethylbenzidine	119-93-7		5.3E-02	C	7.0E-02	C	1.9E-01	C	6.2E-01	C	7.3E-04	C	7.3E-03	C	
1,1-Dimethylhydrazine	57-14-7		1.9E-01	C	2.5E-01	C	6.7E-01	C	2.2E+00	C	1.9E-03	C	2.6E-02	C	
1,2-Dimethylhydrazine	540-73-8		1.3E-02	C	1.7E-02	C	4.7E-02	C	1.5E-01	C	1.8E-04	C	1.8E-03	C	

EPA REGION 6- HUMAN HEALTH MEDIUM-SPECIFIC SCREENING LEVELS

Basis: C=carcinogenic effects
N=non-carcinogenic effects
sat= soil saturation concentration
max= maximum concentration

Contaminant	CAS No.	MCL or Action Level	Risk-Based Screening Levels												Soil Screening Level- Transfers from Soil to: Ground water (DAF=1)
			Soil (ingestion, inhalation, with and without dermal exposure routes)								Ambient Air (Residential Scenario)		Tap Water (Residential Scenario: Ingestion & Inhalation)		
			Residential		Residential w/o dermal		Industrial		Industrial w/o dermal						
		ug/l	mg/kg		mg/kg		mg/kg		mg/kg		ug/m3		ug/l		mg/kg
Dimethylphenethylamine	122-09-8		6.1E+01	N	7.8E+01	N	6.2E+02	N	2.0E+03	N	3.7E+00	N	3.7E+01	N	
2,4-Dimethylphenol	105-67-9		1.2E+03	N	1.6E+03	N	1.2E+04	N	4.1E+04	N	7.3E+01	N	7.3E+02	N	4.0E-01
2,6-Dimethylphenol	576-26-1		3.6E+01	N	4.7E+01	N	3.7E+02	N	1.2E+03	N	2.2E+00	N	2.2E+01	N	
3,4-Dimethylphenol	95-65-8		6.1E+01	N	7.8E+01	N	6.2E+02	N	2.0E+03	N	3.7E+00	N	3.7E+01	N	
Dimethyl phthalate	131-11-3		1.0E+05	max	1.0E+05	max	1.0E+05	max	1.0E+05	max	3.7E+04	N	3.7E+05	N	
4,6-Dinitro-o-cyclohexyl phenol	131-89-5		1.2E+02	N	1.6E+02	N	1.2E+03	N	4.1E+03	N	7.3E+00	N	7.3E+01	N	
1,2-Dinitrobenzene	528-29-0		2.4E+01	N	3.1E+01	N	2.5E+02	N	8.2E+02	N	1.5E+00	N	1.5E+01	N	
1,3-Dinitrobenzene	99-65-0		6.1E+00	N	7.8E+00	N	6.2E+01	N	2.0E+02	N	3.7E-01	N	3.7E+00	N	
1,4-Dinitrobenzene	100-25-4		2.4E+01	N	3.1E+01	N	2.5E+02	N	8.2E+02	N	1.5E+00	N	1.5E+01	N	
2,4-Dinitrophenol	51-28-5		1.2E+02	N	1.6E+02	N	1.2E+03	N	4.1E+03	N	7.3E+00	N	7.3E+01	N	1.0E-02
Dinitrotoluene mixture	25321-14-6		7.1E-01	C	9.4E-01	C	2.6E+00	C	8.4E+00	C	9.9E-03	C	9.9E-02	C	4.0E-05
2,4-Dinitrotoluene	121-14-2		1.2E+02	N	1.6E+02	N	1.2E+03	N	4.1E+03	N	7.3E+00	N	7.3E+01	N	4.0E-05
2,6-Dinitrotoluene	606-20-2		6.1E+01	N	7.8E+01	N	6.2E+02	N	2.0E+03	N	3.7E+00	N	3.7E+01	N	3.0E-05
Dinoseb	88-85-7	7.0E+00	6.1E+01	N	7.8E+01	N	6.2E+02	N	2.0E+03	N	3.7E+00	N	3.7E+01	N	
di-n-Octyl phthalate	117-84-0		1.2E+03	N	1.6E+03	N	1.2E+04	N	4.1E+04	N	7.3E+01	N	7.3E+02	N	1.0E+04
1,4-Dioxane	123-91-1		4.4E+01	C	5.8E+01	C	1.6E+02	C	5.2E+02	C	6.1E-01	C	6.1E+00	C	
Dioxin (2,3,7,8-TCDD)	1746-01-6		3.9E-06	C	4.3E-06	C	2.3E-05	C	3.8E-05	C	4.5E-08	C	4.5E-07	C	
Diphenylamine	122-39-4		1.5E+03	N	2.0E+03	N	1.6E+04	N	5.1E+04	N	9.1E+01	N	9.1E+02	N	
1,2-Diphenylhydrazine	122-66-7		6.0E-01	C	8.0E-01	C	2.2E+00	C	7.2E+00	C	8.7E-03	C	8.4E-02	C	
Diphenyl sulfone	127-63-9		5.5E+02	N	7.0E+02	N	5.6E+03	N	1.8E+04	N	3.3E+01	N	3.3E+02	N	
Diquat	85-00-7	2.0E+01	1.3E+02	N	1.7E+02	N	1.4E+03	N	4.5E+03	N	8.0E+00	N	8.0E+01	N	
Disulfoton	298-04-4		2.4E+00	N	3.1E+00	N	2.5E+01	N	8.2E+01	N	1.5E-01	N	1.5E+00	N	
1,4-Dithiane	505-29-3		6.1E+02	N	7.8E+02	N	6.2E+03	N	2.0E+04	N	3.7E+01	N	3.7E+02	N	
Diuron	330-54-1		1.2E+02	N	1.6E+02	N	1.2E+03	N	4.1E+03	N	7.3E+00	N	7.3E+01	N	
Endosulfan	115-29-7		3.6E+02	N	4.7E+02	N	3.7E+03	N	1.2E+04	N	2.2E+01	N	2.2E+02	N	9.0E-01
Endothall	145-73-3	1.0E+02	1.2E+03	N	1.6E+03	N	1.2E+04	N	4.1E+04	N	7.3E+01	N	7.3E+02	N	

EPA REGION 6- HUMAN HEALTH MEDIUM-SPECIFIC SCREENING LEVELS

Basis: C=carcinogenic effects
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max= maximum concentration

Contaminant	CAS No.	MCL or Action Level	Risk-Based Screening Levels								Soil Screening Level- Transfers from Soil to: Ground water (DAF=1)
			Soil (ingestion, inhalation, with and without dermal exposure routes)						Ambient Air (Residential Scenario)	Tap Water (Residential Scenario: Ingestion & Inhalation)	
			Residential		Residential w/o dermal		Industrial		Industrial w/o dermal		
		ug/l	mg/kg		mg/kg		mg/kg		mg/kg	ug/m3	ug/l	mg/kg
Endrin	72-20-8	2.0E+00	1.8E+01	N	2.3E+01	N	1.9E+02	N	6.1E+02	N	1.1E+00	N	1.1E+01	N	5.0E-02
Epichlorohydrin	106-89-8		7.5E+00	N	7.6E+00	N	2.5E+01	N	2.6E+01	N	1.0E+00	N	2.0E+00	N	
Ethion	563-12-2		3.0E+01	N	3.9E+01	N	3.1E+02	N	1.0E+03	N	1.8E+00	N	1.8E+01	N	
2-Ethoxyethanol	110-80-5		2.4E+04	N	3.1E+04	N	1.0E+05	max	1.0E+05	max	2.1E+02	N	1.5E+04	N	
2-Ethoxyethanol acetate	111-15-9		1.8E+04	N	2.3E+04	N	1.0E+05	max	1.0E+05	max	1.1E+03	N	1.1E+04	N	
Ethyl acetate	141-78-6		1.7E+04	N	1.9E+04	N	3.7E+04	sat	3.7E+04	sat	3.3E+03	N	5.5E+03	N	
Ethylbenzene	100-41-4	7.0E+02	2.3E+02	sat	2.3E+02	sat	2.3E+02	sat	2.3E+02	sat	1.1E+03	N	1.3E+03	N	7.0E-01
Ethyl chloride	75-00-3		1.6E+03	sat	1.6E+03	sat	1.6E+03	sat	1.6E+03	sat	1.0E+04	N	8.6E+03	N	
Ethylene diamine	107-15-3		1.2E+03	N	1.6E+03	N	1.2E+04	N	4.1E+04	N	7.3E+01	N	7.3E+02	N	
Ethylene glycol	107-21-1		1.0E+05	max	1.0E+05	max	1.0E+05	max	1.0E+05	max	7.3E+03	N	7.3E+04	N	
Ethylene glycol, monobutyl ether	111-76-2		3.5E+02	N	4.5E+02	N	3.6E+03	N	1.2E+04	N	2.1E+01	N	2.1E+02	N	
Ethylene oxide	75-21-8		1.3E-01	C	1.4E-01	C	3.1E-01	C	3.6E-01	C	1.9E-02	C	2.4E-02	C	
Ethylene thiourea (ETU)	96-45-7		4.4E+00	C	5.8E+00	C	1.6E+01	C	5.2E+01	C	6.1E-02	C	6.1E-01	C	
Ethyl ether	60-29-7		1.8E+03	sat	1.8E+03	sat	1.8E+03	sat	1.8E+03	sat	7.3E+02	N	1.2E+03	N	
Ethyl methacrylate	97-63-2		1.4E+02	sat	1.4E+02	sat	1.4E+02	sat	1.4E+02	sat	3.3E+02	N	5.5E+02	N	
Fenamiphos	22224-92-6		1.5E+01	N	2.0E+01	N	1.6E+02	N	5.1E+02	N	9.1E-01	N	9.1E+00	N	
Fluometuron	2164-17-2		7.9E+02	N	1.0E+03	N	8.1E+03	N	2.7E+04	N	4.7E+01	N	4.7E+02	N	
Fluoride	16984-48-8		3.6E+03	N	4.7E+03	N	3.7E+04	N	1.0E+05	max			2.2E+03	N	
Fomesafen	72178-02-0		2.5E+00	C	3.4E+00	C	9.2E+00	C	3.0E+01	C	3.5E-02	C	3.5E-01	C	
Fonofos	944-22-9		1.2E+02	N	1.6E+02	N	1.2E+03	N	4.1E+03	N	7.3E+00	N	7.3E+01	N	
Formaldehyde	50-00-0		9.1E+03	N	1.2E+04	N	9.3E+04	N	1.0E+05	max	1.5E-01	C	5.5E+03	N	
Formic Acid	64-18-6		1.0E+05	max	1.0E+05	max	1.0E+05	max	1.0E+05	max	7.3E+03	N	7.3E+04	N	
Furan	110-00-9		2.5E+00	N	2.5E+00	N	8.5E+00	N	8.6E+00	N	3.7E+00	N	6.1E+00	N	
Furazolidone	67-45-8		1.3E-01	C	1.7E-01	C	4.6E-01	C	1.5E+00	C	1.8E-03	C	1.8E-02	C	
Furfural	98-01-1		1.8E+02	N	2.3E+02	N	1.9E+03	N	6.1E+03	N	5.2E+01	N	1.1E+02	N	
Glycidaldehyde	765-34-4		2.4E+01	N	3.1E+01	N	2.5E+02	N	8.2E+02	N	1.0E+00	N	1.5E+01	N	

EPA REGION 6- HUMAN HEALTH MEDIUM-SPECIFIC SCREENING LEVELS

Basis: C=carcinogenic effects
N=non-carcinogenic effects
sat= soil saturation concentration
max= maximum concentration

Contaminant	CAS No.	MCL or Action Level	Risk-Based Screening Levels												Soil Screening Level- Transfers from Soil to: Ground water (DAF=1)
			Soil (ingestion, inhalation, with and without dermal exposure routes)								Ambient Air (Residential Scenario)		Tap Water (Residential Scenario: Ingestion & Inhalation)		
			Residential		Residential w/o dermal		Industrial		Industrial w/o dermal						
		ug/l	mg/kg		mg/kg		mg/kg		mg/kg		ug/m3		ug/l		mg/kg
Glyphosate	1071-83-6	7.0E+02	6.1E+03	N	7.8E+03	N	6.2E+04	N	1.0E+05	max	3.7E+02	N	3.7E+03	N	
Heptachlor	76-44-8	1.0E-01	1.1E-01	C	1.4E-01	C	3.9E-01	C	1.3E+00	C	1.5E-03	C	1.5E-02	C	1.0E+00
Heptachlor epoxide	1024-57-3	2.0E-01	5.3E-02	C	7.0E-02	C	1.9E-01	C	6.3E-01	C	7.4E-04	C	7.4E-03	C	3.0E-02
Hexabromobenzene	87-82-1		1.2E+02	N	1.6E+02	N	1.2E+03	N	4.1E+03	N	7.3E+00	N	7.3E+01	N	
Hexachlorobenzene	118-74-1	1.0E+00	3.0E-01	C	4.0E-01	C	1.1E+00	C	3.6E+00	C	4.2E-03	C	4.2E-02	C	1.0E-01
Hexachlorobutadiene	87-68-3		6.2E+00	C	8.2E+00	C	2.2E+01	C	7.3E+01	C	8.7E-02	C	8.6E-01	C	1.0E-01
HCH (alpha)	319-84-6		9.0E-02	C	1.0E-01	C	4.8E-01	C	9.1E-01	C	1.1E-03	C	1.1E-02	C	3.0E-05
HCH (beta)	319-85-7		3.1E-01	C	3.6E-01	C	1.7E+00	C	3.2E+00	C	3.7E-03	C	3.7E-02	C	1.0E-04
HCH (gamma) Lindane	58-89-9	2.0E-01	4.4E-01	C	4.9E-01	C	2.3E+00	C	4.4E+00	C	5.2E-03	C	5.2E-02	C	5.0E-04
HCH-technical	608-73-1		3.1E-01	C	3.6E-01	C	1.7E+00	C	3.2E+00	C	3.8E-03	C	3.7E-02	C	1.0E-04
Hexachlorocyclo-pentadiene	77-47-4	5.0E+01	4.2E+02	N	5.4E+02	N	4.2E+03	N	1.3E+04	N	7.3E-02	N	2.6E+02	N	2.0E+01
Hexachlorodibenzo-p-dioxin mixture (HxCDD)	19408-74-3		7.8E-05	C	1.0E-04	C	2.8E-04	C	9.2E-04	C	1.5E-06	C	1.1E-05	C	
Hexachloroethane	67-72-1		3.5E+01	C	4.6E+01	C	1.2E+02	C	4.1E+02	C	4.8E-01	C	4.8E+00	C	2.0E-02
Hexachlorophene	70-30-4		1.8E+01	N	2.3E+01	N	1.9E+02	N	6.1E+02	N	1.1E+00	N	1.1E+01	N	
Hexahydro-1,3,5-trinitro-1,3,5-triazine	121-82-4		4.4E+00	C	5.8E+00	C	1.6E+01	C	5.2E+01	C	6.1E-02	C	6.1E-01	C	
1,6-Hexamethylene diisocyanate	822-06-0		1.7E-01	N	2.2E-01	N	1.8E+00	N	5.8E+00	N	1.0E-02	N	1.0E-01	N	
n-Hexane	110-54-3		1.1E+02	sat	1.1E+02	sat	1.1E+02	sat	1.1E+02	sat	2.1E+02	N	3.5E+02	N	
Hexazinone	51235-04-2		2.0E+03	N	2.6E+03	N	2.1E+04	N	6.7E+04	N	1.2E+02	N	1.2E+03	N	
Hydrazine, hydrazine sulfate	302-01-2		1.6E-01	C	2.1E-01	C	5.8E-01	C	1.9E+00	C	3.9E-04	C	2.2E-02	C	
Hydrogen chloride	7647-01-0		1.0E+05	max	1.0E+05	max	1.0E+05	max	1.0E+05	max	2.1E+01	N			
Hydrogen sulfide	7783-06-4		1.8E+02	N	2.3E+02	N	1.9E+03	N	6.1E+03	N	1.0E+00	N	1.1E+02	N	
p-Hydroquinone	123-31-9		2.4E+03	N	3.1E+03	N	2.5E+04	N	8.2E+04	N	1.5E+02	N	1.5E+03	N	

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Basis: C=carcinogenic effects
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sat= soil saturation concentration
max= maximum concentration

Contaminant	CAS No.	MCL or Action Level	Risk-Based Screening Levels												Soil Screening Level- Transfers from Soil to: Ground water (DAF=1)
			Soil (ingestion, inhalation, with and without dermal exposure routes)								Ambient Air (Residential Scenario)		Tap Water (Residential Scenario: Ingestion & Inhalation)		
			Residential		Residential w/o dermal		Industrial		Industrial w/o dermal						
		ug/l	mg/kg		mg/kg		mg/kg		mg/kg		ug/m3		ug/l		mg/kg
Iron	7439-89-6		2.3E+04	N	2.3E+04	N	1.0E+05	max	1.0E+05	max			1.1E+04	N	
Isobutanol	78-83-1		1.1E+04	N	1.3E+04	N	4.0E+04	sat	4.0E+04	sat	1.1E+03	N	1.8E+03	N	
Isophorone	78-59-1		5.1E+02	C	6.7E+02	C	1.8E+03	C	6.0E+03	C	7.1E+00	C	7.1E+01	C	3.0E-02
Isopropalin	33820-53-0		9.1E+02	N	1.2E+03	N	9.3E+03	N	3.1E+04	N	5.5E+01	N	5.5E+02	N	
Isopropyl methyl phosphonic acid	1832-54-8		6.1E+03	N	7.8E+03	N	6.2E+04	N	1.0E+05	max	4.0E+02	N	3.7E+03	N	
Kepone	143-50-0		2.7E-02	C	3.6E-02	C	9.7E-02	C	3.2E-01	C	3.7E-04	C	3.7E-03	C	
Lead	7439-92-1	1.5E+01	4.0E+02				2.0E+03						1.5E+01		
Lead (tetraethyl)	78-00-2		6.1E-03	N	7.8E-03	N	6.2E-02	N	2.0E-01	N			3.7E-03	N	
Lithium	7439-93-2		1.6E+03	N	1.6E+03	N	4.1E+04	N	4.1E+04	N			7.3E+02	N	
Malathion	121-75-5		1.2E+03	N	1.6E+03	N	1.2E+04	N	4.1E+04	N	7.3E+01	N	7.3E+02	N	
Maleic anhydride	108-31-6		6.1E+03	N	7.8E+03	N	6.2E+04	N	1.0E+05	max	3.7E+02	N	3.7E+03	N	
Manganese and compounds	7439-96-5		3.2E+03	N	3.2E+03	N	4.7E+04	N	4.7E+04	N	5.1E-02	N	1.7E+03	N	
Mephosfolan	950-10-7		5.5E+00	N	7.0E+00	N	5.6E+01	N	1.8E+02	N	3.3E-01	N	3.3E+00	N	
Mepiquat	24307-26-4		1.8E+03	N	2.3E+03	N	1.9E+04	N	6.1E+04	N	1.1E+02	N	1.1E+03	N	
2-Mercaptobenzothiazole	149-30-4		1.7E+01	C	2.2E+01	C	6.0E+01	C	2.0E+02	C	2.3E-01	C	2.3E+00	C	
Mercury and compounds	7487-94-7	2.0E+00	2.3E+01	N	2.3E+01	N	6.1E+02	N	6.1E+02	N			1.1E+01	N	
Mercury (elemental)	7439-97-6										3.1E-01	N			
Mercury (methyl)	22967-92-6		6.1E+00	N	7.8E+00	N	6.2E+01	N	2.0E+02	N			3.7E+00	N	
Methacrylonitrile	126-98-7		1.9E+00	N	2.1E+00	N	8.0E+00	N	8.8E+00	N	7.3E-01	N	1.0E+00	N	
Methanol	67-56-1		3.0E+04	N	3.9E+04	N	1.0E+05	max	1.0E+05	max	1.8E+03	N	1.8E+04	N	
Methidathion	950-37-8		6.1E+01	N	7.8E+01	N	6.2E+02	N	2.0E+03	N	3.7E+00	N	3.7E+01	N	
Methoxychlor	72-43-5	4.0E+01	3.0E+02	N	3.9E+02	N	3.1E+03	N	1.0E+04	N	1.8E+01	N	1.8E+02	N	8.0E+00
Methyl acetate	79-20-9		2.0E+04	N	2.2E+04	N	8.7E+04	N	9.6E+04	N	3.7E+03	N	6.1E+03	N	
Methyl acrylate	96-33-3		6.9E+01	N	7.0E+01	N	2.3E+02	N	2.3E+02	N	1.1E+02	N	1.8E+02	N	
2-Methylaniline (o-	95-53-4		2.0E+00	C	2.7E+00	C	7.3E+00	C	2.4E+01	C	2.8E-02	C	2.8E-01	C	

EPA REGION 6- HUMAN HEALTH MEDIUM-SPECIFIC SCREENING LEVELS

Basis: C=carcinogenic effects
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sat= soil saturation concentration
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Contaminant	CAS No.	MCL or Action Level	Risk-Based Screening Levels												Soil Screening Level- Transfers from Soil to: Ground water (DAF=1)
			Soil (ingestion, inhalation, with and without dermal exposure routes)								Ambient Air (Residential Scenario)		Tap Water (Residential Scenario: Ingestion & Inhalation)		
			Residential		Residential w/o dermal		Industrial		Industrial w/o dermal						
		ug/l	mg/kg		mg/kg		mg/kg		mg/kg		ug/m3		ug/l		mg/kg
toluidine)															
2-Methyl-4-chlorophenoxyacetic acid	94-74-6		3.0E+01	N	3.9E+01	N	3.1E+02	N	1.0E+03	N	1.8E+00	N	1.8E+01	N	
4-(2-Methyl-4-chlorophenoxy) butyric acid (MCPB)	94-81-5		6.1E+02	N	7.8E+02	N	6.2E+03	N	2.0E+04	N	3.7E+01	N	3.7E+02	N	
2-(2-Methyl-4-chlorophenoxy) propionic acid	93-65-2		6.1E+01	N	7.8E+01	N	6.2E+02	N	2.0E+03	N	3.7E+00	N	3.7E+01	N	
2-(2-Methyl-1,4-chlorophenoxy) propionic acid (MCPP)	16484-77-8		6.1E+01	N	7.8E+01	N	6.2E+02	N	2.0E+03	N	3.7E+00	N	3.7E+01	N	
Methylcyclohexane	108-87-2		1.4E+02	sat	1.4E+02	sat	1.4E+02	sat	1.4E+02	sat	3.1E+03	N	5.2E+03	N	
4,4'-Methylene bis(2-chloroaniline)	101-14-4		3.7E+00	C	4.9E+00	C	1.3E+01	C	4.4E+01	C	5.2E-02	C	5.2E-01	C	
4,4'-Methylene bis(N,N'-dimethyl)aniline	101-61-1		1.1E+01	C	1.4E+01	C	3.8E+01	C	1.2E+02	C	1.5E-01	C	1.5E+00	C	
Methylene bromide	74-95-3		1.3E+02	N	1.4E+02	N	5.2E+02	N	5.5E+02	N	3.7E+01	N	6.1E+01	N	
Methylene chloride	75-09-2		8.6E+00	C	8.9E+00	C	1.9E+01	C	2.1E+01	C	4.1E+00	C	4.3E+00	C	1.0E-03
4,4'-Methylenediphenyl isocyanate	101-68-8		1.0E+01	N	1.3E+01	N	1.1E+02	N	3.5E+02	N	6.2E-01	N	6.2E+00	N	
Methyl ethyl ketone	78-93-3		7.0E+03	N	7.3E+03	N	2.6E+04	N	2.8E+04	N	1.0E+03	N	1.9E+03	N	
Methyl hydrazine	60-34-4		4.4E-01	C	5.8E-01	C	1.6E+00	C	5.2E+00	C	6.1E-03	C	6.1E-02	C	
Methyl isobutyl ketone	108-10-1		7.6E+02	N	7.9E+02	N	2.8E+03	N	2.9E+03	N	8.3E+01	N	1.6E+02	N	
Methyl mercaptan	74-93-1		3.5E+01	N	4.5E+01	N	3.6E+02	N	1.2E+03	N	2.1E+00	N	2.1E+01	N	
Methyl methacrylate	80-62-6		2.2E+03	N	2.2E+03	N	2.7E+03	sat	2.7E+03	sat	7.3E+02	N	1.4E+03	N	
2-Methyl-5-nitroaniline	99-55-8		1.5E+01	C	1.9E+01	C	5.3E+01	C	1.7E+02	C	2.0E-01	C	2.0E+00	C	
Methyl parathion	298-00-0		1.5E+01	N	2.0E+01	N	1.6E+02	N	5.1E+02	N	9.1E-01	N	9.1E+00	N	

EPA REGION 6- HUMAN HEALTH MEDIUM-SPECIFIC SCREENING LEVELS

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Contaminant	CAS No.	MCL or Action Level	Risk-Based Screening Levels										Soil Screening Level- Transfers from Soil to: Ground water (DAF=1)
			Soil (ingestion, inhalation, with and without dermal exposure routes)						Ambient Air (Residential Scenario)		Tap Water (Residential Scenario: Ingestion & Inhalation)		
			Residential		Residential w/o dermal		Industrial		Industrial w/o dermal				
		ug/l	mg/kg		mg/kg		mg/kg		mg/kg		ug/m3		ug/l		mg/kg
2-Methylphenol	95-48-7		3.0E+03	N	3.9E+03	N	3.1E+04	N	1.0E+05	max	1.8E+02	N	1.8E+03	N	8.0E-01
3-Methylphenol	108-39-4		3.0E+03	N	3.9E+03	N	3.1E+04	N	1.0E+05	max	1.8E+02	N	1.8E+03	N	
4-Methylphenol	106-44-5		3.0E+02	N	3.9E+02	N	3.1E+03	N	1.0E+04	N	1.8E+01	N	1.8E+02	N	
Methyl phosphonic acid	993-13-5		1.2E+03	N	1.6E+03	N	1.2E+04	N	4.1E+04	N	7.3E+01	N	7.3E+02	N	
Methyl styrene (mixture)	25013-15-4		1.2E+02	N	1.3E+02	N	5.1E+02	N	5.6E+02	N	4.2E+01	N	6.0E+01	N	
Methyl styrene (alpha)	98-83-9		6.8E+02	sat	6.8E+02	sat	6.8E+02	sat	6.8E+02	sat	2.6E+02	N	4.3E+02	N	
Methyl tertbutyl ether (MTBE)	1634-04-4										3.1E+03	N	2.0E+01		
Metolaclor (Dual)	51218-45-2		9.1E+03	N	1.2E+04	N	9.3E+04	N	1.0E+05	max	5.5E+02	N	5.5E+03	N	
Mirex	2385-85-5		2.7E-01	C	3.6E-01	C	9.7E-01	C	3.2E+00	C	3.7E-03	C	3.7E-02	C	
Molybdenum	7439-98-7		3.9E+02	N	3.9E+02	N	1.0E+04	N	1.0E+04	N			1.8E+02	N	
Monochloramine	10599-90-3		6.1E+03	N	7.8E+03	N	6.2E+04	N	1.0E+05	max	3.7E+02	N	3.7E+03	N	
Naled	300-76-5		1.2E+02	N	1.6E+02	N	1.2E+03	N	4.1E+03	N	7.3E+00	N	7.3E+01	N	
Nickel and compounds	7440-02-0	1.0E+02	1.6E+03	N	1.6E+03	N	4.1E+04	N	4.1E+04	N			7.3E+02	N	7.0E+00
Nickel refinery dust	n/a		1.1E+04	C	1.1E+04	C	2.2E+04	C	2.2E+04	C	8.0E-03	C			
Nickel subsulfide	12035-72-2		5.2E+03	C	5.2E+03	C	1.1E+04	C	1.1E+04	C	4.0E-03	C			
Nitrate	14797-55-8	1.0E+04											1.0E+04		
Nitric Oxide	10102-43-9		6.1E+03	N	7.8E+03	N	6.2E+04	N	1.0E+05	max			3.7E+03	N	
Nitrite	14797-65-0	1.0E+03											1.0E+03		
2-Nitroaniline	88-74-4		3.6E+00	N	4.7E+00	N	3.7E+01	N	1.2E+02	N	2.1E-01	N	2.2E+00	N	
Nitrobenzene	98-95-3		1.7E+01	N	2.0E+01	N	9.1E+01	N	1.1E+02	N	2.1E+00	N	3.4E+00	N	7.0E-03
Nitrofurantoin	67-20-9		4.2E+03	N	5.5E+03	N	4.4E+04	N	1.0E+05	max	2.6E+02	N	2.6E+03	N	
Nitrofurazone	59-87-0		3.2E-01	C	4.3E-01	C	1.2E+00	C	3.8E+00	C	7.2E-04	C	4.5E-02	C	
Nitrogen dioxide	101102-44-0		6.1E+04	N	7.8E+04	N	1.0E+05	max	1.0E+05	max			3.7E+04	N	
4-Nitrophenol	100-02-7		3.8E+03	N	4.8E+03	N	3.9E+04	N	1.0E+05	max	2.3E+02	N	2.3E+03	N	
2-Nitropropane	79-46-9		5.1E-02	C	6.8E-02	C	1.9E-01	C	6.1E-01	C	7.2E-04	C	1.2E-03	C	
N-Nitrosodi-n-butylamine	924-16-3		2.3E-02	C	2.4E-02	C	5.4E-02	C	6.2E-02	C	1.2E-03	C	2.0E-03	C	

EPA REGION 6- HUMAN HEALTH MEDIUM-SPECIFIC SCREENING LEVELS

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Contaminant	CAS No.	MCL or Action Level	Risk-Based Screening Levels										Soil Screening Level- Transfers from Soil to: Ground water (DAF=1)
			Soil (ingestion, inhalation, with and without dermal exposure routes)						Ambient Air (Residential Scenario)		Tap Water (Residential Scenario: Ingestion & Inhalation)		
			Residential		Residential w/o dermal		Industrial		Industrial w/o dermal				
		ug/l	mg/kg		mg/kg		mg/kg		mg/kg		ug/m3		ug/l		mg/kg
N-Nitrosodiethanolamine	1116-54-7		1.7E-01	C	2.3E-01	C	6.2E-01	C	2.0E+00	C	2.4E-03	C	2.4E-02	C	
N-Nitrosodiethylamine	55-18-5		3.2E-03	C	4.3E-03	C	1.2E-02	C	3.8E-02	C	4.5E-05	C	4.5E-04	C	
N-Nitrosodimethylamine	62-75-9		9.5E-03	C	1.3E-02	C	3.4E-02	C	1.1E-01	C	1.4E-04	C	1.3E-03	C	
N-Nitrosodiphenylamine	86-30-6		9.9E+01	C	1.3E+02	C	3.6E+02	C	1.2E+03	C	1.4E+00	C	1.4E+01	C	6.0E-02
N-Nitroso di-n-propylamine	621-64-7		6.9E-02	C	9.1E-02	C	2.5E-01	C	8.2E-01	C	9.6E-04	C	9.6E-03	C	2.0E-06
N-Nitroso-N-methylethylamine	10595-95-6		2.2E-02	C	2.9E-02	C	7.9E-02	C	2.6E-01	C	3.1E-04	C	3.1E-03	C	
N-Nitrosopyrrolidine	930-55-2		2.3E-01	C	3.0E-01	C	8.3E-01	C	2.7E+00	C	3.1E-03	C	3.2E-02	C	
m-Nitrotoluene	99-08-1		6.1E+02	N	7.8E+02	N	6.2E+03	N	2.0E+04	N	3.7E+01	N	3.7E+02	N	
o-Nitrotoluene	99-08-1		6.1E+02	N	7.8E+02	N	6.2E+03	N	2.0E+04	N	3.7E+01	N	3.7E+02	N	
p-Nitrotoluene	99-99-0		6.1E+02	N	7.8E+02	N	6.2E+03	N	2.0E+04	N	3.7E+01	N	3.7E+02	N	
NuStar	85509-19-9		4.2E+01	N	5.5E+01	N	4.4E+02	N	1.4E+03	N	2.6E+00	N	2.6E+01	N	
Octahydro-1357-tetranitro-1357- tetrazocine (HMX)	2691-41-0		3.0E+03	N	3.9E+03	N	3.1E+04	N	1.0E+05	max	1.8E+02	N	1.8E+03	N	
Oryzalin	19044-88-3		3.0E+03	N	3.9E+03	N	3.1E+04	N	1.0E+05	max	1.8E+02	N	1.8E+03	N	
Oxadiazon	19666-30-9		3.0E+02	N	3.9E+02	N	3.1E+03	N	1.0E+04	N	1.8E+01	N	1.8E+02	N	
Oxamyl	23135-22-0	2.0E+02	1.5E+03	N	2.0E+03	N	1.6E+04	N	5.1E+04	N	9.1E+01	N	9.1E+02	N	
Oxyfluorfen	42874-03-3		1.8E+02	N	2.3E+02	N	1.9E+03	N	6.1E+03	N	1.1E+01	N	1.1E+02	N	
Paraquat	4685-14-7		2.7E+02	N	3.5E+02	N	2.8E+03	N	9.2E+03	N	1.6E+01	N	1.6E+02	N	
Parathion	56-38-2		3.6E+02	N	4.7E+02	N	3.7E+03	N	1.2E+04	N	2.2E+01	N	2.2E+02	N	
Pentachlorobenzene	608-93-5		4.9E+01	N	6.3E+01	N	5.0E+02	N	1.6E+03	N	2.9E+00	N	2.9E+01	N	
Pentachloronitrobenzene	82-68-8		1.9E+00	C	2.5E+00	C	6.7E+00	C	2.2E+01	C	2.6E-02	C	2.6E-01	C	
Pentachlorophenol	87-86-5	1.0E+00	2.9E+00	C	5.3E+00	C	7.1E+00	C	4.8E+01	C	5.6E-02	C	5.6E-01	C	1.0E-03
Perchlorate	7601-90-3		3.9E+01	N	3.9E+01	N	1.0E+03	N	1.0E+03	N			1.8E+01	N	
Permethrin	52645-53-1		3.0E+03	N	3.9E+03	N	3.1E+04	N	1.0E+05	max	1.8E+02	N	1.8E+03	N	
Phenol	108-95-2		3.6E+04	N	4.7E+04	N	1.0E+05	max	1.0E+05	max	2.2E+03	N	2.2E+04	N	5.0E+00

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Contaminant	CAS No.	MCL or Action Level	Risk-Based Screening Levels												Soil Screening Level- Transfers from Soil to: Ground water (DAF=1)
			Soil (ingestion, inhalation, with and without dermal exposure routes)								Ambient Air (Residential Scenario)		Tap Water (Residential Scenario: Ingestion & Inhalation)		
			Residential		Residential w/o dermal		Industrial		Industrial w/o dermal						
		ug/l	mg/kg		mg/kg		mg/kg		mg/kg		ug/m3		ug/l		mg/kg
Phenothiazine	92-84-2		1.2E+02	N	1.6E+02	N	1.2E+03	N	4.1E+03	N	7.3E+00	N	7.3E+01	N	
m-Phenylenediamine	108-45-2		3.6E+02	N	4.7E+02	N	3.7E+03	N	1.2E+04	N	2.2E+01	N	2.2E+02	N	
p-Phenylenediamine	106-50-3		1.2E+04	N	1.5E+04	N	1.0E+05	max	1.0E+05	max	6.9E+02	N	6.9E+03	N	
Phenylmercuric acetate	62-38-4		4.9E+00	N	6.3E+00	N	5.0E+01	N	1.6E+02	N	2.9E-01	N	2.9E+00	N	
2-Phenylphenol	90-43-7		2.5E+02	C	3.3E+02	C	9.0E+02	C	2.9E+03	C	3.5E+00	C	3.5E+01	C	
Phosphine	7803-51-2		1.8E+01	N	2.3E+01	N	1.9E+02	N	6.1E+02	N	3.1E-01	N	1.1E+01	N	
Phosphoric acid	7664-38-2										1.0E+01	N			
Phosphorus (white)	7723-14-0		1.6E+00	N	1.6E+00	N	4.1E+01	N	4.1E+01	N			7.3E-01	N	
p-Phthalic acid	100-21-0		6.1E+04	N	7.8E+04	N	1.0E+05	max	1.0E+05	max	3.7E+03	N	3.7E+04	N	
Phthalic anhydride	85-44-9		1.0E+05	max	1.0E+05	max	1.0E+05	max	1.0E+05	max	1.2E+02	N	7.3E+04	N	
Polybrominated biphenyls			5.4E-02	C	7.2E-02	C	2.0E-01	C	6.4E-01	C	7.6E-04	C	7.6E-03	C	
Polychlorinated biphenyls (PCBs)	1336-36-3	5.0E-01	2.2E-01	C	3.2E-01	C	6.8E-01	C	2.9E+00	C	3.4E-03	C	3.4E-02	C	
Aroclor 1016	12674-11-2		3.9E+00	N	5.5E+00	N	3.4E+01	N	1.4E+02	N	2.6E-01	N	2.6E+00	N	
Aroclor 1254	11097-69-1		1.1E+00	N	1.6E+00	N	9.8E+00	N	4.1E+01	N	7.3E-02	N	7.3E-01	N	
Polynuclear aromatic hydrocarbons															
Acenaphthene	83-32-9		2.8E+03	N	3.7E+03	N	2.0E+04	N	3.8E+04	N	2.2E+02	N	3.7E+02	N	2.9E+01
Anthracene	120-12-7		1.6E+04	N	2.2E+04	N	1.0E+05	max	1.0E+05	max	1.1E+03	N	1.8E+03	N	5.9E+02
Benz[a]anthracene	56-55-3		6.2E-01	C	8.8E-01	C	2.0E+00	C	7.8E+00	C	2.2E-02	C	9.2E-02	C	8.0E-02
Benzo[b]fluoranthene	205-99-2		6.2E-01	C	8.8E-01	C	2.0E+00	C	7.8E+00	C	2.2E-02	C	9.2E-02	C	2.0E-01
Benzo[k]fluoranthene	207-08-9		6.2E+00	C	8.8E+00	C	2.0E+01	C	7.8E+01	C	2.2E-01	C	9.2E-01	C	2.0E+00
Benzo[a]pyrene	50-32-8	2.0E-01	6.2E-02	C	8.8E-02	C	2.0E-01	C	7.8E-01	C	2.2E-03	C	9.2E-03	C	4.0E-01
Chrysene	218-01-9		6.2E+01	C	8.8E+01	C	2.0E+02	C	7.8E+02	C	2.2E+00	C	9.2E+00	C	8.0E+00
Dibenz[ah]anthracene	53-70-3		6.2E-02	C	8.8E-02	C	2.0E-01	C	7.8E-01	C	2.2E-03	C	9.2E-03	C	8.0E-02
Fluoranthene	206-44-0		2.3E+03	N	3.1E+03	N	2.1E+04	N	8.2E+04	N	1.5E+02	N	1.5E+03	N	2.1E+02
Fluorene	86-73-7		2.0E+03	N	2.6E+03	N	1.5E+04	N	3.3E+04	N	1.5E+02	N	2.4E+02	N	2.8E+01
Indeno[1,2,3-cd]pyrene	193-39-5		6.2E-01	C	8.8E-01	C	2.0E+00	C	7.8E+00	C	2.2E-02	C	9.2E-02	C	7.0E-01

EPA REGION 6- HUMAN HEALTH MEDIUM-SPECIFIC SCREENING LEVELS

Basis: C=carcinogenic effects
N=non-carcinogenic effects
sat= soil saturation concentration
max= maximum concentration

Contaminant	CAS No.	MCL or Action Level	Risk-Based Screening Levels												Soil Screening Level- Transfers from Soil to: Ground water (DAF=1)
			Soil (ingestion, inhalation, with and without dermal exposure routes)								Ambient Air (Residential Scenario)		Tap Water (Residential Scenario: Ingestion & Inhalation)		
			Residential		Residential w/o dermal		Industrial		Industrial w/o dermal						
		ug/l	mg/kg		mg/kg		mg/kg		mg/kg		ug/m3		ug/l		mg/kg
Naphthalene	91-20-3		5.5E+01	N	5.6E+01	N	1.9E+02	N	1.9E+02	N	3.1E+00	N	6.2E+00	N	4.0E+00
Pyrene	129-00-0		1.7E+03	N	2.3E+03	N	1.5E+04	N	5.4E+04	N	1.1E+02	N	1.8E+02	N	2.1E+02
Prometon	1610-18-0		9.1E+02	N	1.2E+03	N	9.3E+03	N	3.1E+04	N	5.5E+01	N	5.5E+02	N	
Prometryn	7287-19-6		2.4E+02	N	3.1E+02	N	2.5E+03	N	8.2E+03	N	1.5E+01	N	1.5E+02	N	
Propachlor	1918-16-7		7.9E+02	N	1.0E+03	N	8.1E+03	N	2.7E+04	N	4.7E+01	N	4.7E+02	N	
Propanil	709-98-8		3.0E+02	N	3.9E+02	N	3.1E+03	N	1.0E+04	N	1.8E+01	N	1.8E+02	N	
Propargite	2312-35-8		1.2E+03	N	1.6E+03	N	1.2E+04	N	4.1E+04	N	7.3E+01	N	7.3E+02	N	
Propargyl alcohol	107-19-7		1.2E+02	N	1.6E+02	N	1.2E+03	N	4.1E+03	N	7.3E+00	N	7.3E+01	N	
Propazine	139-40-2		1.2E+03	N	1.6E+03	N	1.2E+04	N	4.1E+04	N	7.3E+01	N	7.3E+02	N	
Propiconazole	60207-90-1		7.9E+02	N	1.0E+03	N	8.1E+03	N	2.7E+04	N	4.7E+01	N	4.7E+02	N	
iso-Propylbenzene	104-5-18		1.3E+02	N	1.3E+02	N	3.9E+02	sat	3.9E+02	sat	3.7E+01	N	6.1E+01	N	
n-Propylbenzene	104-51-8		1.4E+02	N	1.4E+02	N	2.4E+02	sat	2.4E+02	sat	3.7E+01	N	6.1E+01	N	
Propylene glycol	57-55-6		1.0E+05	max	1.0E+05	max	1.0E+05	max	1.0E+05	max	7.3E+04	N	7.3E+05	N	
Propylene glycol, monoethyl ether	111-35-3		4.2E+04	N	5.5E+04	N	1.0E+05	max	1.0E+05	max	2.6E+03	N	2.6E+04	N	
Propylene glycol, monomethyl ether	107-98-2		4.2E+04	N	5.5E+04	N	1.0E+05	max	1.0E+05	max	2.1E+03	N	2.6E+04	N	
Propylene oxide	75-56-9		1.6E+00	C	1.9E+00	C	4.9E+00	C	9.1E+00	C	5.2E-01	C	2.2E-01	C	
Pursuit	81335-77-5		1.5E+04	N	2.0E+04	N	1.0E+05	max	1.0E+05	max	9.1E+02	N	9.1E+03	N	
Pyridine	110-86-1		6.1E+01	N	7.8E+01	N	6.2E+02	N	2.0E+03	N	3.7E+00	N	3.7E+01	N	
Quinoline	91-22-5		4.0E-02	C	5.3E-02	C	1.5E-01	C	4.8E-01	C	5.6E-04	C	5.6E-03	C	
RDX (Cyclonite)	121-82-4		4.4E+00	C	5.8E+00	C	1.6E+01	C	5.2E+01	C	6.1E-02	C	6.1E-01	C	
Resmethrin	10453-86-8		1.8E+03	N	2.3E+03	N	1.9E+04	N	6.1E+04	N	1.1E+02	N	1.1E+03	N	
Ronnel	299-84-3		3.0E+03	N	3.9E+03	N	3.1E+04	N	1.0E+05	max	1.8E+02	N	1.8E+03	N	
Rotenone	83-79-4		2.4E+02	N	3.1E+02	N	2.5E+03	N	8.2E+03	N	1.5E+01	N	1.5E+02	N	
Selenious Acid	7783-00-8		3.0E+02	N	3.9E+02	N	3.1E+03	N	1.0E+04	N			1.8E+02	N	
Selenium	7782-49-2	5.0E+01	3.9E+02	N	3.9E+02	N	1.0E+04	N	1.0E+04	N			1.8E+02	N	3.0E-01

EPA REGION 6- HUMAN HEALTH MEDIUM-SPECIFIC SCREENING LEVELS

Basis: C=carcinogenic effects
N=non-carcinogenic effects
sat= soil saturation concentration
max= maximum concentration

Contaminant	CAS No.	MCL or Action Level	Risk-Based Screening Levels												Soil Screening Level- Transfers from Soil to: Ground water (DAF=1)
			Soil (ingestion, inhalation, with and without dermal exposure routes)								Ambient Air (Residential Scenario)		Tap Water (Residential Scenario: Ingestion & Inhalation)		
			Residential		Residential w/o dermal		Industrial		Industrial w/o dermal						
		ug/l	mg/kg		mg/kg		mg/kg		mg/kg		ug/m3		ug/l		mg/kg
Silver and compounds	7440-22-4		3.9E+02	N	3.9E+02	N	1.0E+04	N	1.0E+04	N			1.8E+02	N	2.0E+00
Simazine	122-34-9	4.0E+00	4.0E+00	C	5.3E+00	C	1.5E+01	C	4.8E+01	C	5.6E-02	C	5.6E-01	C	
Sodium azide	26628-22-8		2.4E+02	N	3.1E+02	N	2.5E+03	N	8.2E+03	N	1.5E+01	N	1.5E+02	N	
Sodium diethyldithiocarbamate	148-18-5		1.8E+00	C	2.4E+00	C	6.5E+00	C	2.1E+01	C	2.5E-02	C	2.5E-01	C	
Sodium fluoroacetate	62-74-8		1.2E+00	N	1.6E+00	N	1.2E+01	N	4.1E+01	N	7.3E-02	N	7.3E-01	N	
Sodium metavanadate	13718-26-8		6.1E+01	N	7.8E+01	N	6.2E+02	N	2.0E+03	N	3.7E+00	N	3.7E+01	N	
Strontium, stable	7440-24-6		4.7E+04	N	4.7E+04	N	1.0E+05	max	1.0E+05	max			2.2E+04	N	
Strychnine	57-24-9		1.8E+01	N	2.3E+01	N	1.9E+02	N	6.1E+02	N	1.1E+00	N	1.1E+01	N	
Styrene	100-42-5	1.0E+02	1.7E+03	sat	1.7E+03	sat	1.7E+03	sat	1.7E+03	sat	1.1E+03	N	1.6E+03	N	2.0E-01
2,3,7,8-TCDD (dioxin)	1746-01-6	3.0E-05	3.9E-06	C	4.3E-06	C	2.3E-05	C	3.8E-05	C	4.5E-08	C	4.5E-07	C	
1,2,4,5-Tetrachlorobenzene	95-94-3		1.8E+01	N	2.3E+01	N	1.9E+02	N	6.1E+02	N	1.1E+00	N	1.1E+01	N	
1,1,1,2-Tetrachloroethane	630-20-6		2.9E+00	C	3.0E+00	C	6.6E+00	C	7.1E+00	C	2.6E-01	C	4.3E-01	C	
1,1,2,2-Tetrachloroethane	79-34-5		3.7E-01	C	3.8E-01	C	8.4E-01	C	9.0E-01	C	3.3E-02	C	5.5E-02	C	2.0E-04
Tetrachloroethylene (PCE)	127-18-4	5.0E+00	4.9E+00	C	5.7E+00	C	1.3E+01	C	1.9E+01	C	3.3E+00	C	1.1E+00	C	3.0E-03
2,3,4,6-Tetrachlorophenol	58-90-2		1.8E+03	N	2.3E+03	N	1.9E+04	N	6.1E+04	N	1.1E+02	N	1.1E+03	N	
p,a,a,a-Tetrachlorotoluene	5216-25-1		2.4E-02	C	3.2E-02	C	8.7E-02	C	2.9E-01	C	3.4E-04	C	3.4E-03	C	
Tetrachlorovinphos	961-11-5		2.0E+01	C	2.7E+01	C	7.3E+01	C	2.4E+02	C	2.8E-01	C	2.8E+00	C	
Tetrahydrofuran	109-99-9		5.2E+03	N	6.7E+03	N	5.3E+04	N	1.0E+05	max	3.1E+02	N	3.1E+03	N	
Thallic oxide	1314-32-5		5.5E+00	N	5.5E+00	N	1.4E+02	N	1.4E+02	N			2.6E+00	N	
Thallium acetate	563-68-8	2.0E+00	7.0E+00	N	7.0E+00	N	1.8E+02	N	1.8E+02	N			3.3E+00	N	4.0E-01
Thallium carbonate	6533-73-9	2.0E+00	6.3E+00	N	6.3E+00	N	1.6E+02	N	1.6E+02	N			2.9E+00	N	4.0E-01
Thallium chloride	7791-12-0	2.0E+00	6.3E+00	N	6.3E+00	N	1.6E+02	N	1.6E+02	N			2.9E+00	N	4.0E-01
Thallium nitrate	10102-45-1	2.0E+00	7.0E+00	N	7.0E+00	N	1.8E+02	N	1.8E+02	N			3.3E+00	N	4.0E-01
Thallium selenite	12039-52-0	2.0E+00	7.0E+00	N	7.0E+00	N	1.8E+02	N	1.8E+02	N			3.3E+00	N	4.0E-01
Thallium sulfate	7446-18-6	2.0E+00	6.3E+00	N	6.3E+00	N	1.6E+02	N	1.6E+02	N			2.9E+00	N	4.0E-01

EPA REGION 6- HUMAN HEALTH MEDIUM-SPECIFIC SCREENING LEVELS

Basis: C=carcinogenic effects
N=non-carcinogenic effects
sat= soil saturation concentration
max= maximum concentration

Contaminant	CAS No.	MCL or Action Level	Risk-Based Screening Levels										Soil Screening Level- Transfers from Soil to: Ground water (DAF=1)
			Soil (ingestion, inhalation, with and without dermal exposure routes)						Ambient Air (Residential Scenario)		Tap Water (Residential Scenario: Ingestion & Inhalation)		
			Residential		Residential w/o dermal		Industrial		Industrial w/o dermal				
		ug/l	mg/kg		mg/kg		mg/kg		mg/kg		ug/m3		ug/l		mg/kg
Thiobencarb	28249-77-6		6.1E+02	N	7.8E+02	N	6.2E+03	N	2.0E+04	N	3.7E+01	N	3.7E+02	N	
Thiocyanate	N/A		6.1E+03	N	7.8E+03	N	6.2E+04	N	1.0E+05	max	3.7E+02	N	3.7E+03	N	
Tin and compounds	N/A		4.7E+04	N	4.7E+04	N	1.0E+05	max	1.0E+05	max			2.2E+04	N	
Toluene	108-88-3	1.0E+03	5.2E+02	sat	5.2E+02	sat	5.2E+02	sat	5.2E+02	sat	4.0E+02	N	7.2E+02	N	6.0E-01
Toluene-2,4-diamine	95-80-7		1.5E-01	C	2.0E-01	C	5.5E-01	C	1.8E+00	C	2.1E-03	C	2.1E-02	C	
Toluene-2,5-diamine	95-70-5		3.6E+04	N	4.7E+04	N	1.0E+05	max	1.0E+05	max	2.2E+03	N	2.2E+04	N	
Toluene-2,6-diamine	823-40-5		1.2E+04	N	1.6E+04	N	1.0E+05	max	1.0E+05	max	7.3E+02	N	7.3E+03	N	
p-Toluidine	106-49-0		2.5E+00	C	3.4E+00	C	9.2E+00	C	3.0E+01	C	3.5E-02	C	3.5E-01	C	
Toxaphene	8001-35-2	3.0E+00	4.4E-01	C	5.8E-01	C	1.6E+00	C	5.2E+00	C	6.0E-03	C	6.1E-02	C	2.0E+00
1,2,4-Tribromobenzene	615-54-3		3.0E+02	N	3.9E+02	N	3.1E+03	N	1.0E+04	N	1.8E+01	N	1.8E+02	N	
Tributyltin oxide (TBTO)	56-35-9		1.8E+01	N	2.3E+01	N	1.9E+02	N	6.1E+02	N			1.1E+01	N	
2,4,6-Trichloroaniline	634-93-5		1.4E+01	C	1.9E+01	C	5.1E+01	C	1.7E+02	C	2.0E-01	C	2.0E+00	C	
1,2,4-Trichlorobenzene	120-82-1	7.0E+01	5.2E+02	N	6.5E+02	N	3.0E+03	sat	3.0E+03	sat	2.1E+02	N	1.9E+02	N	3.0E-01
1,1,1-Trichloroethane	71-55-6	2.0E+02	7.1E+02	N	7.7E+02	N	1.4E+03	sat	1.4E+03	sat	1.0E+03	N	7.9E+02	N	1.0E-01
1,1,2-Trichloroethane	79-00-5	5.0E+00	8.2E-01	C	8.4E-01	C	1.8E+00	C	1.9E+00	C	1.2E-01	C	2.0E-01	C	9.0E-04
Trichloroethylene (TCE)	79-01-6	5.0E+00	2.7E+00	C	2.8E+00	C	6.0E+00	C	6.1E+00	C	1.1E+00	C	1.6E+00	C	3.0E-03
Trichlorofluoromethane	75-69-4		3.8E+02	N	3.9E+02	N	1.3E+03	N	1.3E+03	N	7.3E+02	N	1.3E+03	N	
2,4,5-Trichlorophenol	95-95-4		6.1E+03	N	7.8E+03	N	6.2E+04	N	1.0E+05	max	3.7E+02	N	3.7E+03	N	1.4E+01
2,4,6-Trichlorophenol	88-06-2		4.4E+01	C	5.8E+01	C	1.6E+02	C	5.2E+02	C	6.2E-01	C	6.1E+00	C	8.0E-03
2,4,5-Trichlorophenoxyacetic Acid	93-76-5		6.1E+02	N	7.8E+02	N	6.2E+03	N	2.0E+04	N	3.7E+01	N	3.7E+02	N	
2-(2,4,5-Trichlorophenoxy) propionic acid	93-72-1		4.9E+02	N	6.3E+02	N	5.0E+03	N	1.6E+04	N	2.9E+01	N	2.9E+02	N	
1,1,2-Trichloropropane	598-77-6		1.5E+01	N	1.5E+01	N	5.1E+01	N	5.1E+01	N	1.8E+01	N	3.0E+01	N	
1,2,3-Trichloropropane	96-18-4		1.4E-03	C	1.4E-03	C	3.1E-03	C	3.1E-03	C	9.6E-04	C	1.6E-03	C	
1,2,3-Trichloropropene	96-19-5		1.1E+01	N	1.2E+01	N	3.8E+01	N	3.9E+01	N	1.8E+01	N	3.0E+01	N	

EPA REGION 6- HUMAN HEALTH MEDIUM-SPECIFIC SCREENING LEVELS

Basis: C=carcinogenic effects
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sat= soil saturation concentration
max= maximum concentration

Contaminant	CAS No.	MCL or Action Level	Risk-Based Screening Levels										Soil Screening Level- Transfers from Soil to: Ground water (DAF=1)
			Soil (ingestion, inhalation, with and without dermal exposure routes)						Ambient Air (Residential Scenario)		Tap Water (Residential Scenario: Ingestion & Inhalation)		
			Residential		Residential w/o dermal		Industrial		Industrial w/o dermal				
		ug/l	mg/kg		mg/kg		mg/kg		mg/kg		ug/m3		ug/l		mg/kg
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1		5.6E+03	sat	5.6E+03	sat	5.6E+03	sat	5.6E+03	sat	3.1E+04	N	5.9E+04	N	
Triethylamine	121-44-8		2.2E+01	N	2.3E+01	N	8.4E+01	N	8.8E+01	N	7.3E+00	N	1.2E+01	N	
1,2,4-Trimethylbenzene	95-63-6		5.2E+01	N	5.2E+01	N	1.7E+02	N	1.7E+02	N	6.2E+00	N	1.2E+01	N	
1,3,5-Trimethylbenzene	108-67-8		2.1E+01	N	2.1E+01	N	7.0E+01	N	7.0E+01	N	6.2E+00	N	1.2E+01	N	
Trimethyl phosphate	512-56-1		1.3E+01	C	1.7E+01	C	4.7E+01	C	1.5E+02	C	1.8E-01	C	1.8E+00	C	
1,3,5-Trinitrobenzene	99-35-4		1.8E+03	N	2.3E+03	N	1.9E+04	N	6.1E+04	N	1.1E+02	N	1.1E+03	N	
Trinitrophenylmethyl-nitramine	479-45-8		6.1E+02	N	7.8E+02	N	6.2E+03	N	2.0E+04	N	3.7E+01	N	3.7E+02	N	
2,4,6-Trinitrotoluene	118-96-7		1.6E+01	C	2.1E+01	C	5.8E+01	C	1.9E+02	C	2.2E-01	C	2.2E+00	C	
Vanadium	7440-62-2		5.5E+02	N	5.5E+02	N	1.4E+04	N	1.4E+04	N			2.6E+02	N	3.0E+02
Vanadium pentoxide	1314-62-1		7.0E+02	N	7.0E+02	N	1.8E+04	N	1.8E+04	N			3.3E+02	N	3.0E+02
Vanadium sulfate	13701-70-7		1.6E+03	N	1.6E+03	N	4.1E+04	N	4.1E+04	N			7.3E+02	N	3.0E+02
Vinclozolin	50471-44-8		1.5E+03	N	2.0E+03	N	1.6E+04	N	5.1E+04	N	9.1E+01	N	9.1E+02	N	
Vinyl acetate	108-05-4		4.3E+02	N	4.3E+02	N	1.4E+03	N	1.4E+03	N	2.1E+02	N	4.1E+02	N	8.0E+00
Vinyl bromide	593-60-2		1.9E-01	C	1.9E-01	C	4.1E-01	C	4.2E-01	C	6.1E-02	C	1.0E-01	C	
Vinyl chloride	75-01-4	2.0E+00	2.1E-02	C	2.2E-02	C	4.7E-02	C	4.9E-02	C	2.2E-02	C	2.0E-02	C	7.0E-04
Warfarin	81-81-2		1.8E+01	N	2.3E+01	N	1.9E+02	N	6.1E+02	N	1.1E+00	N	1.1E+01	N	
m-Xylene	108-38-3		2.1E+02	sat	2.1E+02	sat	2.1E+02	sat	2.1E+02	sat	7.3E+02	N	1.4E+03	N	1.0E+01
o-Xylene	95-47-6		2.8E+02	sat	2.8E+02	sat	2.8E+02	sat	2.8E+02	sat	7.3E+02	N	1.4E+03	N	9.0E+00
p-Xylene	106-42-3		3.7E+02	sat	3.7E+02	sat	3.7E+02	sat	3.7E+02	sat					1.0E+01
Zinc	7440-66-6		2.3E+04	N	2.3E+04	N	1.0E+05	max	1.0E+05	max			1.1E+04	N	6.2E+02
Zinc phosphide	1314-84-7		2.3E+01	N	2.3E+01	N	6.1E+02	N	6.1E+02	N			1.1E+01	N	
Zineb	12122-67-7		3.0E+03	N	3.9E+03	N	3.1E+04	N	1.0E+05	max	1.8E+02	N	1.8E+03	N	

J.0 SOLID WASTE MANAGEMENT UNITS

The information provided in this section is submitted in accordance with the applicable requirements of 20 NMAC 4.1 Subpart IX, §270.14(d). The solid waste management units (SWMUs) identified at Ciniza are listed in Ciniza's Hazardous Waste Facility Permit NMD000333211-2 (EPA 1988).

Ciniza uses the definition of a SWMU presented in 50 *Federal Register* (FR) 278702. This definition states that a SWMU is "any unit at the facility from which hazardous constituents might migrate, irrespective of whether the unit was intended for the management of solid and/or hazardous wastes." Applying the definition to units at Ciniza, the following have the potential to be considered SWMUs:

- Container storage units
- Tanks
- Surface impoundments
- Waste piles
- Land treatment units
- Landfills
- Incinerators
- Underground injection wells
- Physical, chemical, and biological treatment units
- Recycling units
- Areas contaminated by routine and systematic discharges from process areas

In August 1987, a RCRA Facility Assessment (RFA) was conducted at Ciniza that identified 17 SWMUs and 10 *units of concern* requiring investigation as sources of suspected releases of hazardous material to the environment. From the original 27 SWMUs identified in the Resource Conservation Recovery Act Facility Assessment (RFA), EPA identified and designated 13 SWMUs in the HSWA permit. The *Aeration Basin*, not previously classified as either a SWMU or *unit of concern*, was added to the list in the HSWA permit as (i) *Aeration Basin* resulting in 14 SWMUs. In 1990, in response to permit requirements, Ciniza conducted a release verification and source characterization study and developed a site-specific Resource Conservation Act Facility Investigation (RFI) Work Plan. In the RFI Work Plan the 14 SWMUs were reduced to 13 because the *Inactive Land Treatment Area* and the *Drainage Ditch* were combined to become SWMU No. 9, the *Drainage Ditch Near the Inactive Land Treatment Area.*

The Ciniza SWMU numbering system differs in the various Ciniza and EPA reference documents related to SWMUs. The 1998 HSWA permit lists each SWMU preceded by a lowercase roman numeral. The lowercase roman numerals reflects the document numbering format, not SWMU identification numbers. The 1990 RFI Work Plan provides the first SWMU numbering system for the 14 SWMUs. EPA letters, 1994, refer to both the RFI Work Plan numbering system and to arabic numbers assigned to the roman numerals used in the HSWA permit as a format numbering system. Table J-2 provides a crosswalk between the SWMU numbers designated

in the various reference documents. This Part B post-closure permit application uses the SWMU numbering system from the RFI Work Plan.

Between November 1990, and October 1992, Ciniza prepared three RFI reports covering the 14 SWMUs and submitted them to the EPA for review and comment. Based on the nature and extent of contamination detected during the RFI, 10 of the SWMUs were recommended for no further action. The four remaining SWMUs were recommended for corrective action. Voluntary Corrective Action Plans (VCAPs) were prepared for these four SWMUs and submitted to EPA for review. The following sections describe the activities conducted during RFIs and correctives actions conducted, as required. Table J-1 provides the SWMU number, SWMU title, and current status of the Ciniza SWMUs; Figure J-14 depicts the 13 SWMUs on the survey plat; and Volume III of this Part B post-closure application provides SWMU Summary Reports as Appendices I-1 through I-13.

J.1 SWMU No. 1, Aeration Basin

SWMU No. 1 (Figure J-1) consists of three cells located west of the Ciniza tank farm. The three cells include two aerated lagoons and Evaporation Pond No. 1. The aeration basins site was identified as a SWMU, and designated as SWMU No. 1 during a RFI conducted at the refinery in the early 1990's. Soil samples were collected on the perimeter of the site and analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and metals. Based on soil sample results, Ciniza recommended NFA for SWMU No. 1. EPA formally agreed with this finding (Attachment J-1); however, EPA required periodic soil sample collection around the aeration basin every five years. Ciniza submitted a survey plat of the site to EPA in 1995. Ciniza conducted the first sampling event in October 1996, and submitted results to the New Mexico Oil Conservation Division (NMOCD) in their Quarterly Progress Report for fourth quarter 1996. The *Aeration Basin - SWMU No. 1 Summary* is included as Appendix I-1.

J.2 SWMU No. 2, Evaporation Ponds

SWMU No. 2 (Figure J-2) consists of a series of evaporation ponds located west and northwest of the Ciniza tank farm. The evaporation pond area was identified as a SWMU, and designated as SWMU No. 2 during a RFI conducted at the refinery in the early 1990's. This investigation included both soil and groundwater sampling and analysis. Samples were collected around the perimeter of the ponds and were sampled for VOCs, SVOCs, and metals. Ciniza recommended NFA for this SWMU and EPA formally approved the finding of NFA on January 7, 1994 (Attachment J-1); however, EPA requested follow-up groundwater sampling from the seven groundwater wells surrounding the evaporation ponds every five years, with analysis identical to that required in the RFI. Ciniza initiated the five-year sampling schedule in 1996. The survey plat, as required, was submitted to EPA in 1995. The *Evaporation Ponds - SWMU No. 2 Summary* is included as Appendix I-2.

J.3 SWMU No. 3, Empty Container Storage Area

SWMU No. 3 (Figure J-3) consists of the empty container storage area, which was located behind the maintenance buildings. The area was used for storing empty drums awaiting recycle. The empty container storage area was identified as a SWMU, and designated as SWMU No. 3, during a RFI conducted at the refinery in the early 1990's. The investigation focused on soil sampling and anaysis. Soil borings were drilled to a depth of 4.5 ft, within the perimeter of the empty container storage area. Samples were collected from each boring in accordance with procedures specified in the Ciniza Sampling and Analysis Plan. Samples were analyzed for priority VOCs using EPA-approved methods.

Ciniza recommended NFA for this SWMU and EPA formally approved the finding of NFA on January 7, 1994 (Attachment J-1). The survey plat as required was submitted to EPA in 1995. The *Empty Container Storage - SWMU No. 3 Summary* is included as Appendix I-3.

J.4 SWMU No. 4, Old Burn Pit

SWMU No. 4 (Figure J-4) consists of the old burn pit located just north of the Ciniza tank farm. The old burn pit was used to burn acid-soluble oils (ASOs). ASOs are heavy-molecular-weight, asphalt-type, cross-polymerized hydrocarbons. The old burn pit was identified as a SWMU, and designated as SWMU No. 4, during a RFI conducted at the refinery during the early 1990's. The RFI investigation included soil sampling and analysis. Soil borings were drilled to a depth of 4.5 ft, within the perimeter of the old burn pit. Soil samples were collected from each boring and were analyzed for VOCs, SVOCs, total metals, and pH using EPA-approved methods. Trace organics and metals were detected. Ciniza recommended NFA for this SWMU, which was rejected by EPA (Attachment J-1). The EPA required additional borings with samples collected at 6 and 10 ft. As an interim measure, an engineered earthen cap composed of low hydraulic conductivity, native soil has been installed over the site. The *Old Burn Pit - SWMU No. 4 Summary* details these activities and is included as Appendix I-4.

J.5 SWMU No. 5, Landfill Areas

In 1987 five inactive solid waste landfill areas were identified a SWMU during a RFA. No further action was recommended at one site, but further evaluation was required at the other four landfill areas. A subsequent RFI designated these four inactive solid waste landfill areas collectively as SWMU No. 5. SWMU No. 5 (Figure J-5) is located midway between the Ciniza tank farm and air strip. Three of the landfill areas are contiguous, and the fourth is located approximately 50 feet north of the main landfill area. The landfills were used to dispose of

nonregulated materials from refinery construction, maintenance, and operational activities.. The landfills have been inactive since the early 1980s.

Landfill Area SWMU No. 5 was recommended for corrective action in the Phase III RFI. A VCAP was submitted in March 1993; the recommendation was regrading of the landfills, compaction and placement of a 6-in. vegetated cover layer. EPA approved the VCAP on January 5, 1994 (Attachment J-1). Ciniza proceeded with capping the landfills in accordance with the approved VCAP. This activity has been documented in the *Landfill Area - SWMU No. 5 Closure Certification*. The closure certification report is included as Appendix I-5 and provides certification of closure by a registered Professional Engineer.

J.6 SWMU No. 6, Tank Farm—Leaded Gasoline Tanks

SWMU No. 6 (Figure J-6) consists of 10 tanks in the refinery storage area that were used for the storage of leaded gasolines. The tank farm area was identified as a SWMU, and designated as SWMU No. 6, during a RFI conducted at the refinery in the early 1990's. Trace organics and metals were detected. In 1994, EPA requested additional sampling at greater depth (Attachment J-1). Vertical borings were made near the manway of each tank and an angle boring was made at a preapproved location around each tank. Soil samples were collected and analyzed for benzene, toluene, ethylbenzene, and xylene (BTEX); lead; and nickel. Laboratory analysis of the free product indicated that it was gasoline.

Ciniza submitted a VCAP in April 1996 (Giant 1996). The VCAP proposed product recovery from the two investigation wells, with downgradient well monitoring thereafter. The NMOCD approved the VCAP with modifications, which included drilling six borings to identify the vertical and horizontal extent of the gasoline plume. Corrective action is proceeding in accordance with the VCAP. The *Tank Farm—Leaded Gasoline Tanks - SWMU No. 6 Summary* is included as Appendix I-6.

J.7 SWMU No. 7, Fire Training Area

SWMU No. 7 (Figure J-7) consists of the fire training area located adjacent to the idle process equipment storage area. It consists of a fire water header, a 4-ft-high by 16-ft-diameter tank, and an industrial pump on a cement pedestal. The fire training area was used two to three times a year to train Ciniza Refinery fire crews. The fire training area was identified as a SWMU, and designated as SWMU No. 7, during a RFI conducted at the refinery in the early 1990's. The investigation included soil sampling and analysis. Soil borings were drilled to a depth of 4.5 ft around the perimeter of the fire training area. Soil samples were collected at each boring and sampled for oil and grease and total petroleum hydrocarbons (TPH) using EPA-approved methods.

The *Fire Training Area* SWMU No. 7 was recommended for corrective action in the Phase III RFI and a VCAP was submitted in March 1993 (Giant 1993a). The VCAP recommends removing the existing steel tank, aeration of soils beneath the tank to a depth of 5 ft, amending soils with fertilizer and water to increase biological degradation, and quarterly monitoring. When oil and grease are at, or below cleanup levels, closure will be initiated. The EPA approved the VCAP January 5, 1994. Corrective action is proceeding in accordance with the VCAP. The *Fire Training Area - SWMU No. 7 Summary* is included as Appendix I-7.

J.8 SWMU No. 8, Railroad Rack Lagoon

SWMU No. 8 (Figure J-8) consists of the railroad rack lagoon, and its overflow ditch and fanout. This area is located to the north of the refinery tank farm area near the railway spur. The railroad rack lagoon was identified as a SWMU, and designated as SWMU No. 8, during a RFI conducted at the refinery in the early 1990's. Soil samples from adjacent and under the railroad rack lagoon and within the overflow ditch and fanout area were collected and analyzed during this initial investigation. A Final Remedy Plan was proposed in the Phase I RFI supplemental report, which included diverting drainage water around the railroad rack from the existing lagoon to the refinery wastewater system; plugging the old system; transferring the lagoon liquids to the refinery wastewater system; and treating contaminated soils. This procedure was formalized through a VCAP for the Railroad Rack Lagoon. The VCAP was submitted to the EPA in December 1992 and approved in November 1993 (Attachment J-1); however, additional site monitoring during soil remediation is required. Ciniza completed the piping modifications and evacuation of lagoon liquids by June 1994. Corrective action is ongoing in accordance with the approved VCAP criteria. The *Railroad Rack Lagoon - SWMU No. 8 Summary* is included as Appendix I-8.

J.9 SWMU No. 9 and No. 14, Drainage Ditch Near the Inactive Land Farm

SWMU No. 9 (Figure J-9) consists of an inactive treatment area and associated drainage ditch. This SWMU is located north of the Ciniza tank farm. In 1990 the *Inactive Land Treatment Unit* and *Drainage Ditch* were identified as SWMU No. 9 and SWMU No. 14, respectively. They were combined to become SWMU No. 9, the *Drainage Ditch Near the Inactive Land Treatment Area*. Specific sample activities at SWMU No. 9 included vertical soil borings at the inactive treatment area. The soil samples were analyzed for VOCs, SVOCs, and total metals. Ciniza recommended NFA for the *Drainage Ditch Near the Inactive Land Treatment Area;* a survey plat was submitted to EPA in July 1995 (Attachment J-1). The *Drainage Ditch Near the Inactive Land Farm - SWMU No. 9 and No. 14 Summary* is included as Appendix I-9.

J.10 SWMU No. 10, Sludge Pits

SWMU No. 10 (Figure J-10) consists of two former American Petroleum Institute (API) separator sludge pits located to the west of the existing API separator. The pits were backfilled in 1980. The sludge pit area was identified as a SWMU, and designated as SWMU No. 10, during a RFI conducted at the refinery in the early 1990's. Soil borings were advanced at this site, and samples were collected and analyzed for VOCs, SVOCs, and metals. Soil sampling results detected organic contaminants. A Final Remedy Plan was proposed in the Phase I RFI supplemental report, which included remediation of the soils. In place remediation of the soils was formalized in the VCAP for the Sludge Pits submitted to the EPA in December 1992. The EPA approved the VCAP in November 1993, requiring additional site monitoring. The additional monitoring was completed in 1994. Ciniza is proceeding with corrective actions in accordance with the approved VCAP criteria. The *Sludge Pits - SWMU No. 10 Summary* is submitted as Appendix I-10.

J.11 SWMU No. 11, Secondary Oil Skimmer

SWMU No. 11 (Figure J-11) consists of the secondary oil skimmer located south of the main evaporation ponds. Prior to removal, it was used as a backup oil skimmer during maintenance activities on the primary oil skimmer. During a 1987 RFA the secondary oil skimmer was identified as a *unit of concern*. Subsequent investigation determined this area to be a SWMU, designated as SWMU No. 11. Soil samples were collected from the oil skimmer area in accordance with the Ciniza Sampling and Analysis Plan. Each of the borings and analyzed for VOCs and SVOCs using EPA-approved methods. Based on sample results, Ciniza recommended NFA. The EPA rejected the recommendation and required two additional borings with samples collected at 10 ft. Additional monitoring was completed. Ciniza is proceeding with corrective actions in accordance with the approved VCAP criteria. The *Secondary Oil Skimmer - SWMU No. 11 Summary* is submitted as Appendix I-11.

J.12 SWMU No. 12, Contact Wastewater Collection System

SWMU No. 12 (Figure J-12) consists of the piping runs and catch basins of the Contact Wastewater Collection System (CWWCS). A Vactor system was used to clean the sewer boxes and underground lines. Once cleaned, the lines were inspected by inserting TV cameras inside the pipe and video taping the inside of the lines. The inspection showed evidence of pitting and corrosion throughout the CWWCS; however, it did not show any evidence of leaks or exfiltration of hydrocarbons into the surrounding soil. NFA was recommended for the CWWCS in the Phase I RFI report. EPA rejected the NFA recommendation and required inspection of the CWWCS every five years, beginning in calendar year 1996. The inspection was to be identical to the one performed in the RFI unless better technologies are proposed by Ciniza and approved by EPA. Ciniza is currently inspecting the system and will notify the NMOCD upon completion. CWWCS is also regulated by the NMOCD pursuant to Clean Water Act (G10-32-Part A). Because the CWWCS is a closed loop system connected to a

permitted unit, it is exempt from HSWA based on Criterion 2 (Attachment J-1). The *Contact Wastewater Collection System - SWMU No. 12 Summary* is submitted as Appendix I-12.

J.13 SWMU No. 13, Drainage Ditch Between API Evaporation Ponds and Neutralization Tank Evaporation Ponds (a.k.a. Drainage Ditch Between API Evaporation Ponds and the North Series and South Series of Ponds)

SWMU No. 13 (Figure J-13) consists of the small overflow lagoon known as Pond No. 10 and its associated drainage ditch. The drainage ditch site was identified as a SWMU, and designated as SWMU No. 13, during a RFI conducted at the refinery in the early 1990's. Based on the results of soil collected on the perimeter of the pond and beside the ditch, Ciniza recommended NFA for this SWMU. The EPA concurred with this finding of NFA and approved cessation of the investigative process; however, they required soil sample collection around the drainage ditch every five years, with analysis identical to that required in the RFI. The EPA reviewed Ciniza's proposal and in August 1994, agreed to the five-year sampling schedule to begin in 1995. Ciniza also submitted a survey plat of the site in July 1995. Ciniza conducted the first sampling event in October 1996, and submitted results to the NMOCD in their Quarterly Progress Report for fourth-quarter 1996. The *Drainage Ditch Between API Evaporation Ponds and Neutralization Tank Evaporation Ponds - SWMU No. 13 Summary* is submitted as Appendix I-13.

Table J-1. Solid Waste Management Units

SWMU No.[1]	SWMU Title	Status	Report
1	The Aeration Basin (i)[2]	EPA approval of NFA given in January 1994. Survey plat[3] submitted to EPA. Investigative process complete. Five-year sampling of soil around basin required again in 2001.	Appendix I-1: Aeration Basin - SWMU No. 1 Summary
2	The Evaporation Ponds (ii)	EPA approval of NFA given in January 1994. Investigative process complete. Follow-up monitoring required. Survey plat[3] submitted. Five-year sampling required again in 2001.	Appendix I-2: Evaporation Ponds - SWMU No. 2 Summary
3	Empty Container Storage Area (v)	EPA approval of NFA given January 1994. Investigative process complete. Survey plat[3] submitted to EPA.	Appendix I-3: Empty Container Storage Area - SWMU No. 3 Summary
4	Old Burn Pit (viii)	RFI 1990; sampling report identified corrective action. Site capped in 1998. Investigative process complete. Survey plat[3] submitted.	Appendix I-4: Old Burn Pit - SWMU No. 4 Summary
5	Landfill Areas (vii)	VCAP submitted February 1993 and approved in January 1994. Closure plan prepared and certified by PE, 1998.	Appendix I-5: Landfill Areas - SWMU No. 5 Closure Certification
6	The Tank Farm—Leaded Gasoline Tanks (iii)	VCAP submitted in April 1996. Investigative process complete. Corrective action currently under way. Survey plat[3] submitted.	Appendix I-6: Tank Farm—Leaded Gasoline Tanks - SWMU No. 6 Summary
7	Fire Training Area (iv)	VCAP submitted in March 1993, and approved via fax in March 1996. RFI sampling complete. Investigative process complete. Survey plat[3] submitted. Corrective action ongoing.	Appendix I-7: Fire Training Area - SWMU No. 7 Summary
8	The Railroad Rack Lagoon (vi)	VCAP submitted in December 1992, and approved in November 1994. RFI sampling complete. Investigative process complete. Corrective action ongoing. Survey plat[3] submitted.	Appendix I-8: Railroad Rack Lagoon - SWMU No. 8 Summary
9	The Drainage Ditch Near the Inactive Land Farm (x and xiii)	RFI sampling complete. Report on additional RFI sampling suggested NFA. Investigative process complete. Survey plat[3] submitted to EPA.	Appendix I-9: Drainage Ditch and the Inactive Land Farm - SWMU No. 9 Summary
10	The Sludge Pits (ix)	VCAP submitted in December 1992, and approved in January 1994. RFI sampling complete. Investigative process complete. Proceed with closure activities. Survey plat[3] submitted.	Appendix I-10: Sludge Pits - SWMU No. 10 Summary

Table J-1. Solid Waste Management Units (Continued)

SWMU No.[1]	SWMU Title	Status	Report
11	Secondary Oil Skimmer (xi)	RFI sampling complete. Report on additional RFI sampling suggested NFA. Investigative process complete. Corrective action ongoing. Survey plat[3] submitted.	Appendix I-11: Secondary Oil Skimmer - SWMU No. 11 Summary
12	Contact Wastewater Collection System (CWWCS) (xii)	Investigative process complete. EPA requires inspection every 5 years. Ciniza currently repairing and inspecting system. Will notify NMOCD upon completion.	Appendix I-12: Contact Wastewater Collection System - SWMU No. 12 Summary
13	The Drainage Ditch Between API Evaporation Ponds and Neutralization Tank Evaporation Ponds (xiv)	EPA approval of NFA given in January 1994. Follow-up monitoring required. Survey plat[3] submitted to EPA. Soil sampling collected around drainage ditch required again in 2001.	Appendix I-13: Drainage Ditch Between API Evaporation Ponds and Neutralization Tank Evaporation Ponds - SWMU No. 13 Summary

[1]Solid Waste Management Unit Numbers as designated in the RCRA Facility Investigation Work Plan (submitted May 1990).

[2]Solid Waste Management Unit Numbers as designated in the HSWA Permit (Section C, Corrective Actions for Continuing Releases, 5.(a)(1). December 1988.

[3]See Figure J-14.

Table J-2. Ciniza Refinery—Solid Waste Management Unit Identification

Description	HSWA[1] Permit 1988	RFI[2] Work Plan 1990	EPA[3] Letters 1994	LTU[4] Post-Closure Part B 1998
Aeration Basin	i	1	1	1
Evaporation Ponds	ii	2	2	2
Empty Container Storage Area	v	3	5	3
Old Burn Pit	viii	4	8	4
Landfill Areas	vii	5	7	5
Tank Farm	iii	6	6	6
Fire Training Area	iv	7	4	7
Railroad Rack Lagoon, Overflow Ditch and Fan Out Area	vi	8	8	8
Inactive Land Treatment Area	x and xiii	9	—	9 and 14
Sludge Pits	ix	10	9	10
Secondary Oil Skimmer and Associated Drainage Ditch	xi	11	11	11
Contact Waste Water Collection System	xii	12	13	12
Drainage Ditch Between APIs Evaporation Ponds and Neutralization Tank Evaporation Ponds	xiv	13	13	13
Drainage Ditch near the Inactive Land Treatment Area		14		

[1]Solid Waste Management Unit Numbers as designated in the HSWA Permit (Section C, Corrective Actions for Continuing Releases, 5(a)(1), December 1988.

[2]Solid Waste Management Unit Numbers as designated in the RCRA Facility Investigation Work Plan (submitted May 1990).

[3]Solid Waste Management Unit Numbers as designated in the EPA letters (provided as Attachment J-1).

[4]Solid Waste Management Unit Numbers as designated in the RCRA Part B Post-Closure Application (Volume III, Appendix J-1 through J-13).

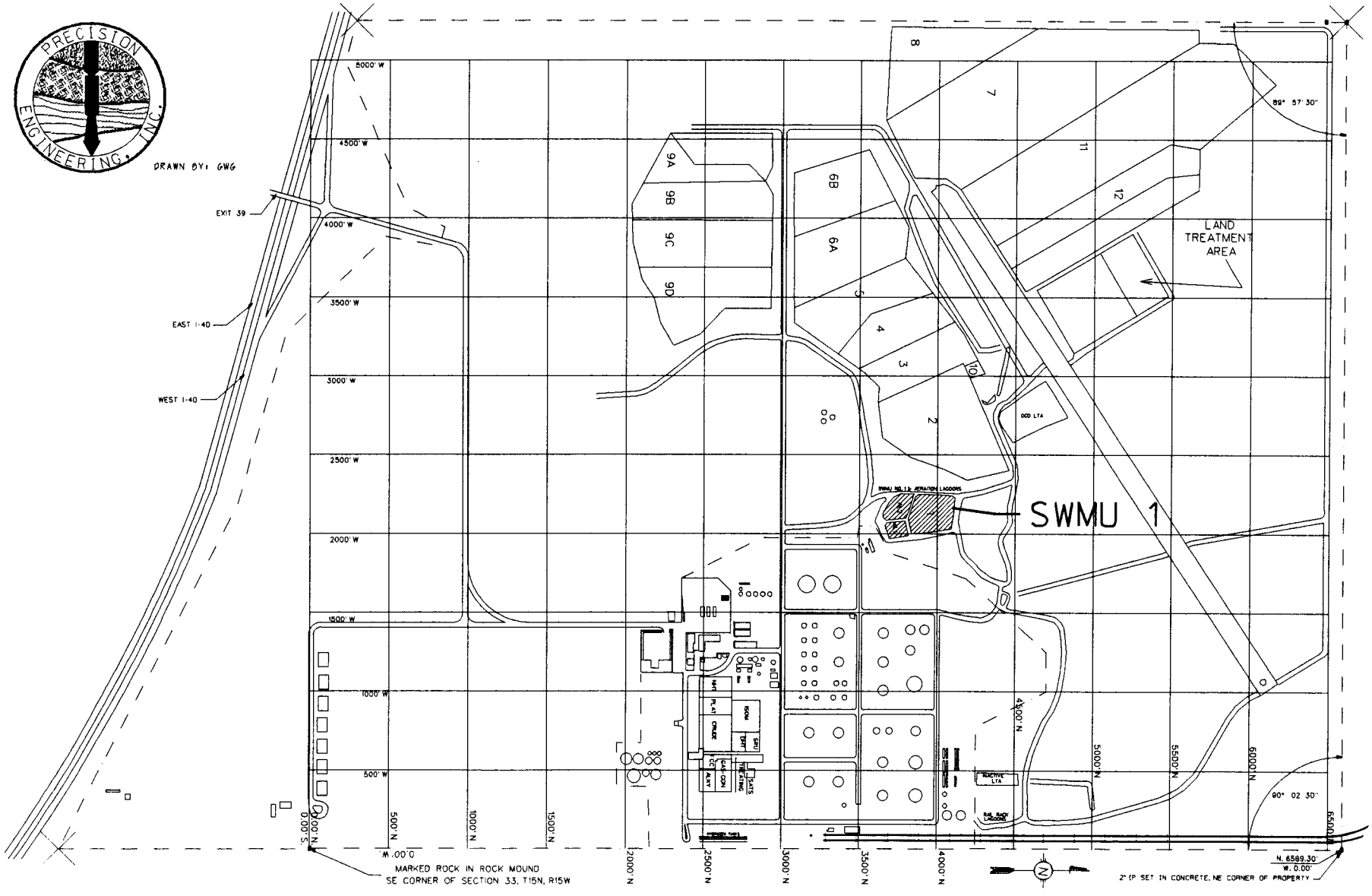

Figure J-1a. SWMU No. 1, Aeration Basin

Figure J-1b. SWMU No. 1, Aeration Basin Detail Photo

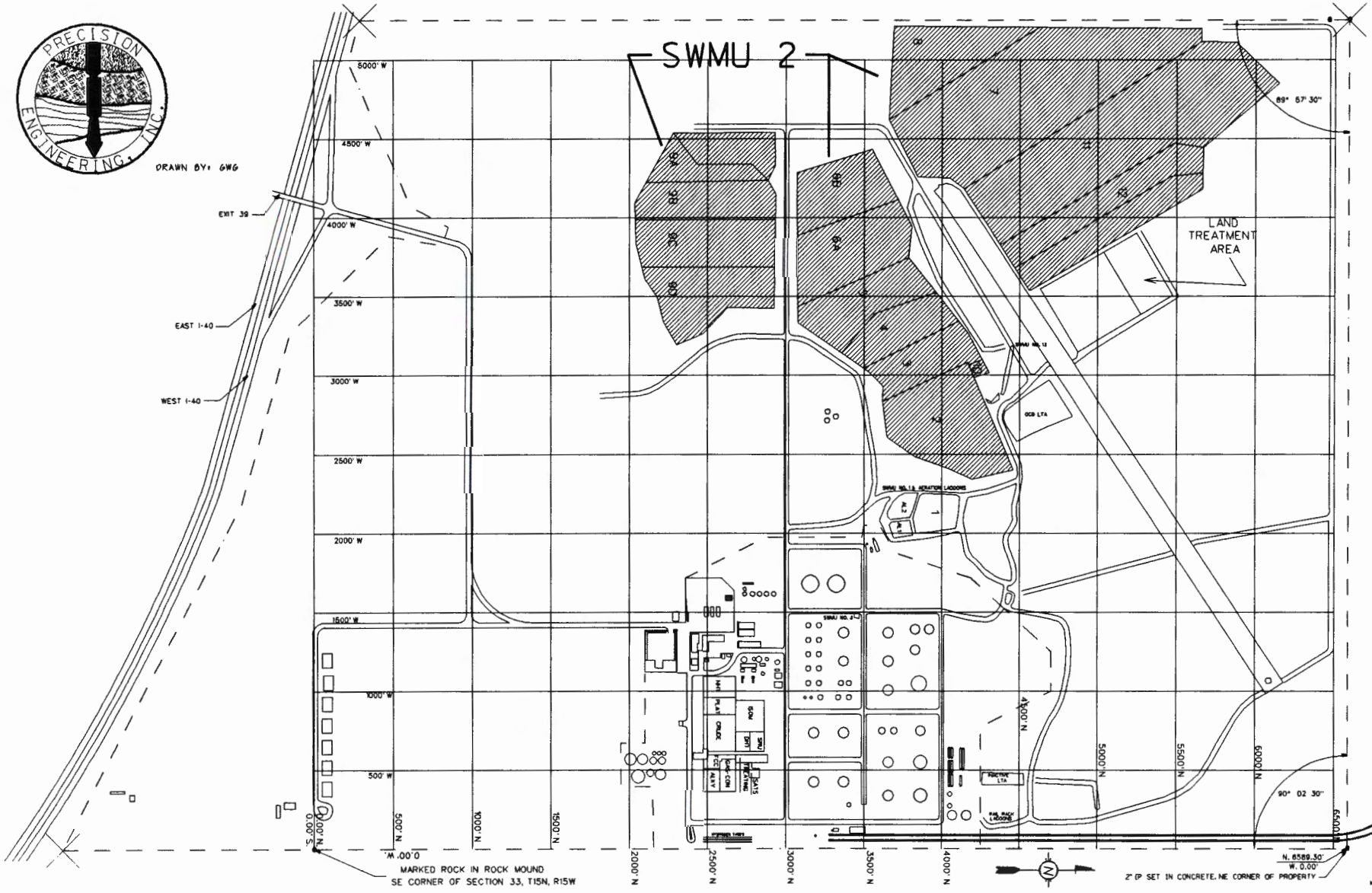

Figure J-2a. SWMU No. 2, Evaporation Ponds

Figure J-2b. SWMU No. 2, Evaporation Ponds Detail Photo

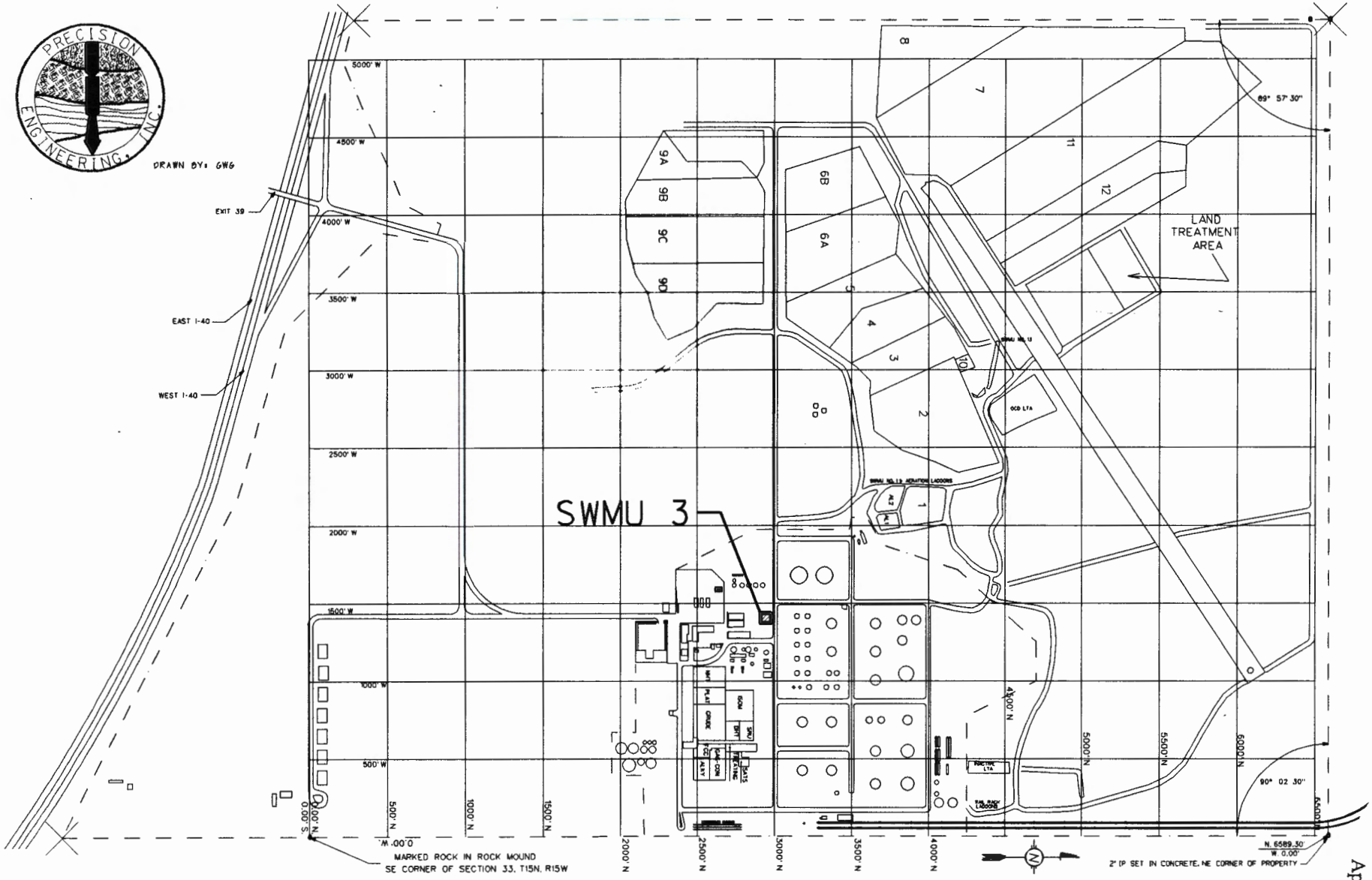

Figure J-3a. SWMU No. 3, Empty Container Storage Area

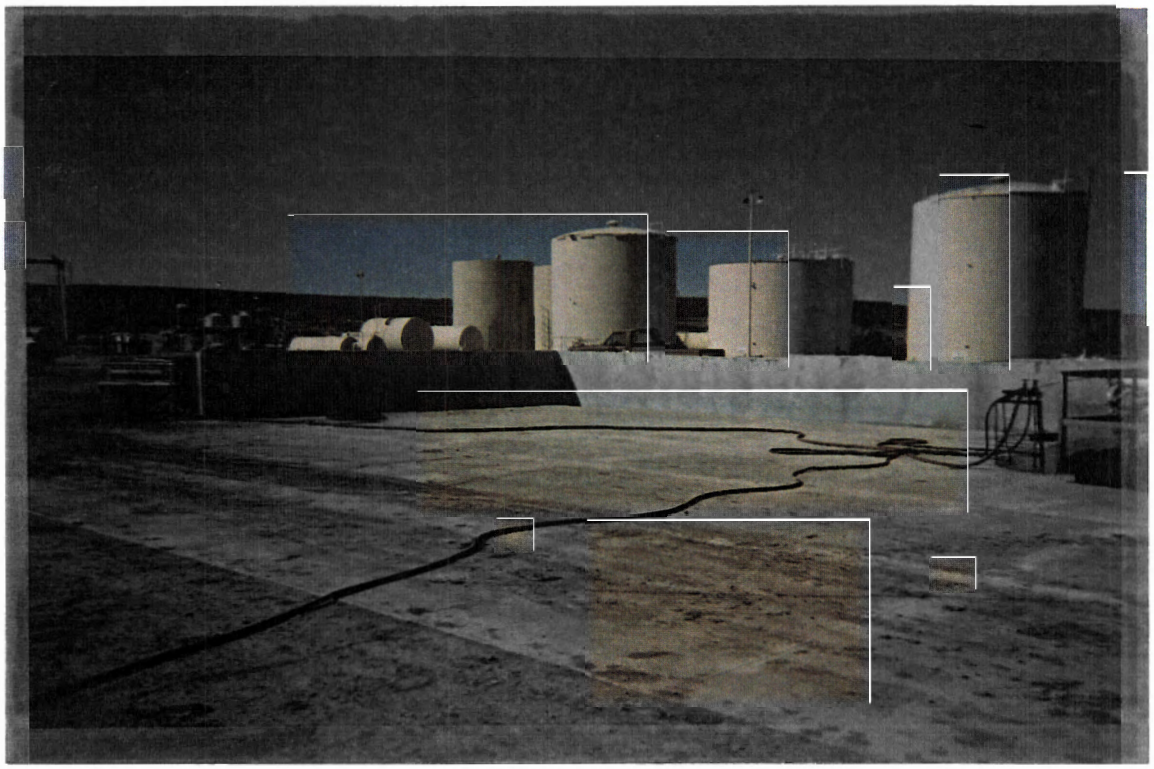

Figure J-3b. SWMU No. 3, Empty Container Storage Area Detail Photo

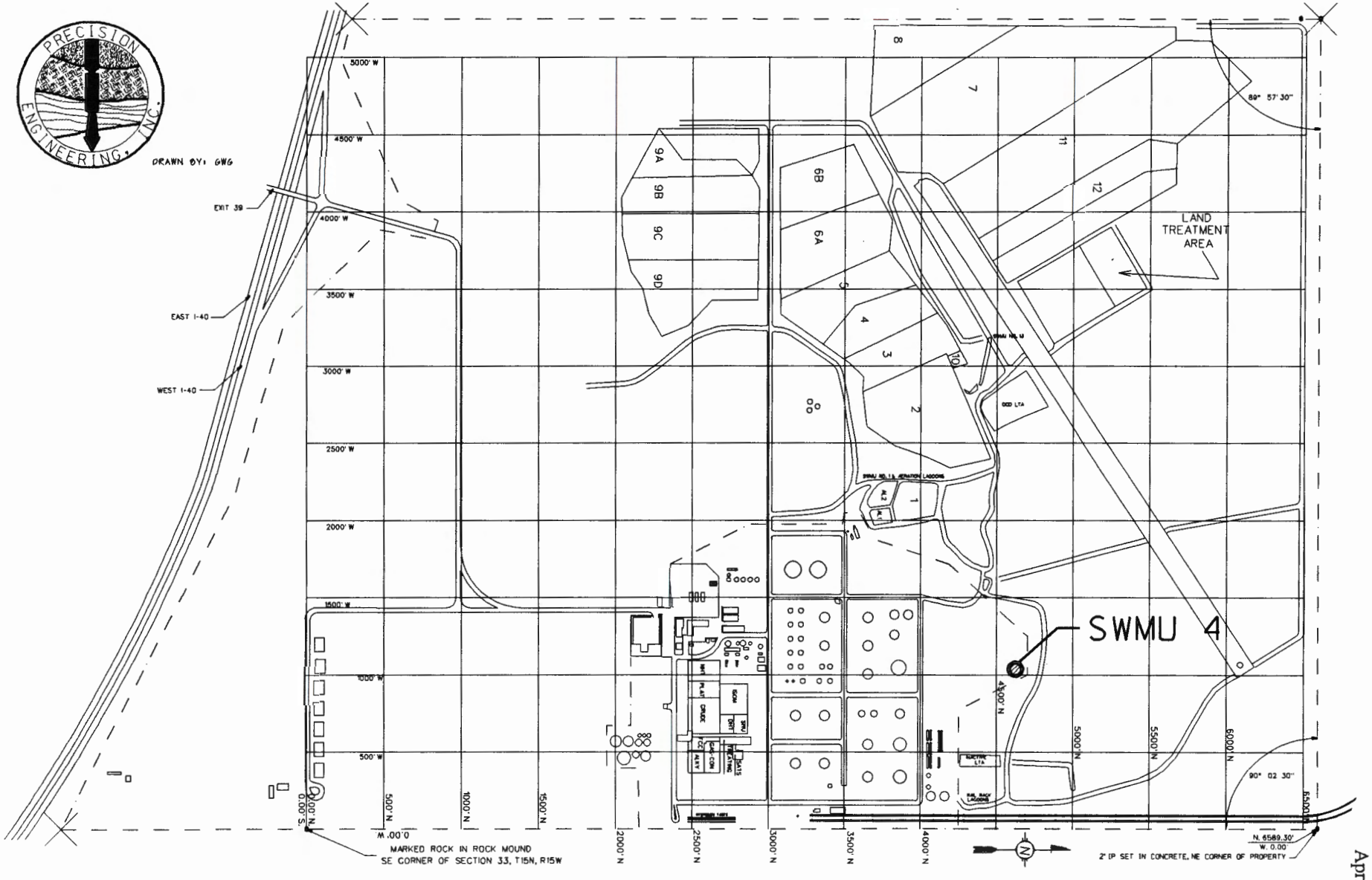

Figure J-4a. SWMU No. 4, Old Burn Pit

Figure J-4b. SWMU No. 4, Old Burn Pit Detail Photo

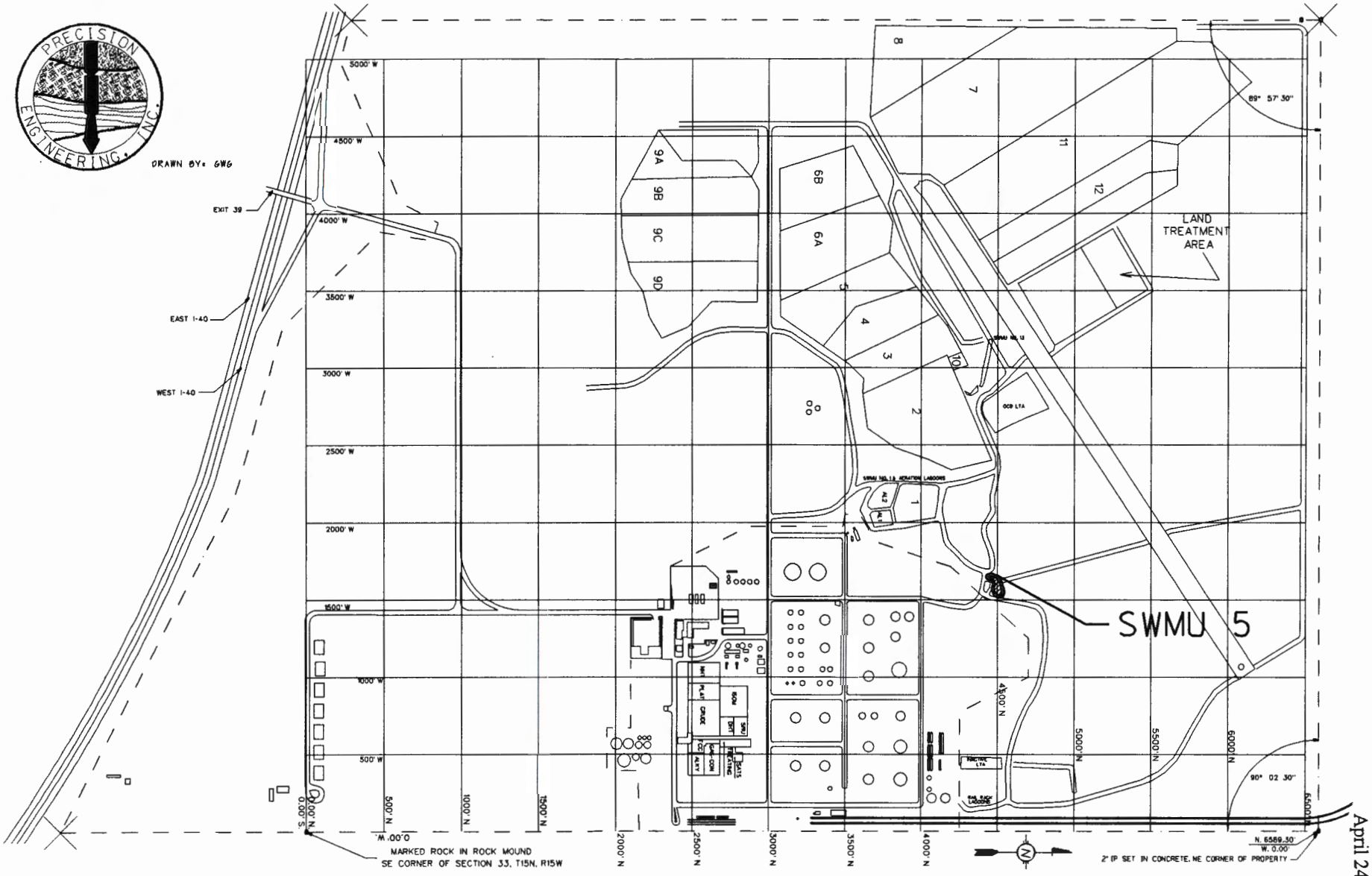

Figure J-5a. SWMU No. 5, Landfill Areas

Figure J-5b. SWMU No. 5, Landfill Areas Detail Photo

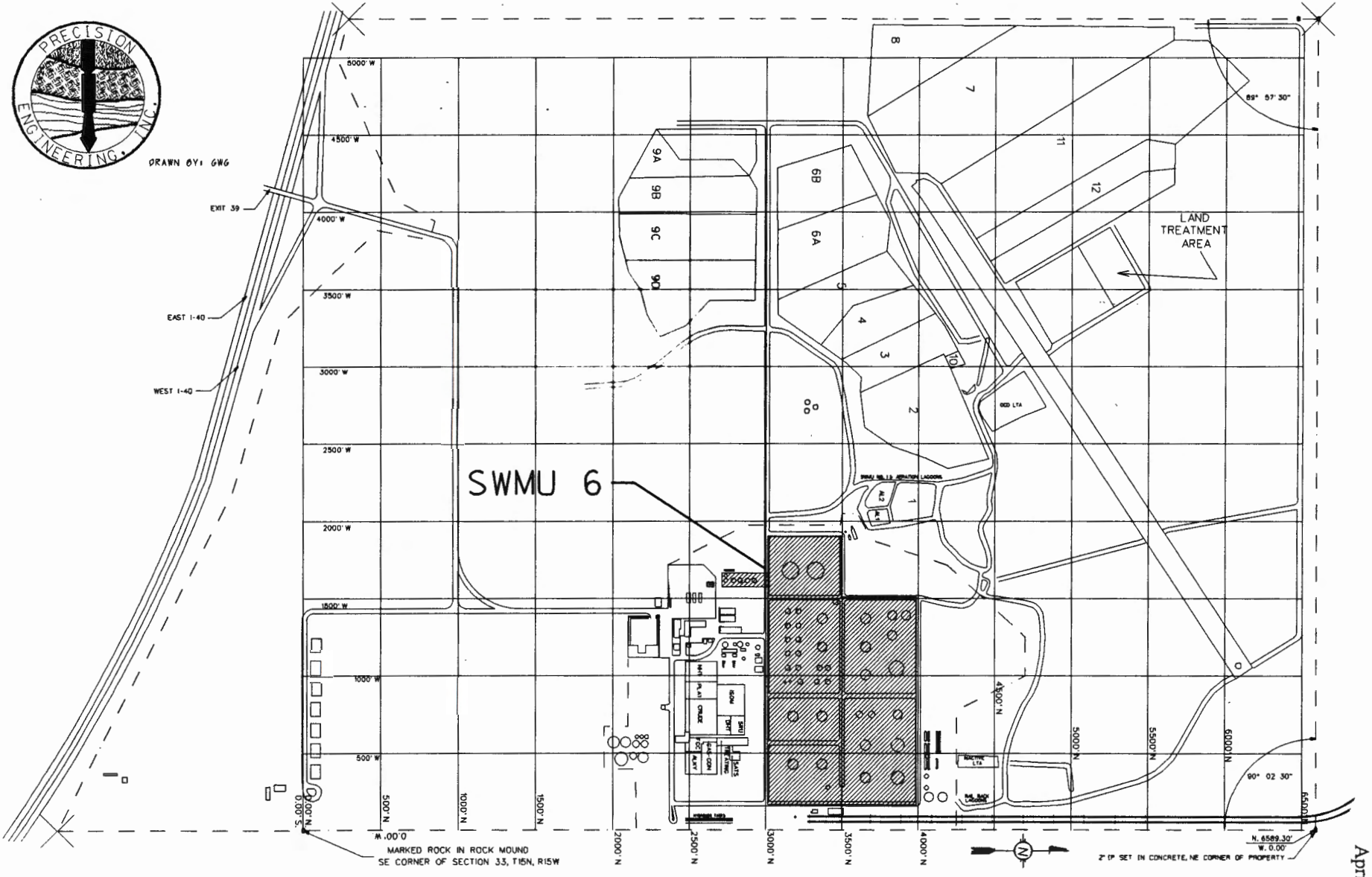

Figure J-6a. SWMU No. 6, Tank Farm—Leaded Gasoline Tanks

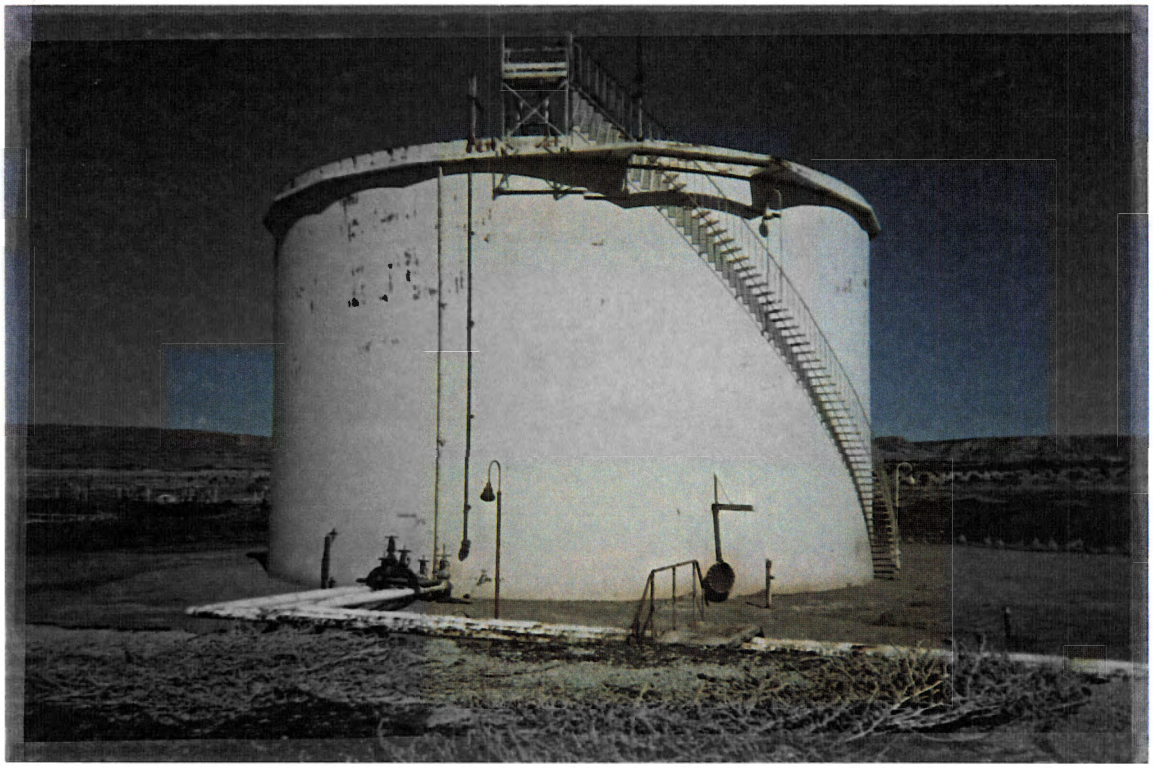

Figure J-6b. SWMU No. 6, Tank Farm—Leaded Gasoline Tanks Detail Photo

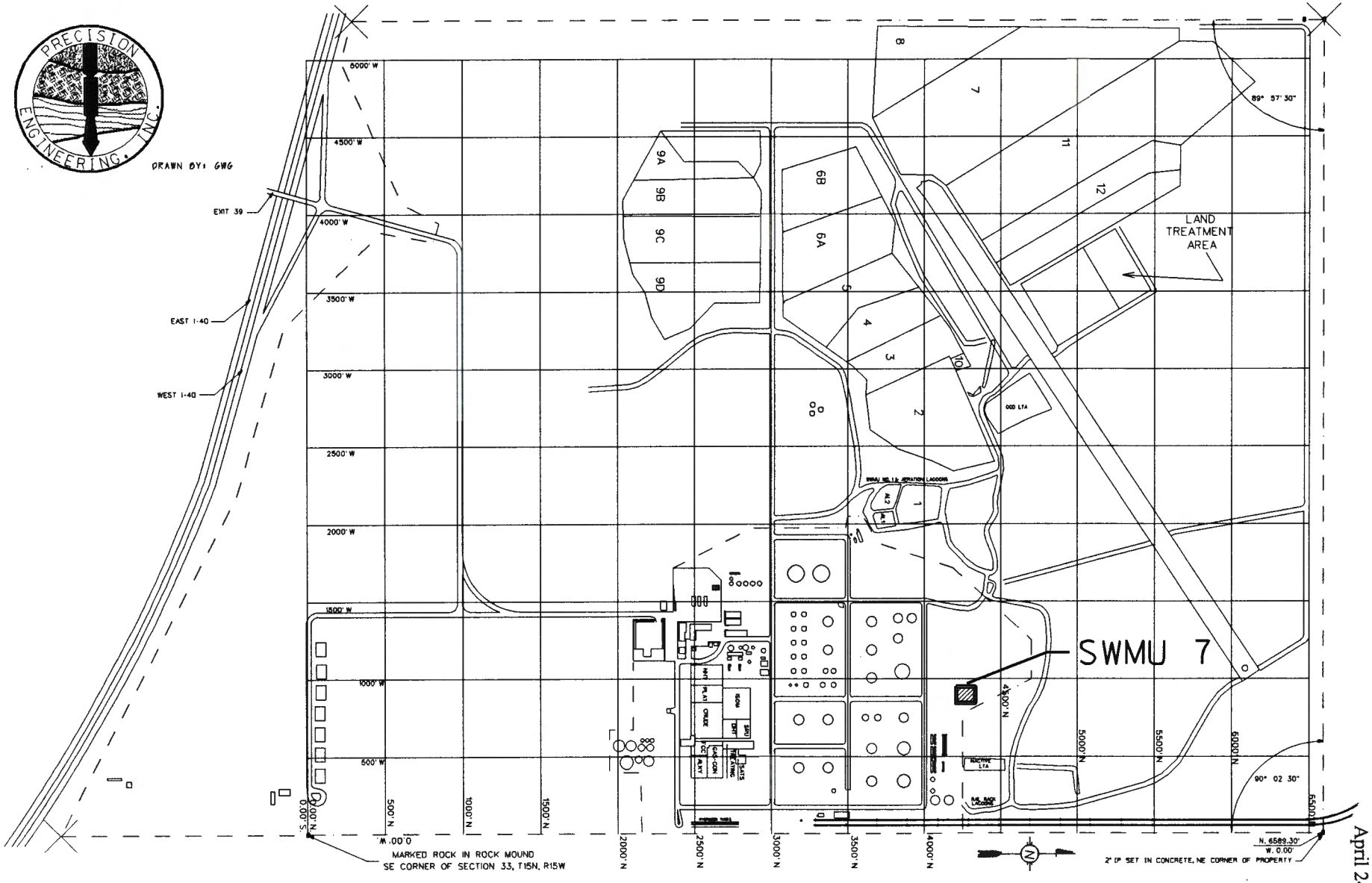

Figure J-7a. SWMU No. 7, Fire Training Area

Figure J-7b. SWMU No. 7, Fire Training Area Detail Photo

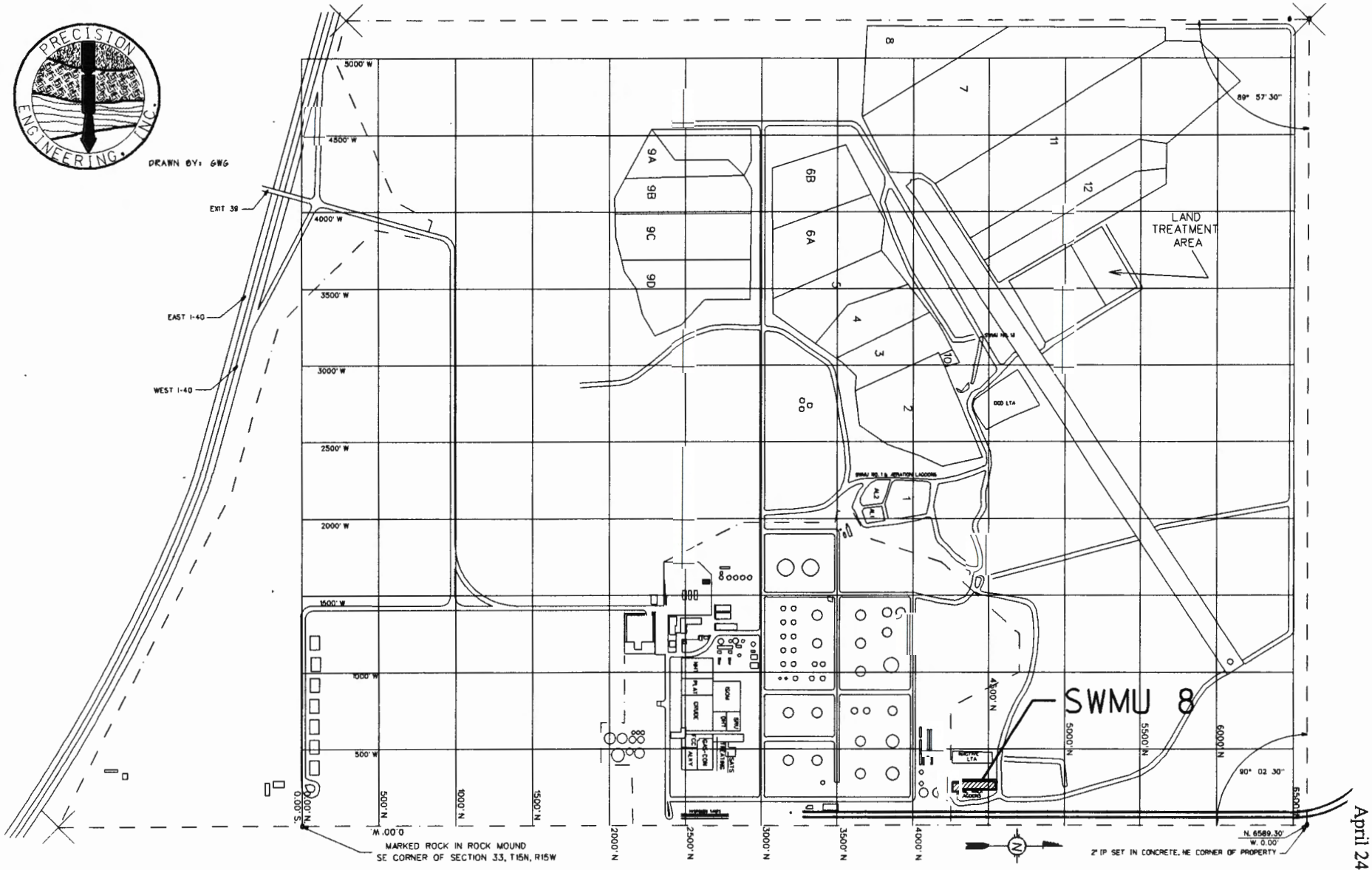

Figure J-8a. SWMU No. 8, Railroad Rack Lagoon

Figure J-8b. SWMU No. 8, Railroad Rack Lagoon Detail Photo

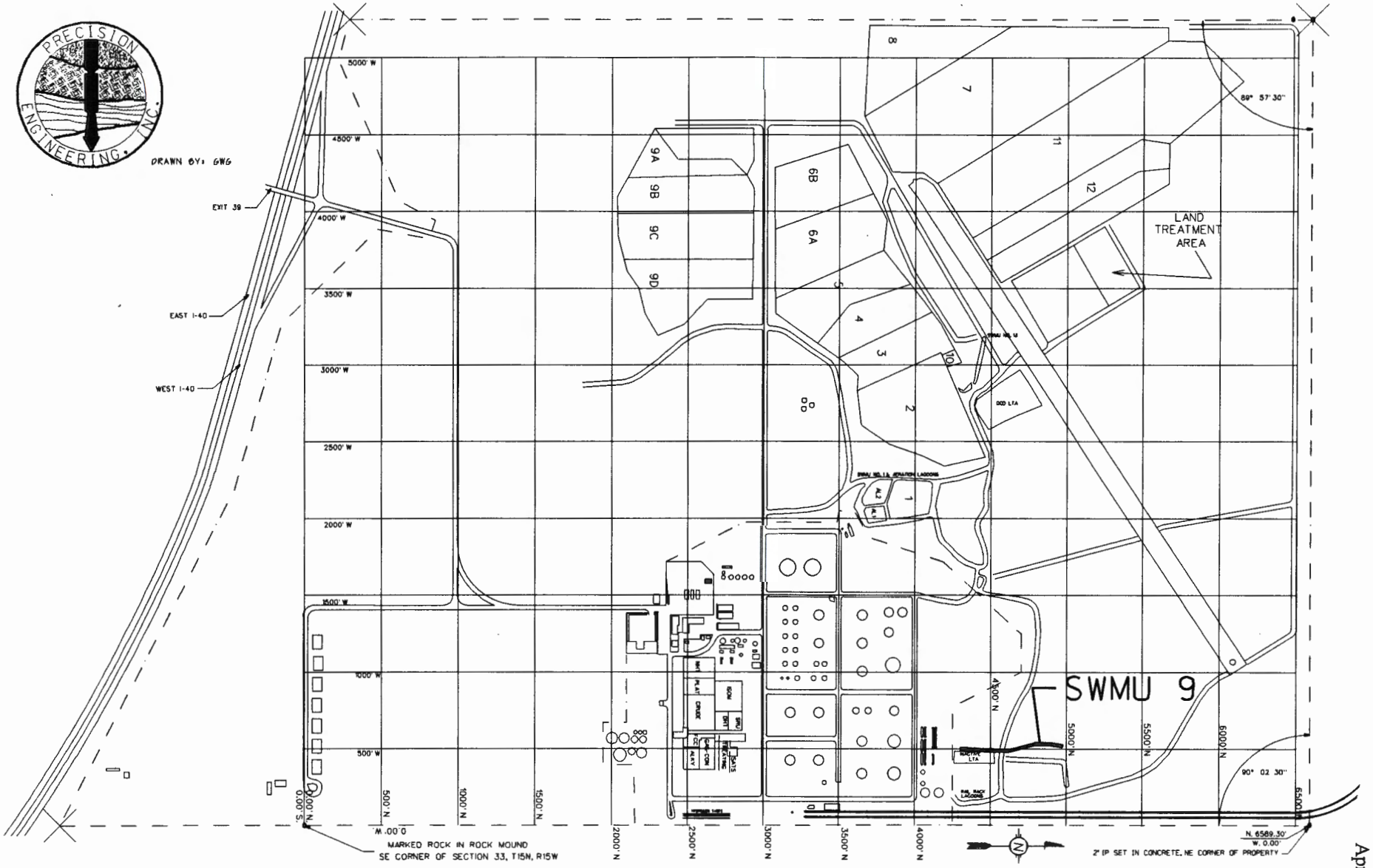

Figure J-9a. SWMU No. 9, Drainage Ditch Near the Inactive Land Farm

Figure J-9b. SWMU No. 9, Drainage Ditch and the Inactive Land Farm Detail Photo

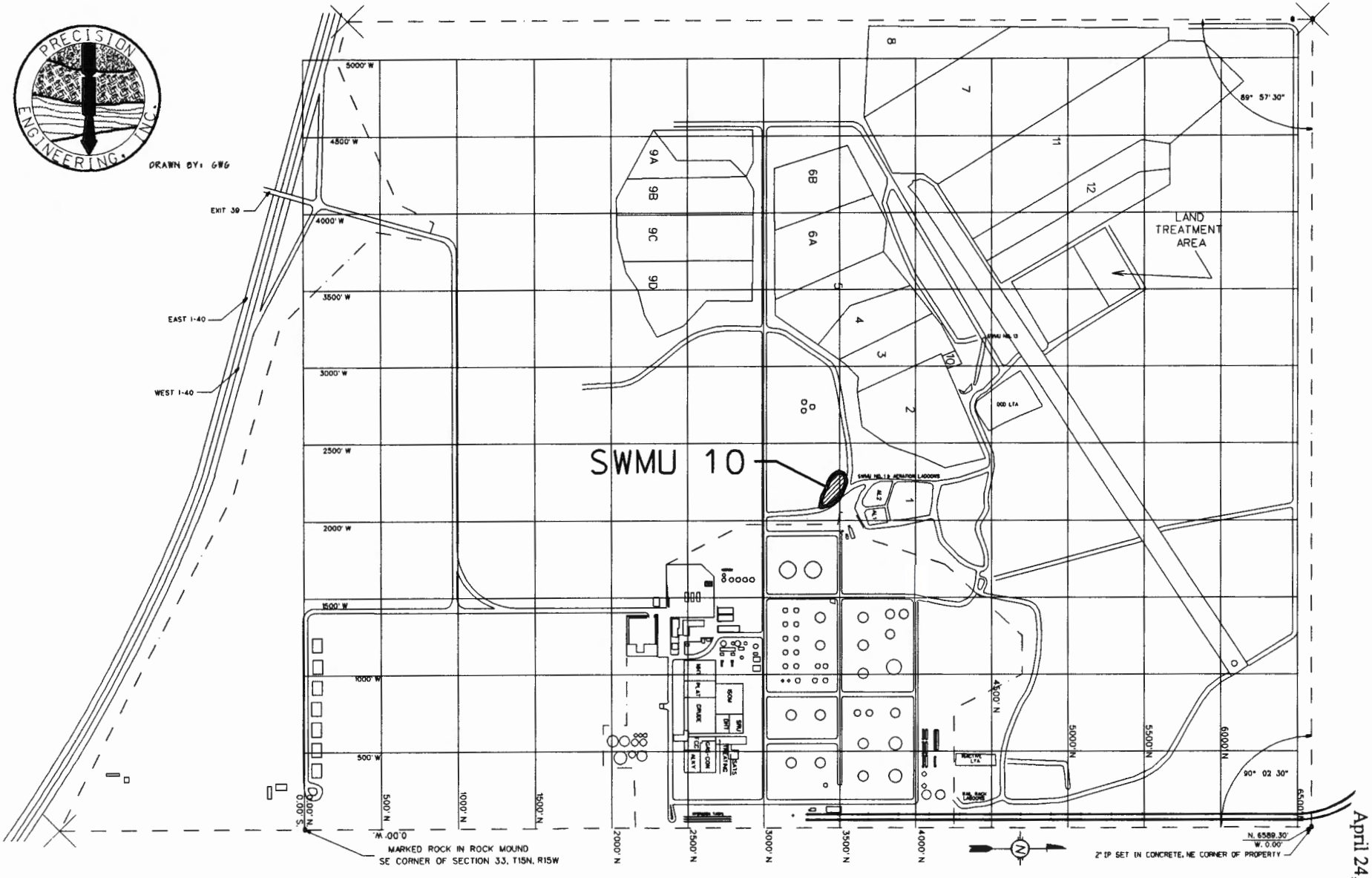

Figure J-10a. SWMU No. 10, Sludge Pits

Figure J-10b. SWMU No. 10, Sludge Pits Detail Photo

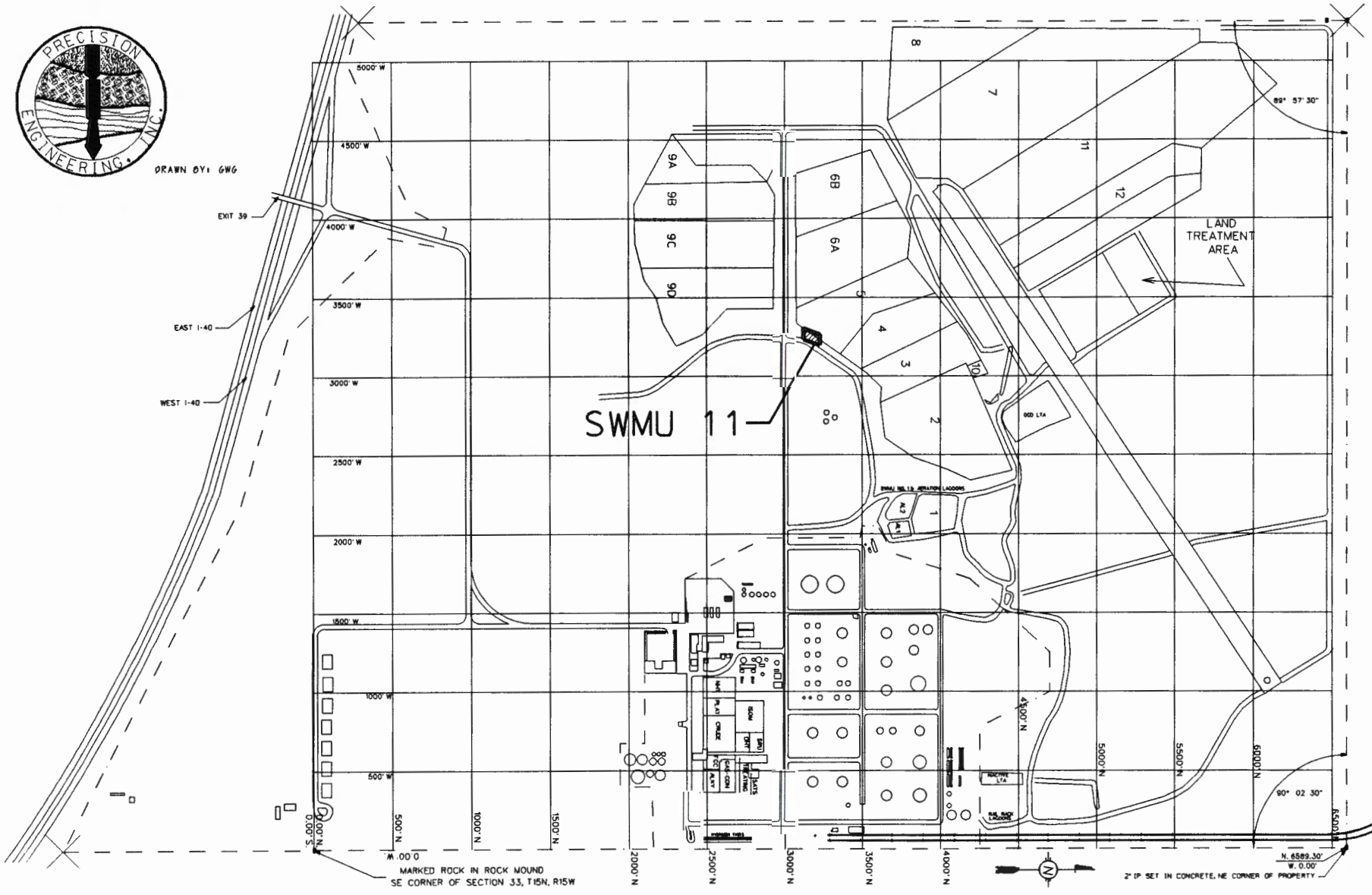

Figure J-11a. SWMU No. 11, Secondary Oil Skimmer

Figure J-11b. SWMU No. 11, Secondary Oil Skimmer Detail Photo

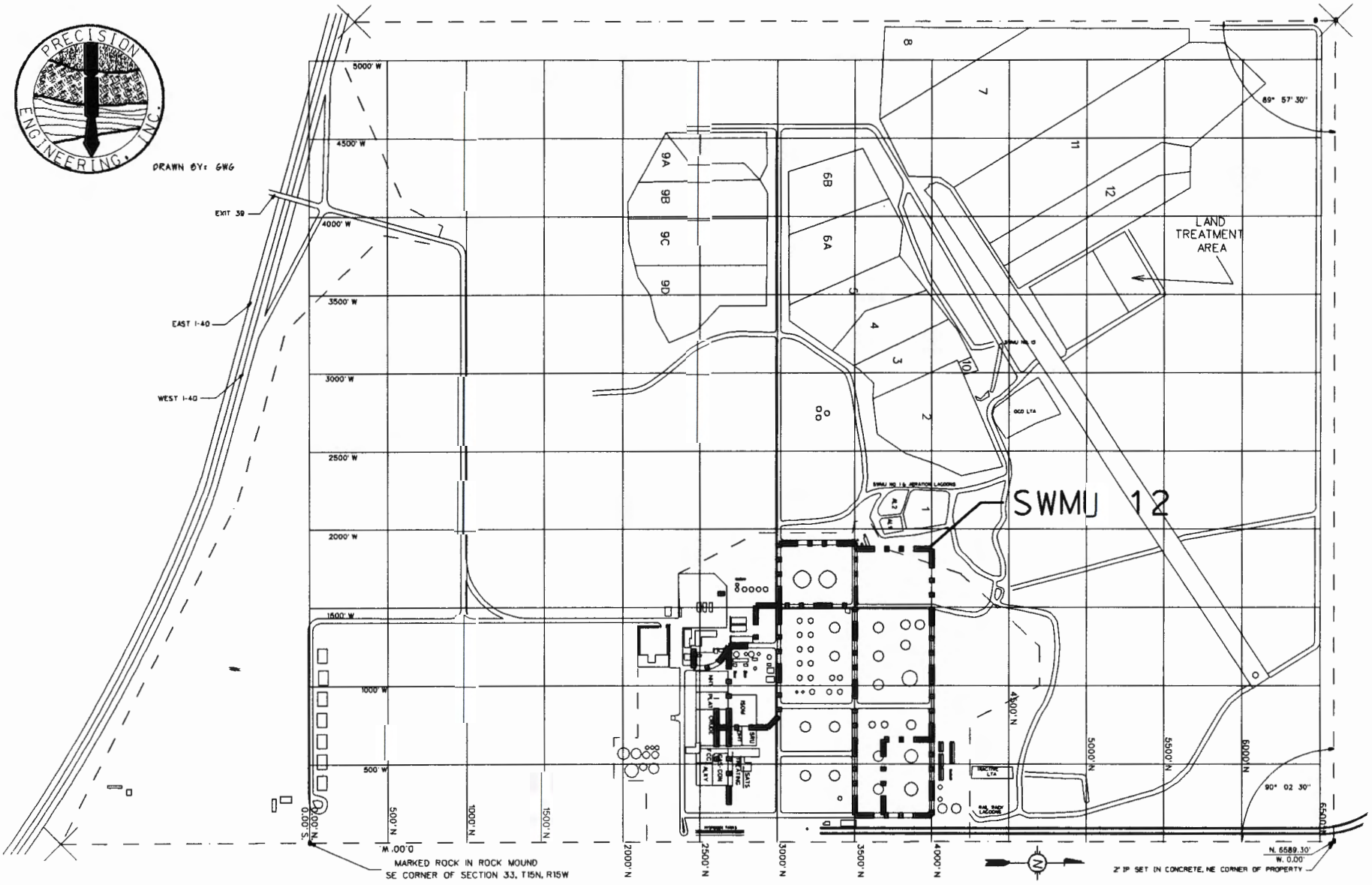

Figure J-12a. SWMU No. 12, Contact Wastewater Collection System

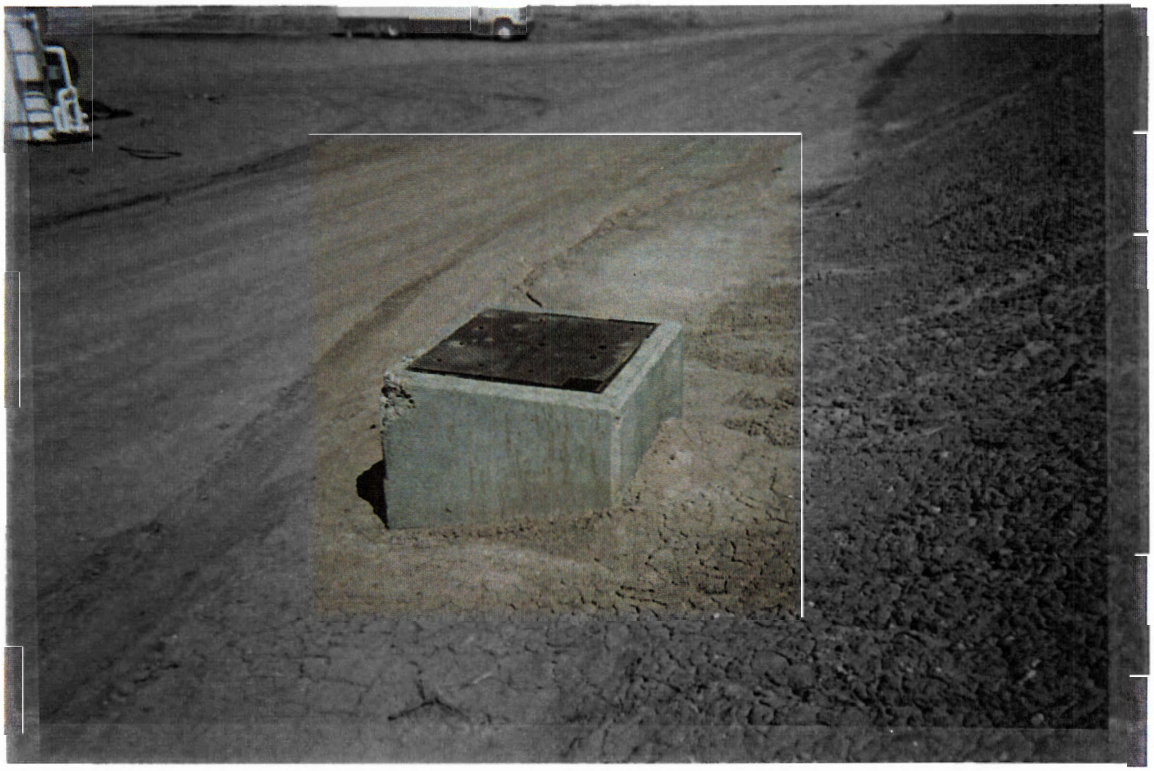

Figure J-12b. SWMU No. 12, Contact Wastewater Collection System Detail Photo

CINIZA REFINERY
SITE MAP

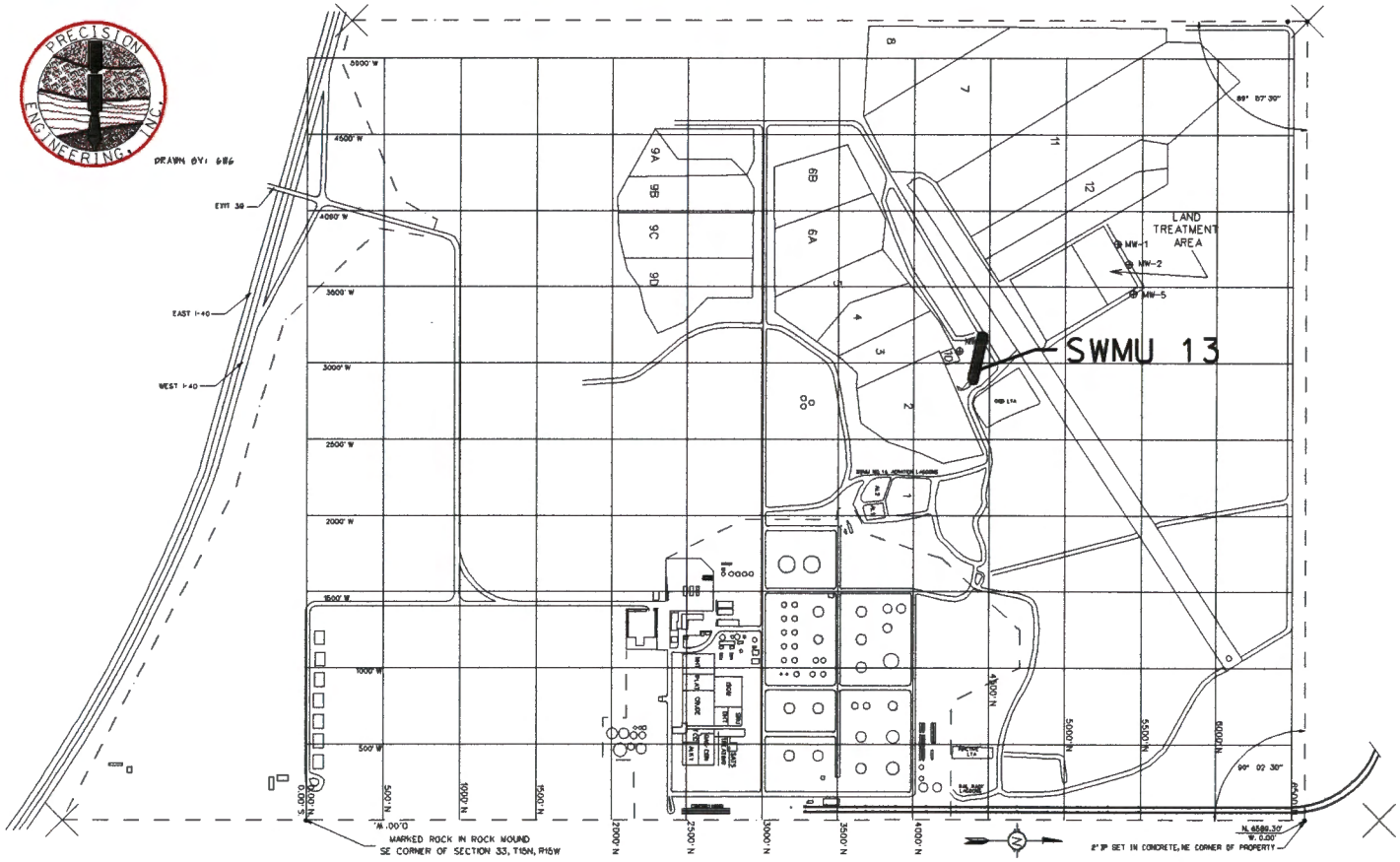

Figure J-13

Drainage Ditch Between
APIs Evaporation Ponds And Neutralization Tank Evaporation Ponds

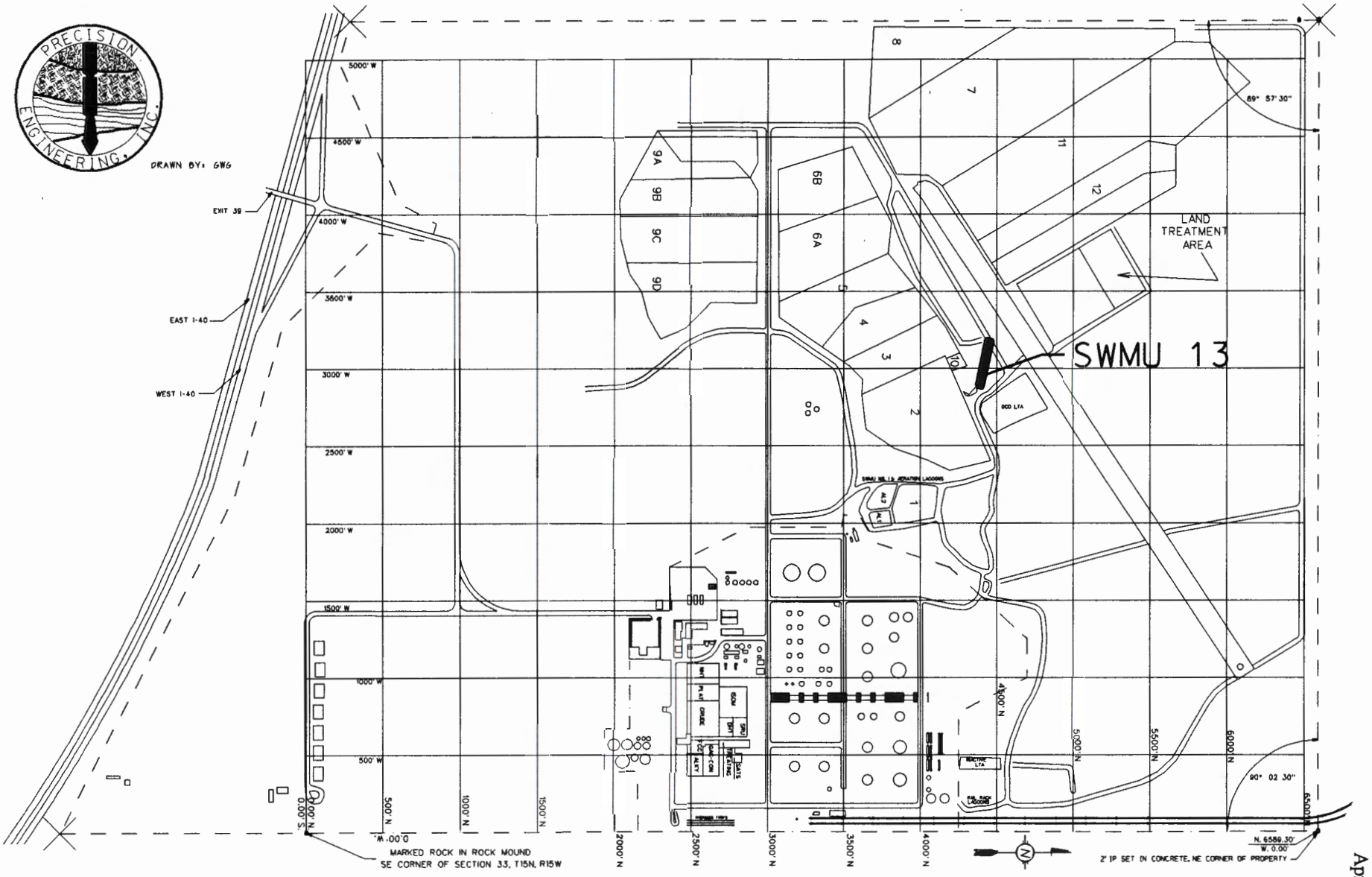

Figure J-13a. SWMU No. 13, Drainage Ditch Between API Evaporation Ponds and Neutralization Tank Evaporation Ponds

Figure J-13b. SWMU No. 13, Drainage Ditch Between API Evaporation Ponds and Neutralization Tank Evaporation Ponds Detail Photo

Attachment J-1

Approval Documentation

FACSIMILE TRANSMITTAL

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION 6
1445 ROSS AVENUE
DALLAS, TEXAS 75202-2733

MULTIMEDIA PERMITTING AND PLANNING DIVISION

NEW MEXICO AND FEDERAL FACILITIES SECTION

PLEASE PRINT IN BLACK INK ONLY

TO:	Ed Horst, Environmental Manager - Giant Refining Company, Ciniza
MACHINE NUMBER: 505.722.0210	VERIFICATION NUMBER: 505.722.0227
FROM: James A. Harris, Jr., RCRA Facility Manager/Geologist	
PHONE: (214) 665-8302	Mail Code: 6PD-N
OFFICE: New Mexico/Federal Facilities Section	PAGES, INCLUDING COVER SHEET 3
DATE: March 15, 1996	

PLEASE NUMBER ALL PAGES

INFORMATION FOR SENDING FACSIMILE MESSAGES

EQUIPMENT:	FACSIMILE NUMBER:	VERIFICATION NUMBER:
PANAFAX UF-766	(214) 665-6762	(214) 665-6760

COMMENTS

Ed,

Here's what I have been using to track Giant, Ciniza's corrective action progress. Please review and let's discuss it next week. Have a good one.

Thanx,

JAMES

SWMU TRACKING LIST - GIANT REFINE[illegible] EPA ID: NMD000333211, Gallup, NM

SWMU # now using 5/90 RFI WKPLN Designation; HSWA in ( ).	PHASE/GROUP	STATUS	COMMENTS/NOTES
6: The Tank Farm - Leaded Gasoline Tanks (3)	Phase I		Additional sampling for extent of contamination and confirmation sampling is required; completed first quarter '95
9: The Drainage Ditch near the Inactive Land Farm (10 & 13)	"		Survey Plat submitted; closure certification must be submitted prior to initiating Class III Permit Mod process
8: The Railroad Rack Lagoon (6)	"	under voluntary corrective action	monitoring requirements submitted w/quarterly status reports; notify EPA when final closure has been initiated; Survey Plat submitted; closure certification must be submitted prior to initiating Class III Permit Mod process
8: The Overflow Ditch (associated w/Railroad Rack Lagoon) (6)	"	"	"
8: The Fan Out Area (associated w/Railroad Rack Lagoon) (6)	"	"	"
10: The Sludge Pits (9)	"	"	monitoring requirements submitted w/quarterly status reports; notify EPA when final closure has been initiated

1: The ..eration Basin (1)	Phase II	soil ..d groundwater sampling every five years	RFI PHII RPT APP 1/9.. w/modifications; Survey Plat submitted; closure certification must be submitted prior to initiating Class III Permit Mod process
2: The Evaporation Ponds (2)	"	"	Survey and closure certification must be submitted prior to initiating Class III Permit Mod process
12: Contact Waste Water Collection System (CWWCS)	"	Inspection every 5 years beginning 1996	
13: The Drainage Ditch between APIs Evaporation Ponds and the Neutralization Tank Evaporation Ponds (14)	"	soil and groundwater sampling every five years	Survey Plat submitted; closure certification must be submitted prior to initiating Class III Permit Mod process
3: Empty Container Storage Area (5)	Phase III		"
4: Old Burn Pit (8)	"		
5: Landfill Areas (7)	"	a Voluntary Corrective Action (VCA) Plan to cap the "Landfill Areas" was submitted in March 1993.	EPA approved the VCA Plan on January 5, 1994 but required that additional soil borings be completed prior to Giant proceeding with the capping activities
7: Fire Training Area (4)	"	Under VCA	
11: Secondary Oil Skimmer (11)	"	Under VCA	discolored soil is the natural color; there is no hydrocarbon staining or odors detected; reference to "black fill" sand is actually "back fill"

Prepared by: James A. Harris, Jr.\6HPN as at March 13, 1996

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 6
1445 ROSS AVENUE, SUITE 1200
DALLAS, TX 75202-2733

JAN 07 1994

RECEIVED
JAN 12 1994
GIANT REFINING CO.
CINIZA REFINERY

CERTIFIED MAIL: RETURN RECEIPT REQUESTED

Mr. John J. Stokes, Manager
Giant Refining Company
Route 3, Box 7
Gallup, New Mexico 87301

RE: RFI Phase I and Phase II Supplemental Reports and Voluntary Corrective Action Plan
Giant Refining Co.
NMD000333211

Dear Mr. Stokes:

The Environmental Protection Agency (EPA) hereby approves your RCRA Facility Investigation (RFI) Phase I Supplemental Report, dated October 21, 1991, with the enclosed list of modifications. Your Corrective Action Plans (CAPs) for the Sludge Pits and the Railroad Rack Lagoon, submitted in November and December, 1992, respectfully, are also approved with the enclosed list of modifications.

The EPA is requiring that additional monitoring be completed at several sites. An annual report detailing the monitoring results shall be submitted to the EPA by December 31, 1994, and each year thereafter. The EPA is also requiring that additional soil sampling be completed at the Sludge Pits and the Tank Farm. Sampling results shall be submitted to the EPA by October 1, 1994. Further information concerning the additional monitoring and sampling requirements may be found in the attached list of modifications.

If you have any further questions or need additional information, please contact Nancy Morlock at (214) 655-6650 or Richard Mayer at (214) 655-7442.

Sincerely yours,

Allyn M. Davis

Allyn M. Davis, Director
Hazardous Waste Management Division (6H)

Enclosure

cc: Kathleen Sisneros, NMED

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APPROVAL WITH MODIFICATIONS
RFI PHASE I SUPPLEMENTARY REPORT
RFI PHASE II REPORT AND THE
VOLUNTARY CORRECTIVE ACTION PLANS

The Environmental Protection Agency (EPA) has completed a technical review of Giant Refining's RCRA Facility Investigation (RFI) Phase I Supplementary Report; RFI Phase II Report; and voluntary Corrective Action Plan (CAP) for the Sludge Pits and Railroad Rack Lagoon. The subject reports are hereby approved with the following comments and modifications.

GENERAL COMMENTS

SWMU 1, The Aeration Basin; SWMU 2, The Evaporation Pond; and SWMU 13, The Drainage Ditch

The EPA agrees with the finding of no further action for Solid Waste Management Units (SWMUs) 1, 2 and 13. The EPA is, however, requiring periodic monitoring of these SWMUs (see below under Modifications). However, this approval is contingent upon the completion of a survey plat for these SWMUs. The survey plats shall be completed in accordance with the requirements set forth in 40 CFR 264.116. Giant shall submit copies of the completed survey plats to the EPA for review and approval. Upon approval, Giant may submit a Class III permit modification to terminate the RFI/Corrective Measures Study (CMS) process for these SWMUs.

SWMU 6, The Tank Farm

The EPA disagrees with Giant on their recommendation of no further action. Sampling results indicate that 9 of the 13 samples taken at the 11 foot interval (the deepest interval sampled) contained elevated levels of BTEX constituents. One sample at the 16 foot interval also contained elevated BTEX levels. The EPA is therefore requiring deeper sampling at specified points (see below under Modifications).

SWMU 8, The Railroad Rack Lagoon, Overflow Ditch and Fan Out Area

The EPA agrees with the finding of no further action for this SWMU. The EPA understands that Giant has elected to perform voluntary corrective measures at this unit which will include bioremediation of the wastes with periodic soil and waste monitoring. Giant's voluntary bioremediation should reduce the volume and toxicity of the wastes while continuing to periodically monitor the SWMU. The EPA will, however, require that additional monitoring be completed (see below under Modifications). The EPA is also requiring that a survey plat be completed for this SWMU. The survey plat shall be completed in accordance with the requirements set forth in 40 CFR 264.116. Giant shall submit a copy of the completed survey plat to the EPA for review and approval. Upon approval, Giant may submit a Class III permit modification to terminate the RFI/Corrective Measures Study (CMS) process for this SWMU.

SWMU 9, The Sludge Pits
The EPA is unable to approve Giant's finding of no further action for this SWMU. Two (2) soil samples collected at the 15 foot interval (the deepest interval sampled) contained semivolatile contaminants. The EPA is therefore requiring deeper sampling at specified points (see below under Modifications). Giant may begin the voluntary bioremediation (see SWMU #8 voluntary corrective action) under the CAP after the deeper soil samples have been completed.

MODIFICATIONS

SWMU 1, The Aeration Basin
Giant shall take soil samples around the Aeration Basin every two (2) years beginning in calendar year 1994. Sampling requirements shall be identical to those performed during the previous RFI, except that all soil borings shall be angled and an additional sample shall be collected at the 20-21 foot interval. Results shall be included in the appropriate Annual Monitoring Report (1994, 1996, etc.).

SWMU 6, The Tank Farm
Giant shall complete additional soil borings as close as possible to the following sample points (numbers correspond to previous RFI sampling points completed in May, 1991): 21, 22, 23, 25, 26, 27, 30, and 31. The sampling interval shall be at 16 feet, with the exception of sample point 31 which shall be sampled at 20 feet. Samples shall be analyzed for BTEX constituents. Sampling must extend vertically until no subsequent increase in contamination levels is likely to occur. A minimum of two (2) "clean" samples are required to verify delineation. The results of this sampling event shall be submitted to EPA by October 1, 1994.

SWMU 2, Evaporation Ponds
Giant shall monitor the seven (7) groundwater wells around the evaporation ponds biannually for the same constituents monitored for in the original RFI. Results shall be included in the Annual Monitoring Report.

SWMU 13, Drainage Ditch between APIs Evaporation Ponds and Neutralization Tank Evaporation Ponds
Giant shall conduct soil sampling around the Drainage Ditch every two (2) years, with sampling beginning in calendar year 1994. Sampling procedures and analytical constituents shall be identical to those required in the RFI, except that all soil borings shall be angled and an additional interval shall be sampled at from 6.0-6.5 feet. Results shall be included in the appropriate Annual Monitoring Report (1994, 1996, etc.).

SWMU 6, The Railroad Rack Lagoon
Giant shall take 5 soil borings within the lagoon after it has ceased receiving wastes. Three (3) of the five (5) borings must be sampled at the 0-1 foot interval. All borings must be sampled at the 5-6 foot interval, the 10-11 foot interval, and the 14-15 foot interval. Sampling procedures and analytical constituents shall be identical to those required in the previous RFI. Sampling results shall be included in the 1994 Annual Monitoring Report.

Additionally, all six (6) borings required under the CAP closure (Section 5.0) must be sampled at the 5-6, 10-11, and 14-15 foot interval. Sampling procedures and analytical constituents shall be identical to those required in the previous RFI. Sampling results shall be included in the appropriate Annual Monitoring Report.

Monitoring requirements under the voluntary CAP shall be submitted to EPA in the appropriate quarterly progress report. Giant shall notify the EPA when final closure of the Railroad Rack Lagoon has been initiated.

Continuation of SWMU 6, The Overflow Ditch
Giant shall complete three (3) soil borings in the Overflow Ditch after closing the Railroad Rack Lagoon. Sampling procedures and analytical constituents shall be identical to those required in the previous RFI. Soil samples shall be collected at the 3.0 - 4.0 and 6.5 - 7.0 foot interval. All results shall be included in the 1994 Annual Monitoring Report.

Continuation of SWMU 6, The Fan Out Area
Giant shall complete four (4) soil borings in the Fan Out Area after closure of the Railroad Rack Lagoon has been completed. Sampling procedures and analytical constituents shall be identical to those required in the previous RFI. Soil samples shall be collected at the 3.0 - 4.0 and 6.5 - 7.0 foot interval. Results shall be included in the 1994 Annual Monitoring Report.

SWMU #12, Contact Waste Water Collection System (CWWCS)
Giant shall perform an inspection of the CWWCS every five years beginning in calendar year 1996. The inspection shall be identical to the one performed in the previous RFI. If better technological equipment is developed, Giant may request that an alternative method be used. Results shall be included in the appropriate Annual Monitoring Report.

SWMU 9, The Sludge Pits
Giant shall complete soil borings as close as possible to sampling points 6 and 7 (numbers correspond to previous RFI sampling points, completed in May, 1991). Sampling intervals shall be at 18.0 -19.0 foot and 24.0 - 25.0 foot. Sampling procedures and analytical constituents shall be identical to those required in the previous

RFI. Sampling must extend vertically until no subsequent increase in contamination levels is likely to occur. A minimum of two (2) "clean" samples are required to verify delineation. The results of this sampling event shall be submitted to the EPA by October 1, 1994.

Before final closure of the West Pit under the CAP, all soil borings shall be sampled at the 18.0 - 19.0 and 24.0 - 25.0 foot intervals. Sampling procedures and analytical constituents shall be identical to those required in the previous RFI. Four (4) soil borings shall also be completed (before closure) in the East Pit using the same requirements specified for the West Pit borings. Results shall be included in the appropriate Annual Monitoring Report.

Monitoring requirements under the voluntary CAP shall be submitted to EPA in the appropriate quarterly progress report. Giant shall notify the EPA when final closure of the Sludge Pits has been initiated.

Soil Boring Logs: The EPA has included an example of a soil boring log to be used for all future borings.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 6
1445 ROSS AVENUE, SUITE 1200
DALLAS, TX 75202-2733

JAN 7 1994

RECEIVED
JAN 12 1994
GIANT REFINING CO.
CINIZA REFINERY

CERTIFIED MAIL: RETURN RECEIPT REQUESTED

Mr. John J. Stokes, Manager
Giant Refining Company
Route 3, Box 7
Gallup, New Mexico 87301

RE: RCRA Facility Investigation (RFI) Phase III Report and Voluntary Corrective Action Plan
Giant Refining Co.
NMD000333211

Dear Mr. Stokes:

The Environmental Protection Agency (EPA) hereby approves your RCRA Facility Investigation Phase III Report dated November 3, 1992, with the enclosed modifications. The EPA is requiring that additional soil sampling be completed at several sites, including the Landfill Areas, the Old Burn Pit, the Secondary Skimmer, and the Fire Training Area. A supplementary report detailing the results of these sampling activities shall be submitted to the EPA by December 31, 1994.

Additionally, the EPA is approving the voluntary Corrective Action Plan for the Landfill Areas, submitted in March, 1993.

If you have any further questions or need additional information, please contact Nancy Morlock at (214) 655-6650 or Richard Mayer at (214) 655-7442.

Sincerely yours,

Jack Dinta

for Allyn M. Davis, Director
Hazardous Waste Management Division (6H)

Enclosure

cc: Kathleen Sisneros, NMED

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APPROVAL WITH MODIFICATIONS
GIANT REFINING COMPANY
RCRA FACILITY INVESTIGATION PHASE III REPORT
AND THE
CORRECTIVE ACTION PLAN FOR THE LANDFILL AREAS

The Environmental Protection Agency (EPA) has completed a technical review of your RCRA Facility Investigation (RFI) Phase III Report, dated October, 1992, and your voluntary Corrective Action Plan for the Landfill Area, dated February, 1993. The subject reports are hereby approved with the following comments and modifications.

GENERAL COMMENTS

SWMU 5, The Empty Container Storage Area
The EPA hereby approves the finding of No Further Action (NFA) for Solid Waste Management Unit (SWMU) number three (3), the Empty Container Storage Area. However, this approval is contingent upon the completion of a survey plat for the unit. The survey plat shall be completed in accordance with the procedures outlined in 40 CFR 264.116. Giant shall submit a copy of the survey plat to the EPA for review and approval. Upon approval, Giant may submit a Class III permit modification to terminate the RFI/Corrective Measures Study (CMS) process for the Empty Container Storage Area.

SWMU 8, The Old Burn Pit
Due to the presence of elevated levels of volatile and semivolatile contaminants in soil samples from this unit, the EPA is unable to approve Giant's finding of No Further Action. All three (3) soil samples taken at the 4.5 foot interval (the deepest interval sampled) contained elevated levels of heavy molecular weight semivolatiles. Additionally, one of the three (3) samples at the 4.5 foot interval also contained elevated BTEX levels. The EPA is therefore requiring deeper sampling at specified points (see below under Modifications).

SWMU 11, The Secondary Oil Skimmer
Due to the presence of elevated levels of volatile and semivolatile contaminants in soil samples from this unit, the EPA is unable to approve Giant's finding of No Further Action. One of the two (2) samples taken at the 3.0 foot interval (the deepest interval sampled) contained volatile and semivolatile contaminants. The EPA is therefore requiring deeper sampling at specified points (see below under Modifications).

SWMU 4, The Fire Training Area
Due to the presence of elevated levels of oil and grease in soil samples from this unit, the EPA is unable to approve Giant's finding of No Further Action. Two (2) of the four (4) samples

taken at the 4.5 foot interval (the deepest interval sampled) contained oil and grease above 2,000 ppm. The EPA is therefore requiring deeper sampling at specified points (see below under Modifications).

SWMU 7, The Landfill Areas

Because soil borings completed in this unit indicate the presence of waste and metal contamination at depths up to 9.5 feet, the EPA is requiring that additional soil borings be completed at greater depths. These additional soil borings will be installed in order to:

1) Verify that saturated zones found in three (3) of the 12 deepest soil boring intervals are isolated and are not connected to the groundwater;
2) Ensure that the vertical extent of waste emplacement has been defined;
3) Confirm that the vertical extent of metal contamination has been delineated.

Following the completion of the additional soil borings in the Landfill Areas, Giant may proceed with the capping of the landfills as per their voluntary Corrective Action Plan.

MODIFICATIONS

Note: All referenced sampling points correspond to the previous RFI sampling points completed in May, 1992. Soil boring logs included in future report submittals shall follow the attached example.

SWMU #8, The Old Burn Pit

Giant shall complete soil borings as close as possible to sample points one (1), two (2) and three (3). Sampling intervals shall be at six (6) and (10) feet and must extend vertically until no subsequent increase in contaminant levels is likely to occur. A minimum of two (2) "clean" samples are required to verify delineation. Sampling procedures and analytical requirements are identical to those required in the previous RFI. The results of this sampling event shall be submitted to the EPA by December 31, 1994.

SWMU #11, The Secondary Oil Skimmer

Giant shall complete two (2) soil borings within the area occupied by the former Skimmer. All borings must be sampled at the 5-6 foot and 9-10 foot interval. Sampling shall extend vertically until no subsequent increase in contaminant levels is likely to occur. A minimum of two (2) "clean" samples are required to delineate contamination. Sampling procedures and analytical requirements are identical to those required in the previous RFI. The results of this sampling event shall be due to EPA by December 31, 1994.

SWMU #4, The Fire Training Area

Giant shall complete angled soil borings as close as possible to sample points one (1) and two (2). Sampling intervals shall be at 7 and 11 feet. Sampling must extend vertically until no subsequent increase in contaminant levels is likely to occur. A minimum of two (2) "clean" samples are required to delineate contamination. Sampling procedures shall be identical to those required in the previous RFI. Analytical constituents shall include the Skinner constituents. The results of this sampling event shall be submitted to the EPA by December 31, 1994.

SWMU #7, The Landfill Areas

Giant shall take soil borings as close as possible to sample points two (2) through seven (7), and nine (9). Sampling intervals shall be at 11 feet, 16 feet and 20 feet. Sampling must extend vertically until no subsequent increase in contaminant levels is likely to occur. A minimum of two (2) "clean" samples are required to delineate contamination. Sampling procedures shall be identical to those required in the previous RFI. Giant shall analyze all samples for metals. If volatile or semivolatile contamination is encountered when sampling, then those constituents shall be analyzed also. The results of this sampling event shall be due to EPA by December 31, 1994.

New Mexico Envrionment Department
Hazardous and Radioactive Materials Bureau
RCRA Permits Management Program

RPMP Document Requirement Guide

Controlled Document #
51

NO FURTHER ACTION (NFA) PROPOSALS
CRITERIA

NFA Criterion 1 The Solid Waste Management Unit/Area of Concern (SWMU/AOC) cannot be located, does not to exist or is a duplicate SWMU/AOC.

NFA Criterion 2 The SWMU/AOC has never been used for the management (i.e., generation, treatment, storage and/or disposal) of Resource Conservation and Recovery Act (RCRA) solid waste or hazardous wastes and/or constituents or other Comprehensive Environmental Response, Conservation and Liability Act (CERCLA) hazardous substances.

NFA Criterion 3 No release to the environment has occurred or is likely to occur in the future from the SWMU/AOC.

NFA Criterion 4 A release from the SWMU/AOC to the environment has occurred, but the SWMU/AOC was characterized and/or remediated under another authority (such as the New Mexico Environment Department's Underground Storage Tank or Ground Water Quality Bureaus), which adequately addressed RCRA corrective action, and documentation, such as a closure letter, is available.

NFA Criterion 5 The SWMU/AOC has been characterized or remediated in accordance with current applicable state or federal regulations, and the available data indicate that contaminants pose an acceptable level of risk under current and projected future land use.

K.0 OTHER FEDERAL LAWS

Title 20, *New Mexico Administrative Code*, Chapter 4, Part 1, Subpart IX, §270.3 and §270.14(b)(20) requires that the following federal laws be given consideration when applying for a Resource Conservation and Recovery Act permit. When any of these laws is applicable, its procedures must be followed:

- *The Wild and Scenic Rivers Act (*16 United States Code [U.S.C.] 1273 et seq.*)*. This Act provides for a national wild and scenic rivers system and prohibits construction of any waterway that would have a direct adverse effect on the values for which a wild and scenic river was established.

- *The National Historic Preservation Act of 1966 (16 U.S.C. 470 et seq.)*. This Act establishes a program for the preservation of historic properties throughout the country; the Act has provisions that require mitigation of adverse effects to registered properties.

- *The Endangered Species Act of 1973 (16 U.S.C. 1531)*. This Act provides for the conservation of endangered and threatened species of fish, wildlife, and plants. It requires assurance that any action will not jeopardize the continued existence of any endangered or threatened species or adversely affect its critical habitat.

- *The Coastal Zone Management Act of 1972 (16 U.S.C. 1451 et seq.)*. This Act establishes national policy for the management, use, protection, and development of land and water resources of the nation's coastal zones. Section 307(c) of the Act and implementing regulations prohibit the EPA from issuing a permit for any activity affecting coastal zone land or water without the certification from the applicant that the activity is in compliance with the state Coastal Zone Management Program.

- *The Fish and Wildlife Act of 1934, as amended (16 U.S.C. 661 et seq.)*. This Act promotes the conservation of wildlife, fish, and game, and integrates this conservation with water resource projects. Certain provisions of the Act require that permits proposing or authorizing the impoundment, diversion, or other control or modification of any body of water be considered by the appropriate state agency for impacts to wildlife resources.

Because Ciniza has ongoing programs subject to the National Historic Preservation Act, the Endangered Species Act, and the Fish and Wildlife Act, consideration was given to these federal laws. Provisions in The Wild and Scenic Rivers Act and the Coastal Zone Management Act are not applicable to Ciniza's activities.

L.0 CERTIFICATION

In accordance with the *New Mexico Administrative Code*, Title 20, Chapter 4, Part 1, Subpart IX, §270.11(d), revised January 1, 1997, 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 ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Carl Shook, Executive Vice President, Operations
Giant Industries Inc.
23733 N. Scottsdale Road
Scottsdale, Arizona 85255

3/16/2000
Date

M.0 REFERENCES

50 FR 278702. July 15, 1985. *Federal Register* 50: 278702.

20 NMAC 4.1 Subpart V. Title 20, New Mexico Administrative Code, Chapter 4, Part 1, Subpart V, "Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities," Santa Fe, New Mexico, New Mexico Environmental Improvement Board.

20 NMAC 4.1 Subpart IX. Title 20, New Mexico Administrative Code, Chapter 4, Part 1, Subpart IX, "The Hazardous Waste Permit Program," Santa Fe, New Mexico, New Mexico Environmental Improvement Board.

API. 1983. *Land Treatment Practices in the Petroleum Industry*. American Petroleum Institute.

Ciniza. 1992. *RFI Phase III Draft Report, Applied Environmental*. Gallup, New Mexico, Giant Refining Company, October 1992.

Dames and Moore. 1981. *Groundwater and Soils Investigation*, Gallup, New Mexico, Giant Refining Company, March 1981.

EPA. 1986. *RCRA Ground Water Monitoring Technical Enforcement Guidance Document*. OSWER-9950.1. Washington, D.C., U.S. Environmental Protection Agency.

EPA. 1988. *Functional Guidelines for Evaluating Inorganics Analyses*. Washington, D.C., U.S. Environmental Protection Agency.

EPA. 1991. *National Functional Guidelines for Organic Data Review*. Washington, D.C., U.S. Environmental Protection Agency.

EPA. 1992. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*. Volumes I and II, SW-846, 3rd ed., Washington, D.C., Office of Solid Waste, U.S. Environmental Protection Agency.

Giant Refining Company. 1984. *Part B Application for a Hazardous Waste Permit for the Ciniza Refinery Land Treatment Facility*. Gallup, New Mexico, Giant Refining Company, December 1, 1984.

Giant Refining Company. 1988. *Land Treatment Demonstration Volume 1-Engineering Report*. Gallup, New Mexico, May 1988.

Giant Refining Company. 1993a. *Corrective Action Plan Fire Training Area Ciniza Refinery*. Gallup, New Mexico, February 1993

Giant Refining Company. 1993b. *Corrective Action Plan Landfills Area Ciniza Refinery*. Gallup, New Mexico, February 1993

Giant Refining Company. 1996. *Corrective Action Plan Tank Farm—Leaded Gasoline Tanks Ciniza Refinery*. Gallup, New Mexico, April 1996.

NMED. 1998. *RPMP Document Requirement Guide*, Santa Fe, New Mexico, New Mexico Environment Department/Hazardous and Radioactive Material Bureau, April 1998.

NMEID. 1988. *Hazardous Waste Facility Permit.* NMD000333211-2, Santa Fe, New Mexico, New Mexico Environmental Improvement Department, November 4, 1988.

NOAA. *Precipitation Frequency Atlas for the Western United States*, Atlas No. 2, Boulder, Colorado, National Oceanic and Atmosphere Administration.

Revision 0

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RCRA
PART A AND PART B
POST-CLOSURE
PERMIT APPLICATION

LAND TREATMENT UNIT
GIANT REFINING COMPANY
CINIZA REFINERY

VOLUME II
APPENDICES A THROUGH H

BMITTED TO: NEW MEXICO ENVIRONMENT DEPARTMENT
HAZARDOUS AND RADIOACTIVE MATERIALS BUREAU
P.O. BOX 26110
SANTA FE, NEW MEXICO 87502

TE SUBMITTED: APRIL 24, 1998

EPARED BY: CINIZA REFINERY
ROUTE 3, BOX 7
GALLUP, NEW MEXICO 87301

APPENDICES

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D	Land Treatment Demonstration Engineering Report
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H	Financial Test and Corporate Guarantee (Closure and Post-Closure)

ACRONYMS AND ABBREVIATIONS

%C	percent of completeness
%R	percent recovery
20 NMAC 4.1	Title 20 *New Mexico Administrative Code*, Chapter 4, Part 1
ASO	acid-soluble oil
BFB	4-bromofluorobenzene
BTEX	benzene, toluene, ethyl benzene, and xylene
BTZ	below the treatment zone
CAP	Corrective Action Plan
CEC	carbon exchange capacity
CFR	*Code of Federal Regulations*
Ciniza	Giant Refining Company—Ciniza Refinery
CME	comprehensive monitoring evaluation
C:N:P	carbon:nitrogen:phosphorous
COC	chain of custody
CWWCS	Contact Wastewater Collection System
DMP	detection monitoring plan
DOT	U.S. Department of Transportation
EDP	early detection plan
EDS	early detection system
EDW	early detection well
EM	environmental manager
EPA	U.S. Environmental Protection Agency
FR	*Federal Register*
FRP	facility response plan
Giant	Giant Refining Company
I-40	Interstate-40
LCS	laboratory control sample
LTD	land treatment demonstration
LTU	land treatment unit
MDL	method detection limit
MW	monitoring well
NFA	no further action
NMAC	*New Mexico Administrative Code*
NMED	New Mexico Environment Department
NMED/HRMB	New Mexico Environment Department/Hazardous and Radioactive Material Bureau
NMOCD	New Mexico Oil Conservation Division
PHC	principal hazardous constituents
PPE	personal protective equipment
PVC	polyvinyl chloride
QA	quality assurance
QA/QC	quality assurance/quality control
QC	quality control
RCRA	Resource Conservation and Recovery Act
RFA	Resource Conservation Recovery Act Facility Assessment
RFI	Resource Conservation Recovery Act Facility Investigation
RPD	relative percent difference
SAL	screening action level
SAP	sampling and analysis plan

SMW	shallow monitoring wells
SOP	standard operating procedure
SVOC	semivolatile organic compound
SWMU	solid waste management unit
TPH	total petroleum hydrocarbons
TEGD	*RCRA Ground Water Monitoring Technical Enforcement Guidance Document* (EPA 1986)
U.S.C.	*United States Code*
UST	underground storage tank
VCAP	Voluntary Corrective Action Plan
VOA	volatile organic analyte
VOC	volatile organic compound
WAP	waste analysis plan
ZOI	zone of incorporation

APPENDIX A

Chemical and Physical Properties of Hazardous Waste Streams

2.0 CHEMICAL AND PHYSICAL PROPERTIES OF HAZARDOUS WASTES

The Ciniza Refinery generates the following listed hazardous wastes:

ID	HAZARDOUS WASTE
D007	Cooling water filter sludge
K049	Slop Oil emulsion solids
K050	Heat Exchanger Bundle Cleaning Sludge
K051	API separator sludge
K052	Leaded Tank bottoms

The wastes are generated through intermittent cleaning operations. Because small volumes are generated on an intermittent schedule, development of characterization analysis is accomplished by waste analyses at each cleaning event. The following sections provide characterization based on industry-wide reports and available Ciniza Refinery data.

2.1 Hazardous Waste Properties - Industry Data

2.1.1 Waste: API Separator Sludge

Reference: Brown, K.W.; Deuel, Jr., L.E.; Thomas, J.C.; Land Treatability of Refinery and Petrochemical Sludges; July 30, 1982; Grant No. R 805474013; USEPA, Cincinatti, OH 45268; pages 15 and 101.

Analysis A:

Parameter	Value
Density	1.2g/cm3
Cd	3.3 ppm
Cr	51.0 ppm
Cu	227.7 ppm
Pb	14.1 ppm
Ni	14.1 ppm
Se	9.2 ppm
Na	1,734.8 ppm
Va	6.5 ppm
Zn	555.2 ppm
Percent H_2O	46.0 percent
Residue	49.3 percent
Total Carbon	7.3 percent
Ash	41.0 percent
Sulfur	0.9 percent
Total N	0.1 percent
Total extractable C	10.0 percent
Pentane extractable	72.0 percent
Benzene extractable	22.0 percent
CH_3C_{12} extractable	6.0 percent

Analytical Method A

Water content was determined by distillation. Solvent extractables were quantified gravimetrically after being refluxed five times with the respective solvents in a Soxhlet apparatus. Residues were heated at 750°C to determine ash content. Total sulfur was ascertained by an iodometric titration of SO_2 after oxidative combustion using a Leco induction furnace. Total N was found by Nesslerization following ammonification of all N sources with a H_2SO_4:K_2SO_4 and mercuric oxide solution. Wet combustion with potassium dichromate and H_2So_4:H_3PO_4 was used to determine C by gravimetric analysis of CO_2 evolution. Metals were measured using atomic absorption spectrophotometry following a HNO_2-H_2O_2 digestion of the sludge.

Analysis B:

Parameter	New Percent (weight) of Bulk Sludge
Water	45.7
Soxhlet Extractable (total)	9.93
Pentane fraction	7.17
Benzene fraction	2.20
Dichloromethane fraction	0.56
Residue	
Air dry	40.6
Stable to 750.C	37.8
Sulfur	0.88
Nitrogen	0.09
Carbon (wet combustion)	7.3

Distribution of hydrocarbons gravimetrically determined after fractionation of extracts on silica gel.

Saturates, percent	64
Aromatics, percent	36

Analytical Method B:

Composition of the API separator sludge is in percent of wet weight. Sequential Soxhlet extraction showed that 9.9 percent of the waste was solvent extractable. Reversing the order of solvent had no affect on the total extractable value but drastically altered the distribution. Dichloromethane extracted 100 percent of the materials partitioned by solvents, with succeeding benzene and pentane fractions coming up clean. Greater than 85 percent of the API separator sludge wet mass was attributed to water and a non-extractable residue. An average of 37.8 percent of the wet weight components or 95 percent of the non-extractable and heat stable residue is attributed to structural water loss from the mineral fraction. The average total organic carbon (TOC) determined by wet oxidation and gravimetric assay of CO_2 absorbed

was 7.3 percent on a wet weight basis. This value compares favorably to the total extracted value considering that hydrocarbons contain other elements than just carbon.

The API separator sludge material contained approximately 10 percent extractable hydrocarbons distributed as 60 percent saturates and 40 percent aromatic in character. Eighty-six percent of the carbon value assayed by wet combustion technique was quantified by GLC, standardized to a carbon response. Nearly 80 percent of the total extracted hydrocarbons were recovered following fractionation on silica gel. The saturate fraction was characteristically 88 percent carbon. No attempt was made to characterize the aromatic fraction of the API separator sludge, other than by gas-liqud chromatographic analysis.

2.1.2 Waste: API Separator Sludge

Reference: Berkowitz, J.B. *et al*; A.D. Little, Inc.; Land Treatment Field Studies, Volume 2. Oily Waste From a Petroleum Refinery; May 1981; Contract No. 60-03-2602; USEPA, Cincinnati, OH 45268; page 7.

Analysis:

Parameter	Percent by Weight
Water	55
Oil	11
Solids	34

Analytical Method:

No Data Available

2.1.3 Waste: API Separator and Cooling Tower Sludge

Reference: Environmental Research and Technology, Inc.; The Land Treatability of Appendix VIII Constitutents Present in Petroleum Industry Wastes; Document B-974-220, May 1984, American Petroleum Institute (API).

ANALYSIS:

Waste	Percent		
	Hydrocarbons or oil	Water	Solids
API Separator Sludge	8	73	19
Cooling Tower Sludges	1	74	25

Analysis Method:

Engineering-Science, Inc. 1976. The 1976 API Refinery Solid Waste Survey. Prepared for the American Petroleum Institute, Washington, D.C.

2.1.4 Waste: API Separator Sludge, Leaded Tank Bottoms, Cooling Tower Sludge, Heat Exchange Bundle Cleaning Sludge, Slop Oil Emulsion Solids

ReferenceERT, May 1984, page 3-8

Analysis: Parameter (mg/kg)[a]

Waste	Arsenic		Beryllium	Cadium		Chromium		Cyanide		Fluoride	Lead	
	Eng/Sc	Jacobs	Jacobs	Eng/Sc	Jacobs	Eng/Sc	Jacbos	Eng/Sc	Jacobs	Eng/Sc	Eng/Sc	Jacobs
API Separator Sludge	2.0	6.2	0.0025	1.04	0.42	161.5	253.0	0.29	0.001	4.5	45.0	26.0
Tank Bottoms (Leaded)	NA	294	0.0025	NA	6.3	NA	11.4	NA	0.009	NA	NA	790.0
Cooling Tower Sludge[b]	8.3	8.2	0.0013	0.9	0.3	865.0	554.0	NA	0.1	NA	48.0	38.0
Heat Exchange Bundle Cleaning Sludge	NA	10.6	0.20	NA	1.3	NA	311.0	NA	1.7	NA	NA	78.0
Slop Oil Emulsion Solids	NA	7.4	0.0025	NA	0.19	NA	525.0	NA	0.001	NA	NA	28.1

Waste	Mercury		Nickel		Selenium		Vanadium		Copper		Zinc	
	Eng/Sc	Jacobs	Eng/Sc	Jacobs	Eng/Sc	Jacobs	Eng/Sc	Jacobs	Eng/Sc	Jacobs	Eng/Sc	Jacobs
API Separator Sludge	0.3	0.4	11.7	19.3	0.2	0.001	13.7	9.8	55.2	18.6	191.6	298.0
Cooling Tower Sludge[b]	0.12	0.09	15.0	6.8	1.6	0.015	29.0	7.8	170.0	50.0	490.0	675.0
Tank Bottoms (Leaded)	NA	0.57	NA	314.0	NA	6.95	NA	5.4	NA	141.0	NA	9092.0
Heat Exchange Bundle Cleaning Sludge	NA	1.9	NA	116.0	NA	27.2	NA	25.0	NA	71.0	NA	194.0
Slop Oil Emulsion Solids	NA	0.59	NA	50.0	NA	1.0	NA	25.0	NA	48.0	NA	250.0

[a] Jacobs data reported on a dry weight basis, Eng/Sc is on a whole/weight basis.
[b] Engineering Science (Eng/Sc) data is for solid phase only.
NA = Not Analyzed

2.1.5 Waste: API Separator Sludge, Leaded Tank Bottoms, Cooling Tower Sludge, Heat Exchanger Bundle Cleaning Sludge, Slop Oil Emulsion Solids

Reference: ERT, MAY 1984

Analysis:

Waste	Benzo-a-Pyrene mg/kg	Phenol mg/kg
API Separate Sludge	0.004	6.5
Leaded Tank Bottoms	0.21	126
Cooling Tower Sludge	0.004	3.5
Heat Exchanger Bundle Cleaning Sludge	2.2	13.3
Slop Oil Emulsion Solids	0.003	15.0

Analysis Method:

Jacobs Engineering Co., 1976. Assessment of Hazardous Waste Practices in the Petroleum Refining Industry. PB-219-059. USEPA.

2.1.6 Waste: API Separator Sludge

Reference: ERT, May 1984

Analysis:

Parameter	mg/kg
Benzene	230
Toluene	1200
Phenol	0.19
Benzo-a-anthracene	160
Chrysene	140

Analysis Method:

Can Viro Consultants, 1983. The Significance of Trace Substances in Petroleum Industry Sludges Disposed of on Land: A Literature Survey. PACE Report No. 83-2.

2.1.7 WASTE: API Separator and Slop Oil Solids

Reference: ERT, MAY 1984

Analysis:

Parameter	EP Toxicity Extracts mg/l in extract[a] API Separator	Slop Oil Emulsion Solids
Toluene	0.31 - 5.7	4.8 - 13
Napthalene	0.01 - 0.24	0.14 - 1.6
Fluoranthene	0.035 - 9.4	1.7
Chrysene/ Benzanthracene	0.14 - 15	0.40 - 1.5
Benzo-a-pyrene/ Benzofluoranthene	22.7	2.9

[a]The concentration in micrograms/grams of original solid is at least 20 times the value given for mg/l in extract

Analysis Method:

Burke, S.L. and Wagner, I, 1982. Characterization and Treatment of Aqueous Waste and Residues from Petroleum Refineries. EPA Cooperative Agreement No. CR 806798.

2.1.8 Waste: Refinery Sludges

Reference:

(ERT, June 1983) Environmental Research and Technology, Inc. June 1983; Land treatment Practices in the Petroleum Industry; prepared for the American Petroleum Institute (API).

Analysis:

Parameter	mg/kg Range of values Mean of values Median of values Number of samples
Arsenic	0 - 317 31.3 8.3 30

Cadmium	0 - 19.4 4.3 1.59 30
Chromium, Total	1 - 5009 387.3 66.6 30
Copper	0 - 527 80.5 17.6 29
Lead	0 - 1914 191.6 31.2 30
Mercury	0 - 26.4 2.5 0.4 30
Nickel	2.3 - 520 57.3 20.7 30
Selenium	0 - 437.7 33.7 4.15 30
Vanadium	0 - 176.9 30.1 10.6 30
Zinc	2.5 - 3130 413.5 66.1 30

Analysis Method:

Engineering Science, Inc., 1976. The 1976 API Refinery Solid Waste Survey. Prepared for the American Petroleum Institute (API), Washington, D.C.

2.1.9 Waste: API Separator Sludge and Composite Oily Sludge (Slop Oil Emulsion Solids)

Reference: ERT, June 1983, page 2-8.

Analysis:

API Separator Sludge

Parameter	Value, percent (weight)/range
Sludge Oil Content	9.0 4.6 - 17.6
Oil Phase Hydrocarbon Fractions	
Saturates	53.5 48.0 - 66.1
Olefins	1.3 0 - 2.3
Aromatics	33.3 30.3 - 36.0
Polar/Asphaltenes	12.6 8.5 - 19.9
Phenols	2.8 mg/l

Composite Oily Sludge

Parameter	Value, percent (weight)/range
Sludge Oil Content	21.8 3.2 - 41.0
Oil Phase Hydrocarbon Fractions	
Saturations	59.6 51.3 - 70.2
Olefins	2.6 0.9 - 2.9
Aromatics	30.2 24.7 - 35.5
Polar/Asphaltenes	7.6 5.9 - 12.8

Phenols	6.7 mg/l 0.9 - 14.9 mg/l

Analysis Method:

Weldon, R., 1982. Biodegradation of Oily Sludge by Soil Microorganisms. Prepared for the American Petroleum Institute (API), Washington, D.C.

2.1.10 Waste: API Separator Sludge

Reference: ERT, June 1983, page A-12

Analysis:

Parameter	Value
Oil	25 percent
Water	60 percent
Solids	15 percent
Chromium	100-500 ppm
Copper	500-1500 ppm
Nickel	100-500 ppm
Zinc	500-1000 ppm
pH	8.0

Analysis Method:

American Petroleum Institute, 1983. Personal communique with participating companies. API, Washington, D.C.

2.2 Hazardous Waste Properties - Ciniza Refinery Data

Appendix A contains reports for the wastes land treated at Ciniza Refinery which cover the period November 1980 through March 1984 and where performed by the private laboratory, Controls for Environmental Pollution, Inc., Santa Fe, New Mexico.

Based on the recent analyses of the wastes to be land treated at Ciniza, suggestions of Region VI EPA staff, and the Appendix VIII 40 CFR 261 constituent list, waste sampling and analyses listed in Table 2.2-1 are being completed.

TABLE 2.2-1

CINIZA REFINERY WASTES PHYSICAL AND CHEMICAL PARAMETERS REQUESTED NOVEMBER, 1984[a]

==========

Listed analyses for D007, K049, K050 and K051 shall be submitted to USEPA in a timely manner after receiving the revised Appendix VIII procedures guidance; waste K052 shall be analyzed after the next leaded tank cleaning event.

Physical Parameters

1. Bulk density
2. Solids weight fraction
3. Oil weight fraction
4. Water weight fraction

Chemical-Inorganic Parameters

5. Electrical conductivity
6. pH
7. Antimony (App. VIII)
8. Arsenic (App. VIII)
9. Barium (App. VIII)
10. Beryllium (App. VIII)
11. Cadmium (App. VIII)
12. Chromium (App. VIII)
13. Mercury (App. VIII)
14. Lead (App. VIII)
15. Nickel (App. VIII)
16. Selenium (App. VIII)
17. Vanadium (App. VIII)

Chemical - Organic Parameters

18. Volatile organic compounds fraction

19. Total organic carbon

Appendix VIII Constituents

20. Acetonitrile (Ethanenitrile)
21. Acrolein (2-Propenal)
22. Acrylonitrile (2-Propenenitrile)
23. Aniline (Benzenamine)
24. Benz (c) acridine (3,4-Benzacridine)
25. Benz (a) anthracene (1,2-Benzanthracene)
26. Benzene (Cyclohexatriene)
27. Benzenethiol (thiophenol)
28. Benzidine (1,1-Biphenyl-4, 4-diamine)

29. Benzo (b) fluoranthene (2,3-Benzofluoranthene)
30. Benzo (j) fluoranthene (7,8-Benzofluoranthene)
31. Benzo (a) pyrene (3,4-Benzophyrene)
32. Benzyl chloride (Benzene, (Chloromethyl)-)
33. Bis (2-chloroethyl) ether (Ethane, 1,1-oxybis (2-chloro-)
34. Bis (2-chloroisopropyl) ether (Propane, 2,2-oxybis (2-chloro-))
35. Bis (chloromethyl) ether (Methane, oxybis (chloro))
36. Bis 2-ethylhexyl) phthalate (1,2-Benzenedicarboxylic acid, bis (2-ethylhexyl) ester)
37. Butyl benzyl phthalate (1,2-Benzenedicarboxylic acid, butyl phenylmethyl ester)
38. Carbon disulfide (carbon bisulfide)
39. p-Chloro-m-cresol
40. Chlorobenzene (Benzene, chloro-)
41. Chloroform (Methane, trichloro-)
42. Chloromethane (Methyl chloride)
43. 2-Chloronapthalene (Naphthalene, beta-chloro-)
44. 2-Chlorophenol (Phenol, o-chloro-)
45. Chrysens (1,2-Benphenanthrene)
46. Cresols (Cresylic acid) (Phenol, methyl-)
47. Crotonaldehyde (2 Butenal)
48. Cyanide
49. Dibenz (a,h) acridine (1,2,5,6-Dibenzacridine)
50. Dibenz (a,j) acridine (1,2,7,8-Dibenzacridine)
51. Dibenz (a,h) anthracene (1,2,5,6-Dibezanthracene)
52. 7H-Dibenzo (c,g) carbazole (3,4,5,6-Dibenzcarbazole)
53. Dibenzo (a,e) pyrene (a,2,4,5-Dibenzpyrene)
54. Dibenzo (a,h) pyrene (1,2,5,6-Dibenzpyrene)
55. Dibenzo (a,i) pyrene (1,2,7,8-Dibenzpyrene)
56. 1,2-Dibromoethane (Ethylene-dibromide)
57. Di-n-butyl phthalate (1,2-Bezenedicarboxylic acid, dibutyl ester)
58. Dichlorobenzenes
59. 1,2-Dichloroethane (Ethylene dichloride)
60. trans-1,2-Dichloroethene (1,2-Dichlorethylene)
61. 1,1-Dichloroethylene (Ethene, 1,1-dichloro)
62. Dichloromethane (Methylene chloride)
63. Dichloropropane
64. Dichloropropanol
65. Diethytl phthalate (1,2-Benzenedicarboxylic acid, dimethyl ester)
66. 7,12-Dimethyl-benz(a)anthracene
67. 2,4-Dimethylphenol (Phenol, 2,4-dimethyl-)
68. Dimethyl phthalate (1,2-Benzenedicarboxylic acid, dimethyl ester)
69. 4,6-Dinitro-o-cresol
70. 2,4-Dinitrophenol (Phenol, 2,4-nitro-)
71. 2,4-Dinitrotoluene (Benzene, 1-methyl-2,4-dinitro-)
72. Di-n-octylphthalate (1,2-Benzenedicarboxylic acid, dioctyl ester)
73. 1,4-Dioxane (1,4-Diethylene oxide)
74. 1,2-Diphenylhydrazine (Hydrazine, 1,2-diphenyl-)
75. Ethyleneimine (Azridine)
76. Ethylene oxide (Oxirane)
77. Fluoranthene (Benzo (j,k) fluorene)
78. Formaldehyde
79. Hydrogen sulfide (sulfur hydride)
80. Indeno (1,2,3-cd)pyrene (1-10(1,2-phenylene)pyrene)
81. Methanethiol (Thiomethanol)

82. 3-Methylchlolanthrene (benz (j) aceanthrylene, 1,2-dihydro-3-methyl-)
83. Methyl ethyl ketone (MEK) (2-Butanone)
84. Naphthalene
85. p-Nitroaniline (Benzenamine, 4-nitro-)
86. Nitrobenzene (Benzenamine, 4-nitro-)
87. Nitrobenzene (Benzene, nitro-)
88. 4-Nitrophenol (Phenol, pentachloro-)
89. Pentachlorophenol (Phenol, pentachloro-)
90. Phenol (Benzene, hydroxy-)
91. Pyridine
92. Tetrachloroethanes
93. Tetrachloroethylene (Ethene, 1,1,2,2-tetra chloro-)
94. Toluene (Benzene, methyl-)
95. Trichlorobenzenes
96. Trichloroethanes
97. Trichloroethene (Trichloroethylene)
98. Trichlorophenols

NON-APPENDIX VIII CONSTITUENTS EXPECTED TO BE PRESENT

99. Cobalt
100. 1-Methylnapthalene
101. Styrene
102. Hydroquinone
103. Anthracene
104. Indene
105. 5-Nitro acenapthene
106. Quinoline
107. Phenanthrene
108. Pyrene

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[a]Parameters include those requested in the Region VI technical review comments of September 21, 1984 and the Appendix VIII constituents listed in the Memorandum dated April 3, 1984 from John Skinner, Director, Office of Solid Waste Analysis for Land Treatment Permit Applications.

The analytical methods employed to analyze the parameters listed in Table 2.2-1 are shown in Table 2.2-2.

Table 2.2-2 ANALYTICAL METHODS FOR CINIZA HAZARDOUS WASTE CHARACTERIZATION

Non-Appendix VIII Constituents

Parameter/Constituent	Method/Reference
Bulk density	213 E/a
Solids weight fraction	209 E/a
Oil weight fraction	503 A/a
Water weight fraction	503 A/a
Electrical Conductivity	120.1/b
pH	150.1/b
Volatile organic compounds	c
Total organic carbon	415.1/b
Table 2.2-1, 99-108	Same as Appendix VIII

Appendix VIII Constituents[e,f]

Parameter/Constituent	Test Method/Reference
all metals	3050/d
Volatile compounds	8240 with polyethylene glycol (PEG)/d
semi-volatile compounds	Attachment 2/e

[a]Standard Methods for the Examination of Water and Wastewater, Fifteenth Edition American Public Health Associates, Inc., North York, N.Y. 10019

[b]EPA-600 4-79-020; Methods for Chemical Analysis of Water and Waster, March 1979.

[c]SW-874 Hazardous Waste Land Treatment; USEPA, April 1983: volatile organic compound fraction determination; page 114.

[d]SW-846 Test Methods for Evaluating Solid Waste-Physical/Chemical Methods; Second Edition; USEPA, July 1982

[e]Memorandum: Guidance on Petroleum Refinery Waste Analysis for Land Treatment Permit Applications; John Skinner, Director of Office of Solid Waste; April 1984 (see Appendix A-2 of the Permit)

[f]Proposed sampling and Analytical Methodologies, supplemental to SW-846, FR Vol 49, No. 191, October 1, 1984; available as PB 85-103-026, National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161, 703-467--4600.

APPENDIX A

CUSTOMER Dames and Moore
ADDRESS Suite 398W, City Center
CITY 6400 Uptown Blvd., N.E.
ATTENTION Albuquerque, NM 87110
INVOICE NO Bill Mead
012050

REPORT OF ANALYSIS

SAMPLES RECEIVED 11/10/80 | CUSTOMER ORDER NUMBER

TYPE OF ANALYSIS Sludge

EPA ID	Sample Identification	Type of Analysis		
K052	Leaded Tank Sludge;	Lead (Total)	690	ug/g
	Tank 59	EP Lead	0.08	mg/liter
	Date Collected 11/4/80	Total Organic Lead	2.4	ug/gm

APPROVED BY
Elmer D. Martinez, Operations Division, M
12/11/80 PAGE 19 OF 19 PAGE

Controls for Environmental Pollution, Inc.
P.O. Box 5351 • 1925 Rosina • Santa Fe, New Mexico 87502
Telephone 505/982-9841

CUSTOMER Dames & Moore
ADDRESS Suite 398W, City Center
CITY 6400 Uptown Blvd., N.E.
ATTENTION Albuquerque, NM 87110
INVOICE NO Bill Mead
012179

REPORT OF ANALYSIS

SAMPLES RECEIVED 11/10/80 CUSTOMER ORDER NUMBER

TYPE OF ANALYSIS Sludge (Date Collected 11/6/80)

Sample Identification	Type of Analysis	mg/liter
API Seperator Emulsion	Arsenic	< 0.01
[illegible] ID — K051	Barium	< 10
	Cadmium	< 0.001
	Chromium	0.006
	Chromium 6+	< 0.01
	Lead (Total)	6.1
	Mercury	< 0.004
	Selenium	< 0.01
	Silver	< 0.01
	Total Chrome	200 ug/gm
		percent by weight
	Total Organic Carbon	17.8

APPROVED BY
Elmer D. Martinez, Operations Division, Mgr
12/24/80 PAGE 1 OF 1 PAGE

Controls for Environmental Pollution, Inc.
P. O. Box 5351 • 1925 Rosina • Santa Fe, New Mexico 87502

Controls for Environmental Pollution, Inc.
P.O. BOX 5351 • Santa Fe, New Mexico 87502
LOCAL 505/982-9841
OUT OF STATE 800/545-[illegible]

CEP, Inc. REPORT

LAB # 84-03-404

CEIVED: 03/30/84

04/25/84 15:22:12

REPORT TO: Giant Refining Company
Route 3 Box 7
Gallup, NM 87301

ATTEN: R. C. Anderson

CLIENT: GIANT REF SAMPLES: 3
OMPANY: Giant Refining Company
CILITY:

PREPARED BY: Controls for Environmental Pollution, Inc.
1925 Rosina Street
Santa Fe, NM 87502

ATTEN:
PHONE: (505) 982-9841

CERTIFIED BY

CONTACT: GAIL

ORK ID: Water Quality
TAKEN:
TRANS: Self
TYPE: Sludge
P.O. #: 75623
NVOICE: under separate cover

Analyses reported as mg/liter were done on an EP Toxicity prep.

SAMPLE IDENTIFICATION

Cooling Tower Sludge
Heat Exchanger Sludge
API Seperator Sludge

CEP, Inc. TEST CODES and NAMES used on this report

AG 1	Silver
AS 1	Arsenic
BA 1	Barium
CD 1	Cadmium
CR 1	Chromium
CR 6 1	Chromium, Hexavalent (6+)
CR S	Chromium
HG 1	Mercury
O G 5	Oil and Grease
PB 1	Lead
PB S	Lead
PH S	pH
SE 1	Selenium
TOC 5	Total Organic Carbon

Controls for Environmental Pollution, Inc.
P.O. BOX 5351 • Santa Fe, New Mexico 87502
INSTATE 505/982-9611
OUT OF STATE 800/545-1188

E 2

REPORT OF ANALYSIS

LAB # 84-03-404

PLE IDENTIFICATION	DATE COLLECTED	TYPE OF ANALYSIS	mg/liter	
ling Tower Sludge	03/29/84	Silver	<0.01	
		Arsenic	<0.01	
		Barium	0.4	
		Cadmium	<0.001	
		Chromium	0.063	
		Chromium, Hexavalent	<0.01	
		Chromium	170	(ug/gram)
		Mercury	<0.0004	
		Oil and Grease	29,000	(ug/gram)
		Lead	0.001	
		Lead	140	(ug/gram)
		pH	9.15	(units)
		Selenium	<0.01	
		Total Organic Carbon	>400,000	

Controls for Environmental Pollution, Inc.
PO BOX 5351 • Santa Fe, New Mexico 87502
WEST 505/982-9844
OUT OF STATE 800/545-2448

REPORT OF ANALYSIS

LAB # 84-03-404

MPLE IDENTIFICATION	DATE COLLECTED	TYPE OF ANALYSIS	mg/liter	
st Exchanger Sludge	03/29/84	Silver	<0.01	
		Arsenic	<0.01	
		Barium	0.1	
		Cadmium	0.001	
		Chromium	<0.001	
		Chromium, Hexavalent	<0.01	
		Chromium	15	(ug/gram)
		Mercury	<0.0004	
		Oil and Grease	22,500	(ug/gram)
		Lead	0.003	
		Lead	330	(ug/gram)
		pH	11.2	(units)
		Selenium	<0.01	
		Total Organic Carbon	>400,000	

Controls for Environmental Pollution, Inc.
P.O. BOX 5351 • Santa Fe, New Mexico 87502
IN STATE 505/982-9811
OUT OF STATE 800/545-2188

REPORT OF ANALYSIS

LAB # 84-03-404

PLE IDENTIFICATION	DATE COLLECTED	TYPE OF ANALYSIS	mg/liter	
I Seperator Sludge	03/13/84	Silver	<0.01	
		Arsenic	<0.01	
		Barium	0.4	
		Cadmium	<0.001	
		Chromium	0.036	
		Chromium, Hexavalent	<0.01	
		Chromium	10	(ug/gram)
		Mercury	<0.0004	
		Oil and Grease	26,000	(ug/gram)
		Lead	<0.001	
		Lead	340	(ug/gram)
		pH	9.30	(units)
		Selenium	<0.01	
		Total Organic Carbon	>400,000	

ATTACHEMENT C-2

WASTE ANALYSIS PLAN

(Taken from *Part B Application for a Hazardous Waste Permit for The Ciniza Refinery Land Treatment Facility*, Giant Refining Company, December 1, 1984)

3.0 WASTE ANALYSIS PLAN

The parameters and rationales for analyses are summarized on Table 3.0-1. Sampling methods, sampling frequencies, and analytical methods are summarized in Tables 3.0-2, 3.0-3, and 3.0-4 respectively.

Samples of wastes treated at the land farm shall be taken and analyzed for those components needed to guarantee proper treatment. The presence of key Appendix VIII constituents shall be determined to monitor their degradation and buildup in land treatment soils. Key constituents shall be determined based on Appendix VIII characterization work in progress (see Section 2.2). Key constituents shall be selected based on low biodegradation rates or high soil mobility rates.

Each cleaning event's samples (one per truck load) shall be analyzed at the refinery laboratory for bulk density, oil fraction, water fraction, solids fraction, electrical conductivity, pH and ignitability. A composite sample for each cleaning event from all trucks will be shipped to an independent laboratory for heavy metals and key Appendix VIII constituents.

3.1 Cooling Water Filter Sludge (D007) Sampling Method, Analysis and Frequency

Cooling water sludge is picked up with a vacuum truck and hauled and spread at the Land Treatment Facility. The analyses of land-treated wastes are designed to yield data needed for maintenence of the land treatment operation and environmental data to estimate metals loading of the Land Treatment Facility. Additional data on metal accumulation at the Facility is determined by soil sampling and analysis.

Sampling will be conducted in accordance with procedures given in Samplers and Sampling Procedures for Hazardous Waste Streams, EPA 600/2-80-018.

All level composite samples will be taken from each vacuum truck load hauled to the Land Treatment Facility. Samples will be taken through the truck's top hatchway using a composite liquid water sampler (Coliwasa). Samples will be put in a one gallon wide mouth linear polyethylene (LPE) bottle with LPE cap to form an event composite sample. These are discussed in detail in section 30.5.2.5 of this document. The composite samples will be split into three samples and placed into one quart LPE bottles. One sample shall be analyzed within six hours for Non-Appendix VIII constituents (Table 3.0-4). The second composite will be prepared for an independent laboratory for metals and key Appendix VIII Constituent Analysis. Third sample, also in a glass bottle shall retained be for one year. This sample shall

consist of a one quart glass bottle with a teflon-lined cap and a 20 to 40 cc glass vial. All (samples) shall be labeled and documented in accordance with the quidelines found in Samples and Sampling Procedures for Hazardous Waste Streams EPA 600/2-80-018. These documentation procedures are discussed in detail in Section 30.5.2.5 of this document. The frequency of analysis will occur at each cleaning event or twice per year.

3.2 Slop Oil Emulsion Solids (K049) Sampling Method, Analysis, and Frequency

Slop tank sludge is picked up and transferred with a vacuum truck. Each truck load will be sampled, a composite sample formed, and analyzed at the refinery laboratory for Non-Appendix VIII Constituents. A composite sample for each tank cleaned will be shipped to an independent laboratory for metals and key Appendix VIII Criteria Constituent Analysis. Sampling of vacuum trucks will be conducted in accordance with procedures given in Samplers and Sampling Procedures for Hazardous Waste Streams EPA 600/2-80-018.

Sampling, sample spitting and documentation will be performed in the same manner as for cooling water filter sludge (Section 3.1).

3.3 Heat Exchanger Bundle Cleaning Sludge (K050) Sampling Method, Analysis, and Frequency

The heat exchanger bundle cleaning sludge is a small volume left after water washing of the exchangers. The waste is predominantely solids with residual water. The waste is spread at the Land Treatment Facility. The sludge is of small enough volume and low water and oil content to make its impact on the Land Treatment Facility operation insignificant. The sludge washed from the exchanger is allowed to dewater by settling. The water flows to the plant sewer. The remaining wet solids are shoveled into barrels for transport to the Land Treatment Facility. A composite sample will be collected for each cleaning event prior to loading the wastes into barrels. Each sample will be split into thirds, one third being analyzed at the refinery laboratory for pH, percent oil , percent water, percent solids, and ignitability. Another will be analyzed for metals and key Appendix VIII Constituents. A third split sample shall be retained for one year.

The sludge will be sampled prior to loading into barrels. Three quart composite samples will be taken using the solids sampling procedure prescribed in Samplers and Sampling Procedures for Hazardous Waste Streams, EPA 600/2-80-018.

Frequency of analysis is at each cleaning event or every 1.5 years.

3.4 API Separator Sludge (K051) Sampling Method, Analysis, and Frequency

The nature and handling of API separator sludge is the same as that for slop oil emulsion. The separator sludge is picked up with a vacuum truck and hauled to the Land Treatment Facility. Sampling rationale, sampling method, and analytical procedures are the same as for slop oil emulsion. The API separator is cleaned twice per year and sampling will occur at each cleaning.

3.5 Leaded Tank Bottoms (K052) Sampling Method, Analysis, and Frequency

The sampling rationale, sampling method and analytical procedures for leaded tank bottoms are the same as for slop oil emulsions. The tank bottoms generated by tank cleaning are picked up with a vacuum truck and hauled to the Land Treatment Facility. Each truck load will be sampled, the samples combined to give three event composite samples . One sample analyzed on site for pH, precent oil, percent water, percent solids, conductivity and ignitability. The second sample is shipped to an independant laboratory for metals and key Appendix VIII constitutent analysis. The third sample is retained for a minimum of one year. Tanks are cleaned on a five year cycle.

3.6 Internal Laboratory Quality Assurance/Quality Control

Giant Refining maintains a quality assurance/quality control program for hazardous waste related samples analyzed at the refinery laboratory to:

- assure proper labeling of samples,
- assure proper analytical methods,
- assure accurate reproducible results, and
- assure proper documentation.

3.6.1 Sample Labeling and Documentation:

Samples for internal analysis are taken in accordance with methods defined in Table 3.0-2 and Sections 29.6.2 and 30.5.2.2. The waste samples are sealed and labled, the lables include the following information:

- date and time sample is taken,
- initials of sampler,
- sample ID number,
- sample description,
- analytical work required,
- the date to which the sample is to be retained.

A sample transmittal sheet shown as Figure 3.6-1 is completed and accompanies the sample. Soil samples are labeled in accordance with Section 29.6.2. Records as specified in section 29.6.3 shall be kept

of all sampling events in the Land Treatment Facility field log book. The sample is transported in a refinery vehicle directly to the laboratory by the sampler. At the laboratory, samples are logged in and assigned a laboratory sample number. Analytical work is recorded in a laboratory log book. Analytical results are sent by internal mail to the Refinery Environmental Engineer. Samples are retained for a minimum of one year, longer if so stated on the sample label. Samples past the retainage age are taken to the land treatment area and spread.

3.6.2 Analytical Q/A

Analytical methods are defined on Table 3.0.4. Analytical Q/A is summarized as follows:

Bulk Density	No accepted standardization procedure is available. One sample will be split per batch of samples. Analysis will be held suspect if split samples differ by more than 5%.
Oil, Solids and Water	No accepted standardization procedure is available. One sample will be split per batch of samples. Analysis will be held suspect if split samples differ by more than repeatability and reproducability guidelines given in ASTM-96-73.

Electrical Conductivity	The conductivity instrument shall be calibrated against a calcium chloride solution prior to testing each sample batch and recalibrated after each five samples. One sample per batch shall be split. Analysis will be held suspect if split sample results differ by more than the accuracy defined in method 120.1.
pH	The pH meter shall be zeroed and calibrated with two known buffer solutions that bracket the expected pH prior to each sample test. One sample shall be split per batch. Analysis will be held suspect if split sample results differ by more than 0.2 pH units.
Ignitability	P-xylene shall be used as a reference standard and will be determined in duplicate at least once per sample batch. The reference standard should give an average of the 2 analysis of 81°F ± 1.5°F. One sample will be split per batch. Results will be held suspect if split results differ by 18°F (reference ASTM-93-77 Method B).

3.6.3 Equipment Inspection and Maintenance

The equipment used in the tests run internally are in daily use at the refinery providing product quality control analysis and operations parameter analysis. The equipment is standardized daily. Maintenance shall follow the manufacture's recommended procedures. Further definition of maintenance practices are not given since the equipment involved is inexpensive and subject to periodic replacement.

3.6.4 Technician Qualification

Technicians are generally selected from refinery staff and put on a 3 to 4 week training program. The Laboratory Supervisor observes during training and tests, prospective technicians using cross samples and split samples. Once qualified, the technicians performance is reviewed at least annually by observing analytical procedures and using cross and split samples.

TABLE 3.0-1

PARAMETERS AND RATIONALE FOR ANALYSIS
APPLICABLE TO WASTES D007, K049, K050, K051, and K052

PARAMETER	RATIONALE
Bulk density	Used to obtain weights of oil, water, solids, and metals applied to soil.
Oil fraction	Determines land treatment oil loading rates.
Water fraction	Determines moisture and solids fraction additions to land treatment soils.
Electrical conductivity	Used to estimate the soluble salts applied to the soils.
pH	Determines effects of waste application to land treatment soil.
Ignitability	Determines safe handling characteristics and the presence of volatile hydrocarbons.
Key Appendix VIII	Determines hazardous Constituents that limit application rate.
Total lead	Determines lead accumulation in soil.
Total chromium	Determines chrome accumulation in soil.

TABLE 3.0-2

SAMPLING METHODS[a]

HAZARDOUS WASTE	DESCRIPTION OF SAMPLING
Cooling Water Filter	One all-levels sample from (D007) each truck using a Coliwasa sampler. Prepare one composite sample for each cleaning event for analysis.
Slop Oil Emulsions Solids (K049)	Same as D007
Heat Exchanger Bundle Cleaning Sludge (K050)	One representative composite sample from each cleaning event taken with a scoop.
API Separator Sludge (K051)	One all-levels sample from (K051) each truck using a Coliwasa sampler. Prepare one composite sample for each cleaning event for analysis.
Leaded Tank Bottoms (K052)	Same as K051

[a]Sampling methods shall follow sampling vacuum truck and waste solids as described in EPA 60012-80-018, Samplers and Sampling Procedures for Hazardous Waste Streams, California Department of Health Services, prepared for Municipal Environmental Research Lab, Cincinnati, OH, January, 1980

TABLE 3.0-3

SAMPLING FREQUENCY

HAZARDOUS WASTE	FREQUENCY
Cooling Water Filter Sludge (D007)	Each cleaning event-twice every year
Slop Oil Emulsions Solids (K049)	Each cleaning event-every five years
Heat Exchanger Bundle Cleaning Sludge (K050)	Each cleaning event-every year to year and a half
API Separator Sludge (K051)	Each cleaning event-two per year
Tank Bottoms (K052)	Each cleaning event-every five years

TABLE 3.0-4

ANALYTICAL METHODS FOR WASTES
D007, K049, K050, K051, AND K052

Non-Appendix VIII Constituents

Parameter/Constituent	Test Method/Reference
Buld density	213 A/a
Solids weight fraction	209 A/a
Oil Weight fraction	503 A/a or ASTM-D96-73/a
Water weight fraction	503 A/a
Electrical Conductivity	120.1/b
pH	150.1/b
Ignitability	1010 /b

Appendix VIII Constituents e,f,g

Parameter/Constituent	Test Method/Reference
All Metals	3050/d
Volatile compounds	8240 with polyethylene glycol (PEG)/d
Semi-volatile compounds	Attachment 2/e

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[a]Standard Methods for the Examination of Water and Wastewater Fifteenth Edition American Public Health Associates, Inc., North York, N.Y. 10019; ASTM-96-73 (see Appendix B this Permit)

[b]EPA-600 4-79-020; Methods for Chemical Analysis of Water and Wastes, March 1979

[c]Pensky-Martens Closed-Cup flash point based on ASTM D93-77

[d]SW-846 Test Methods for Evaluating Solid Waste-Physical/Chemical Methods; Second Edition; USEPA, July 1982

[e]Memorandum: Guidance on Petroleum Refinery Waste Analysis for Land Treatment Permit Applications; John Skinner, Director of Office of Solid Waste; April 1984

[f]Proposed sampling and Analytical Methodologies, supplemental to SW-846, FR Vol. 49, No. 191, October 1, 1984; available as PB 85-103-026, National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161, 703-467-4600

[g]Appendix VIII and other Non-Appendix VIII key constituents will be added for routine analysis based on the initial waste characterization tests as shown in Table 2.2-2

FIGURE 3.6-1
INTERNAL SAMPLE
TRANSMITTAL SHEET

GIANT
REFINING COMPANY

ROUTE 3, BOX 7 • GALLUP, NEW MEXICO 87301
(505) 722-3833 • TWX 910-981-0504

DATE _____

_____
_____
_____
_____

Submitted by _____
Date Sampled _____
Sample Number

SAMPLES TRANSMITTED

_____
_____
_____
_____

WE REQUEST THAT THE FOLLOWING TESTS BE RUN ON THE ABOVE SAMPLE (S):

_____
_____
_____

REMARKS: _____
_____

ALL CORRESPONDENCE AND INVOICING SHOULD BE REFERENCED TO THE ABOVE SAMPLE NUMBER. Upon completion of the tests please forward copies of the results as follows:

copies to:

_____
_____
_____

_____
_____
_____

APPENDIX B

Waste Analysis Plan

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APPENDIX C

Land Treatment Unit Historical Information and Data

LAND TREATMENT UNIT HISTORICAL INFORMATION AND DATA

1.0 LAND TREATMENT HISTORY

Historical LTU information and data extracted from existing permit applications, operating permits, operating records, and other source documents are provided as Appendix C. The inclusion of this appendix does not imply that historical information and data have been verified.

In August 1980, Ciniza Refinery (Ciniza) notified the U.S. Environmental Protection Agency (EPA) that it was a generator and operator of a hazardous waste management facility. In November 1980, Ciniza submitted a Part A permit application as an "existing facility" (defined at 40 *Code of Federal Regulations* §260.10). This granted Ciniza interim status for their Land Treatment Unit (LTU) operations. In response to notice from the Regional Administrator, Ciniza submitted a Part B permit application in December 1983. Based on changing guidance, Ciniza submitted a land treatment demonstration plan (LTD) and an application for a two-phase LTD permit in April 1985. On February 9, 1987, Ciniza was issued a Short-term LTD Permit (NMD000333211-1) to conduct a hazardous waste land LTD. The LTD was conducted to identify the land treatment capabilities for refinery waste generated by Ciniza. The LTD defined waste management parameters (e.g., rate-limiting constituent, application-limiting constituent, capacity-limiting constituent, and unit life of the LTU). This was accomplished by identifying the Principal Hazardous Constituents (PHCs) present in refinery waste streams and measuring their degradation, transformation, and immobilization in the treatment zone of the LTU. From the results of the LTD and a modified Part B permit application, Ciniza was issued a Hazardous Waste Facility Permit (NMD 000333211-2) on November 4, 1988. Ciniza has not applied hazardous wastes to the LTU since November 8, 1990.

1.1 Land Treatment Program [20 NMAC 4.1, Subpart IX, §270.20(b)]

Ciniza's Hazardous Waste Facility Permit established operational requirements for the LTU. These requirements inchinclude procedural and engineering controls necessary to ensure that hazardous constituents are fully treated within the LTU without uncontrolled release to the environment.

The LTU consists of a treatment zone of soil extending 5 ft deep from the original soil surface. This depth is shallow enough to ensure that the treatment zone is more than 3 ft above the seasonal high water table. The zone of incorporation (ZOI) within the treatment zone is the volume of soil to which the waste was directly applied.

The ZOI for the Ciniza LTU is the top 12 in. of the treatment zone. The LTU was designed and constructed to prevent both washout of any hazardous waste and to prevent inundation of and discharge from the permitted unit through the use of a continuous dike which surrounds the LTU at an elevation of 3 ft above the natural grade.

The ZOI was tilled during permitted operations to encourage aerobic microbial activity and improve chemical reaction rates. During active treatment soil nutrients were applied, as necessary, to optimize carbon:nitrogen: phosphorous (C:N:P) ratios. Applications of Ciniza wastes to the LTU were limited to ensure that treatment processes were not overwhelmed or poisoned. Performance indicators (e.g., soil moisture, pH, total organic carbon) were monitored in the ZOI to ensure that treatment was proceeding.

1.2 Treatment Zone Description [20 NMAC 4.1, Subpart IX, §270.20(b)(2) and §270.20(b)(5)]
The LTU consists of three 480-by-240-ft sections, each of which contain 2.6 acres (1.0 hectares) of available treatment surface. Each section is delineated by a continuous dike to prevent site runon and runoff. The treatment zone extends 5-ft deep from the top of the soil within the diked section. The top 12 in. of the treatment zone is the ZOI. The ZOI is tilled when active to encourage aerobic degradation of organics and to maintain moisture content of the soil. This leaves 4 ft of the treatment zone undisturbed.

The soil within the treatment zone is silty clay containing closely-spaced root systems in the uppermost 3 to 4 ft. Field infiltration rates (the rate at which water penetrates into the soil surface) averages 1.0×10^{-3} cm/sec or 3.6 cm/hr. Soil permeability as determined by laboratory measurements averages 1.9×10^{-5} cm/sec or 6.8×10^{-2} cm/hr for three locations at the 6- to 12-in. depth. Field infiltration rate allows prediction of runoff and erosion; permeability (hydraulic conductivity) allows estimation of vertical water movement rates in the soil. The treatment zone soils have a saturated hydraulic conductivity rating of "moderately low" by the U.S. Department of Agriculture Class (Giant Refining Company Part B Permit Application 1984). The low permeability of the treatment zone soil assists in retarding the vertical movement of hazardous constituents through the treatment zone.

The silty clay soil has a high cation exchange capacity (CEC). The CEC is the total amount of exchangeable cations that the soil has to exchange with cations in the soil solution. The exchangeable cations in the LTU are the heavy metals present in the Ciniza wastes. The high CEC results in high sorption of heavy metals in the LTU soils, assuming other factors (such as soil pH) are favorable.

1.3 List of Wastes [20 NMAC 4.1, Subpart IX, §270.20(b)(1)]

This section, compiled from information found in Ciniza's Hazardous Waste Facility Permit, identifies the Ciniza waste streams approved for application to the LTU, their associated U.S. Environmental Protection Agency hazardous waste numbers, and their annual application limits. Table 1-1 summarizes this information.

1.3.1 Potentially Ignitable Materials (D001)

Ignitable materials applied to the LTU from 1988 to 1990, were generated by refinery operations, specifically filter clay from kerosene filters, unleaded fuels tank bottoms, and soils contaminated by petroleum product spills occurring within the refinery grounds. This waste stream did not include degreasing solvents used within the plant or waste lubricants generated by refinery equipment and vehicles.

1.3.2 Cooling Water Filter Sludge (D007)

Cooling water filter sludge was approved for LTU application, but was never applied. Cooling water filter sludge was generated from the filtration of circulated cooling water to remove solids. The solids were removed to prevent sedimentation and fouling of heat exchangers. The filtered solids were predominately dusts aspirated into the cooling tower.

1.3.3 Slop Oil Emulsion Sludge (K049)

Slop oil emulsion sludge applied to the LTU from 1987 to 1990, was generated when oil collected in the refinery American Petroleum Institute (API) separator was pumped to slop oil recovery tanks. The oil eventually fed to the Crude Unit. The water collected in the tank was drained back into the API separator. The slop tanks are cleaned of sludge approximately every five years.

1.3.4 Heat Exchanger Bundle Cleaning Sludge (K050)

Heat exchanger bundle cleaning sludge applied to the LTU from 1987 to 1990, was generated as process units were shut down for maintenance and cleaning. The units were either steam cleaned or water washed with mechanical cleaning, where needed. The cleaning water and sludges were collected in the refinery sewer system which flows to an API separator. The remaining sludge was shoveled into barrels for treatment at the LTU.

1.3.5 API Separator Sludge (K051)

API separator sludge applied to the LTU from 1987 to 1990, was generated from the cleaning of the API separators. Refinery wastewaters, including those from the cooling tower and tank farm, were serviced by the oily water sewer system. The oily water sewer system discharged to a two-parallel-bay API separator. The oil

collected from the separator was recovered as slop oil and charged as feed to the Fluid Catalytic Cracking Unit or the Crude Distillation Unit. The oil-free and sludge-free water from the API separator was discharged to the refinery evaporation ponds. The sludge collected in the bottom of the API separator was picked up with a vacuum truck for treatment at the LTU.

1.3.6 Leaded Tank Bottoms (K052)

Leaded tank bottoms applied to the LTU in 1990, were generated when leaded gasoline tanks were cleaned. The leaded sludge was collected with a vacuum truck for treatment at the LTU.

1.4 Volume of Wastes [20 NMAC 4.1, Subpart IX, §270.20(b)(1)]

Table 1-2 (compiled from LTU logbook entries) provides the volume, in barrels and tons, of each waste stream applied to the LTU from 1987 through 1993. Nonhazardous waste was applied to the LTU from 1990 through 1993, in compliance with the Hazardous Waste Facility Permit. Tonnages were calculated from barrel volumes. Permitted treatment application of waste was initiated in 1988, and was completed in 1990. Hazardous wastes generated (i.e., D001, D007, K049, K050, K051, and K052) after 1990, are managed off-site at permitted treatment, storage, and disposal facilities.

1.5 Operating Procedures [20 NMAC 4.1, Subpart IX, §270.20(b)(2)]

Approved waste streams applied to the LTU were managed so that annual hazardous waste volumes did not exceed the 1,275 tons authorized by the Hazardous Waste Facility Permit. The volume of each waste stream placed in the LTU was also monitored to ensure that annual application limits were not exceeded. These application limits were developed from the waste management parameters identified by the *Land Treatment Demonstration Volume I - Engineering Report*, (Giant Refining Company 1988) (Appendix D).

Wastes were collected from the plant using a vacuum truck or through mechanical methods and containerized within the vacuum truck or drums. Wastes were transported to the LTU via the vacuum truck or flatbed truck. All vehicles contaminated with LTU soils and waste were washed sufficiently to prevent contamination from being transported to uncontaminated areas. Contaminated rinse water was either routed to the plant's API separator or spread on the LTU. Wastes were applied uniformly to the LTU to prevent pooling on the surface. The LTU is divided into three cells, as shown on Figure B-2. Hazardous wastes were applied to cells 1 and 2 from 1981 to 1990. No hazardous wastes were ever applied to Cell 3. Wastes were distributed over the treatment areas not to exceed 10 percent by weight of oils and greases anywhere within the ZOI. Nonhazardous waste applications were managed to ensure that oil and grease loads did not exceed the 10-percent weight limit.

The top 12 in. of soil were tilled twice following waste application to distribute waste into the ZOI. During the degradation season (April through October) cells 1, 2, and 3 of the LTU were tilled at least once per month to enhance microbial and chemical degradation of the waste.

To protect microbial viability, treatment maintenance parameters (e.g., oil and grease, pH, moisture content, C:N:P) have been monitored in the soils, as described in Section 1.9.1. Monitoring provided information necessary to ensure that treatment maintenance parameters did not exceed acceptable ranges. If acceptable ranges were exceeded, activities such as reduction in waste loading rates or addition of fertilizer, lime, acid, or moisture were conducted to maintain proper treatment. Ciniza personnel inspected the LTU weekly to ensure that runon/ runoff controls and soil moisture levels were monitored. Inspections were conducted in accordance with the Hazardous Waste Facility Permit (No. NMD 0000333211-2).

1.6 Surface Water Control [20 NMAC 4.1, Subpart V, §264.273 and Subpart IX, §270.20(c)(1)]
Figure B-3 shows the drainage areas and 100-year floodplain relative to the refinery and the LTU. Existing drainage channels can contain the 100-year event within the areas delineated on Figure B-3. Any future expansion of the refinery will not be constructed within the 100-year floodplain. Accumulation of on-site flows is rare and standing water remains a maximum of three to five days due to the dry climate. Each LTU cell is surrounded by a continuous dike to prevent inundation of and discharge from the unit. The dike is maintained at an elevation of 3 ft above the natural grade. The vacuum truck and tilling equipment enter the sections by ramps located in the northeast corner and northeast side of the LTU.

1.7 Collection and Control of Runoff [20 NMAC 4.1, Subpart V, §264.273; and Subpart IX, §270.20(c)(2)]
The peak storm runoff for the LTU is based on the 25-year, 24-hour storm, which specifies a four percent annual probability that the amount will be equaled or exceeded. For the Gallup area, direct runoff during the peak storm is calculated at 1.6 in.. The 3-ft berm surrounding the LTU is more than adequate to contain the 1.6-in. peak storm runoff. Ciniza personnel inspect the LTU to ensure that the integrity of the berm is maintained.

1.8 Control of Wind Dispersal [20 NMAC 4.1, Subpart V, §264.273(f) and Subpart IX, §270.20(c)(6)]
Waste was applied to the LTU when average wind speeds were below 10 mi/hr. Soil moisture and oil content levels retained particulates on the soil surface. During the winter months the soil surface is typically wet or frozen so that wind dispersal is controlled. Additionally, Ciniza personnel spray water onto the LTU surface to control wind dispersal. Ciniza personnel inspect the LTU to ensure that wind dispersal control is effective.

1.9 Unsaturated Zone Monitoring Plan [20 NMAC 4.1, Subpart V, §264.278 and Subpart IX, §270.20(b)(3)] Ciniza has conducted unsaturated zone monitoring of the LTU to verify that treatment operations are successfully degrading, transforming, or immobilizing hazardous waste constituents. Treatment performance has been tracked by measuring for migration of hazardous constituents to below the treatment zone (BTZ) soils (approximately 5.5-ft depth) and treatment maintenance parameters in ZOI soils (12-in. depth). To track treatment performance, four soil core samples were taken bimonthly during the degradation season from ZOI soils, and four soil core samples were taken semiannually from the BTZ soils. Sample locations were selected randomly from each of the three LTU cells. Monitoring BTZ ensures that hazardous constituents are not released BTZ.

1.9.1 Sampling and Analysis Plan

Samples were obtained following the protocols in established sampling and analysis plans (SAPs). The SAPs identified procedures for obtaining soil samples, determining sampling locations, decontaminating equipment; chain-of-custody; analytical procedures; and quality assurance/quality control requirements. The SAPs implemented the requirements for sampling and analysis presented in the Ciniza Hazardous Waste Facility Permit. Table 1-3 identifies the minimum analytical parameters for soil monitoring, their frequency, and rationale as presented in the permit. Analytical parameters were selected based on the PHCs identified in the LTD. The LTD also established the background soil values for the site. Climate and soil characteristics of the Ciniza site are such that there is no appreciable soil-pore liquid.

1.9.2 Monitoring Results

Sampling and analysis of the LTU has been conducted in accordance with SAPs to meet the requirements of the Ciniza Hazardous Waste Facility Permit. Analytical results have been reported to the EPA or the New Mexico Environment Department/Hazardous and Radioactive Materials Bureau (NMED/HRMB) for review and comment. Anomalies or questions concerning analytical results were addressed on a case-by-case basis between Ciniza and EPA or NMED/HRMB. No release of hazardous constituents from the LTU has ever been confirmed. The detection of hazardous constituents above background levels has been sparse, erratic, and invalidated. Detections of hazardous constituents have been found, through data validation, to be laboratory contamination. Remaining detections have not been reproducible upon subsequent sampling events.

2.0 GROUNDWATER HISTORY

2.1 Interim Status Period Groundwater Monitoring Data [20 NMAC 4.1, Subpart V, §265.90 through §265.94 and Subpart IX, §270.14(c)(1)]

Operating under interim status from 1980 to 1987, the LTU was subject to regulations under 40 *Code of Federal Regulations* (CFR) 265, Subpart F. These regulations require monitoring of the uppermost aquifer beneath the unit for possible effects upon the groundwater system. A groundwater monitoring well (MW) network of one upgradient and three downgradient wells had to be in place and a program of monitoring procedures initiated by November 1981. Ciniza contracted Dames & Moore to develop a groundwater monitoring plan and install MWs necessary to meet the RCRA requirements. The MW system was completed and the program established by November 1981. The MW locations are shown on Figure B-3.

Background water (water that is unaffected by leakage from the LTU) was sampled from MW-4, which is completed in the Sonsela aquifer and located upgradient from the LTU as determined from the potentiometric surface associated with the Sonsela aquifer. Water that passed beneath the LTU in the Sonsela aquifer was sampled from MW-1, MW-2, and MW-3, located downgradient from the LTU. It was found later that MW-3 was not screened in the Sonsela aquifer. MW-3 was closed and replaced by MW-5 in 1987. MW-1, MW-2, MW-4, and MW-5 were cased with 5-in. schedule 160 PVC casing, and a gravel pack was placed in the annulus between the slotted casing and the borehole wall to enable collection of groundwater samples. The annulus above the screened aquifer was filled with bentonite cement of extremely low permeability to prevent contamination of samples.

MW series wells were sampled in accordance with Ciniza's Groundwater Monitoring Plan (Dames & Moore, 1981). The plan identified three groups of parameters to be analyzed in the sampling program (see Table 2-1). Analytical results were reported to the EPA and/or NMED/HRMB in annual reports. The reports included the values of all group parameters measured during each year in each MW; statistical evaluations (arithmetic mean and variance for comparison with initial background mean using the Student's t-test); and water table elevation evaluations.

In September 1985, the shallow monitoring wells (SMWs) were installed and sampled to establish an early detection system. The SMWs had been installed in the water-yielding sands above the Chinle slope wash. It appears that at least four thin lenses or pockets of sand exist above the Chinle shale between the ground surface and the top of the Sonsela sandstone. The upper two sands are dry. The third sand outcrops under the refinery

ponds south of the LTU and ends before reaching the north boundary of the LTU. SMW-1, SMW-2, and SMW-3 (up gradient wells) are completed in this sand. The fourth sand is saturated and is perched immediately above the Chinle shale. SMW-4, SMW-5, and SMW-6 (downgradient wells) are completed in the fourth sand.

EPA Region 6 inspected the Ciniza Refinery in February 1985. Based on this inspection, the EPA issued the Comprehensive Monitoring Evaluation (CME) report. The CME found that neither the MW nor the SMW series was adequate to meet the minimum requirements for monitoring of one upgradient well and three downgradient wells because MW-3 was not completed within the Sonsela aquifer, and the upgradient and downgradient SMWs were completed in two different sands charged by different sources of water. Ciniza and the EPA negotiated a monitoring program, which was incorporated into the Hazardous Waste Facility Permit (issued November 1988).

2.2 Groundwater History - Permitted Groundwater Monitoring Data [20 NMAC 4.1, Subpart V, §264.90 through §264.94]

The permitted groundwater monitoring program included an early detection monitoring system consisting of wells SMW-3, SMW-4, SMW-5, and SMW-6 and a detection monitoring system consisting of wells MW-1, MW-2, MW-4, and a new well, MW-5, completed within the Sonsela aquifer. Attachment H of the Hazardous Waste Facility Permit required Ciniza to identify a new background well designed to monitor the Sonsela formation aquifer. Well OW-11 was identified in the Hazardous Waste Facility Permit as the required background well.

The new monitoring program wells were sampled in accordance with Ciniza's Hazardous Waste Facility Permit. The permit identified three groups of parameters to be analyzed in the sampling program (see Table 2-2).

Semiannual groundwater reports including tabulated results and graphs have been submitted to the EPA and/or the NMED/HRMB for review and comment. Anomalies or questions concerning analytical results were addressed on a case-by-case basis between Ciniza and the EPA and/or NMED/HRMB. No release of hazardous constituents in the Sonsela aquifer has ever been confirmed. Detection of hazardous constituents above background levels has been sparse, erratic, and invalidated. Most detections of hazardous constituents have been found to be laboratory contamination when data were validated. Remaining detections have not been reproducible upon subsequent sampling events.

Table 1-1. Approved Waste Streams Applied to the Land Treatment Unit

EPA Hazardous Waste No.	Waste Description	Annual Application Limit (tons)
D001	Ignitable materials	50
D007	Cooling Water Filter Sludge	5
K049	Slop Oil Emulsion Sludge	200
K050	Heat Exchanger Bundle Cleaning Sludge	15
K051	API Separator Sludge	1,000
K052	Tank Bottoms (Leaded)	5

Table 1-2. Waste Stream Volumes Applied to Permitted Land Treatment Unit (1987 through 1993)

Dated Units	Ignitable Material D001[a]	CWF Sludge D007	Slop Oil K049[a]	Heat Exch Sludge K050[a]	API Sludge K051[a]	Tank Bottoms K052[a]	Non Haz Waste	Assoc Waste waters	Total[c]
1987[b] BBL	0	0	998	13	2171	0	0	628	3810
1987 Tons	0	0	200	3	434	0	0	126	763
1988 BBL	215	0	140	0	3435	0	15	3345	7150
1988 Tons	43	0	28	0	687	0	3	669	1430
1989 BBL	12	0	0	0	3675	0	4400	0	8087
1989 Tons	2	0	0	0	735	0	880	0	1617
1990 BBL	0	0	0	15	2345	25	6222	0	8607
1990 Tons	0	0	0	3	469	5	1244	0	1721
1991 BBL	0	0	0	0	0	0	3336	684	4020
1991 Tons	0	0	0	0	0	0	667	137	804
1992 BBL	0	0	0	0	0	0	1579	0	1579
1992 Tons	0	0	0	0	0	0	316	0	316
1993 BBL	0	0	0	0	0	0	1230	0	1230
1993 Tons	0	0	0	0	0	0	246	0	246
1987- 1993 TOTAL TONS[a]	45		228	6	2325	5			

Source: LTU logbook entries.

BBL = Barrels

[a]Per RCRA Code
[b]1987 Land Treatment Demonstration.
[c]Total calculations corrected (Benchmark 1998).

Table 1-3. Permit Required Soil Monitoring Analytical Parameters

Depth	Parameter	Frequency	Method[b]	Rationale
ZOI	Oil and Grease	Bimonthly [a]	EPA-600/413 SW-846/9070	To determine whether soil loading rates have been within the 10 percent oil and grease loading limit.
ZOI	pH	Semiannually	EPA-600/150.1 SW-846/9040	To ensure that soil pH supports microbial degradation and chemical immobilization. Target 6.0-9.0.
ZOI	C:N:P	Semiannually	EPA-600/ 351.3, 365.2	To ensure that an optimal ratio of nutrients is maintained for microbial activity and to support chemical reaction. Target 50:2:1
BTZ	Moisture Content	Semiannually	ASTM	Required by permit.
BTZ	pH	Semiannually	EPA-600/ 150.1 SW-846/ 9040	Required by permit.
BTZ	Total organic carbon	Semiannually	EPA 600/ 415 SW-846/ 9060	Required by permit.
BTZ	Ethyl benzene m-xylene o&p-xylene o-cresol m&p-cresol Pyrene Phenanthrene 1-methylnaphthalene Benzo(a)pyrene Chrysene	Semiannually	SW-846/ 8240, 8270	To determine whether PHCs identified in the LTD are migrating out of the treatment zone.

Source: NMEID (1988).

[a]Samples taken bimonthly during the degradation season of April 1 through October 31.
[b]Or other EPA-approved analytical procedure.

Table 2-1. Groundwater Monitoring Plan (1981) Parameters Analyzed

Parameter Group	Group Description	Group Parameters	Sampling Frequency
1	Interim primary drinking water standards	Arsenic Barium Cadmium Chromium Fluoride Lead Mercury Nitrate (as N) Selenium Silver Endrin Lindane Methoxychlor Toxaphene 2,4-D 2,4,5-TP (Silvex) Radium Gross Alpha Gross Beta Coliform Bacteria	One sample taken from all wells quarterly for the first year.
2	Groundwater quality parameters	Chloride Iron Manganese Phenols Sodium Sulfate	One sample taken from all wells quarterly for the first year; one sample taken from all wells annually for subsequent years
3	Indicator parameters of groundwater contamination	pH Specific Conductance Total Organic Carbon Total Organic Halogen	Four samples taken from upgradient well; one sample taken from downgradient wells; quarterly for the first year; four samples taken from all wells semiannually in subsequent years

Source: Dames and Moore (1981).

Table 2-2. Ciniza Hazardous Waste Facility Permit (1988) Groundwater Parameters Analyzed

Parameter Group Source	Monitoring Parameters			Monitoring Frequency
Table G-2	Temperature			Semiannual
	pH (Replicate of 4 samples)			
	Conductivity (Replicate of 4 samples)			
	Volatile Contaminants			
	Water Level (Replicate of 2 measurements)			
	Lead (total) (Early detection system only)			
	Chromium (total) (Early detection system only)			
Table G-3	pH (Replicate of 4 samples)			Annual
	Conductivity (Replicate of 4 samples)			
	Volatile Contaminants (Replicate of 2 samples)			
	Water Level (Replicate of 2 measurements)			
	Arsenic	Barium	Cadmium	
	Chromium	Lead	Mercury	
	Selenium	Silver	Sodium	
	Calcium	Manganese	Chloride	
	Sulfate	TDS	Phenol	
	Carbonate and bicarbonate			
Table G-4	Organic PHCs			When indicated by significant difference in above parameters.
	Ethyl benzene	m-xylene		
	o&p-xylene	o-cresol		
	m&p-cresol	Pyrene		
	Phenanthrene	1-methylnaphthalene		
	Chrysene	2,4,6-trichlorophenols		
	Benzo-b-fluoranthene	7,12-dimethylbenzanthracene		
	Benzo-a-anthracene	Bis (2-ethylhexyl) phthalate		
	2-Chlorophenol	Benzo-j-fluoranthene		
	Fluoranthene	1,1-Dichloroethene		
	1,1,1-Trichloroethane	Benzene		
	Tetrachloroethene	Benzo (a) pyrene		
	Toluene	Methylethylketone		
	Naphthalene			
	Inorganic PHCs			
	Barium	Cadmium		
	Chromium	Copper		
	Lead	Nickel		
	Selenium	Silver		
	Zinc			

Source: NMEID (1988).

APPENDIX D

Land Treatment Demonstration Engineering Report

Lockwood, Andrews
& Newnam, Inc.

Engineering · Architecture · Planning · Project Management

GIANT REFINING COMPANY

GALLUP, NEW MEXICO

LAND TREATMENT DEMONSTRATION
VOLUME I - ENGINEERING REPORT

PRESENTED TO
NEW MEXICO HEALTH AND ENVIRONMENT DEPARTMENT
BY
APPLIED EARTH SCIENCES, INC.
MAY 1988

LAND TREATMENT DEMONSTRATION

ENGINEERING REPORT

PRESENTED TO

GIANT REFINING CO.

FOR

APPLIED EARTH SCIENCES

BY

LOCKWOOD, ANDREWS & NEWNAM, INC.

MAY, 1988

LAND TREATMENT DEMONSTRATION
DRAFT
ENGINEERING REPORT

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G COMPOSITE WASTE CALCULATION
H STATISTICAL METHODS AND CALCULATIONS

1.0 EXECUTIVE SUMMARY

Giant Refining is an independently owned oil company which processes Four Corners crude oil in order to produce petroleum products for distribution in the New Mexico, Arizona and Colorado region. Major products produced at the refinery are gasoline, diesel fuel, jet fuel and residual fuel oil. The refinery process produces several wastes which are considered by the U.S. E.P.A. to be hazardous and are listed as such. These wastes are treated on site using conventional land treatment technology. As part of the permitting requirements for the treatment facility a land treatment demonstration was conducted.

The land treatment demonstration is designed to evaluate the principal processes involved in the treatment of hazardous waste applied to the land treatment unit. These processes include degradation, transformation and/or immobilization of the hazardous constituents found in the wastes.

The land treatment demonstration is designed to provide the New Mexico Health and Environment Department, Environmental Improvements Division the information necessary to define two elements of the land treatment program. First, the demonstration establishes what wastes may be managed by the treatment unit. Second, the results of the treatment demonstration will be available to define the waste management practices, including loading rates and unit life, that will be incorporated into the facility permit.

The treatment demonstration contains information derived from actual facility operating experience, published literature, laboratory analysis and field studies. With this information, the report will define the principal hazardous constituents (PHC's), and determine the degradation rates, the half lives and the migration times of the PHC's. From this information, the loading rates, based on the rate limiting constituent (RLC) and the application limiting constituent (ALC), are determined. Also determined are the capacity limiting constituent (CLC) and the unit life.

Determination of principal hazardous constituents is based on persistence and degradation criteria defined in NMHWMR-4, 206.D.9.f.(1)(b). Loading rates were based on degradation and toxicity criteria. The limiting constituents are presented in Table 1.0.

Parameters	Constituent	Amount of Waste
Capacity Limiting Constituent (CLC)	Zinc	7,125,000 lb waste/ac
Application Limiting Constituent (ALC)	M-Xylene	254,880 lb waste/ac/app
Rate Limiting Constituent (RLC)	1-methylnaphehalene	2,448,000 lb waste/ac

TABLE 1.0 LIMITING CONSTITUENTS

The following table is a summary of waste management parameters determined from the land treatment demonstration.

PHC's

Organics	Metals
Ethylbenzene	Barium
m-Xylene	Cadmium
o&p-Xylene	Chromium
o-Cresol	Copper
m&p-Cresol	Lead
Pyrene	Nickel
Phenanthrene	Selenium
1-Methylnaphthalene	Silver
Benzo(a)pyrene	Zinc
Chyrsene	

Loading Rates

Application	lb/ac/application
API Separator Sludge	254,880
Heat Exchanger Sludge	1,770
Slop Oil	93,810
Leaded Tank Bottoms	3,540
Total Waste	354,000

Annual	lb/ac/yr
API Separator Sludge	2,448,000
Heat Exchanger Sludge	17,000
Slop Oil	901,000
Leaded Tank Bottom	34,000
Total Waste	3,400,000

Facility Capacity 35,400,000 lb/ac

Facility Life* - 10 years

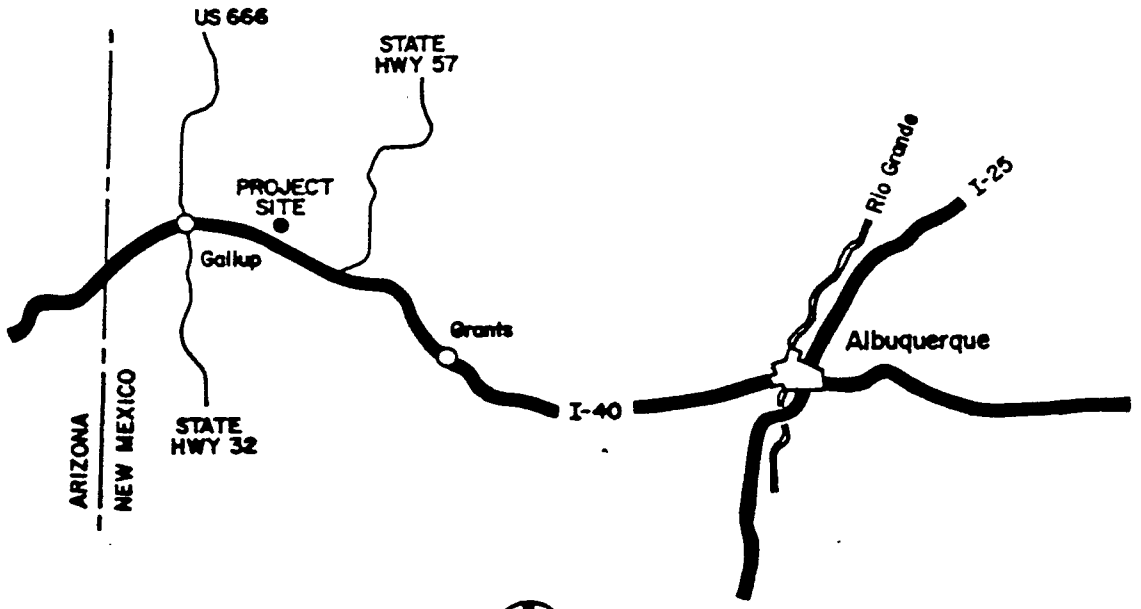
* Based on twice the present annual application rate to date.

TABLE 1.1 WASTE MANAGEMENT OPERATING PARAMETERS

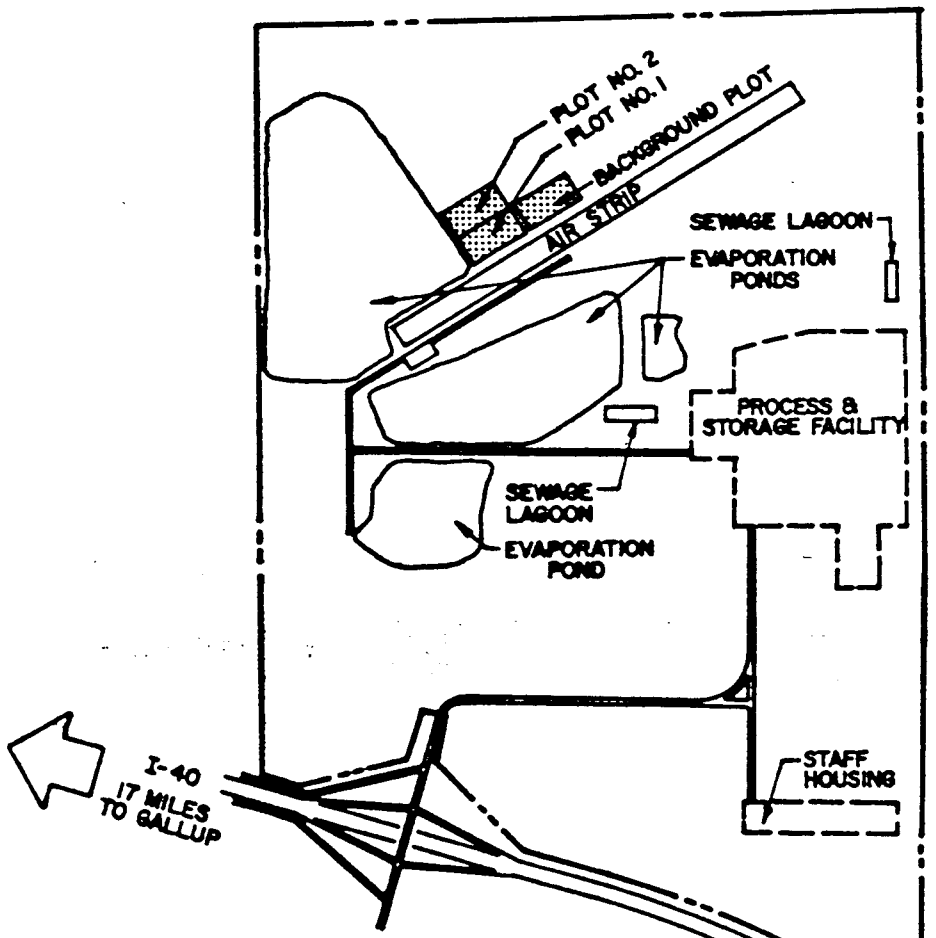
2.0 PROJECT DESCRIPTION

Based on the Demonstration Permit (NMD000333211-1) and the Permit Application Report (June 1986, Appendix A), a Land Treatment Demonstration was conducted to show treatment capabilities for refinery waste generated by Giant Refining Company. The demonstration occurred on Giant Refining Company land, approximately 17 miles east of Gallup, New Mexico, north of Interstate 40 (see Figure 2.0) utilizing the existing land treatment facility. The demonstration period lasted from April 1987 through March 1988.

The demonstration permit allowed the application of five types of waste. These waste types are listed in Table 2.0. Three of the original five designated wastes were applied to and incorporated into the treatment areas, Plots 1 and 2. On each 2.4-acre plot, the following wastes were placed: slop oil solids, API separator sludge and heat exchanger sludge. Cooling tower sludge has been eliminated from the waste stream, due to process changes that eliminated chromate in cooling water, and leaded tank bottoms are dumped at a frequency of about once every two years. The treatment area was then tilled after each waste application. The plots are surrounded by a dike. Adjacent to the treatment area is a background plot with no dikes or waste application. The background plot was monitored for any natural variations that could then be compared to the treatment plots' characteristics.



VICINITY MAP NORTH



SITE PLAN NORTH

FIGURE 2.0

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GIANT REFINING COMPANY - GALLUP, NM
LAND TREATMENT DEMONSTRATION
VICINITY & SITE PLAN

Cooling Tower Sludge
Slop Oil
API Separator Sludge
Heat Exchanger Sludge
Leaded Tank Bottoms

TABLE 2.0 WASTE TYPES AUTHORIZED FOR APPLICATION ON THE GIANT REFINERY LAND TREATMENT FACILITY

Quarterly soil sampling of the plots occurred during the demonstration, as well as sampling prior to and after the demonstration period. Sample points were established by a random point generation based on an established grid system.

3.0 DEMONSTRATION METHODS

3.1 WASTE APPLICATION

According to the Demonstration Permit, page 9, a maximum of 4,093 barrels, or 964 tons, of waste can be applied per year for both treatment areas combined. During the demonstration period, 3,045 barrels of waste or about 660 tons were applied to both Plots 1 and 2. The waste was applied during the degradation season (April through October) in six sequences as shown in Table 3.0.

1987	Waste Type	Amount* BBL's	Amount* Tons
April 29	Slop Oil/Heat Exchange Sludge	26	5.1
May 5	Slop Oil	225	38.8
May 7	Slop Oil	330	56.6
May 8	Slop Oil	55	9.5
July 15	Slop Oil	238	41.1
July 16-21	API Sludge	2,171	508.9
	TOTAL	3,045	660

* From Giant Refining Field Notes 1/87 through 3/88, Robert McClenahan, Jr.

TABLE 3.0 WASTE APPLICATION SEQUENCE

Estimated amounts and sources of wastes are shown in Table 3.1. This table also shows the percent each waste type contributes to the total waste applied.

Waste Type	Estimated Annual Quantity (Tons)	Annual Waste Loading Rate (BBL/Acre)	Annual Oil Loading Rate (BBL/Acre)	Weight Percent
Slop Oil	142	179	30.6	21.5
API Separator Sludge	509	452	25.8	77.0
Heat Exchanger Sludge	3.4	27	0.5	0.5
Leaded Tank* Bottoms	6.2	5.2	NA	1.0
TOTALS	660.6	663.2	56.9	100.0

TABLE 3.1 WASTE SOURCES AND AMOUNTS FROM LAND TREATMENT DEMONSTRATION
(*Estimated from Permit Application, Table 2.1)

Incorporation of the waste began with a vacuum truck equipped with a distribution system. The system fairly evenly distributed the waste behind the truck on the plots. When possible, within two days of waste application, the top 12 inches of soil was tilled to facilitate the breakdown of the waste by soil microbes. Since the soil pH was slightly alkaline to begin with, the applied waste did not alter the pH above 9.0 or below 6.0. Therefore, no pH adjustment was necessary during the demonstration period.

Plots were also plowed on a monthly basis to further degrade the waste. This was done during the degradation months (April through October). The demonstration area was also monitored weekly for berm damage and no berm damage was noted during the demonstration period.

Wastes applied included API separator sludge, heat exchanger sludge and slop oil emulsions. In Table 3.2, waste characteristics as of March 1986 are presented; only the detected amounts are reported. The complete laboratory reports are in the Permit Application Report found in Appendix A-2.

API sludges comprise the major volume (77 percent) of applied wastes. According to the March 1986 analysis, this waste is approximately 6 percent oil, 37 percent water and 57 percent solids. The slop oil emulsions make up about 21 percent of the waste and heat exchanger sludge about 0.5 percent of the waste. Although leaded tank bottoms were not applied, it is estimated they will make up about 1 percent of the applied waste.

	API Separator Sludge (mg/Kg)	Slop Oil (mg/Kg)	Heat Exchange Sludge (mg/Kg)	Leaded Tank Bottoms (mg/Kg)
Bis(2-ethylhexyl)phthate	<5.0	<5.0	<40	--
Anthracene	9	<5.0	<40	--
Benzo(a)anthracene	5	<5.0	220	--
Chrysene	13	<5.0	420	--
Fluoranthene	3	<2.5	34	<0.01
1-Methylnaphthalene	470	210	380	--
Naphthalene	120	64.0	50	--
Phenanthrene	85	22.0	280	--
Pyrene	16	5	120	--
Benzene	9	190	1.5	<0.01
Ethylbenzene	20	420	12.0	<0.01
Toluene	60	1200	20.0	<0.01
M-Xylene	61	1600	41.0	--
O&P-Xylene	52	1300	38.0	--
O-Cresol	47	8.1	<0.5	--
M&P-Cresol	230	33.0	0.7	--
Phenol	420	150	<1.0	--
2,4 Dimethylphenol	<2	1.1	<0.5	--
Benzene(b)fluoranthene	<4	<5.0	100	<0.01
Benzo(a)pyrene	<4	<5.0	83	--
V(vanadium)	14.0	1.8	40	--
Hg(mercury)	2.7	14.0	4.1	--
Sb(antimony)	2.4	ND	<2	6.8
As(arsenic)	19	4.0	60.0	40.0
Ba(barium)	760	520.0	120.0	934.0
Be(beryllium)	0.5	ND	0.4	0.1
Cd(cadmium)	3.6	1.8	2.7	80.0
Cr(chromium)	920	52.0	1000.0	250.0
Cu(copper)	760	86.0	830.0	600.0
Pb(lead)	330	80	73	17,800.0
Ni(nickel)	91	18	46	800.0
Se(selenium)	11	ND	11	2.0
Ag(silver)	1.6	0.4	0.6	23.0
Zn(zinc)	2040.0	1700.0	510.0	180.0
Co(cobalt)	22.0	3.4	12.0	--

TABLE 3.2 WASTE CHARACTERISTICS, MARCH 1986

3.2 SAMPLING

Pre-demonstration samples in all the plots were taken on April 28 and 29, 1987 to determine the existing soil constituents. Six soil borings were made in the background plot as well as twelve borings in each of the two treatment plots. Sample points in the treatment plots are shown in Figure 3.1 and in the background plot are shown in Figure 3.2.

Quarterly samples were then taken in September, 1987, December, 1987 and March, 1988, and the sample locations are shown in Figures 3.3, 3.4 and 3.5 respectively. The post demonstration sampling was taken in April, 1988 and the sample locations are shown in Figures 3.6 and 3.7.

Boring sites were chosen by generating random coordinates within each plot. Samples were then taken and organized relative to each plot, set of borings and depth interval. Table 3.3 shows the interval spacing and the number of borings composited per sample.

Interval one samples were composites of three borings from the same plot. Interval two through five were composites of the same six borings from the same plot. Interval six samples were not composited and are therefore individual samples from each boring.

Interval (Vertical)	Composite Range
One (0' to 1')	3 borings* composited
Two (1' to 2')	6 borings* composited
Three (2' to 3')	6 borings* composited
Four (3' to 4')	6 borings* composited
Five (4' to 5')	6 borings* composited
Six (5' to 6')	Each boring is sampled separately.

* Borings were located within the same plot.

TABLE 3.3 VERTICAL SAMPLE INTERVAL SPACING

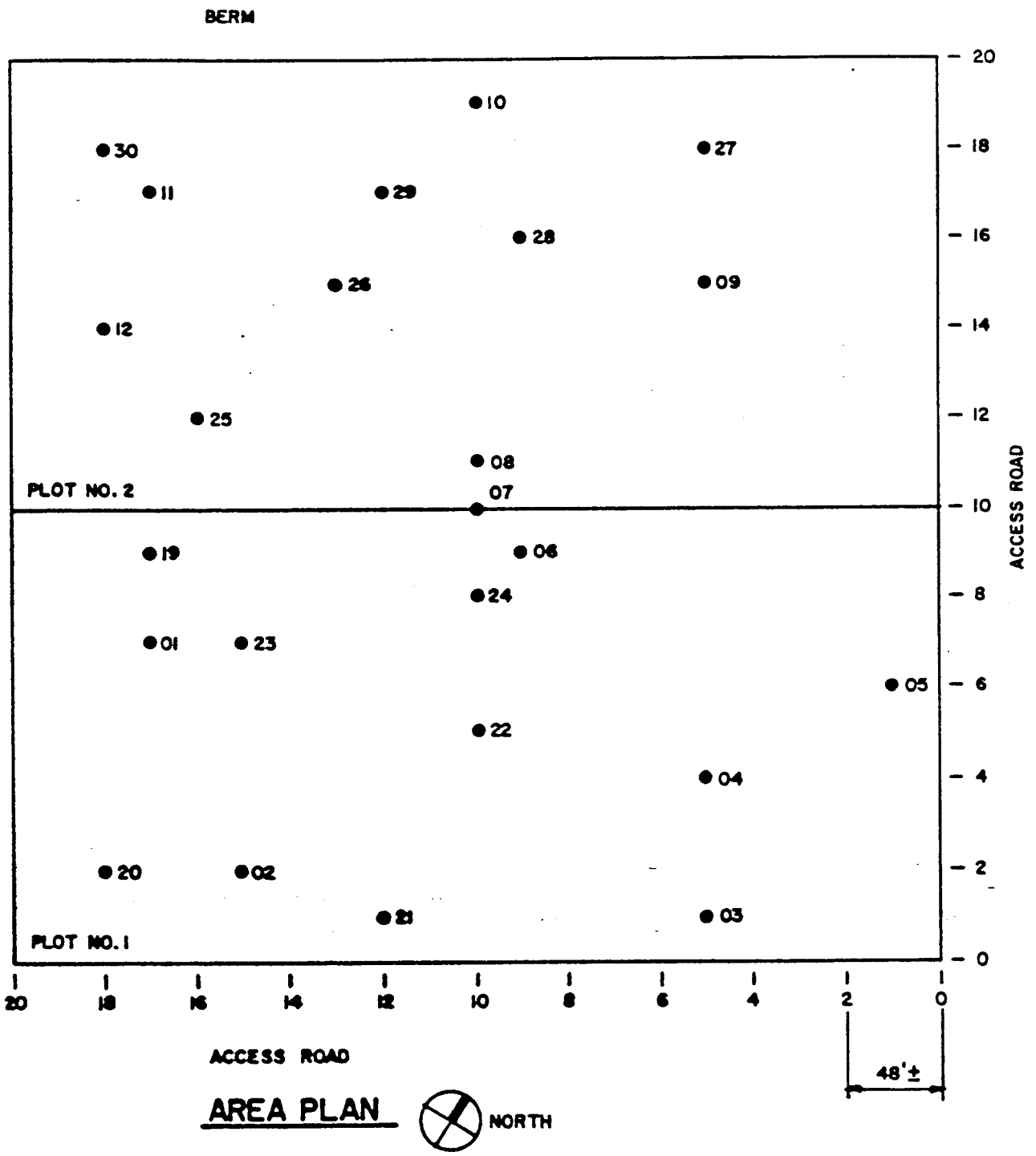

FIGURE 3.1

GIANT REFINING COMPANY - GALLUP, NM
LAND TREATMENT DEMONSTRATION
SAMPLE LOCATIONS - EVENT NO. 1, APRIL '87

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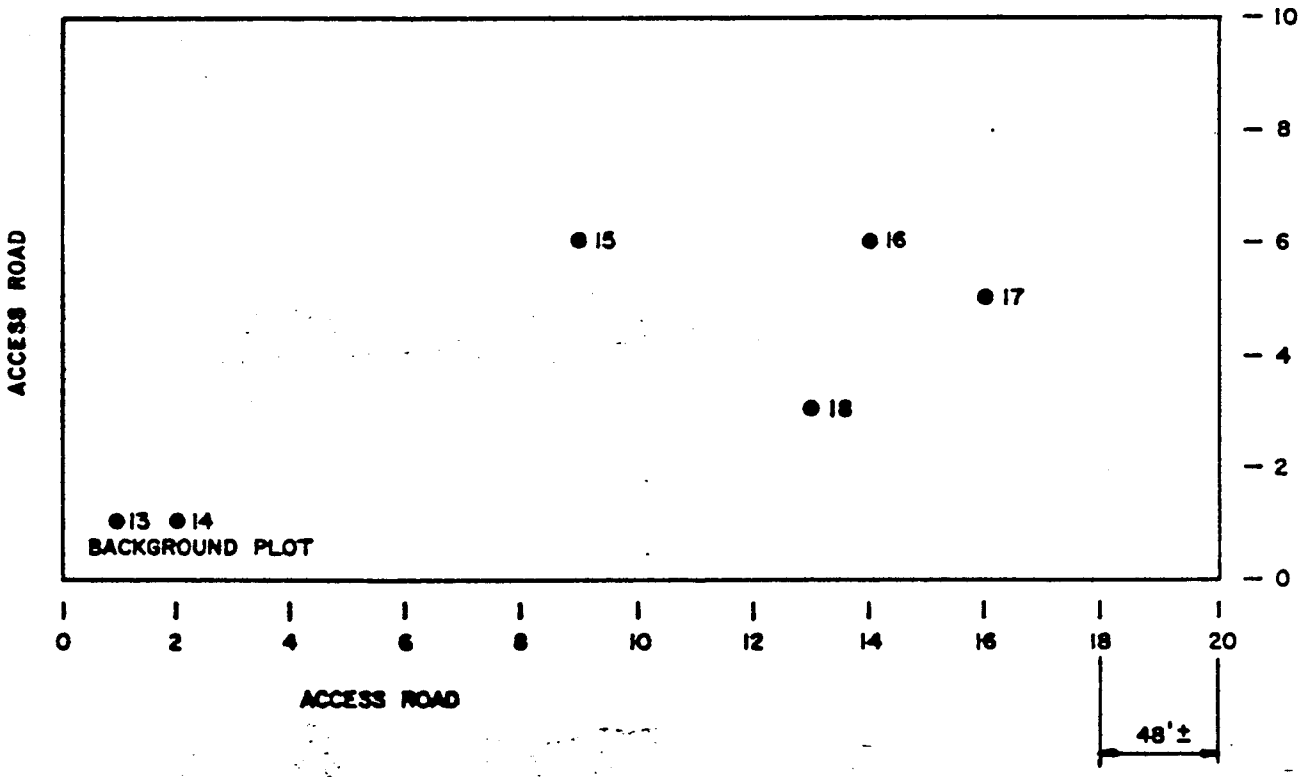


AREA PLAN

FIGURE 3.2

GIANT REFINING COMPANY-GALLUP, NM
LAND TREATMENT DEMONSTRATION
SAMPLE LOCATIONS-PRE DEMO EVENT, APR '87

Lockwood, Andrews & Newnam, Inc.

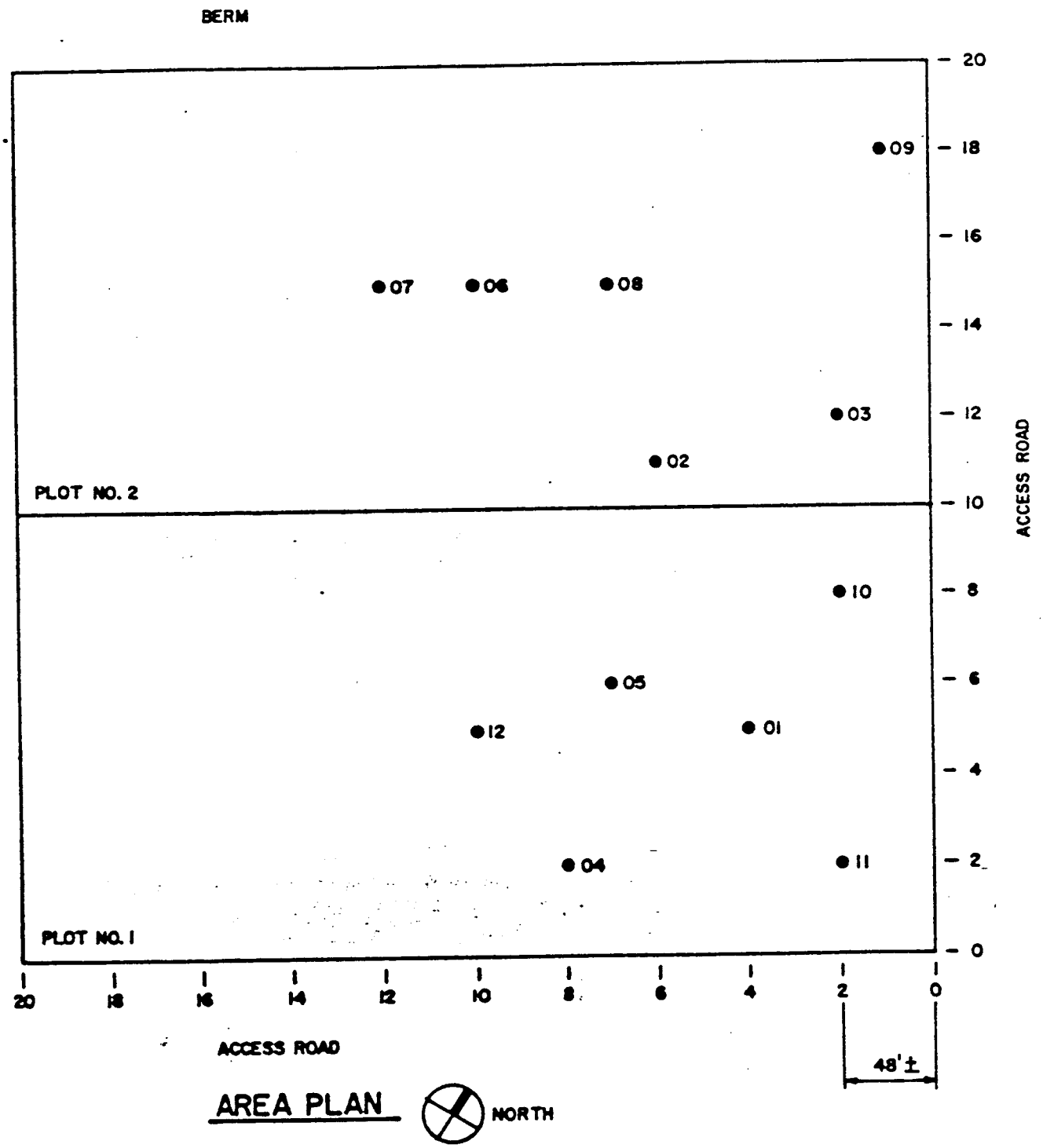
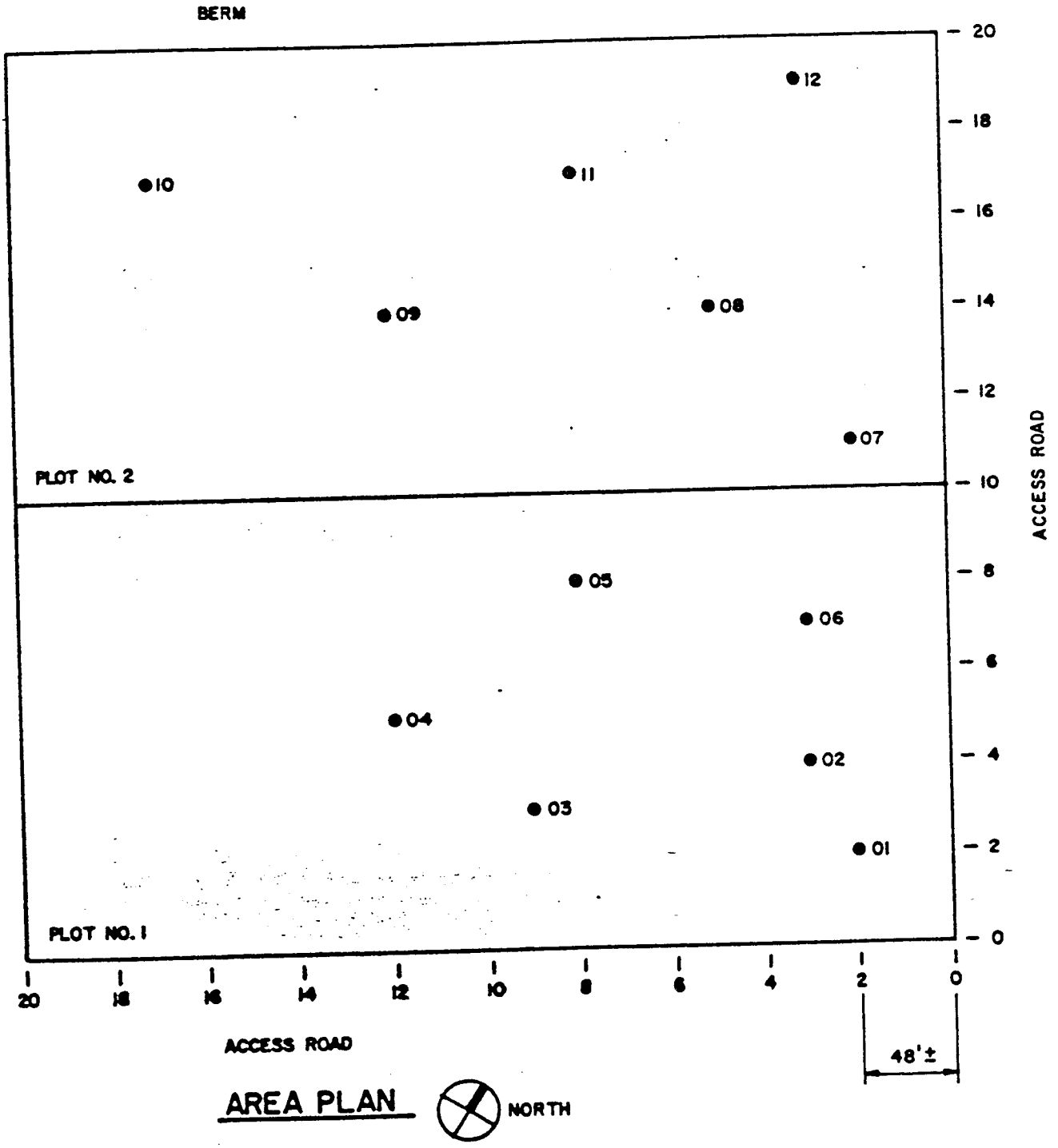


FIGURE 3.3

GIANT REFINING COMPANY - GALLUP, NM
LAND TREATMENT DEMONSTRATION
SAMPLE LOCATIONS - EVENT NO. 2, SEPT '87

Lockwood, Andrews & Newnam, Inc.



AREA PLAN

FIGURE 3.4

GIANT REFINING COMPANY - GALLUP, NM
LAND TREATMENT DEMONSTRATION
SAMPLE LOCATIONS - EVENT NO. 3, DEC '87

Lockwood, Andrew & Newnam, Inc.

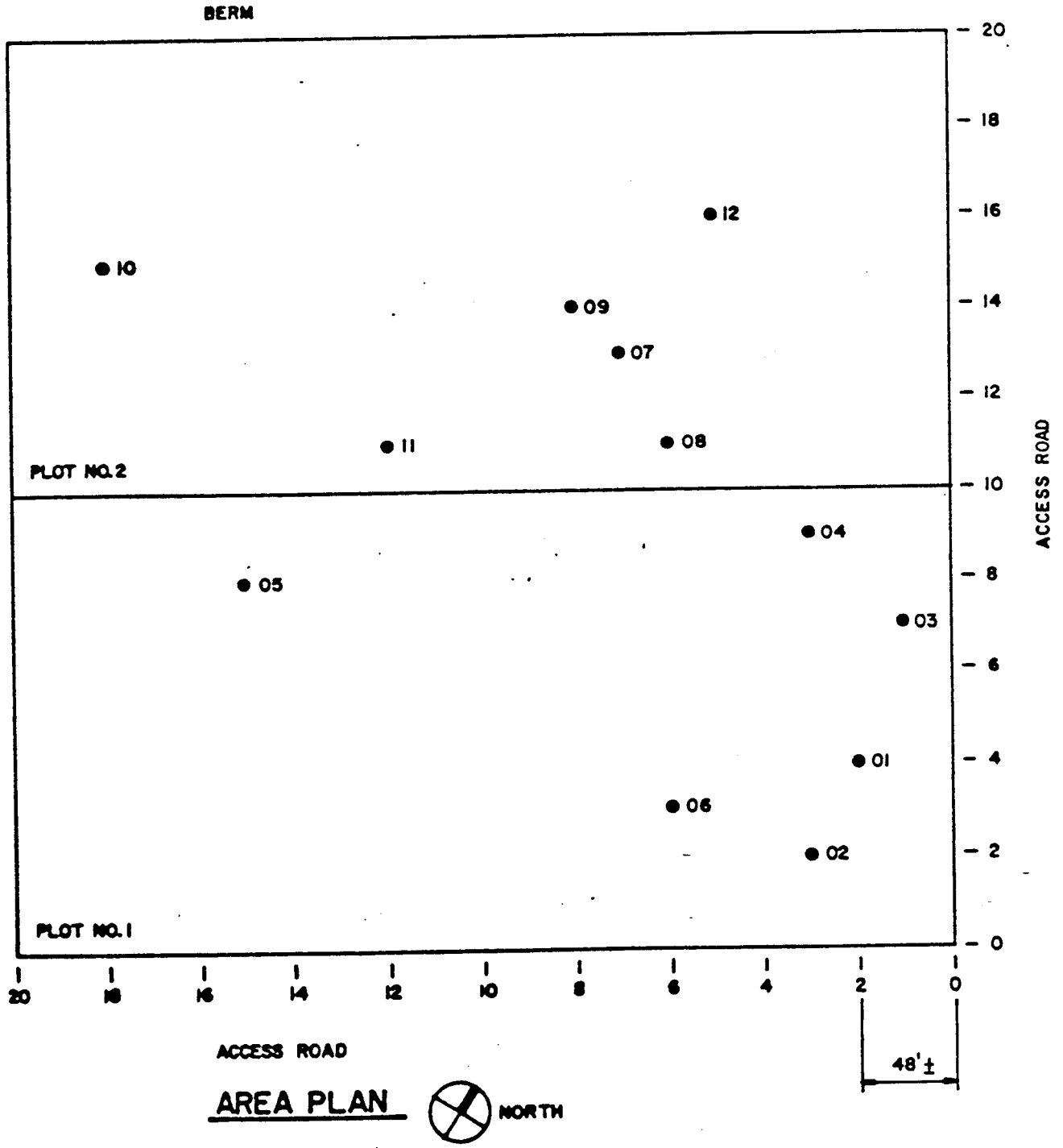


FIGURE 3.5

GIANT REFINING COMPANY - GALLUP, NM
LAND TREATMENT DEMONSTRATION
SAMPLE LOCATIONS - EVENT NO. 4, MAR '88

Lockwood, Andrews & Newnam, Inc.
Engineering · Architecture · Planning · Project Management

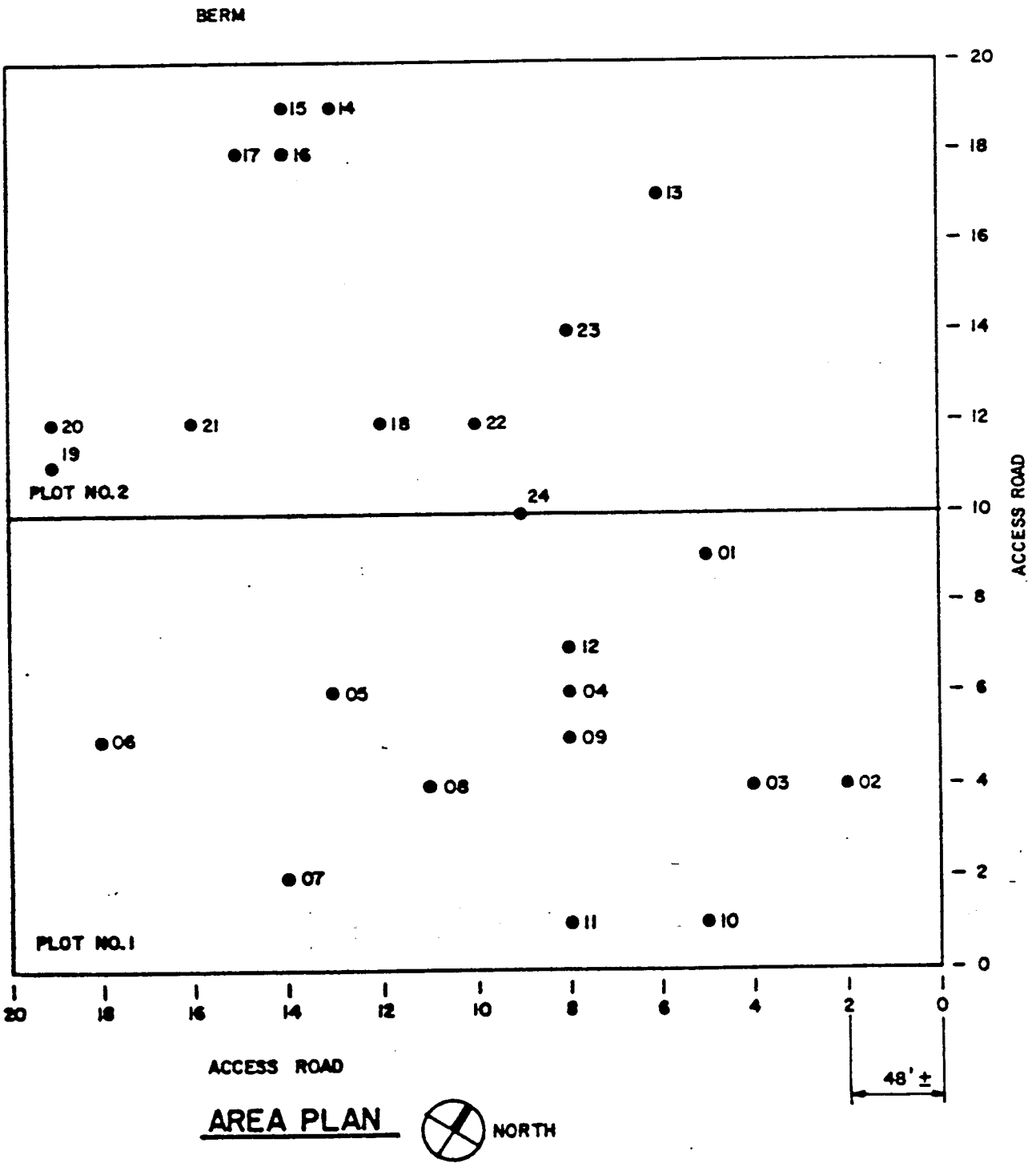
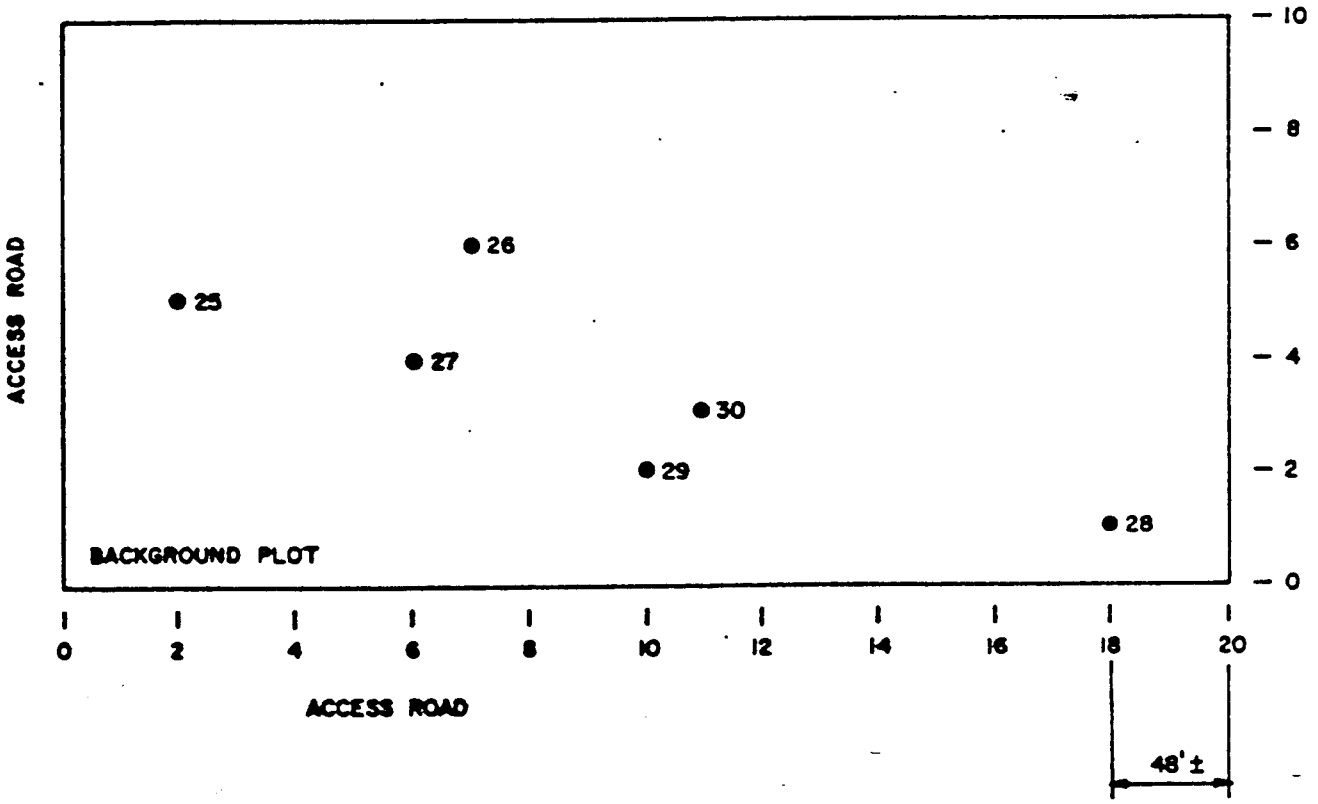


FIGURE 3.6

GIANT REFINING COMPANY - GALLUP, NM
LAND TREATMENT DEMONSTRATION
SAMPLE LOCATIONS - EVENT NO. 5, APR '88

Lockwood, Andrews & Newnam, Inc.



AREA PLAN

FIGURE 3.7

GIANT REFINING COMPANY - GALLUP, NM
LAND TREATMENT DEMONSTRATION
SAMPLE LOCATIONS - EVENT NO. 5, APR '88

Lockwood, Andrews & Newnam, Inc.

In Plots 1 and 2, both pre and post demonstration sampling efforts included all Intervals (One through Six). During the three quarterly sampling events only Intervals One through Five were sampled. The background plot was sampled at all Intervals (One through Six) prior to and after the demonstration period.

Parameter	Pre-Demo 4/87	9/87	12/87	3/88	Post-Demo 4/88
Modified Skinner List[1]	24	0	0	0	36
Total Metals (Ba Cr Pb Zn)	16	12	12	12	24
Polynuclear Aromatic Hydrocarbons (GC)	16	12	12	12	24
Tier I Parameters[2]	24	0	0	0	24

TABLE 3.4 NUMBER OF BORINGS ANALYZED FOR LISTED PARAMETERS
[1]Demonstration permit, Attachment I, page 7, Tables 2-3 and 2-4.
[2]Demonstration permit, Attachment I, page 20, Table 4-2.

Samples for each treatment area were taken from six soil borings and were composited and analyzed as follows:

1. Samples from Interval One were composited in groups of three borings, with those borings located within the same treatment plot. These samples were analyzed for Tier 1 parameters and "Modified" Skinner List. Both of these lists are located in the Permit Application Report, pages 7 and 20;

2. Samples from Intervals Two through Five were composited horizontally by depth interval within each treatment plot, in groups of six borings. Each composited sample was analyzed for barium, chromium, lead and zinc, in addition to selected "Modified" Skinner List parameters and;

3. Samples from Interval Six were analyzed on a individual boring basis for Tier 1 parameters and "Modified" Skinner List.

Background samples were taken from a minimum of six borings and were analyzed and composited as follows:

1. Samples from Interval One were composited in groups of three borings. The samples were analyzed for Tier 1 and "Modified" Skinner List parameters.

2. Samples from Intervals Two through Six were analyzed for barium chromium lead and zinc in addition to selected "Modified" Skinner List parameters.

In addition to the above stated analyses, microtox analysis of both background and treatment plots was conducted. These samples were taken before demonstration waste application (4/28/87), immediately after application (4/29/87), two months after last waste application (9/7/87), five months after last waste application (12/21/87), seven months after last waste application (3/17/88), and after the demonstration period (4/7/88). Bulk density, porosity and cation exchange capacity tests were performed after the demonstration period. Compiled waste analysis results can be found in Appendix C.

The following procedure was used to process samples:

Sampling Procedure

1. Move onto sample location.

2. Drill down to approximately two feet with a hollow stem auger equipped with a split spoon sampler.

3. Recover sampler and transport to sampling area.

4. Drill and collect rest of sample and transport to sampling area.

5. Open split spoon to expose and extricate sample.

6. After extrication, measure and vertically log sample.

7. Divide core into one foot intervals by cutting with a clean knife.

8. Put each Interval into an appropriately labeled Ziploc bag to hold until compositing time.

9. Put ziploc samples in cooler on ice.

10. Prior to compositing, label sample jars with time, date, name of sampler, project, and sample number and analysis required. Record information in field log.

11. Composite intervals by placing sample on decontaminated stainless steel cookie sheet and remove outer one-half inch of core. Place remaining sample into a stainless steel bowl and using a clean spoon and knife, break the sample into fine pieces and mix.

12. Divide the sample in the bowl into quarters. Take a spoonful out of each quarter and place in sample jars until full. Tighten cap on jar and place in cooler with ice.

13. Continue with Steps 4 through 10 until enough coring have been collected to composite those intervals. (Note: Three borings comprise an interval one sample and six borings comprise interval two through interval five samples.)

14. Follow Steps 12 and 13 to composite samples.

15. Continue until all soil samples have been collected, composited and sealed.

3.3 QUALITY ASSURANCE/QUALITY CONTROL

QA/QC was ensured by several methods. Field methods, sample chain of custody and laboratory methods are the main areas of QA/QC.

Field methods incorporated field duplicates and field blanks. Field duplicates ensure that compositing methods were effective in creating a homogeneous sample. Field blanks determined that equipment decontamination between sampling efforts was thorough.

As a part of QA/QC, chain of custodies were filled out and placed inside the cooler before it was sealed. Chain of custodies included such information as time, date, collector, and analysis required as well as date shipped. The cooler was then sealed with laboratory issued seals. Laboratory records indicate that all shipments arrived intact.

Laboratory methods are critical to obtain reliable results.

The Enseco (Rocky Mountain Analytical) laboratories operate a QA/QC program designed to ensure the generation of scientifically valid data by monitoring laboratory operations. Routine QA/QC procedures include the use of approved methodologies, independent verification of analytical standards, use of duplicate Laboratory Control Samples to assess the precision and accuracy of the methodology on a routine basis, and a system of data review.

In addition, the Enseco laboratories maintain a comprehensive set of certifications from both state and federal governmental agencies which require frequent analyses of blind audit samples. Enseco-Rocky Mountain Analytical Laboratory is certified by the EPA under the EPA/CLP program for both Organic and Inorganic analyses, under the USATHAMA (U.S. Army) program, by the Army Corps of Engineers, and the states of Colorado, New Jersey, New York, Utah, and Florida, among others.

3.4 CHEMICAL ANALYSIS

3.4.1 Methods

Enseco-Rocky Mountain Analytical Laboratory performs analytical services according to methods approved by EPA and other regulatory agencies, whenever possible.

Methods for metals and organic compounds are primarily derived from three sources of EPA methods: 1) the methods promulgated in 40 CFR 136 for priority pollutants, 2) the methods published in EPA Manual SW-846 and 3) methods developed by the EPA-EMSL/LV for Superfund investigations, as well as several documents published by the EPA and Enseco-Rocky Mountain Analytical Laboratory in 1984 and 1985. These methods all use the same generic technology as summarized below:

- Metals: acid digestion followed by analyses using Inductively Coupled Plasma (ICP) supported by graphite furnace Atomic Absorption (AA).
- Volatile Organics: purge and trap Gas Chromatography/Mass Spectroscopy (GC/MS) or purge and trap Gas Chromatography (GC) with a selective detector.
- Semivolatile (base/neutral and acid) organics: solvent extraction followed by capillary column GC/MS.

Exact method references are given in the following tables.

Test	Description	Methodology	Reference
VOA	Volatile Organics	Purge & Trap, GC/MS	624(1)/8240(2)
BNA	Semivolatile Organics	Extraction, GC/MS	625(1)/8270(2)
601	Halogenated Volatile Organics	Purge & Trap, GC/Hall	601(1)/8010(2)
THM	Trihalomethanes	Purge & Trap, GC/Hall	601(1)/8010(2)
602	Aromatic Volatile Organics	Purge & Trap, GC/PID[1]	602(1)/8020(2)
604	Phenols	Extraction, GC/FID[2]	604(1)/8040(2)
605	Benzidines	Extraction, HPLC[3]	605(1)/8050(2)
606	Phthalate Esters	Extraction, GC/FID	606(1)/8060(2)
PNA	Polynuclear Aromatic Hydrocarbons	Extraction, HPLC	610(1)/8310(2)
611	Haloethers	Extraction, GC/ECD[4]	611(1)
GC FID	Hydrocarbon Scan	Extraction,	D3328-78(3)

TABLE 3.4 ANALYTICAL METHODOLOGY - ORGANIC TESTS
[1]PID - Photo Ionization Detector
[2]FID - Flame Ionization Detector
[3]HPLC - High Performance Liquid Chromatography
[4]ECD - Electron Capture Detector

Test	Description	Methodology	Reference
ICP	Trace Metals	ICP Emission Spectroscopy	200.7(1)/6010(2)
FSB	Antimony	Furnace Atomic Absorption	204.2(1)/7041(2)
FAS	Arsenic	Furnace Atomic Absorption	206.2(1)/7060(2)
FCD	Cadmium	Furnace Atomic Absorption	213.2(1)/7131(2)
FPB	Lead	Furnace Atomic Absorption	239.2(1)/7421(2)
FSE	Selenium	Furnace Atomic Absorption	270.2(1)/7740(2)
FAG	Silver	Furnace Atomic Absorption	272.2(1)/7761(2)
FTL	Thallium	Furnace Atomic Absorption	279.2(1)/7841(2)
CVHG	Mercury	Cold Vapor Atomic	245.1(1)/7471(2)
CR+6	Chromium (VI)	Colorimetric	312B(3)
IC SO4	Sulfate	IC	300.0(1)
SPESO4	Sulfate	Manual Turbidmetric	375.4(1)
TECNOXT	Nitrate+Nitrite as N	Cd Reduction Colorimetric	353.2(1)
METPH	pH	Meter	150.1(1)/9045(2)
ICP	Total Phosphorus as P	Digestion-ICP/AES	200.7(1)
TOCTOC	Total Organic	UV Oxidation-IR	415.2(1)
BAL O&G	Oil and Grease	Freon Extraction-Gravimetric	413.1(1)
IR AO&G	Oil and Grease	Freon Extraction-IR	413.2(1)
STEPHEN	Phenolics	Distillation-Colorimetric	420.1(1)

TABLE 3.5 ANALYTICAL METHODOLOGY - INORGANIC TESTS

References:

(1) Code of Federal Regulations, Chapter 40, Part 136 (40 CFR 136)

(2) EPA Manual SW-846, 3rd Edition, 1987

(3) "Annual Book of ASTM Standards," Volume 11.01, 1985.

Another test performed was the Microtox analysis. The MICROTOX system is intended to determine the toxicity of aqueous samples or aqueous extracts of samples using a bacterial indicator system. The analysis may be used to test a variety of samples. These may include industrial discharges, POTW influent and effluent streams and other miscellaneous environmental samples.

The method uses bioluminescent bacteria as a test organism. Exposure of the bacteria, under controlled conditions, to toxicants will produce a diminished bacterial light output. This change is recorded and is used to calculate a value describing the relative toxicity of the test material.

The microtox analyzer utilizes a photomultiplier tube (PMT) to amplify the signal resulting from the bacterial photolumenescence. Accordingly, samples which are turbid or highly colored should be avoided or compensated for.

3.4.2 Data Reduction

Data reduction began in the laboratory when all the data for a sample was compiled into a set of meaningful numbers. The data was further reduced when it was compiled by depth and core composites. After compiling, the data was catalogued by analytical category (PNA, VOA, metals, inorganics and microtox). A spread sheet format was utilized to sort the analytical categories and create an easily read data report.

3.5 SURFACE WATER CONTROLS

Water is the principal route by which pollutants could be transported from the land treatment area. Contaminants may either be dissolved or suspended in water and potentially carried off-site by surface waters or to groundwater. Consequently, water control is of primary importance in the management of a land treatment facility. To provide proper water management, a water balance must be developed to determine the required water management controls.

3.5.1 Water Balance

The water balance is used not only to determine runoff and runon controls but also to develop hydraulic loading rates.

Peak Storm Requirements: The peak storm runoff for the land treatment facility is based on the 25-year, 24-hour storm, which specifies a 4 percent annual probability that the amount will be equaled or exceeded. Peak runoff calculations are based on the method in Section 8.3.4.1 of EPA Manual SW-874. Appendix D has a brief discussion of the methods and calculations used to determine the potential peak storm runoff for this region. For the Gallup Area, direct runoff during the peak storm is estimated to be 1.6 inches.

Normal Seasonal Requirements: The normal seasonal requirements are based on monthly data and assume that there is no net change in the volume of runoff on a long-term basis. The water budget is derived from the following expression:

$$P + W = Ev + L + R$$

where:

P = precipitation
W = water applied in waste
Ev = water lost in evaporation
L = water lost in leachate
R = runoff to be collected

Further, runoff R is the sum of the storage volume S plus the discharge volume D. The discharge is proposed to be held to zero; therefore, the entire runoff R is equal to the storage S. Also assumed is that the leachate volume L is zero, therefore increasing the required storage. The final water balance expression then is:

$$S = P + W - Ev - L - D$$

where the terms are defined as above.

Precipitation values used were for the most recent 2-year period available from the National Oceanographic and Atmosphere Administration. Evaporation data was taken from Figure 8.9 through 8.20, EPA Manual SW 874. The average water with the applied waste was 0.06 inch per month, during application months. Leachate and discharge were set to zero. Based on these assumptions and data, the water budget shows no storage required on either a monthly or yearly basis. Water balance calculations are presented in Appendix D.

3.5.2 Runon Controls

The land treatment area is enclosed by a continuous berm, 3 feet above the natural grade. From the permit application report, this is sufficient to protect from runon due to the 100-year flood.

3.5.3 Runoff Controls

No additional runoff controls are required for normal monthly operations because the water balance shows no storage requirements due to high regional evaporative conditions. For peak storm events, 1.6 inch of runoff is predicted and the 3-foot berm will easily accommodate this.

4.0 TECHNICAL

Data derived from field studies, laboratory analysis, published literature and actual facility operating experience is used to develop waste management parameters. The parameters are developed by evaluating the principal treatment processes, such as, degradation, transformation and immobilization. From this evaluation the PHC's are defined, and the degradation rates, the half lives and the migration times for the PHC's are determined. Also, the Rate Limiting Constituent (RLC), Application Limiting Constituent (ALC), Capacity Limiting Constituent (CLC) and the unit life of the facility will be determined.

4.1 PRINCIPAL HAZARDOUS CONSTITUENTS (PHC)

The first step in demonstrating the complete degradation, transformation and immobilization of the waste within the treatment zone is to determine the PHC's of the wastes. According to 40 CFR Section 264.278, PHC's are defined as "hazardous constituents contained in the waste to be applied to the unit that are the most difficult to treat, considering the combined effects of degradation, transformation, and immobilization".

PHC identification is divided into two sections. The first section deals with the organic fraction and is based on degradation rates. The second section deals with the inorganic fraction and is based on mobility and soil loading capacity.

4.1.1 PHC Determination - Organics

All Appendix VIII organic constituents of petroleum wastes which are land treated can be degraded in the soil under proper environmental

conditions. Furthermore, all the organics can be temporarily immobilized in the soil prior to degradation.

Preliminary estimates regarding the mobility of individual compounds can be made by comparing the time it takes to degrade a compound (td) to the time it takes the compound to migrate out of the tm. Then the zone of incorporation is defined as the top 12 inches of each plot. Giant has proposed to use only the top one foot to determine degradation and migration times since the demonstration project shows essentially no migration past this zone. Also, even though the treatment zone does extend to a depth of five feet, the conservative assumption is that the top one foot is the most biologically active treatment zone. If td is less than tm, then the compound will degrade before it moves past the actively tilled zone and the treatment is considered complete. The compounds with td values considerably less than tm values do not meet the persistence and mobility criteria of a PHC. Methods for determining tm and td are presented in Appendix E. Table 4.0 compares the tm and td values for all of the organic compounds found in the waste characterization studies. Where the concentration at time t (C_t) is greater than the initial concentration the td can not be determined.

Compound	tm (day)	td (days)
Anthracene	13400	1120
Benzo(a)anthracene	19300	110
Chrysene	19300	250
Fluoranthene	101400	70
1-methylnaphthalene	NA	200
Naphthalene	1100	240
Phenanthrene	13800	240
Pyrene	99200	475
Benzene	500	8.4
Ethyl Benzene	32	110
Toluene	230	104
m-Xylene	50	107
O&P-Xylene	50	105
O-Cresol	2.2	280
M&P-Cresol	2.2	220
Phenol	99	9
2,4-Dimethylphenol	985	$C_t > C_m$
Benzo(a)fluoranthene	1764500	$C_t > C_m$
Benzo(a)pyrene	520800	$C_t > C_m$
Bis(2-ethylhexyl)phthalate	31300	$C_t > C_m$

TABLE 4.0 DEGRADATION TIMES AND MIGRATION TIMES FOR THE ORGANIC COMPOUNDS FOUND IN THE WASTES

All compounds with td greater than tm could be considered potential PHC's. In addition to this criteria, five other compounds are also added to the potential PHC list. These compounds are pyrene, phenanthrene, 1-methylnaphthalene, benzo(a)pyrene and chrysene. These compounds are added because they are the only constituents which were present both in the characterization study and the analysis of field demonstration samples. The potential PHC's are shown in Table 4.1.

Ethyl Benzene
m-Xylene
O&P-Xylene
O-Cresol
M&P-Cresol
Pyrene
Phenanthrene
1-methylnaphthalene
Benzo(a)pyrene
Chyrsene

TABLE 4.1 POTENTIAL ORGANIC PHC's

4.1.2 PHC Determination - Inorganics

Studies have shown that, in general, Appendix VIII inorganics constituents are effectively immobilized in petroleum land treatment facilities (API No. 4379). However, because metals are a conservative species, i.e. nondegradable, there is a safe soil capacity (Ce) which can define the amount of waste load. For this report, the safe soil capacity has been set at the value established by the National Academy of Science and the National Academy of Engineering published in EPA SW874. Any metal whose waste concentration (Cm) is less than Ce is not capable of overloading the treatment unit. Cm is determined on a Residual Solids Basis. If the constituent Cm is greater than Ce, the constituent is a potential PHC. Table 4.2 is a list of the potential metal PHC's. The metal loading ratio calculations can be found in Appendix F.

Barium
Cadmium
Chromium
Copper
Lead
Mercury
Nickel
Selenium
Silver
Zinc

TABLE 4.2 POTENTIAL METAL PHC's

4.2 DEGRADATION COEFFICIENT

Degradation coefficients were calculated for all compounds in the waste characterization studies. These compounds are listed in Table 4.3.

Compound	Calculated Initial Conc. (mg/kg)	Final Conc. (mg/kg)
Anthracene	0.47	0.34
Benzo(a)anthracene	0.33	0.34
Chrysene	0.80	0.34
	(1.70)	0.34
Fluoranthene	0.16	0.34
1-Methylnaphthalene	27.99	0.34
	(7.3)	(0.30)
Naphthalene	7.26	0.34
Phenanthrene	4.86	(0.31)
Pyrene	5.81	(1.21)
Benzene	3.37	0.005
Ethylbenzene	7.45	0.005
Toluene	21.42	0.005
M-Xylene	27.58	0.005
O&P Xylene	22.54	0.005
O-Cresol	2.58	0.34
M&P Cresol	12.53	0.34
Phenol	24.76	0.34
2,4-Dimethylphenol	0.02	0.34
Benzo(b)Fluoranthene	0.03	0.34
Benzol(a)Pyrene	0.02	0.34
Fluorene	1.68	1.23

TABLE 4.3 DEGRADATION COEFFICIENTS PARAMETERS

NA - Not Available
( ) - Actual Analytical Result from ZOI
Initial Conc. - Calculated
Final Conc. - Based Detection Limits

The initial concentration of each constituent was calculated by taking the mass fraction of each compound times the total mass of waste applied. The mass fraction of each compound was different for each type

of waste; see waste characterization section. It was then assumed that for any one application, waste would only be applied to about 80 percent of the land treatment area. After incorporation, the waste should be distributed over the entire depth of the zone of incorporation (ZOI). The initial concentration (Co) then is the total mass of the constituent (Mc) applied divided by 80 percent of the mass of the ZOI (Mz):

$$Co = \frac{Mc}{Mz}$$

The time duration was the interval from the date of the last waste application to the sampling date. That is, 7/21/87 to 12/21/87 or 144 days. Final concentrations were either the actual concentration detected in the core analysis or the laboratories reported detection limits. Degradation rates calculated using detection limits as the final concentration are conservative because the actual final concentration could be much less. Table 4.3 is a list of the initial and final concentrations used to determine degradation coefficients. The degradation rate is assumed to follow a first order model in that the degradation rate is proportional to the concentration of the constituent. The first order rate coefficient (K) can be calculated by:

$$K = \frac{-\ln (Ct/Co)}{t}$$

where: Ct = concentration at time (t)
Co = initial concentration
t = time

Table 4.4 is a summary of K values determined during the Giant Refinery LTD and various ranges reported in the literature. It is important to note that, the higher the K value the faster the compound will degrade.

Compound	K (Giant)	K (API Study)*	K (Published Lit.)*
Anthracene	0.002	0.013 - 0.073	0.08 - 0.019
Benzo(a)Anthracene	--	0.003 - 0.011	0.005 - 0.017
Chrysene	0.006-0.011	0.006 - 0.017	0.010 - 0.126
Fluorathene	--	0.021 - 0.047	0.003 - 0.024
1-Methylnaphthalene	0.022-0.31	0.043 - 0.058	---
Napthalene	0.021	0.013 - 0.019	0.023 - 0.087
Phenanthrene	0.019	0.016 - 0.120	0.01 - 0.03
Pyrene	0.010	0.014 - 0.022	0.007 - 0.067
Benzene*	0.010	0.013 - 0.034	---
Ethyl Benzene	0.045	0.076 - 0.083	---
Toluene	0.058	0.106 - 0.119	---
M-Xylene	0.059	0.057 - 0.087	---
O&P-Xylene	0.058	0.047 - 0.077	---
O-Cresol	0.014	---	---
M&P-Cresol	0.025	---	---
Phenol	0.030	---	---
2,4-Dimethylphenol	---		
Benzo(b)Fluorathene	---	0.003 - 0.005	0.009 - 0.05
Benzo(a)Pyrene	---	---	0.001 - 0.010
Fluorene	0.002	0.007 - 0.068	---

TABLE 4.4 SUMMARY OF DEGRADATION COEFFICIENTS
(*After API No. 4455)

Two compounds, bis(2-ethylhexyl) phthalate and fluorene were also detected during the Land Treatment Demonstration (LTD) corings but were not found during the waste characterization studies. It is assumed that these compounds are degradation products. Degradation coefficients were not determined for these compound for two reasons. First, if they are degradation products the time at which they first appear cannot be determined and, therefore, the time component of the degradation rate is not available. Second, considering they are not present in the waste when it is applied, an initial concentration cannot be determined. Indeed, if they are degradation products, their formation and decomposition would continue even after the waste is applied.

4.3 COMPOSITE WASTE

In order to determine the Rate Limiting Constituent, the Application Limiting Constituent and the Capacity Limiting Constituent, it was necessary to develop a composite waste characterization. There are four waste types which will be treated on the unit. The waste types were described and characterized earlier. Significantly different volumes of each waste type will be applied to the land treatment area (LTA). Also, each waste type has widely varying major constituents.

Loading rates calculated based on the higest concentration of each constituent would be overly conservative and would not account for the relatively small volumes of certain wastes. Conversely, however, loading rates based on the largest volume waste would be too liberal, not accounting for the high concentrations of hazardous constituents in certain wastes. To overcome these problems, a composite waste profile was developed.

The composite waste profile was determined by calculating the weighted average of each potential PHC. The weighted averages are based on the following waste volume fractions:

API Separator Sludge	72.0%
Heat Exchanger Sludge	0.5%
Slop Oil	26.5%
Leaded Tank Bottoms	1.0%

A characterization of the PHC's in the composite waste is shown in Table 4.5.

Constituent	Concentration (mg/Kg)
Ethyl Benzene	113.8
M-Xylene	424
O&P-Xylene	346
O-Cresol	32
M&P-Cresol	157
Pyrene	12.5
Phenanthrene	68.1
1-Methylnaphthalene	396
Benza(a)Pyrene	0.3
Chyrsene	11.1
Antimony	1.8
Arsenic	15.2
Barium	695
Beryllium	0.4
Cadmium	3.8
Chromium	683
Cobalt	16.8
Copper	579
Lead	435
Mercury	5.7
Nickel	78.5
Selenium	8.1
Silver	1.5
Vanadium	10.8
Zinc	1924
% Residual Solids	51.4

TABLE 4.5 COMPOSITE WASTE CHARACTERIZATION

4.4 LOADING RATES

Loading rates were determined separately for the conservative inorganic components and the degradable organic components. The organic constituent defines the rate limiting constituents (RLC) and the application limiting constituents (ALC). The metals define the capacity limiting constituents (CLC).

The degradation of the organic fraction of the waste is the principal objective of the land treatment process. The loading rates are developed from the constituent half life, which is defined as the time required to degrade the waste to one-half of the initial concentration. The half life (t 1/2) is therefore determined from the degradation coefficient (K) by:

$$t\ 1/2 = \frac{-\ln (1/2)}{K}$$

The loading rates are calculated based on some critical soil concentration above which the toxic effects of the constituent is unacceptable. For the compounds in question, the critical concentrations were taken from API publication No. 4455 as the concentration that shows no adverse effect on the degradation rate. For the compounds not found in this reference, we used the actual initial concentration in the LTD. These concentrations also show no adverse effect on the degradation rate and, at a minimum, are a very conservative estimate of critical concentration.

Two types of loading management plans are described in EPA SW 874 for Hazardous Waste Land Treatment (HWLT) units. For the purposes of this report, we will use the more conservative model based on a vegetative cover over the LTA as follows:

$$Cyr = \frac{1/2\ Ccrit}{t\ 1/2}$$

When the vegetative model is used, toxics exhibiting either microbial or plant toxicity may limit the loading rate. The model not used in

this study allows waste applications that exceed the phytotoxicity threshold value. The only constraints would be that the microbial toxicity threshold not be exceeded and that a final vegetative cover can be established after a given number of years.

where:

Cyr = the rate of application of the constituent of interest in the soil (lb/ac/yr)

t 1/2 = constituent half life

C crit = critical concentration of the constituent above which crop yield is affected (lb/ac)

The loading rate (LR) of raw waste is determined by:

$$LR = Cyr/Cu$$

where:

LR = Loading rate of waste (lb/ac/yr)

Cu = Concentration of the compound of interest in the waste (lb/lb)

Table 4.6 lists the critical concentration and the half life for the PHC's presented earlier.

Compound	C crit (lb/ac)	t 1/2 (yr)
Pyrene	7575	0.19
Phenanthrene	801	0.10
1-Methylnaphthalene	156	0.06
Benzo(a)Pyrene	441	0.19
Chyrsene	496	0.17
Ethylbenzene	40.6	0.04
M-Xylene	150	0.03
O&P-Xylene	123	0.03
O-Cresol	140	0.14
M&P-Cresol	680	0.08

TABLE 4.6 CRITICAL CONCENTRATION AND HALF LIFE FOR THE ORGANIC PHC's

Table 4.7 lists the compound loading rate, the constituent fraction and the waste loading rate for the organic PHC's.

Compound	Cyr (lb/ac/yr)	Cu (lb/lb)	LR (lb/ac/yr)
Pyrene	20,000	12.5×10^{-6}	1.6×10^{9}
Phenanthrene	4,000	68.1×10^{-6}	59×10^{6}
1-Methylnaphthalene	1,325	395×10^{-6}	3.4×10^{6}
Benzo(a)pyrene	1,160	0.3×10^{-6}	3.9×10^{9}
Chrysene	1,500	11.1×10^{-6}	140×10^{6}
Ethylbenzene	508	113×10^{-6}	4.5×10^{6}
M-Xylene	2,500	424×10^{-6}	5.9×10^{6}
O&P-Xylene	2,050	340×10^{-6}	5.9×10^{6}
O-Cresol	500	32×10^{-6}	15.6×10^{6}
M&P-Cresol	4,250	157×10^{-6}	27×10^{6}

TABLE 4.7 LOADING RATE ON A CONSTITUENT BASIS, ON A WASTE BASIS AND THE CONSTITUENT FRACTION OF THE WASTE

4.4.1 Rate Limiting Constituent

The rate limiting constituent (RLC) is determined from Table 4.7. The RLC is defined as the constituent which limits the annual application of waste. As shown on Table 4.7, the constituent with the lowest loading rate is 1-methylnaphthalene at 3.4×10^{6} lb/ac/yr on a composite waste basis. This load must be proportioned to the individual types of waste that make up the composite waste. Table 4.9 shows the loading rates on a specific waste basis.

4.4.2 Application Limiting Constituent

The application limiting constituent (ALC) is defined as the constituent which limits the amount of waste that may be applied in a single dose. That is to say, the resulting concentration after the single dose cannot exceed the critical concentration. This value is determined by

dividing the critical concentration by the fraction of each component in the waste. Table 4.8 shows the ALC for the organic PHC's. The ALC is M-Xylene at 354,000 lb/ac/application.

Compound	Ccrit (lb/ac)	Cu (lb/lb)	ALC lb/ac/application
Pyrene	7575	12.5×10^{-6}	610×10^{6}
Phenanthrene	801	68.1×10^{-6}	11.8×10^{6}
1-Methylnaphthalene	156	395×10^{-6}	1500×10^{6}
Chyrsene	496	11.1×10^{-6}	44.7×10^{6}
Ethylbenzene	40.6	113×10^{-6}	0.36×10^{6}
M-Xylene	150	424×10^{-6}	0.35×10^{6}
O&P-Xylene	123	346×10^{-6}	0.35×10^{6}
O-Cresol	140	32×10^{-6}	4.4×10^{6}
M&P-Cresol	680	157×10^{-6}	4.3×10^{6}

TABLE 4.8 APPLICATION LIMITING CONSTITUENTS

Type of Waste	RLC (lb/ac/yr)	ALC (lb/ac/APPLICATION)
API Sludge	2,448,000	254,880
Heat Exchanger Sludge	17,000	1,770
Slop Oil	901,000	93,810
Leaded Tank Bottoms	34,000	3,540

TABLE 4.9 LIMITING LOADING RATES ON A WASTE TYPE BASIS

4.4.3 Capacity Limiting Constituent

The metal fraction of the waste is conservative and is used to determine the capacity limiting constituents (CLC) because it is conservative i.e., non-degradation. A metals loading ratio is determined based on the metal concentration in the composite waste and an acceptable metal loading capacity. The acceptable metal loading capacity for each metal found in the waste characterization study is presented in Table 4.10. Generally, the values are from Table 6.47 of EPA SW-874. These values

are the calculated acceptable soil concentrations as published by the National Academy of Science and National Academy of Engineering at closure. For metals not found in this table, Table 6.46 of of EPA Manual SW-874 was used. This is a table of common ranges of trace metals concentrations in soils (Lindsay, 1979). Mid-range values from Table 6.46 were used.

An acceptable mercury level was not published in SW-874 Table 6.47. However, Van Loon (1974) found that the toxic effect in soil was only detected at concentrations greater than 10 mg/kg. Gracey and Stewart (1977) show no toxic effect in soil at 10 mg/kg concentrations and Beauford et.al. (1977) found no toxic effect to oats at concentration of 25 mg/kg in sand. From this data, it seems reasonable to set an acceptable mercury concentration at 10 mg/kg.

Table 4.10 also contains the metal concentration of the composite waste on a residual solids basis. The ratio of metal concentration to metal capacity is the metals loading ratio (MLR). If this ratio is less than 1, the constituent cannot increase the soil concentration above the soil capacity. The metal with the highest ratio is the capacity limiting constituent (CLC). From Table 4.10, it can be seen the zinc is the CLC.

Metal	Metal Loading (mg/kg)		Metal Capacity (mg/kg)	MLR
Sb	6	(1)	3.3	0.6
As	500		27.9	0.1
Ba	1000	(1)	1278	1.3
Be	50		0.7	0.01
Cd	3		7.0	2.3
Cr	1000		1255	1.3
Co	500		30.9	0.1
Cu	250		1065	4.3
Pb	1000		800	0.8
Hg	10	(2)	10.5	1.1
Ni	100		144	1.4
Se	3		14.9	5.0
Ag	2.5	(1)	2.8	1.1
V	500		19.9	0.04
Zn	500		3538	7.1

(1) Table 6.46 EPA SW-874
(2) See Text

TABLE 4.10 METAL LOADING RATIO

The capacity of the soil on an applied waste basis is shown in Table 4.11. Again, the capacity limiting constituent is Zn at 0.17×10^9 lb of waste or 35.4×10^6 lb/ac.

Compound	Soil Capacity (mg/kg)	Metal Conc. Wet Basis (mg/kg)	Total Mass of Waste (lb)
Ba	1000	695	0.92×10^9
Cd	3	3.8	0.50×10^9
Cr	1000	683	0.93×10^9
Cu	250	579	0.28×10^9
Hg	10	5.7	1.12×10^9
Ni	100	78.5	0.81×10^9
Se	3	8.1	0.24×10^9
Ag	2.5	1.5	1.06×10^9
Zn	500	1924	0.17×10^9

TABLE 4.11 TOTAL METAL CAPACITY OF THE SOIL ON A WASTE BASIS

4.5 CONSTITUENT MIGRATION

A principal concern involved in the land treatment of petroleum refinery wastes is the potential for the migration of hazardous waste constituents beyond the treatment zone. Extensive data from petroleum waste land treatment sites (Linkenheil 1985) indicate that inorganics are essentially immobile provided proper management techniques are practiced. The migration of inorganics will be discussed later. Of greater concern to the migration question is the leaching of organics beyond the treatment zone.

4.5.1 Organics

In order to evaluate the migration potential of the organics, a screening model is employed. Waste, site and operational factors are the input data to a screening model. Using known and estimated organic carbon partition coefficients (Koc) site specific partition coefficients (Kp) can be estimated for the constituents present in the waste. Appendix E contains a tabular listing of the Kp's for the site constituents. Degradation coefficients, discussed elsewhere, are also presented in this appendix.

The screening model requires that the degradation time (td) and the migration time (tm) be determined using the coefficients (see Appendix E). If td is less than tm then the constituent will degrade before it moves beyond the treatment zone and no further evaluation is necessary. If td is greater than tm, then the compound may not be completely degraded before migration beyond the treatment zone and further evaluation is needed.

The t-test statistics show that metal concentrations in the BTZ for the post demonstration sampling event are equal to or less than the metal concentrations found in the BTZ for the predemonstration sampling event. When the final sampling event is compared to the background BTZ samples, the results also show that the metals concentrations in the BTZ for both treatment plots are equal to or less than the background plot, with one exception. The exception is the vanadium concentration in Plot 2. The Plot 2 vanadium concentration of 14.8 mg/kg shows a statistically significant increase over the background concentration of 12.6, however, this is due to the small standard deviation of the Plot 2 vanadium data of 1.46. In actuality, the percentage difference between these two valves is less than 18 percent. These facts lead to the conclusion that although monitoring of this metal concentration should continue, no migration of this metal out of the treatment zone has occurred.

4.6 UNIT LIFE

With the capacity limiting constituent defined, the unit life can be determined. Based on the composite waste and the capacity limiting constituent, the land treatment area can accept maximum of 35.4×10^6 lb/ac of waste. The mass of waste applied per year at current production rate, to the land treatment area during the demonstration period was 1.3×10^6 lb/yr. The annual loading rate is 3.4×10^6 lb/ac/yr based on the RLC. To be conservative, the unit life will be calculated using the annual loading rate.

$$UL = \frac{LCAP}{LR_{RLC}}$$

where:

UL = Unit Life (yr)

LCAP = The waste loading capacity which will not exceed the CLC (35.4×10^6 lb/ac).

LR_{RLC} = Loading rate based on RLC (3.4×10^6 lb/ac/yr)

From the expression above, the land treatment area is estimated to have a unit life of 10 years.

4.7 OPERATIONAL EXPERIENCE

The Giant Refining land treatment facility has been in operation for several years with no detrimental effects to the site. Good records of application rates are available for the site. There is no evidence of groundwater contamination or leachate migration from the unit.

A yearly summary of operational data is presented in Table 4.12 for the years 1984 through 1987. Total waste loading has remained constant during this four year period at between 220,000 lb/ac/yr and 270,000 lb/ac/yr. The oil fraction of the waste is between 6 and 10 percent oil, which gives an oil loading rate of 12,800 lb/ac/yr to 24,600 lb/ac/yr.

Year	Waste Type	Waste Loading Rate (lb/ac/yr)	Oil Loading Rate (lb/ac/yr)
1984	Slop Oil	102,000	17,500
	API Sludge	125,000	7,100
1985	Slop Oil	5,600	960
	API Sludge	264,000	15,000
	Heat Exchanger Sludge	1,500	320
1986	Slop Oil	330	60
	API SLudge	220,000	12,500
	Heat Exchanger Sludge	800	170
1987	Slop Oil	59,000	10,100
	API Sludge	212,500	4,300
	Heat Exchanger Sludge	1,400	300

TABLE 4.12 SUMMARY OF GIANT REFINING LAND TREATMENT UNIT APPLICATION RATES 1984 THROUGH 1987

Table 4.13 is a list of typical land treatment facility's oil application rates at full scale refineries. From this data, it can be seen that the oil application rate at the Giant Refining land treatment facility is at the extreme low end of the typical range. Also, the annual waste application rates are an order of magnitude less than the RLC show in section 4.4.1.

Location	Annual LR BBL/AC	Annual LR (lb/ac/yr)
Montana	70	21,300
California	1900	581,000
New Jersey	650	199,000
Illinois	100	30,500
Mississippi	840	257,000
Louisiana	380	116,000
Washington	650	199,000
Washington	280	85,800
Texas	220	67,300
Texas	680	208,000
Texas	400	122,000
Oklahoma	500	152,000
Oklahoma	110	33,500
Giant	51*	17,100*

TABLE 4.13 TYPICAL OIL APPLICATION RATES FOR LAND TREATMENT UNITS AT FULL SCALE REFINERIES (API, Land Treatment Practices in the Petroleum Industry, June, 1983)
*Four Year Average

5.0 CONCLUSION

The demonstration of treatment at the Giant Refinery land treatment facility was a full-scale field study. Table 4.12 shows that, during the one-year demonstration period, the Land Treatment Area (LTA) treated a typical amount of yearly waste. This is based on operating data from the last four years and considers both waste loading and oil loading.

Degradation studies confirm the degradation or transformation of all the applied wastes. The degradation coefficient and half life values determined from the field study agreed very well with values reported by the American Petroleum Institute and in the literature. From the data produced during this portion of the field study, it can be demonstrated that the facility can efficiently treat waste at and above the current loading rate. In fact, the LTA can treat twice the amount of waste annually applied and still have a facility life of 10 years.

All data obtained during this demonstration confirms that there is no detectable constituent migration from this unit.

From data available to date, the proposed operating parameters are presented in Table 4.14.

Loading Rates

Application	lb/ac/application
API Separator Sludge	254,880
Heat Exchanger Sludge	1,770
Slop Oil	93,810
Leaded Tank Bottoms	3,540
Total Waste	354,000

Annual	lb/ac/yr
API Separator Sludge	2,448,000
Heat Exchanger Sludge	17,000
Slop Oil	901,000
Leaded Tank Bottom	34,000
Total Waste	3,400,000

Facility Capacity 35,400,000 lb/ac

Facility Life* - 10 years

* Based on twice the present annual application rate to data.

TABLE 4.14 PROPOSED OPERATING PARAMETERS

REFERENCES

Beauford, W., J. Barker, and A. R. Barringer, 1977. Uptake and distribution of mercury within higher plants. Physiologia Planetarium 39:261-265.

Gracey, H. I. and J. W. B. Stewart, 1977. The fate of applied mercury in soil. pp. 97-103. In Proc. Int. Conf. Land for Waste Management, Otawa, Can., 1973, Dept. Environ./Nat. Research Council.

Land Treatability of Appendix VIII Constituents Present in Petroleum Refinery Wastes: Laboratory and Modeling Studies, American Petroleum Institute Publication 4455, 1987, API, Washington, D.C.

Land Treatment Practices in the Petroleum Industry, American Petroleum Institute Publication, June 1983, API, Washington, D.C.

Linkenheil, R. Preparing a Treatment Demonstration for Petroleum Industry Land Treatment Facilities. Concord, Mass., Environmental Research and Technology, Inc., 1985.

The Land Treatability of Appendix VIII Constituents Present in Petroleum Industry Wastes, American Petroleum Institute Publication 4379, 1984, API, Washington, D.C.

U.S. Environmental Protection Agency. Hazardous Waste Land Treatment, SW-874, 1983. USEPA; Cincinnati, Ohio.

U.S. Environmental Protection Agency. Land Disposal: Hazardous Wastes, Proceedings of the Seventh Annual Research Symposium, EPA-600/9-81-002b, 1981, Cincinnati, Ohio.

U.S. Environmental Protection Agency. Permit Applicants' Guidance Manual for Hazardous Waste Land Treatment, Storage, and Disposal Facilities. EPA 530 SW-84-004, 1984, Washington, D.C.

U.S. Environmental Protection Agency. Permit Guidance Manual on Hazardous Waste Land Treatment Demonstrations. EPA/530-SW-86-032, 1986, National Technical Information Services, Springfield, Va.

Van Loon, J. C., 1974. Mercury Contamination of vegtation due to the application of sewage sludge as a fertilizer. Environ. Letters 6:211-218.

APPENDIX E

POST-CLOSURE MONITORING PLAN

Zone of Incorporation
Treatment Zone
Chinle Slope
Sonsela Aquifer

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ACRONYMS AND ABBREVIATIONS

%C	numerical expression of the completeness
%R	percent recovery
BFB	4-bromofluorobenzene
BTZ	below treatment zone
Ciniza	Ciniza Refinery
COC	chain-of-custody
DMP	Detection Monitoring Plan
DOT	U.S. Department of Transportation
DQO	data quality objective
EDP	Early Detection Plan
EDS	early detection system
EM	environmental manager
EPA	U.S. Environmental Protection Agency
Giant	Giant Refining Company
LCS	laboratory control sample
LTD	land treatment demonstration
LTU	land treatment unit
MDL	method detection limit
MW	monitoring well
NMED/HRMB	New Mexico Environment Department/Hazardous and Radioactive Materials Bureau
PHC	principal hazardous constituent
PID	photoionization detector
PPE	personal protective equipment
QA	quality assurance
QA/QC	quality assurance/quality control
QC	quality control
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RPD	relative percent difference
SAL	screening action level
SOP	standard operating procedure
SMW	shallow monitoring well
SVOC	semivolatile organic compound
TEGD	*RCRA Ground Water Monitoring Technical Enforcement Guidance Document* (EPA 1986)
VOA	volatile organic analyte
VOC	volatile organic compound
ZOI	zone of incorporation

1.0 INTRODUCTION

1.1 Overview

During the post-closure care period Ciniza proposes a Post-Closure Monitoring Program that encompasses two monitoring sequences: the early detection monitoring for monitoring subsurface conditions to "determine whether hazardous constituents have migrated out of the treatment zone" as required by 20 NMAC 4.1, Subpart V, §264.278, and detection monitoring for monitoring groundwater to protect human health and the environment as required by 20 NMAC 4.1, Subpart V, §264.97. The early detection monitoring works in concert with the detection monitoring for protection of the groundwater resources at Ciniza.

The combination of early detection monitoring and detection monitoring provide the procedures necessary to: define monitoring team responsibilities, define sampling and analytical techniques, specify sample identity, and establish precision and accuracy of reported data.

It is essential to ensure that data generated from these monitoring programs are valid. For data to be valid, they must be supported by documented procedures so that they can be used with confidence to support and defend regulatory decisions. The overall objective for the Land Treatment Unit (LTU) monitoring plan, during the post-closure care period, is to collect accurate and defensible data sufficient to assess the concentrations, if any, of subsurface constituents below the LTU.

1.2 Purpose

This appendix provides instructions for sample collection, water level monitoring, data management, and reporting of annual data; identifies analytical parameters selected for assessing the quality of soil and groundwater; and establishes personnel responsibilities for the LTU soil and groundwater monitoring program. Because quality assurance (QA) is an integral component of the soil and groundwater sampling, analysis, and reporting process, quality assurance/quality control (QA/QC) elements and associated data acceptance criteria are provided to the laboratory(ies) performing sample analysis.

Detailed instructions for performing field activities that will be conducted in conjunction with the post-closure monitoring plan are provided in field operating procedures maintained by the Ciniza Environmental Manager (EM). Detailed procedures are provided for each aspect of the soil and groundwater sampling process, including water-level measurement, sampling equipment operation, field water-quality

measurements, and sample collection. These procedures are intended to support proper field sampling expertise. Samples will be taken under the supervision and direction of qualified engineers, scientists, or other technical personnel.

1.3 Site Location

Ciniza is a crude oil refining facility located in McKinley County, New Mexico, at Township 15 North, Range 15 West, Sections 28 and 33. Ciniza is just north of Interstate 40 (I-40) and approximately 17 miles east of Gallup, New Mexico.

The LTU is located within the Ciniza Refinery property boundary. The LTU consists of three 480-ft x 240-ft sections. Each section is diked and contains 2.6 acres (1.0 hectare) of surface. The LTU treatment zone of soil extends 5 ft deep from the original soil surface. This depth is shallow enough to ensure the treatment zone is more than 3 ft above the seasonal high water table. The zone of incorporation (ZOI) within the treatment zone is the volume of soil to which the waste is directly applied. The ZOI is the top 12 in. of the treatment zone. The LTU was designed and constructed with a continuous berm, which surrounds the LTU at an elevation of approximately 2 ft above the natural grade.

1.4 Geologic and Hydrologic Characteristics

Ciniza is located on a layered geologic formation, which slopes gently to the northwest. Surface soils consist of varied fluvial and alluvial deposits (clay, silt, sand) and imported fill. Below is the Chinle formation, which consists of very low-permeability clays and shales, and effectively serves as an aquiclude, or confinement layer that lies directly above the Sonsela sandstone. The Sonsela sandstone is a water saturated unit and represents the uppermost aquifer in the region. The clays and shales of the Chinle aquiclude have a hydraulic conductivity of 10^{-9} centimeters per second.

Just above the Chinle aquiclude is a zone of water bearing, weathered alluvium known as the Chinle slope wash. Based on hydrologic investigations performed at the site, it has been determined that the Chinle slope wash is hydraulically interconnected with water located in shallow, localized sand lenses (Precision Engineering 1996) located between the Chinle slope wash and the ground surface. Unlike the shallow, localized sand lenses, the Chinle slope wash is continuous and saturated throughout the region underneath the LTU. However, the Chinle slope wash does not meet the regulatory definition of the uppermost aquifer. The water table above the aquiclude slopes to the northwest at a gradient of 0.01 ft/ft. Chinle slope wash

flow direction is depicted in Figure 1-1. The rate of water movement in these claystones is estimated to be less than 1 ft per year (Hazardous Waste Facility Permit).

The Sonsela aquifer is considered to be the uppermost aquifer even though it does not meet the water quality standards for drinking water. The Sonsela aquifer potentiometric surface is shown in Figure 1-2. The Sonsela aquifer is a bed of fine-to-medium grained sandstone, 12 to 15 ft thick, within the upper part of the Chinle formation. The top of the unit is at 100 to 112 ft, and it is overlain by reddish-brown, weathered claystones and sandy claystones. Groundwater in the uppermost aquifer is under artesian confinement in the vicinity of the LTU. The potentiometric surface for groundwater in the aquifer is 70 to 100 ft above the top of the aquifer, or 9 to 31 ft below the surface. The direction of flow in the Sonsela aquifer is northwest and the potentiometric gradient is approximately 0.01 ft/ft directly beneath the Ciniza Refinery. The average linear velocity for water in the uppermost aquifer beneath the LTU is 8.2 ft per year (Giant Refining Company 1984).

The Sonsela Sandstone bed is separated from lower aquifers by a thick sequence of mudstones and siltstones, with a few beds of sandstone and conglomerate. There appears to be no significant hydraulic connection between the Sonsela aquifer from the lower aquifers (Shinarump Member of the Chinle Formation, the Moendopi Formation, and the Permian-age San Andres Limestone-Glorieta Sandstone aquifer). The lower aquifers lie at depths greater than 700 ft. Figure I-1 of the Ciniza Part B Post-Closure Permit Application depicts the stratigraphy beneath the LTU.

2.0 POST-CLOSURE MONITORING PLAN - OVERVIEW

2.1 Scope

Ciniza developed the post-closure monitoring plan to monitor subsurface conditions to "determine whether hazardous constituents have migrated out of the treatment zone" as required by 20 NMAC 4.1, Subpart V, §264.278. The post-closure monitoring plan is comprised of early detection monitoring and detection monitoring. This appendix addresses monitoring of soils and liquids which lie beneath the LTU, including the Sonsela aquifer. The Sonsela is the uppermost aquifer beneath the LTU and is monitored in accordance with detection monitoring procedures. Early detection monitoring involves monitoring the ZOI, and treatment zone, and works in concert with detection monitoring to employ a multi-tiered approach that confirms, at a high level of certainty, the integrity of the LTU.

Early detection monitoring involves sampling the ZOI, treatment zone, and the Chinle slope wash. The Chinle slope wash is contiguous beneath the LTU and may provide a potential pathway for any releases to move beyond the point of compliance. Therefore, in order to be fully protective of human health and the environment, Ciniza developed an early detection monitoring sequence to monitor the Chinle slope wash.

The detection monitoring for the Sonsela aquifer consists of four monitoring wells (MWs). These wells include one MW located upgradient of the LTU to measure background, and three additional MWs located at the point of compliance at the downgradient edge of the LTU. These MWs will be sampled to determine whether the LTU has released hazardous constituents BTZ. This monitoring plan provides economical feasibility and environmental protection while ensuring the technical adequacy of the approach.

2.2 Background Values

2.2.1 Background Soil Samples.

Background soil samples were collected in 1981 from the LTU, prior to any waste application, as part of Ciniza's Ground Water Monitoring Program. In 1987, Ciniza was issued a Short-term Land Treatment Demonstration Permit to conduct a hazardous waste land treatment demonstration (LTD). The LTD included sampling of both ZOI and BTZ soils. In 1988, Ciniza was issued a Hazardous Waste Facility Permit (NMED 1988). Sampling of ZOI and BTZ soils was established as a condition of the permit. Permitted sampling provides ten years of LTU soil data. Cell 3 of the LTU, which has not received hazardous waste at any time, has been routinely sampled during this time. Data from the 1981 sampling and Cell 3 sampling has been used historically as the background. Samples obtained from Cell 3 and analyzed in accordance with the early detection monitoring will be used as the background for determining statistically significant increases in hazardous constituents as required by 20 NMAC 4.1, Subpart V, §264.278(f). Background values for Chinle slope wash samples are not established. Detection of any constituents from Table 2A through 2D may generate additional sampling in consultation with NMED.

2.2.2 Background Sonsela Groundwater Samples

Samples obtained from MW-4 and analyzed in accordance with the detection monitoring will be used as background for determining statistically significant increases in hazardous constituents in the Sonsela aquifer as required by 20 NMAC 4.1, Subpart V, §264.97(a). MW-4 is located between the LTU and the evaporation ponds directly to the south of the LTU. Using MW-4 as background will ensure that any potential impacts from the evaporation ponds can be identified and evaluated in comparison to the other MW sampling data.

2.3 Monitoring Wells

To ensure that post-closure monitoring will provide the best quality data in the future, Ciniza will utilize shallow monitoring well (SMW)-4 to sample the Chinle slope wash, and MW-1, MW-2, MW-4, and MW-5 to sample the Sonsela. MW-4 is located upgradient of the LTU to provide background values. Wells MW-1, MW-2 and MW-5 are located downgradient of the LTU at the point of compliance. The well locations ensure detection of any release from the LTU. All well locations are based on current potentiometric surfaces. Figure 2-1 shows the locations for the wells.

2.3.1 Well Siting

The wells are sited following guidance in the U.S. Environmental Protection Agency (EPA) *Groundwater Monitoring Technical Enforcement Guidance Document*, and the groundwater flow characteristics at the site. In September 1985, shallow monitoring wells were installed around the LTU perimeter as part of early detection monitoring. The shallow monitoring wells were installed in pockets of sand above the Chinle formation that exist as thin lenses above the Chinle shale between the ground surface and the top of the Sonsela sandstone. The shallow monitoring wells SMW-1, SMW-2, SMW-3, SMW-4, SMW-5 and SMW-6 have performed poorly because it has been discovered that they were completed within different sand lenses, which does not allow them to produce consistent data applicable to the LTU. MW-1, MW-2, MW-5 are completed in the Sonsela aquifer and are located directly downgradient of the LTU, as shown on Figures 2-1A and 2-1B. Figure 1-1 shows the direction of groundwater flow. The locations of the three downgradient wells were selected to intercept the groundwater flow moving beneath the LTU. The upgradient well, MW-4 – completed in the Sonsela, is also located based on groundwater flow vectors derived using the potentiometric surface across the site.

2.3.2 Well Construction Specification

SMW-4 was completed using mud rotary drilling techniques following established well construction guidance from *RCRA Ground Water Monitoring Technical Enforcement Guidance Document* (EPA 1986) (TEGD). The well is drilled into the Chinle slope wash and screened across the water-bearing zone within the unit. The well was logged during drilling and completed using an appropriately sized gravel pack and screen slot size. The screened interval is isolated from the remainder of the well using a low permeability annular seal to prevent cross contamination.

Four MWs were installed and completed in October 1981, pursuant to 40 *Code of Federal Regulations* Part 265. Construction of the LTU monitoring wells began in October 1981, and was completed in April 1984.

Current flow patterns in the Sonsela aquifer suggest the configuration of the LTU monitoring well system will provide sound, defensible data throughout the post-closure monitoring period.

The four MWs were constructed using mud rotary drilling techniques following established well construction guidance from *RCRA Ground Water Monitoring Technical Enforcement Guidance Document* (EPA 1986) (TEGD). The wells were drilled into the Sonsela aquifer and screened across the water-bearing zone within the unit. The wells were logged during drilling and completed using an appropriately sized gravel pack and screen slot size. The screened interval is isolated from the remainder of the well using a low permeability annular seal to prevent cross contamination.

3.0 RESPONSIBILITIES

3.1 Responsibilities

The importance of defining responsibilities for the implementation of the procedures must be stressed. All individuals involved with the monitoring program must clearly understand their responsibilities so the procedures detailed in this plan will be conducted successfully and efficiently.

3.2 Environmental Manager

The EM is responsible for the overall design and implementation of this post-closure monitoring plan. The EM develops and approves specific procedures for the conduct of all post-closure monitoring plan activities, and reviews and approves reports. The EM oversees interactions between Ciniza Refinery and the New Mexico Environment Department/ Hazardous and Radioactive Materials Bureau (NMED/HRMB) regarding environmental monitoring of the LTU. The EM appoints a post-closure monitoring plan team leader and field team, assigning responsibilities as described below.

3.3 Team Leader

The team leader, either the EM or a designee, will coordinate and oversee field sampling activities, ensuring that sampling and associated procedures are followed and that quality assurance/quality control (QA/QC) and safety guidelines are met. The team leader reviews and evaluates sample data, prepares and reviews LTU reports, and assures that appropriate samples are collected and analyzed.

3.4 Field Team

The LTU field team consists of one or more scientists, engineers, or technicians, who are responsible for sample collection, handling, shipping, and preparation and maintenance of appropriate data sheets, and completion of sample tracking documentation under the direction of the team leader, in accordance with this post-closure monitoring plan and associated Ciniza field procedures. The field team will inspect, maintain, and ensure proper calibration of equipment prior to use at the LTU, while ensuring that site health and safety requirements are met at all times. The field team will communicate any problems or project changes to the team leader.

3.5 Analytical Laboratory

The contract laboratory used for sample analysis is responsible for supplying sample collection containers and sample shipping containers to the field team. Sample collection containers supplied by the laboratory will be certified as clean by either the laboratory or their supplier. The contract laboratory is responsible for performing analysis in accordance with this post-closure monitoring plan and the data are supported by adequate documentation that meet NMED and U.S. Environmental Protection Agency (EPA) requirements. The laboratory will maintain documentation of sample handling and custody, analytical results, and internal QC data. Additionally, the laboratory will analyze QC samples in accordance with this plan and its own internal QC program for indicators of analytical accuracy and precision. Data generated outside laboratory acceptance limits will trigger an inquiry and, if appropriate, corrective action, as directed by the EM. The laboratory will report the result of the environmental sample and QC sample analyses and any necessary corrective actions that were performed. In the event that more than one contract laboratory is used (e.g., for different analyses), each one has the responsibilities described above.

4.0 QUALITY ASSURANCE/QUALITY CONTROL

4.1 Overview

Ciniza Refinery developed this QA/QC program to ensure that data integrity and quality are maintained for all samples collected and that equipment and records are maintained in accordance with NMED/HRMB guidance. The QA/QC program identifies data quality objectives (DQOs), processes for assuring sample quality, and processes for generating and maintaining quality records. Detailed QA/QC parameters are described in Tables 1A and 1B.

4.1.1 Data Quality Objectives

DQOs are qualitative and quantitative statements that specify the quality of data required to support post-closure care decisions. DQOs are established to ensure that the data collected are of a sufficient and known quality for their intended uses. The overall DQO for the post-closure care of the LTU is to collect accurate and defensible data of known quality that are sufficient to assess the concentrations of constituents in the groundwater underlying the LTU.

4.2 Quality Assurance Objectives

The analytical data generated during the post-closure care period will be specified in terms of accuracy, precision, completeness, representativeness, and comparability. This data will support decisions regarding identification, if any, of hazardous constituent concentrations found BTZ, changes in the monitoring system, and development of characterization and remediation activities as necessary to protect human health and the environment. Each QA/QC objective of the Ciniza QA plan is described below:

4.2.1 Accuracy

Accuracy is the closeness of agreement between a measurement and an accepted reference value. Measurements of accuracy for laboratory activities will include analysis of calibration standards, laboratory control samples (LCSs), matrix spike samples, and surrogate spike samples. The bias component of accuracy is expressed as percent recovery (%R). Percent recovery is expressed as follows:

$$\%R = \frac{measured\ sample\ concentration}{true\ concentration} * 100 \qquad (4\text{-}1)$$

4.2.1.1 Accuracy Objectives for Field Sampling Activities. For field sampling activities, accuracy will be measured through the use of equipment and trip blanks. Equipment blanks will be analyzed to check for contamination due to improper/insufficient decontamination procedures. These blanks will be used for nondedicated boring and sampling equipment.

To ensure equipment has been sufficiently decontaminated, deionized water will be poured over and through the sampling equipment, caught in a clean stainless steel bowl, and poured into the sample bottles. One equipment blank will be taken randomly during each monitoring event involving nondedicated equipment.

One trip blank will be used for each monitoring event involving analysis for volatile organic compounds (VOCs). The trip blank will be prepared and labeled by the laboratory. One 40-mL septum vial will be filled with reagent grade water, transported to the site with the empty sample bottles, carried with the sample bottles during all sampling and shipping activities, and returned to the laboratory for analysis. The trip blank shall not be opened at any time prior to analysis.

4.2.1.2 Accuracy Objectives for Laboratory Measurements. Analytical system accuracy will be quantified using the following laboratory accuracy QC checks: calibration standards, LCSs, laboratory blanks, matrix and surrogate spike samples. Single LCSs and matrix spike and surrogate spike sample analyses will be expressed as %R. Laboratory analytical accuracy is parameter dependent and is prescribed in appropriate laboratory standard operating procedures (SOPs).

4.2.2 Precision

Precision is the agreement among a set of replicate measurements without assumption or knowledge of true value. Precision of data will be derived from duplicate field and laboratory measurements.

4.2.2.1 Precision Objectives for Field Sampling Activities. To measure the precision of field sampling activities, duplicate samples will be collected and analyzed. Duplicates will be collected at a frequency of one duplicate sample for each sampling event. Duplicates will be analyzed for all parameters.

In order to evaluate the precision of the analysis, it is necessary to calculate the relative percent difference (RPD) between the two results of the duplicate analysis. The RPD calculation is as follows:

$$RPD = \frac{(S1 - S2)}{(S1 + S2)/2} \times 100 \qquad (4\text{-}2)$$

where:

$S1$ = Sample Result 1
$S2$ = Sample Result 2

RPD should be less than or equal to 10 percent for values five times greater than the method detection limit (MDL) and plus or minus the detection limit for values less than five times the MDL.

4.2.2.2 Precision Objectives for Laboratory Measurements. Precision of laboratory analyses will be assessed by performing the analyses on two aliquots extracted from one sample or on a matrix spike and matrix spike duplicate with each analytical batch assessed at a minimum frequency of 1 in 20 samples. The laboratory will determine analytical precision control limits by performing replicate analyses of control samples. Precision measurements will be expressed as RPD. Laboratory analytical precision is also parameter dependent and is prescribed in laboratory SOPs.

4.2.2.3 Contamination. In addition to measurements of accuracy and precision, QC checks for contamination will be performed. QC samples including trip blanks, equipment blanks, field blanks, calibration and method blank will be analyzed to assess and document contamination attributable to sample collection equipment, sample handling and shipping, and laboratory reagents, glassware, and equipment. Trip blanks are used to assess VOC sample contamination during shipment and handling and will be collected and analyzed at a frequency of one sample per sample shipment. Field blanks are used to assess field sample collection methods and will be collected and analyzed at a frequency of one per 20 samples (five percent of the samples collected). Method blanks are used to assess contamination resulting from the analytical process and will be analyzed at a frequency of each preparation batch or every 20 samples, whichever is more frequent. Sample blanks will be evaluated following EPA *National Functional Guidelines for Organic Data Review* (EPA 1991) and *Functional Guidelines for Evaluating Inorganics Analyses* (EPA 1988). Only method blanks will be analyzed by classical chemistry methods. The criteria for evaluating method blanks will be established as follows: If method blank results exceed specified detection limits, then that value will become the detection limit for the sample batch. Detection of analytes of interest in blank samples may be used to disqualify some samples, requiring resampling and additional analyses on a case-by-case basis.

4.2.3 Completeness

Completeness is the degree to which sample analyses accurately and precisely represent the media they are intended to represent. Data representativeness for post-closure monitoring will be accomplished through implementing approved sampling procedures and the use of validated analytical methods.

Occurrences that reduce the amount of data collected include sample container breakage in the laboratory and data generated while the laboratory was operating outside prescribed QC limits. All attempts will be made to minimize data loss and to recover lost data whenever possible. The completeness objective for noncritical measurements (i.e., field measurements) is 90 percent and 100 percent for critical measurements

(i.e., compliance data). If completeness objective is not met, the Ciniza EM will determine the need for resampling on a case-by-case basis. Numerical expression of the completeness (%C) of data is as follows:

$$\%C = \frac{number\ of\ samples\ with\ valid\ results}{total\ number\ of\ samples\ taken} * 100 \qquad (4\text{-}3)$$

4.2.4 Representativeness

Representativeness is the degree to which sample analyses accurately and precisely represent the media they are intended to represent. Data representativeness for this early detection monitoring will be accomplished through implementing approved sampling procedures and the use of validated analytical methods. Sampling procedures are designed to minimize factors affecting the integrity of the samples. Groundwater samples will only be collected after well purging criteria have been met. The analytical methods selected are those that will most accurately and precisely represent the true concentration of analytes of interest.

4.2.5 Comparability

Comparability is the extent to which one set of data can be compared to another. Comparability will be achieved through reporting data in consistent units and collection and analysis of samples using consistent methodology. Aqueous samples will consistently be reported in units of measure dictated by the analytical method. Units of measure include:

- Milligrams per liter (mg/L) for alkalinity, inorganic compounds and metals
- Micrograms per liter (µg/L) for VOCs and semi-VOCs (SVOCs)

4.3 Design Control

The monitoring system is designed to meet requirements in 20 NMAC 4.1, Subpart V, §264.97 and §264.278. The specific components are described in Section 5.0.

4.4 Instructions, Procedures, and Drawings

Provisions and responsibilities for the preparation and use of instructions and procedures during the post-closure care period of the LTU are detailed in Ciniza Refinery LTU *Implementing Procedures, Sample Control, and Quality Assurance Requirements* (Ciniza 1998). Quality-affecting activities performed by or on behalf of Ciniza for monitoring are required to be performed in accordance with documented and approved procedures which meet the intent of 20 NMAC 4.1, Subpart V, §264.97 for groundwater and 20 NMAC 4.1, Subpart V, §264.278 for soils.

Technical procedures developed for the predetection monitoring activities at the LTU are maintained by the Environmental Department at Ciniza Refinery. The procedures are sufficiently detailed and include, when applicable, quantitative or qualitative acceptance criteria.

4.5 Document Control

Document control of procedures, used in performing soil and groundwater monitoring functions, is maintained by the Environmental Department at Ciniza Refinery. This control ensures that the latest approved version of procedures is used during monitoring and maintenance activities at the LTU.

4.6 Monitoring and Data Collection Equipment

Data collection equipment is controlled and calibrated to ensure continued accuracy of monitoring data. Results of calibrations, maintenance, and repair are documented. Calibration records identify the reference standard and the relationship to national standards or nationally accepted measurement systems. Records are maintained to track uses of monitoring and data collection equipment. If the equipment is found to be out of tolerance, the equipment is tagged and it is not used until corrections are made.

4.7 Quality Assurance Records

The EM at Ciniza Refinery outlines the policy regarding identification, preparation, collection, storage, maintenance, disposition, and permanent storage of QA records.

QA and Resource Conservation and Recovery Act (RCRA) records document the results of the early detection monitoring implementing procedures and are sufficient to demonstrate that all quality-related aspects are valid. The records will be identifiable, legible, and retrievable in accordance with Ciniza Refinery Records Management Plan.

5.0 POST-CLOSURE MONITORING PLAN - DESCRIPTION

The monitoring plan is designed to meet the monitoring requirements of 20 NMAC 4.1, Subpart V §264.90 through §264.101 and 20 NMAC 4.1, Subpart V, §264.278. Monitoring locations will be selected in order to adequately determine if hazardous constituents have migrated out of the LTU. The number and depth of samples in this plan have been selected to adequately detect potential migration of hazardous constituents and determine successful treatment, degradation, and immobilization in the treatment zone.

5.1 Pre-Sampling Operations

Ciniza will notify the NMED/HRMB a minimum of two weeks prior to a monitoring event. The contract laboratory should be notified of the monitoring event so that they may allocate the personnel and equipment necessary to meet the demands of the sample analyses. The lab should specify and provide the adequate materials, (i.e., coolers, bottles, custody seals, chain of custody [COC] forms, trip blanks) for the monitoring event. Field team personnel should review the field checklists (Attachment 1) to assure that all equipment is available and operational.

5.2 Early Detection: Soil Monitoring

The purpose of monitoring the ZOI and treatment zone is to detect potential migration of hazardous constituents and to ensure that treatment of hazardous constituents within the treatment zone has been successfully completed.

5.2.1 Soil Monitoring Locations

Sampling accuracy will be achieved by randomly selecting six soil monitoring locations over Cell 1 and Cell 2 of the LTU. The locations will be randomly selected each time soil samples are collected. Prior to each sampling time, the six locations are selected as follows:

- Grid the sample area into 6-ft squares and establish the coordinate at the southeast corner of the LTU.
- Using a random number table or generator, select four sampling locations taking care to locate at least one location in each cell.

At least 6-in. of topsoil will be added to the LTU surface during closure activities. ZOI samples will be taken from the 12 in. below the topsoil-ZOI surface. The treatment zone is identified as the top 5 ft of soil and is defined as the environmental control level. Both ZOI and treatment zone samples will be taken from the boring. Sample volumes required by analytical protocol will be collected, taking care not to sample beyond the defined sampling depths.

5.2.2 Soil Monitoring Frequency

The frequency for the monitoring of LTU soils will be conducted as described in Volume I, Section E.0.

5.2.3 Number of Soil Samples

For each monitoring event a total of two samples will be taken from each boring; one sample from the ZOI, and one sample from the treatment zone. A sample is defined as the amount of soil necessary to secure analyses for all of the parameters identified in Section 5.2.2. This results in a total of 12 LTU samples per event. This total does not include QC samples required in Section 4.0. Samples will not be composited for analysis. The samples will be analyzed for Modified Skinner List and TPH as GRO and DRO.

5.3 Early Detection: Chinle Slope Wash Monitoring

The purpose of sampling the SMW-4, completed in the Chinle slope wash, is to detect the migration of hazardous constituents before they reach the point of compliance.

5.3.1 Groundwater Monitoring Locations

Groundwater samples will be collected from SMW-4. SMW-4 is screened only in the Chinle slope wash. Figure 2-1 shows the location of SMW-4 in relation to the LTU. Sample volume will be determined based on analytical protocols specified by the contract laboratory.

5.3.2 Groundwater Monitoring Frequency

The Chinle slope wash sampling frequency is parallel with the detection monitoring of the Sonsela aquifer. The sampling frequency for the Chinle slope wash is summarized in Volume I, Section E.0. Samples will be analyzed for the parameters listed in the modified Skinner list, Table 2A and 2B.

If any sampling event indicates that there has been a statistical increase in the hazardous constituents, then sampling frequency may be modified after consultation with NMED. If a statistically significant increase is indicated and confirmed, appropriate notification to NMED will be provided and a permit modification may be required for further characterization. The characterization, if required, will include all organics and metals in the modified Skinner List. The sampling frequency for the Chinle slope wash is summarized in Volume I, Figure 5-1.

5.4 Sonsela Groundwater Monitoring

Ciniza will sample the MWs completed in the Sonsela aquifer to detect the migration of hazardous constituents if they reach the point of compliance.

5.4.1 Groundwater Monitoring Locations

Groundwater samples will be collected from the four MWs completed in the Sonsela aquifer. Figure 2-1 shows the location of the MWs in relation to the LTU. Sample volume will be determined based on analytical protocols specified by the contract laboratory.

5.4.2 Groundwater Monitoring Frequency

The Sonsela aquifer will be sampled based on the frequency described in Volume I, Figure E-1. Samples will be analyzed for both organics and metals in the modified Skinner list shown in Tables 2A through 2D.

If any sampling event indicates that there has been a statistical increase in the hazardous constituents, then sampling frequency may be modified after consultation with NMED. If a statistically significant increase is indicated and confirmed, appropriate notification to NMED will be provided and a permit modification may be required for further characterization of the Sonsela aquifer. The characterization, if required, will include all organics and metals in the modified Skinner List. Ciniza will establish a compliance monitoring program in the Sonsela aquifer in accordance with 20 NMAC 4.1, Subpart V, §264.99. The sampling frequency for the Sonsela aquifer is summarized in Volume I, Figure 5-1.

5.4.3 Number of Groundwater Samples

One sample will be collected from each MW per sampling event. This results in four groundwater samples per event for the detection monitoring program. This number does not include the QC samples required in Section 4.0.

5.5 Analytical Parameters

Selection of analytical parameters is based on the contaminants expected to be present in the waste and their associated degradation products. Tables 2A through 2D contain the parameters that will be analyzed for during the various phases of sampling operations.

5.6 Sample Collection

Groundwater samples will be collected following the groundwater procedures presented in Section 7.0. These samples will be sent to contract laboratories and analyzed for metals and constituents of concern identified in Tables 2A through 2D. These hazardous constituents are specific to the waste applied to the LTU from 1988 to 1990 during its operational phase.

5.7 Laboratory Analysis

Samples will be analyzed by a commercial laboratory that participates in EPA's Contract Laboratory Program. Methods are specified in Ciniza procurement documents and are selected to be consistent with EPA-recommended procedures in *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (EPA 1997) (SW-846). Data analysis is to provide an objective and reliable means for interpreting data in relation to the objectives of the data collection program. For these monitoring programs, the principal goal of data analysis is the comparison of a data point or data set to a fixed standard or to equivalent data collected at another location and time (such as during operational phase of the LTU, background data, or data collected at a control location). Additional detail on analytical techniques and methods are given in laboratory SOPs.

5.8 Statistical Evaluation of Laboratory Data

As required by 20 NMAC 4.1, Subpart V, §264.97 and §264.278, data collected during monitoring will be evaluated using appropriate statistical techniques. Ciniza has been evaluating the groundwater monitoring data using Cochran's approximation to the Behrens-Fisher Student's T-test for its existing groundwater monitoring program. Ciniza plans to using this methodology to evaluate soil and groundwater monitoring data during the post-closure period. Cochran's approximation to the Behrens-Fisher Student's T-test is shown below:

$$t* = \frac{X_a - X_b}{\sqrt{\frac{S_m^2}{N_m} + \frac{S_b^2}{N_b}}} \tag{5-1}$$

where:

$t*$ = t star
X_a = mean of the sample
X_b = mean of the background
S_m^2 = variance of the sample
S_b^2 = variance of the background
N_m = number of samples
N_b = number of backgrounds

$$t_c = \frac{W_b t_b + W_m t_m}{W_b + W_m} \tag{5-2}$$

where:

t_c = comparison t-star
W_b = variance/number of backgrounds

t_b = t-table with (N_b-1) degrees of freedom at the 0.05 level of significance
W_m = variance/number of samples
t_m = t-table with (N_m-1) degrees of freedom at the 0.05 level of significance

The t-star (t^*) is compared to the comparison t-star (t_c) using the following decision rule.

- If t^* is equal to or larger than t_c then conclude that there most likely has been a significant increase in this parameter.
- If t^* is less than t_c then conclude that there most likely has not been a change in this parameter.

6.0 SAMPLE DOCUMENTATION AND CUSTODY

The integrity of samples from the time of collection through reporting date, sample collection, handling, and custody must be documented. Standardized forms used to document sample management include identification numbers, sample labels, custody tape, the sample tracking logbooks, and the COC form. The forms are briefly defined in the following subsections. All sample documentation will be completed for each sample and reviewed by the team leader for completeness and accuracy.

6.1 Sample Numbers and Labels

A unique sample identification number will be assigned to each sample sent to the laboratory for analysis. The team leader will assign the numbers prior to sample collection. The sample identification numbers are used to track the sample from the time of collection through data reporting. Every sample container sent to the laboratory will be identified with a label affixed to it. Sample label information will be completed in permanent, indelible ink and will contain the following information: sample identification number with sample matrix type; sample location; analysis requested; time and date of collection; preservative(s), if any; and the sampler's name or initials.

6.1.1 Sample Identification Numbering System

The sample identification numbering system is used to identify individual samples. Sample numbers may include a code number or letter attached to the end to identify the type of sample.

Samples for a typical sampling event would be labeled as:

EQUATION

(1) ZOI = Zone of Incorporation
TZ = Treatment Zone

	MW1	=	Monitoring Well # 1
(2)	*234*	=	Grid cell number (enter 000 for well sample)
(3)	1	=	Monitoring event number (for the year)
(4)	98	=	Year (1998)
(5)	*D*	=	Duplicate
	E	=	Equipment Blank
	B	=	Trip Blank

If no letter appears here, it is the original sample

6.2 Custody Seals

Custody seals are used to detect sample tampering from collection through analysis. The custody seals are adhesive-backed strips that are destroyed when removed or when the container is opened. The seal is dated, initialed, and affixed to the sample container in such a manner that it is necessary to break the seal to open the container. Seals are affixed to sample containers in the field immediately after collection. Upon receipt at the laboratory, the laboratory custodian will inspect the seal for integrity; a broken seal invalidates the sample.

6.3 Sample Logbook Record

Field team personnel will record critical information in the sample logbook for each sample collected. The information recorded will include:

- Sample location (well number or boring location)
- Sample identification number
- Date and time of sampling
- Sampling personnel
- Sample collection method
- Field measurements
- COC number
- Date sample(s) were sent to the lab
- Laboratory name
- Comments and observations

It is important that specific observations be recorded concerning site conditions. These include:

- Weather conditions
- Physical surrounding (water, plant growth)
- Evidence of contamination
- Odors or color abnormalities

Sample logbook information is completed in the field by the sampling team and checked by the team leader. When samples are shipped, the information remains in the custody of the EM for sample tracking purposes.

6.4 Chain of Custody

A COC form will be completed during or immediately following sample collection and will accompany the sample through analysis and disposal. The COC form is signed and dated each time the sample custody is transferred. A sample is considered to be in a person's custody if: the sample in his/her physical possession; a sample is in his/her unobstructed view; and/or the sample is placed, by the last person in possession of it, in a secured area with restricted access. During shipment, the carrier's bill number serves as custody verification. Upon receipt of the samples at the laboratory, the laboratory sample custodian acknowledges possession of the samples by signing and dating the COC. The completed COC is returned to the team leader with the laboratory analytical report and becomes part of the permanent record of the sampling event. The COC also may contain specific instructions to the laboratory for sample analysis, potential hazards, and disposal instruction.

The COC shall include the following information:

- Facility name
- Type and number of samples
- Sample location and ID
- Collection dates/times
- Analysis required
- Number of containers for each sample
- Additional remarks or comments as needed
- Sampler's signature
- Signatures of all individuals involved in the chain of possession
- Inclusive dates and times of possession

The original COC must accompany the samples. One copy of the COC form will be kept in the project files.

7.0 FIELD OPERATIONS

This section describes equipment and supplies; and provides general instructions for sample collection, preservation, packaging, and shipping; decontamination; and documentation. By following these instructions sampling personnel will ensure that the sample collected is representative of the soil and groundwater, thus providing scientifically valid and legally defensible analytical data.

The ZOI, treatment zone, Chinle slope wash and the Sonsela aquifer are routinely sampled and monitored. These activities are detailed in Section 7.1 and 7.2. Monitoring related activities include soil collection,

lithologic logging, borehole filling, static water level measurements; equipment calibration; field water quality analyses; and sample handling, shipping, and management. A typical sampling event is depicted on Figure 7-1.

7.1 Soil Procedures

7.1.1 Boreholes/Core Samples.

Boreholes for samples will be advanced by a drilling rig employing hollow-stem augers. There will be no compositing of soil samples. Core samplers are used in conjunction with hollow-stem augers to collect soil samples. A 5 ft, 2.5 in.-diameter, split core barrel will be placed in the lead auger. The tube is pushed into the soil at the same drilling rate as the auger. After the tube is pulled from the soil, it is detached from the drill rod and opened to remove the soil core. The sample must be transferred to the sample container in a timely manner in order to maintain the integrity of the sample and to prevent the potential loss of VOCs if present. Only after the sample has been collected should field observations and measurements (such as photoionization detector [PID] readings) be completed. Split core barrels will be used for obtaining samples of consolidated soil and to penetrate some types of rock.

7.1.2 Soil Screening

Should visual inspection or detection of odors warrant its use, a PID will be used to screen for volatiles. Since prior sampling has not shown significant contamination, the use of a PID is not expected. If the PID is used, all readings will be recorded in the logbook.

7.1.3 Lithologic Logging

Detailed logs will be maintained for each boring. Listed below is a general description of terms to be used to describe the soil characteristics for each boring.

- Lithology
- Color (i.e., light, dark, mottled, mixed)
- Size (fine, medium, coarse)
- Moisture (dry, moist, wet)
- Odor (or no odor)
- Other Descriptive Terms:
  - Lens <1 in.
  - Layer >1 in.
  - Interbedded
  - Slickensided - Soils having inclined planes of weakness, glossy in appearance

Lithologic logs of the entire core shall be used. Samples for VOCs shall be obtained before logging to preclude potential loss of VOCs.

7.1.4 Disposition of Soils

All drill cuttings generated by borehole advancement for soil samples will be spread within the LTU.

7.1.5 Backfill of Borings

All boring shall be backfilled with bentonite clay to prevent migration from the treatment zone.

7.1.6 Soil Sample Collection

To ensure that soil samples obtained for monitoring of LTU post-closure are of a consistently high quality, the following procedure will be used for their collection.

- Use an amber glass bottle to protect the sample from ultraviolet light.
- When sampling wet soils, leave enough headspace in the bottle to allow for expansion.
- Take extreme care to avoid contaminating the bottles or caps. Remove the cap just before filling and replace it as soon as possible after filling. Avoid touching the inside of the bottle or cap. See Section 7.3 for specific guidelines for organic analytes in soil.

7.1.7 Soil Sample Preservation

Appropriate preservation of collected samples is critical for ensuring analytical results are not impacted during transportation and handling before analyses. To ensure that LTU samples are properly preserved the following procedure will be followed:

- If required by analytical protocol, place the container in a cooler. Maintain the samples at or below 4°C.
- Do not expose the sample to extreme hot or cold temperatures or intense sunlight, even if no specific preservation is recommended.
- Deliver the samples to the contract laboratory as soon as practicable.

7.2 Groundwater Procedures

Ciniza sampling personnel will follow the guidelines outlined below for collecting groundwater samples. These samples consist of both field measurements and samples to be sent to the contract laboratory.

7.2.1 Groundwater Level Monitoring

The static groundwater level elevation will be measured in each well prior to well evacuation. This will be accomplished through the use of a steel tape, acoustic well probe or other approved methodology.

7.2.2 Well Purging

The wells will be purged prior to the collection of any groundwater samples, to ensure that a representative sample of the groundwater can be collected. This will be accomplished using a sufficiently low flow rate to minimize the possibility of stripping VOCs from the groundwater recharging the well. To eliminate the possibility of cross-contamination between wells, a dedicated pump for each well will be used to complete the well purging.

One of two methods will be used to complete the well purging. The first method is to remove three well volumes prior to sampling. The well volumes will be calculated based on the measured water level elevation and the size of well bore and gravel pack used during well construction. Because the wells are hydraulically low-yield wells, alternative sampling methods and reporting requirements exist. If sampling results indicate that SMW-4 is dry, this result will be recorded and reported to NMED. Other well water samples will be field measured for pH, temperature, and specific conductance to establish the conditions within the well bore. Then, the necessary samples will be collected and containerized in the order of the parameters' volatilization sensitivity. Once the necessary samples have been collected, the conditions within the well bore will be rechecked for stability by additional field measurements of pH, temperature, and specific conductance. If the field measurements show that conditions have not remained stable within the well bore during the sampling event, additional samples will be collected and the same process of field measurements will be conducted.

7.2.3 Groundwater Sample Collection

To ensure that LTU groundwater samples are of a consistently high quality, the following procedure will be used for their collection.

- Take extreme care to avoid contaminating the sample containers or caps. Remove the cap just before filling and replace it as soon as possible after filling. Avoid touching the inside of the bottle or cap.
- Do not filter the sample unless specified by analytical personnel.

- Do not rinse the sample container.
- Slowly fill each container almost full, except volatile organic analyte (VOA) vials. See Section 7.3 for sampling guidelines for organic analytes.

7.2.4 Groundwater Sample Preservation

Appropriate preservation of collected samples is critical for ensuring analytical results are not impacted during transportation and handling before analyses. To ensure that LTU samples are properly preserved the following procedure will be followed:

- If directed by analytical personnel, add the prescribed preservative. After adding preservative, slowly invert the vial to mix.
- If required by protocol, place the sample in a cooler. Maintain the organic samples and solid metal samples at or below 4°C with frozen Blue Ice. Avoid freezing the sample by packing it with vermiculite to prevent contact between the coolant and the sample container. Aqueous metal samples must not be cooled. Refer to tables 2A through 2D for preservation methods.
- Do not expose the sample to extreme hot or cold temperatures and intense sunlight, even if no specific preservation is recommended.
- Deliver the samples to the contract laboratory as soon as practicable.

7.3 Specific Sampling Guidelines for Organic Analytes in Aqueous or Solid Matrices

Special precautions must be taken to maintain sample integrity when analyzing for VOCs or semi-VOCs. In addition to the general sampling guidelines described for aqueous and solids in Sections 7.1.6, 7.1.7, 7.2.3 and 7.2.4 of this Appendix, sampling personnel follow the guidelines outlined below for collecting aqueous or solid matrix samples to be analyzed for organic analytes:

7.3.1 Volatile Organic Compound Sampling

- To monitor possible contamination, prepare a trip blank from organic-free reagent water before leaving for the sampling site. Carry the trip blank throughout sampling, storage, and transportation.
- Do not collect or store samples in the presence of exhaust fumes from vehicles, equipment, or machinery.
- Collect only grab samples. Compositing samples poses an unknown safety risk; do not composite samples of unknown wastes with suspect organic components.
- *Liquids*. Use standard 40 ml glass, screw-cap VOA vials with Teflon-lined silicone septa for liquid samples. Introduce liquids into the vials gently to reduce agitation that might drive off volatile compounds. Pour aqueous samples into the VOA vial without introducing any air bubbles within

the vial as it is being filled. If bubbling occurs, discard the sample and collect another sample in a new VOA vial. Each VOA vial should be filled until a meniscus is over the lip of the vial. The vials should be completely filled at the time of sampling so that when the septum cap is fitted and sealed (Teflon side toward the sample) and the vial inverted, no headspace is visible. If there are any air bubbles, recollect the sample.

- *Solids*. Use standard 40-mL glass, screw-cap VOA vials with Teflon-lined silicone septa for samples with solid or semi-solid matrices. Introduce the solids into the vials gently to reduce agitation that might drive off VOCs. VOA vials should be completely filled. The VOA vials should be tapped slightly as they are filled to eliminate free air space.

- Seal each VOA vial in a separate plastic bag to prevent cross-contamination between samples, particularly if the sampled waste is suspected of containing high levels of volatile organics. VOA samples may also be contaminated by diffusion of VOCs through the septum during transportation and storage at the Ciniza facility.

7.3.2 Semivolatile Organic Compound Sampling

- Do not collect or store samples in the presence of exhaust fumes from vehicles, equipment, or machinery.

- Collect only grab samples. Compositing of samples poses an unknown safety risk; do not composite samples of unknown, suspect organic analytes.

- Containers used to collect SVOC samples should be specially cleaned with a soap and water wash followed by methanol or isopropanol rinsing. The sample containers should be glass or Teflon and have screw-caps with Teflon-lined septa. Plastic containers or lids may NOT be used. To avoid any possible contamination, sample containers should be filled with care to prevent any portion of the collected sample coming in contact with the sampler's glove.

7.4 Calibration

Proper calibration of equipment used to obtain samples and data for this early detection monitoring is critical for ensuring accuracy and precision of results. Due to changes in technology and subcontractors used for early detection monitoring activities, Ciniza will rely on manufacturer's specifications and instructions for proper calibration of equipment.

7.4.1 Sampling and Monitoring Equipment and Calibration

The equipment used to collect data for this monitoring plan is to be calibrated in accordance with manufacturers' specifications before use. The team leader is responsible for calibrating needed equipment on schedule, in accordance with specifications. The team leader is also responsible for maintaining current calibration records for each piece of equipment. Calibration records will include manufacturers' specifications and instructions for each piece of equipment used in sampling and monitoring.

7.5 Decontamination

The following procedures are applicable to decontamination of drilling equipment and vehicles and sampling equipment.

7.5.1 Drilling Equipment and Vehicles

Decontamination of large drilling equipment and vehicles is required to prevent cross contamination of boreholes from which samples will be retrieved for chemical analysis. This procedure also provides for the protection of personnel subsequent to demobilization from the LTU.

- Wash and mechanically clean augers and split spoon with biodegradable soap and brush. Rinse with potable water.
- Steam augers and split spoon
- Protect equipment, if necessary, when transporting drilling equipment between boreholes, by covering or shielding.

During decontamination of drilling equipment and accessories, it is especially critical to clean the inside of hollow-stem auger flights, drill rods, and bits. Decontamination can be limited to those parts that may come into direct contact with soil sample surfaces.

7.5.2 Sampling Equipment

Sampling equipment includes all sampling devices and containers that are used to collect or contain a sample prior to final sample analysis. Before its use, all sampling equipment that may contribute to the contamination of a sample must be thoroughly cleaned.

Sampling equipment can generally be cleaned by hand. The following procedure will be used for sampling equipment:

- Scrub with biodegradable soap and potable water
- Rinse with deionized water followed by isopropanol
- Allow to air-dry
- Protect, if necessary, to prevent contamination while transporting from borehole to borehole by covering or shielding

8.0 ANALYTICAL PROCEDURES

8.1 Methods

To adequately evaluate analytical data, EPA-approved methods have been selected and are listed in Tables 2A through 2D.

8.2 Detection Limits

It is imperative that the analytical procedures chosen have detection limits that are less than appropriate clean up standards or action levels. Clean up standards for this plan are included in Tables 2A through 2D.

8.3 Sample Container, Preservation, and Holding Times

Sample container selection, preservation techniques, and holding times must be addressed for every sampling activity to ensure that the sample does not deteriorate or become contaminated. Sample deterioration can occur through biological degradation or chemical precipitation. Sample contamination can occur through adsorption, absorption, or leaching effects due to the interaction of the sample and the container material. Sample container selection, preservation techniques, and holding times are listed in Tables 2A through 2D.

8.4 Sample Preparation

Proper sample preparation is an integral part of any analytical program. Sample preparation should be confirmed with the EM.

8.5 Laboratory QA/QC

A copy of the laboratory's QA/QC program as submitted to Ciniza is kept on file. The recommended QA/QC program submitted to Ciniza by the NMED is provided as Attachment 2. If necessary, Ciniza will request that the laboratory's QA/QC program be modified to conform to the NMED QA/QC program.

9.0 REPORTING

9.1 Laboratory Data Reports

Laboratory data are provided as hard copy reports to Ciniza. Laboratory data reports will be maintained by Ciniza and contain the following information for each analytical report:

- A brief narrative summarizing laboratory analyses performed, date of issue, deviations from the analytical method, technical problems affecting data quality, laboratory quality checks, corrective actions (if any), and the project manager's signature approving issuance of the data report.

- Header information for each analytical data summary sheet including: sample number and corresponding laboratory identification number; sample matrix; dates of collection, receipt, preparation and analysis; and analyst's name.
- Analytical parameter, analytical result, reporting units, reporting limit, analytical method used.

- Results of QC sample analyses for all concurrently analyzed QC samples.

- Lab reports will be submitted to NMED as part of reporting requirements.

10.0 RECORDS MANAGEMENT

Records generated during early detection monitoring events will be maintained in Ciniza's project files. Project records include, but are not limited to:

- Sampling and Analysis Plans
- Operating Procedures
- COC Records
- Contract Analytical Laboratory Data Reports
- Instrument Maintenance and Calibration Records
- Control Charts and Calculations
- Raw Analytical Results
- Field Logbooks/Notes

11.0 REFERENCES

20 NMAC 4.1, Subpart V. Title 20, *New Mexico Administrative Code*, Chapter 4, Part 1, Subpart V, "Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities," Santa Fe, New Mexico, New Mexico Environmental Improvement Board.

Dames and Moore. 1981. *Groundwater and Soils Investigation*. Gallup, New Mexico, Giant Refining Company, March 1981.

EPA. 1986. *RCRA Groundwater Monitoring Technical Enforcement Guidance Document*. OSWER-9950.1, Washington, D.C., U.S. Environmental Protection Agency.

EPA. 1988. *Functional Guidelines for Evaluating Inorganics Analyses*. Washington, D.C., U.S. Environmental Protection Agency.

EPA. 1991. *National Functional Guidelines for Organic Data Review*. Washington, D.C., U.S. Environmental Protection Agency.

EPA. 1997. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods.* Final Updates I, II, and III, SW-846, 3d ed., Washington, D.C., Office of Solid Waste, U.S. Environmental Protection Agency.

Giant Refining Company. 1984. *Part B Application for a Hazardous Waste Permit for the Ciniza Refinery Land Treatment Facility.* Gallup, New Mexico, Giant Refining Company, December 1, 1984.

NMEID. 1988. *Hazardous Waste Facility Permit.* NMD000333211, Santa Fe, New Mexico, New Mexico Environmental Improvement Department, November 4, 1988.

Precision Engineering. 1996. *LTU Stratigraphy Report.* Las Cruces, New Mexico, Precision Engineering.

Table 1A. Summary of Laboratory Quality Control Procedures for Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)[a]

Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
BFB Tune	Before each initial calibration and calibration verification (every 12 hours).	Method 8260B, Table 4 acceptance criteria	Perform necessary instrument maintenance/repair and re-analyze.
Instrument calibration (minimum 5 standards)	Initially and as needed (calibration standards to contain all analytes and surrogates)	Not applicable	Not applicable.
System Performance Check Compounds (SPCCs)	Initial calibration: Immediately after calibration and before sample analysis	RFs: Chloromethane ≥ 0.10 1,1-Dichloromethane ≥ 0.10 Bromoform ≥0.10 Chlorobenzene ≥ 0.30 1,1,2,2-Tetrachloroethane ≥ 0.30	Evaluate analytical system and perform corrective maintenance/repair as necessary. Recalibrate instrument.
	Calibration verification: At the beginning of each 12 hour analytical shift	As for initial calibration	Evaluate analytical system and perform corrective action. Re-analyze and recalibrate if necessary.
Calibration Check Compounds (CCCs)	Initial calibration: After calibration and before sample analysis	RSDs for CCCs ≤ 30% RSDs for target analytes ≤ 15%	Evaluate analytical system and perform corrective maintenance/repair as necessary. Recalibrate instrument.
	Calibration verification: At the beginning of each 12 hour analytical	% difference or % drift ≤ 20% for CCCs and all target analytes	Evaluate analytical system and perform corrective action. Re-analyze and recalibrate if necessary.
Linearity of target analytes	After calibration and before sample analysis	RSD ≤ 15%	Recalibrate or use alternate calibration options provided in SW-846, Method 8000.
Retention Time (RT) windows	Initially, establish an absolute retention time for each analyte and surrogate compound according to established and documented procedures	Not applicable	Not applicable.
	Assess the retention times of target analytes in each calibration standard	± 0.06 relative retention times (RRT)	Evaluate analytical system and perform corrective maintenance/repair as necessary. Recalibrate instrument.

Table 1A. Summary of Laboratory Quality Control Procedures for Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)[a] (continued)

Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
	The center of the retention time window for analytes and surrogates is established from the calibration verification standard	Not applicable	Not applicable.
	Assess retention time of internal standards in the calibration verification standard	Within 30 secs of RT in the mid-point initial calibration standard	Investigate analytical system and apply corrective actions as necessary. Re-analyze samples processed while malfunction was in operation. Recalibrate as necessary.
Internal Standards (IS)	Assess IS response in the calibration verification standard	EICP area ≥ -50% or ≤ + 100% of most recent initial calibration	Investigate analytical system and apply corrective actions as necessary. Re-analyze samples processed while malfunction was in operation. Recalibrate as necessary.
Calibration Verification	At the beginning of each 12 hour analytical shift	See acceptance criteria for DFTPP, SPCCs, CCCs, method blank. RTs, IS	Evaluate analytical system, perform corrective action, re-calibrate as necessary.
Surrogates	Each field sample, blank, and QC sample	Laboratory established acceptance limits	Review surrogate recoveries in comparison with other QC sample results (MS/MSD, LCS). Re-extract and/or re-analyze samples, flag data.
Method blank (MB)	Immediately after the calibration verification standardWith every analytical batch (once per 20 samples prepared using the same procedures at the same time)	≤ 5% of the regulatory/contract required limit for the analytes. If no regulatory/contract limit applies, ≤ 3 x MDL	Identify and reduce the source of contamination. Re-extract/re-analyze samples associated with a contaminated blank. Recalibrate as necessary.
Matrix spike (pre-digestion) (MS) [c]	One per batch per matrix or every 20 samples, whichever is more frequent	± 30% of spiked value [b]	Flag data.
Matrix spike duplicate (pre-digestion) (MSD) [c]	One per batch per matrix or every 20 samples, whichever is more frequent	± 30% of spiked value [b] 0-20% RPD [b]	Flag data.

Table 1A. Summary of Laboratory Quality Control Procedures for Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)[a] (continued)

Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
Duplicates (D) [c]	One per batch per matrix or every 20 samples, whichever is more frequent	0-20% RPD [b]	Flag data.
Surrogates	Each field sample, blank, and QC sample	Laboratory established acceptance limits for % recovery (R)	Review surrogate recoveries in comparison with other QC sample results (MS/MSD, LCS). Re-extract and/or re-analyze samples, flag data.
Laboratory Control Sample (LCS)	Once per analytical batch or every 20 samples whichever is more frequent	70-130% recovery (R)[b]	Identify and correct problem. Re-analyze all samples associated with failed LCS.
Method Detection Limit (MDL)	Annually, at a minimum.	≤ 5% regulatory/contract required detection limit	Review analytical protocol, rerun MDL samples, select an alternative method of analysis.

[a] U.S. Environmental Protection Agency, 1986 and all approved updates, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," *SW-846*, Method 8260B and Method 8000B

[b] Laboratory developed in-house control limits must be used if available

[c] Requirement for analysis of duplicate/MS or MS/MSD is sample dependent; if samples are not expected to contain target analytes, MS/MSD should be used.

Table 1B. Summary of Laboratory Quality Control Procedures for Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)[a]

Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
DFTPP Tune	Before initial each calibration and calibration verification (every 12 hours).	Method 8270C, Table 3	Perform necessary instrument maintenance/repair and re-analyze.
Column performance and injection port inertness	Before each initial calibration and calibration verification (every 12 hours).	DDT → DDE and DDD ≤ 20%	Perform necessary instrument maintenance/repair and re-analyze.
Instrument calibration (minimum 5 standards)	Initially and as needed (calibration standards to contain all analytes and surrogates)	Not applicable	Not applicable.
System Performance Check Compounds (SPCCs)	Initial calibration: Immediately after calibration and before sample analysis	RFs for SPCCs ≥ 0.050	Evaluate analytical system and perform corrective maintenance/repair as necessary. Recalibrate instrument.
	Calibration verification: Before sample analysis and once every following 12 hour analytical shift	RFs for SPCCs ≥ 0.050	Evaluate analytical system and perform corrective action. Re-analyze and recalibrate if necessary.
Calibration Check Compounds (CCCs)	Initial calibration: After calibration and before sample analysis	%RSD for CCCs ≤ 30% % RSD for all target analytes ≤ 15%	Evaluate analytical system and perform corrective maintenance/repair. Re-analyze and recalibrate if necessary.
	Calibration verification: Before sample analysis and once every following 12 hour analytical shift	% difference or % drift ≤ 20% for CCCs and all target analytes	Evaluate analytical system and perform corrective maintenance/repair. Re-analyze and recalibrate if necessary.
Linearity of target analytes	After calibration and before sample analysis	RSD ≤ 15%	Recalibrate or use alternate calibration options provided in SW-846, Method 8000.
Retention Time (RT) windows	Initially, establish an absolute retention time for each analyte and surrogate compound according to established and documented procedures	Not applicable	Not applicable.
	Assess the retention times of target analytes in each calibration standard	± 0.06 relative retention times (RRT)	Evaluate analytical system and perform corrective maintenance/repair as necessary. Recalibrate instrument.

Table 1B. Summary of Laboratory Quality Control Procedures for Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)[a] (continued)

Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
	The center of the retention time window for analytes and surrogates is established from the calibration verification standard	Not applicable	Not applicable.
	Assess retention time of internal standards in the calibration verification standard	Within 30 secs of RT in the mid-point initial calibration standard	Investigate analytical system and apply corrective actions as necessary. Re-analyze samples processed while malfunction was in operation. Re-calibrate as necessary.
Internal Standards (IS)	Assess IS response in the calibration verification standard	EICP area >≥ -50% or ≤ + 100% of most recent initial calibration	Investigate analytical system and apply corrective actions as necessary. Re-analyze samples processed while malfunction was in operation. Recalibrate as necessary.
Calibration Verification	At the beginning of each 12 hour analytical shift	See acceptance criteria for DFTPP, SPCCs, CCCs, method blank. RTs, IS	Evaluate analytical system, perform corrective action. Re-calibrate as necessary.
Method blank (MB)	Immediately after the calibration verification standard With every analytical batch (once per 20 samples prepared using the same procedures at the same time)	≤ 5% of the regulatory/contract required limit for the analytes. If no regulatory/contract limit applies, ≤ 3 x MDL	Identify and reduce the source of contamination. Re-extract/re-analyze samples associated with a contaminated blank. Recalibrate as necessary.
Matrix spike (pre-digestion) (MS) [c]	One per batch per matrix or every 20 samples, whichever is more frequent	± 30% of spiked value [b]	Flag data.
Matrix spike duplicate (pre-digestion) (MSD) [c]	One per batch per matrix or every 20 samples, whichever is more frequent	± 30% of spiked value [b] 0-20% RPD [b]	Flag data.
Duplicates (D) [c]	One per batch per matrix or every 20 samples, whichever is more frequent	0-20% RPD [b]	Flag data.

Table 1B. Summary of Laboratory Quality Control Procedures for Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)[a] (continued)

Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
Surrogates	Each field sample, blank, and QC sample	Laboratory established acceptance limits for % recovery (R)	Review surrogate recoveries with regard to other QC sample results (MS/MSD, LCS). Re-extract and/or re-analyze samples, flag data.
Laboratory Control Sample (LCS)	Once per analytical batch or every 20 samples, whichever is more frequent	70-130% recovery (R)[b]	Identify and correct problem. Re-analyze all samples associated with failed LCS.
Method Detection Limit (MDL)	Annually, at a minimum.	≤ 5% regulatory/contract required detection limit	Review analytical protocol, rerun MDL samples, select an alternative method of analysis.

[a] U.S. Environmental Protection Agency, 1986 and all approved updates, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," *SW-846*, Method 8270C and Method 8000B.

[b] Laboratory developed in-house control limits must be used if available.

[c] Requirement for analysis of duplicate/MS or MS/MSD is sample dependent; if samples are not expected to contain target analytes, MS/MSD should be used.

Table 2A. Modified Skinner List 8260 Volatile Organics and PHCs[a]

Parameter	EPA Method SW-846	Description	Containers	Preservative	Holding Time/Days	Liquid Reporting[c] Limit (µg/L)	Soil Reporting[c] Limit (mg/kg)
Benzene	8260	GC/MS	G	4°C	14	5	0.67
2-Butanone (MEK)	8260	GC/MS	G	4°C	14	1900	7000
Carbon Disulfide	8260	GC/MS	G	4°C	14	1000	350
Chlorobenzene	8260	GC/MS	G	4°C	14	39	54
Chloroform	8260	GC/MS	G	4°C	14	0.16	0.24
Chloromethane	8260	GC/MS	G	4°C	14	1.5	1.2
1,1 Dichloroethane	8260	GC/MS	G	4°C	14	25	580
1,2 Dichloroethane	8260	GC/MS	G	4°C	14	5	0.34
1,1 Dichloroethene	8260	GC/MS	G	4°C	14	5.0	0.053
trans-1,2-Dichloroethene	8260	GC/MS	G	4°C	14	100	63
1,4-Dioxane	8260	GC/MS	G	4°C	14	6.1	44
Ethylbenzene[a]	8260	GC/MS	G	4°C	14	700	230
Methylene Chloride	8260	GC/MS	G	4°C	14	4.3	8.6
Styrene	8260	GC/MS	G	4°C	14	100	1700
1,1,2,2-Tetrachloroethane[b]	8260	GC/MS	G	4°C	14	0.055	0.37
Tetrachloroethene[b]	8260	GC/MS	G	4°C	14	5	4.9
Toluene	8260	GC/MS	G	4°C	14	750	1000
1,1,1-Trichloroethane	8260	GC/MS	G	4°C	14	60	200
Trichloroethene	8260	GC/MS	G	4°C	14	5	2.7
Total Xylene[a, d]	8260	GC/MS	G	4°C	14	620	860
Ethylene Dibromide[b]	8260	GC/MS	G	4°C	14	0.1	0.005
Acetone	8260	GC/MS	G	4°C	14	610	1500

[a]Principal hazardous constituent identified in Ciniza Hazardous Waste Facility Permit.
[b]Additional constituents.
[c]Based on EPA Region 6, Human Health Medium-Specific Screening Levels (1999) and NM WQCC Regulations (1996). Analytical detection limits are required to be lower than reporting limits.
[d]Regulatory limits for individual isomers combined into a 'total' limit for these compounds.

mg/kg = milligrams per kilogram
µg/L = microgram per liter
G = glass with Teflon-lined lid
GC/MS = gas chromatography/mass spectrometry

Table 2B. Modified Skinner List 8270 Semivolatile Organics Including TPH and PHCs[a]

Parameter	EPA Method SW-846	Description	Container	Preservative	Holding Time/Days	Liquid Reporting Limit (µg/L)[c]	Soil Reporting Limit (mg/kg)[c]
Anthracene	8270	GC/MS	G	4°C	14	1800	16000
Acenaphthene	8270	GC/MS	G	4°C	14	370	2800
Benzo(a)Anthracene	8270	GC/MS	G	4°C	14	0.09	0.62
Benzo(b)Fluoranthene	8270	GC/MS	G	4°C	14	0.09	0.62
Benzo(k)Fluoranthene	8270	GC/MS	G	4°C	14	0.9	6.2
Benzo(a)Pyrene[a]	8270	GC/MS	G	4°C	14	0.0007	0.062
Butyl Benzyl Phthalate	8270	GC/MS	G	4°C	14	7300	240
Chrysene[a]	8270	GC/MS	G	4°C	14	9.2	62
Diethyl Phthalate	8270	GC/MS	G	4°C	14	29000	49000
7,12-Dimethylbenz(a)-Anthracene	8270	GC/MS	G	4°C	14	[e]	[e]
Dimethyl Phthalate	8270	GC/MS	G	4°C	14	370000	100000
Di-n-Octyl Phthalate	8270	GC/MS	G	4°C	14	730	1200
Fluoranthene	8270	GC/MS	G	4°C	14	1500	2300
Fluorene	8270	GC/MS	G	4°C	14	240	2000
Indeno(1,2,3-cd)Pyrene	8270	GC/MS	G	4°C	14	0.09	0.62
2-Methylnaphthalene[a]	8270	GC/MS	G	4°C	14	30	660
2-Methylphenol (Cresol)	8270	GC/MS	G	4°C	14	1800	3000
3/4-Methylphenol (Cresol)	8270	GC/MS	G	4°C	14	1980	3300
Naphthalene[g]	8270	GC/MS	G	4°C	14	30	55
Nitrobenzene	8270	GC/MS	G	4°C	14	3.4	17
4-Nitrophenol	8270	GC/MS	G	4°C	14	2300	3800
Phenanthrene[a]	8270	GC/MS	G	4°C	14	[e]	[e]
Pyrene[a]	8270	GC/MS	G	4°C	14	180	1700
Pyridine	8270	GC/MS	G	4°C	14	37	61
Quinoline	8270	GC/MS	G	4°C	14	0.0056	0.04
Benzenethiole	8270	GC/MS	G	4°C	14	[e]	[e]
Phenol	8270	GC/MS	G	4°C	14	5	36000
Bis(2-Ethylhexyl)phthalate[b]	8270	GC/MS	G	4°C	14	6.0	35
Dibenz(a,j)acridine[b]	8270	GC/MS	G	4°C	14	[e]	[e]
Dibenz(a,h)-anthracene	8270	GC/MS	G	4°C	14	0.0092	0.062
Dichlorobenzene[b, f]	8270	GC/MS	G	4°C	14	675	410
Methyl Naphthalene	8270	GC/MS	G	4°C	14	30	[e]
2,4-Dimethylphenol	8270	GC/MS	G	4°C	14	730	1200
2,4-Dinitrotoluene	8270	GC/MS	G	4°C	14	73	120

Table 2B. Modified Skinner List 8270 Semivolatile Organics Including TPH and PHCs[a] (Continued)

Parameter	EPA Method SW-846	Description	Container	Preservative	Holding Time/Days	Liquid Reporting Limit (µg/L)[c]	Soil Reporting Limit (mg/kg)[c]
2,4-Dinitrophenol[b]	8270	GC/MS	G	4°C	14	73	120
Benzo(j)Fluoranthene	8270	GC/MS	G	4°C	14	[e]	[e]
2-Chlorophenol	8270	GC/MS	G	4°C	14	30	61
2,4,6-Trichlorophenol	8270	GC/MS	G	4°C	14	6.1	44
Di-n-Butyl Phthalate	8270	GC/MS	G	4°C	14	3700	6100
Benzyl Alcohol[b]	8270	GC/MS	G	4°C	14	11000	18000
Methyl Chrysene	8270	GC/MS	G	4°C	14	[e]	[e]
Total Cresol[a, f]	8270	GC/MS	G	4°C	14	3780	6300
TPH[h]	8015m	GS	G	4°C	7	—	1000

[a]Principal hazardous constituent identified in Ciniza Hazardous Waste Facility Permit.
[b]Additional constituents.
[c]Based on EPA Region 6, Human Health Medium-Specific Screening Levels (1999) and NM WQCC Regulations (1996). Analytical detection limits are required to be lower than reporting limits.
[e]No regulatory limit provided. Laboratory detection limit will be used.
[f]Regulatory limits for individual isomers combined into a 'total' limit for these compounds.
[g]Total naphthalene plus monomethylnaphthalenes regulatory limit is < 30µg/L for aqueous samples.
[h]Total Petroleum Hydrocarbon as Gasoline Range Organics and Diesel Range Organics

µg/L = microgram per liter
mg/kg = milligram per kilogram
G = glass with Teflon-lined lid
GC/MS = gas chromatography/mass spectrometry
GC = gas chromatography

Table 2C. Modified Skinner List Metals and PHCs[a]

Parameter	EPA Method SW-846	Description	Container	Preservative [b]	Holding Time/Days	Aqueous Reporting Limit (µg/L)[c]	Soil Reporting Limit (mg/kg)[c]
Antimony	7060(aq), 6010	GFAA/ICP	P or G	4°C	180	6.0	31
Arsenic	6010	ICP-AES	P or G	4°C	180	50	22
Barium	6010	ICP-AES	P or G	4°C	180	2000	5400
Beryllium	6010	ICP-AES	P or G	4°C	180	4.0	150
Cadmium	6010	ICP-AES	P or G	4°C	180	5.0	39
Chromium[a]	6010	ICP-AES	P or G	4°C	180	50	210
Cobalt	6010	ICP-AES	P or G	4°C	180	50	3400
Lead[a]	6010	ICP-AES	P or G	4°C	180	15	400
Nickel	6010	ICP-AES	P or G	4°C	180	100	1600
Selenium	6010	ICP-AES	P or G	4°C	180	50	390
Silver	6010	ICP-AES	P or G	4°C	180	50	390
Vanadium	6010	ICP-AES	P or G	4°C	180	260	550
Zinc	6010	ICP-AES	P or G	4°C	180	10000	23000

[a]Principal hazardous constituent identified in Ciniza Hazardous Waste Facility Permit.
[b]Aqueous samples are field acidified to pH < 2 with HNO_3 and must not be refrigerated. Non-aqueous samples are cooled to 4°C.
[c]Based on EPA Region 6, Human Health Medium-Specific Screening Levels (1999) and NM WQCC Regulations (1996). Analytical detection limits are required to be lower than reporting limits.

µg/l = microgram per liter
mg/kg = milligram per kilogram
ICP-AES = Inductively Coupled Plasma - Atomic Emission Spectroscopy
G = glass
P = linear polyethylene, polypropylene, or Teflon

Table 2D. Mercury[a] and Cyanide

Parameter	EPA Method SW-846	Description	Container	Preservative	Holding Time/Days	Aqueous Reporting Limit (µg/L)[c]	Soil Reporting Limit (mg/kg)[c]
Mercury[a]	7470/7471	CVAA	P or G	4°C[b]	28	2.0	23.
Cyanide	335.3/ 9010, 9014	Colorimetry	P or G	4°C[d]	14	200	1200

[a]Principal hazardous constituent identified in Ciniza Hazardous Waste Facility Permit.

[b]Aqueous samples are field acidified to pH < 2 with HNO_3 and must not be refrigerated. Non-aqueous samples are cooled to 4°C.

[c]Based on EPA Region 6, Human Health Medium-Specific Screening Levels and NM WQCC Regulations (1996). Analytical detection limits are required to be lower than reporting limits.

[d]Aqueous samples are field adjusted to pH >12 with NaOH and refrigerated. Non-aqueous samples are cooled to 4°C.

µg/l = microgram per liter
mg/kg = milligram per kilogram
CVAA = cold vapor atomic absorption
G = glass
P = linear polyethylene, polypropylene, or Teflon

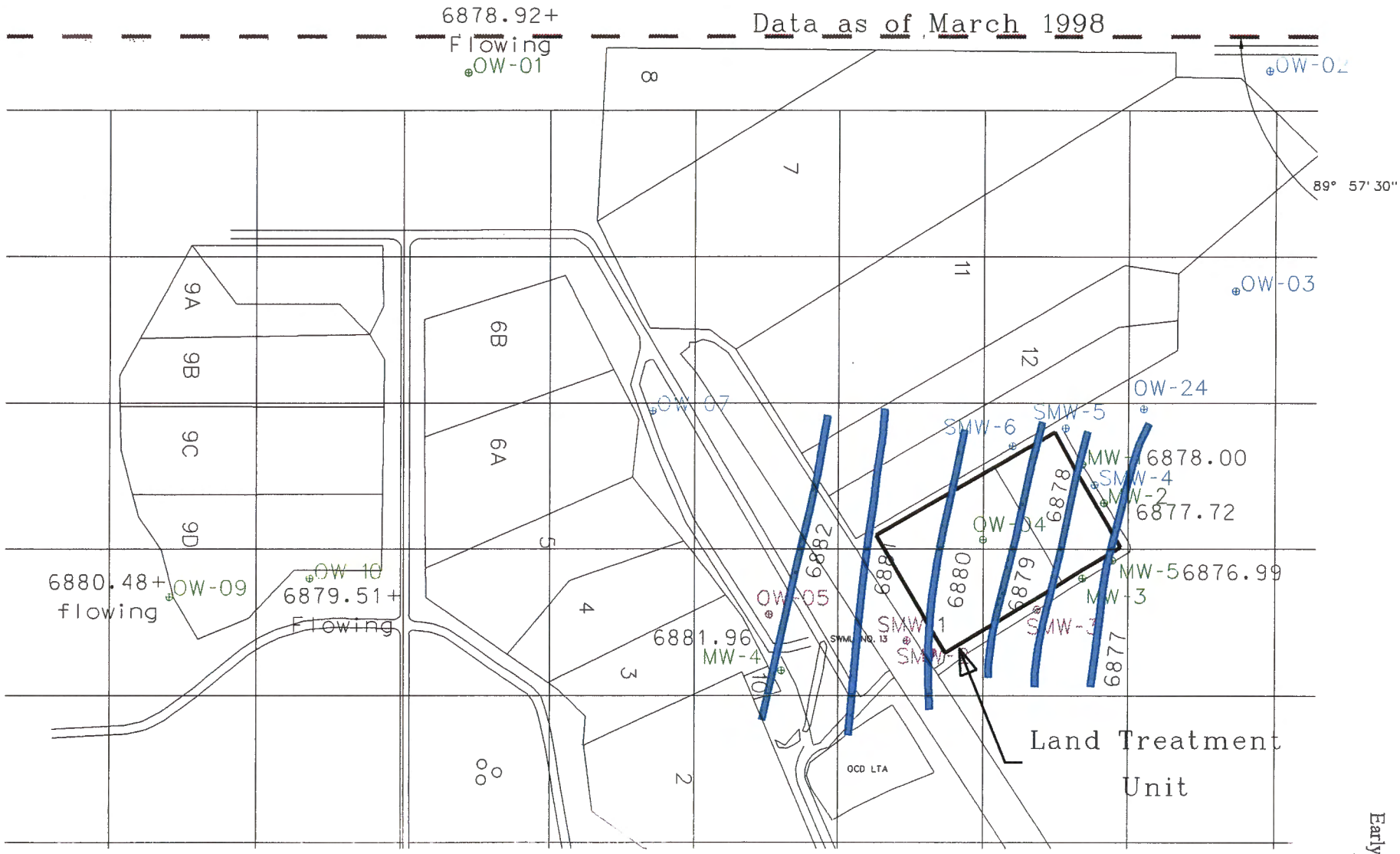


Figure 1-2. Sonsela Potentiometric Surface

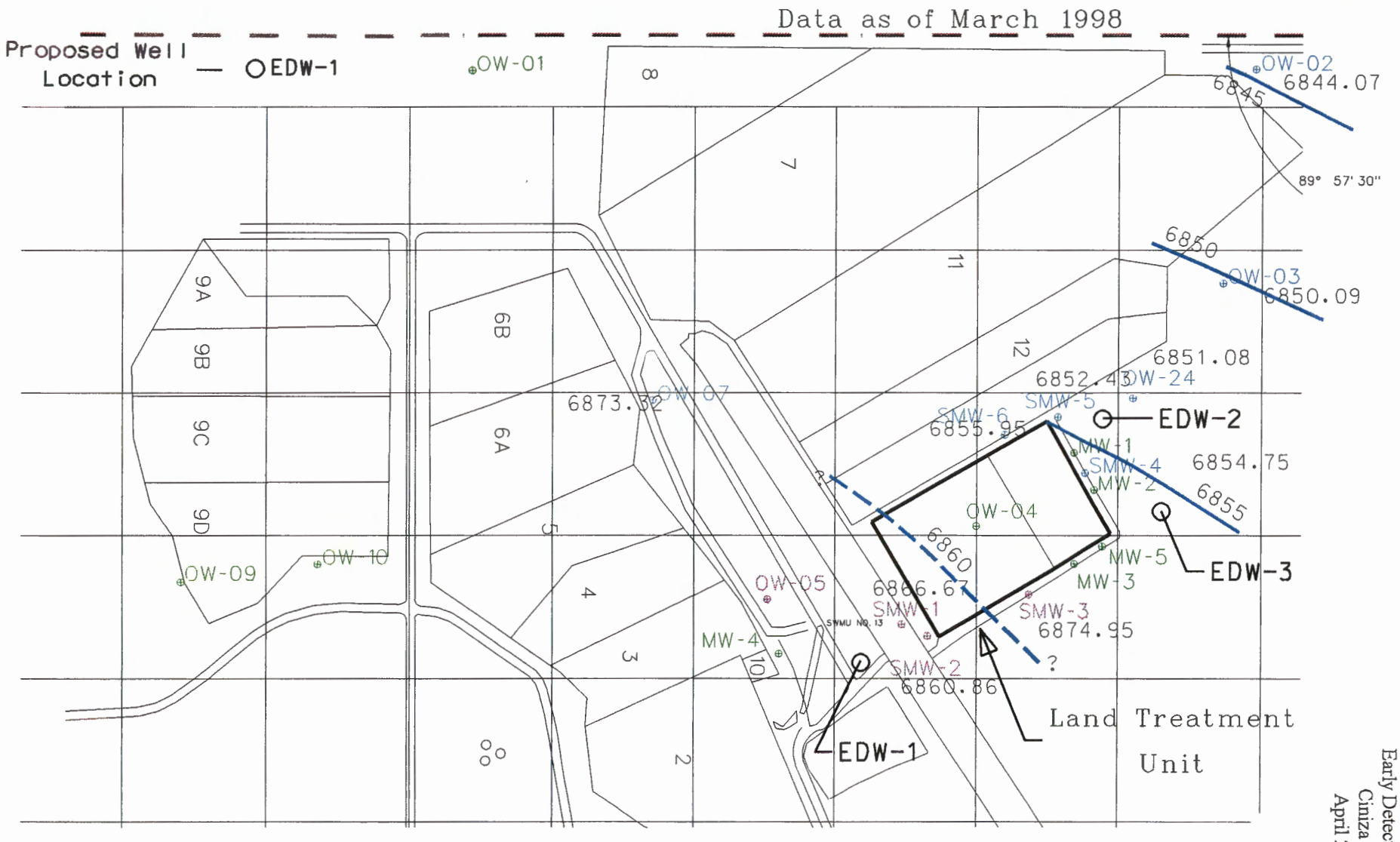
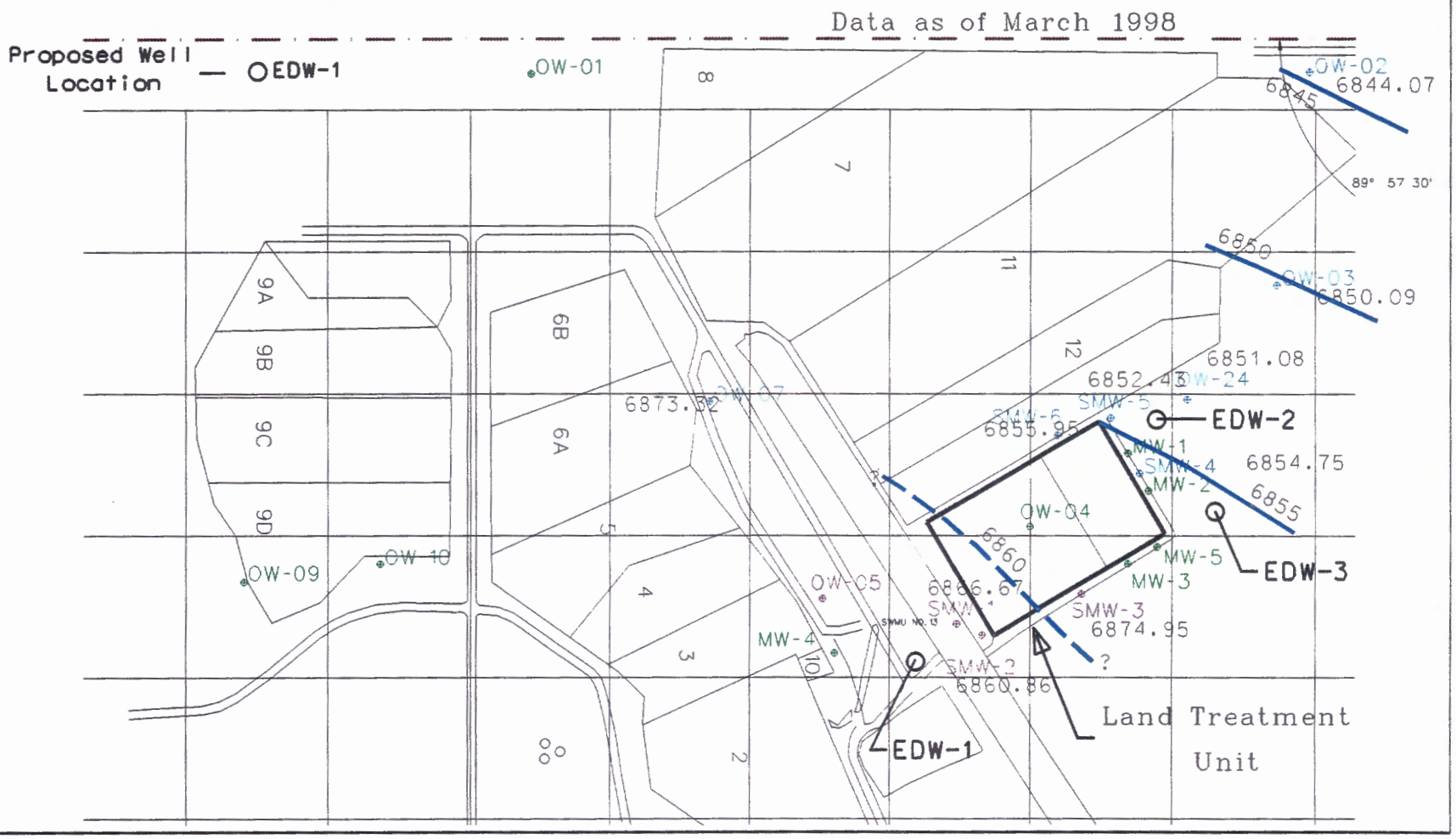


Figure 2-1. Monitoring Well Locations (Chinle Slope Wash Potentiometric Surface)

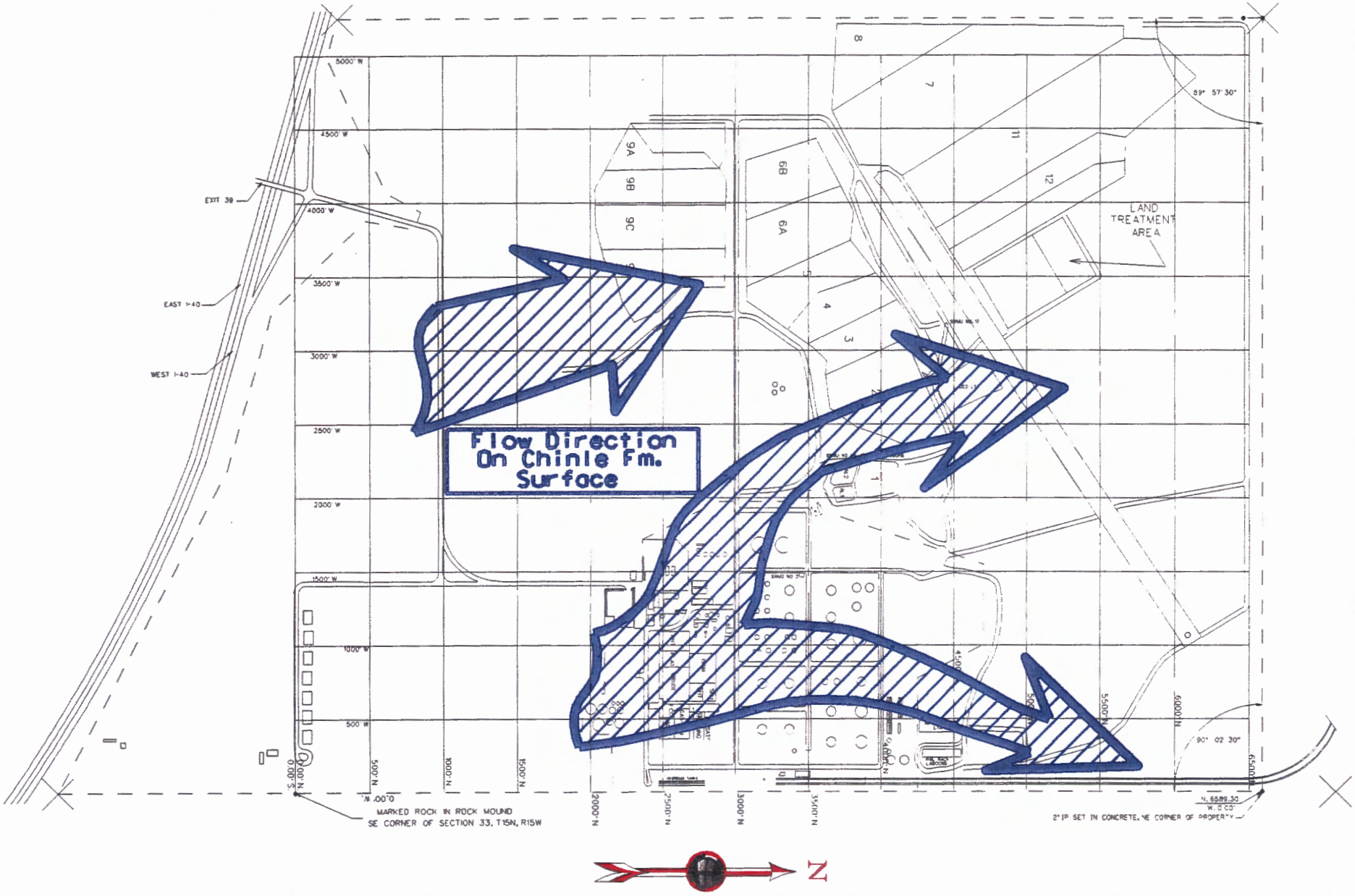
CINIZA REFINERY

Alluvial Wash Piezometric Surface At the LTU- Figure 2-1b



CINIZA REFINERY

Flow Direction on Top of The Chinle Formation



Attachment 1

Field Sampling Checklists

Checklist 1
Equipment and Supplies Checklist
General Sampling

Forms and General Equipment

_____ Field Logbook

_____ Chain-of-Custody/Request for Analysis

_____ First-aid kit

Sample Containers - Based on Specific Procedures

_____ Narrow-mouth amber glass bottles with Teflon®-lined caps (0.5, 1.0, and 2.0 L)

_____ Wide-mouth polyethylene bottles (0.5, 1.0, and 2.0 L)

_____ 250-mL sterile bottle

_____ Glass vials with Teflon®-lined septa (40-mL)

_____ New or cleaned polyethylene narrow-mouth bottles (1.0-L and 500-, 125-, and 60-mL)

Sampling Materials

_____ Ballpoint pen (permanent blue or black ink)

_____ Felt-tip marker pen (permanent blue or black ink)

_____ Disposable surgical gloves (latex, PVC, other suitable plastic, or rubber)

_____ Pipette with disposable tips

_____ NaOH pellets

_____ Kimwipes

_____ Ascorbic acid crystals

_____ Crystalline $Na_2S_2O_3$

_____ Methanol and deionized water in Teflon® wash bottles

_____ Concentrated HNO_3, H_2SO_4, and HCl (5-mL "Toss-It" ampules)

_____ Field test kit for sulfides, when required by analytical personnel

_____ Field test kit for chlorine, when required by analytical personnel

_____ Clipboards (optional)

_____ Deionized water

_____ Paper towels

_____ Stop watch

_____ pH meter

Checklist 1 (Continued)
Equipment and Supplies Checklist
General Sampling

Shipping Material for Analytical Facilities

_____ Thermometer

_____ Insulated coolers

_____ Blue ice

_____ Sample labels

_____ Vermiculite for packaging of samples

_____ Ziplock bags

_____ Integrity seals

_____ Heavy-duty poly bags and ties

_____ Plastic trash can liners

_____ Strapping tape

_____ Other equipment specified in specific procedures

Checklist 2
Field Equipment Checklist
Soil Sampling

	Item		Remarks
_____	PID meter (optional)	_____	Calibrated
_____	Site map with sample locations		
_____	Sample bottles		
_____	Ice chests		
_____	Trip blanks		
_____	Isopropanol		
_____	Deionized water		
_____	Squeeze bottles		
_____	Personal protective equipment		
_____	Chain-of-custody and sample record forms		
_____	Plastic bags (to provide clean surfaces)		
_____	Disposable gloves		
_____	Paper towels		
_____	Tape (for labels and dispenser)		
_____	Sharpie, pens, pencils		
_____	Blue ice or ice		
_____	Zip-lock bags, 1 gallon		
_____	Tape measure		

Checklist 3
Field Equipment Checklist
Groundwater Sampling

	Item	Remarks
_____	PPE	
_____	Sample containers and preservatives	
_____	Spatula	
_____	pH meter	
_____	Storage containers for waste decontamination rinsate (if needed)	
_____	Kimwipes	
_____	Parafilm	
_____	Insulated coolers	
_____	Blue ice	
_____	Vermiculite for packaging of samples	
_____	Plastic sheet	
_____	Filtering apparatus (if needed)	
_____	Camera and film (if needed)	
_____	Field logbook	
_____	Chain-of-Custody/Request for Analysis forms	
_____	Integrity seals	
_____	Sample labels	
_____	Sample analysis request sheet	
_____	Any additional equipment and supplies listed in associated procedures	

Attachment 2

Components of an Adequate Laboratory Quality Assurance/Quality Control Plan

Components of an Adequate Laboratory Quality Assurance/Quality Control Plan

New Mexico Hazardous and Radioactive Materials Bureau
Technical Support Group
(505) 827-4300

1. All constituents identified above the method detection limit (MDL) must be reported.

   The MDL is defined as the estimated concentration at which the signal generated by a known constituent is three standard deviations above the signal generated by a blank, and represents the 99 percent confidence level that the constituent does exist in the sample.

2. The "tune" of the gas chromatometer/mass spectrometer (GC/MS) for volatile organic constituents must be checked and adjusted (if necessary) each 12-hour shift by purging 50 mg of a 4-bromofluorobenzene (BFB) standard. The resultant mass spectra must meet the criteria given in Table 1 before sample analysis proceeds.

3. The "tune" of the GC/MS for semivolatile organic constituents must be checked and adjusted (if necessary) each 12-hour shift by injecting 50 mg of a Decafluorotriphenylphosphine (DFTPP) standard. The resultant mass spectra must meet the criteria given in Table 2 before analysis proceeds.

4. For every 20 samples, perform and report:

   a. Duplicate spike for organics
   b. Duplicate sample analysis for inorganics
   c. Reagent blank, results provided for organic work
   d. Surrogate and spike recoveries (see item 10)
   e. One check sample at or near the Practical Quantitation Limit for a subset of the parameters

5. Analytical results must not be "blank corrected."

6. Any deviation from EPA-approved methodology must have a written Standard Operating Procedure and NMED approval.

7. Detection limits must be generally in line with those listed in Appendix IX of 264.

8. The laboratory must document:

   a. That all samples were extracted, distilled, digested, or prepared (if appropriate) and analyzed within specified holding times.

   b. That if a sample for volatile analysis is received with headspace, this is reported.

   c. The date of sample receipt, extraction and analysis for each sample.

   d. Any problems or anomalies with the analysis should be documented.

e. That all solids were analyzed dry or that the reported results are corrected to reflect dry weight equivalence.

9. The name and signature of the lab manager must appear on each report.

10. The reported surrogate and spike recoveries must fall within: 1) the historical (statistically based) acceptance limits, generated at the laboratory or, 2) the limits tabulated by the appropriate method from the current edition of SW-846, whichever limit is narrower. The actual historical recoveries must be submitted to HRMB with the analysis.

Table 1. BFB Key Ions and Abundance Criteria.

Mass	Ion Abundance Criteria
50	15.0 - 40.0 percent of the base peak
75	30.0 - 60.0 percent of the base peak
95	base peak, 100 percent relative abundance
96	5.0 - 9.0 percent of the base peak
173	less than 2.0 percent of mass 174
174	greater than 50.0 percent of the base peak
175	5.0 - 9.0 percent of mass 174
176	greater than 95.0 percent but less than 101.0 percent of mass 174
177	5.0 - 9.0 percent of mass 176

Table 2. DFTBB Key Ions and Abundance Criteria

Mass	Ion Abundance Criteria
51	30.0 - 60.0 percent of mass 198
68	less than 2.0 percent of mass 69
70	less than 2.0 percent of mass 69
127	40.0 - 60.0 percent of mass 198
197	less than 1.0 percent of mass 198
198	base peak, 100 percent relative abundance
199	5.0 - 9.0 percent of mass 198
275	10.0 - 30.0 percent of mass 198
365	greater than 1.00 percent of mass 198
441	present but less than mass 443
442	greater than 40.0 percent of mass 198
443	17.0 - 23.0 percent of mass 442

APPENDIX F

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APPENDIX G

Well Construction Logs

MONITORING WELL MW-1

SURFACE ELEVATION: 6876 FEET
(Unsurveyed)

DEPTH IN FEET	LABORATORY TEST DATA: TESTS REPORTED ELSEWHERE	ATTERBERG LIMITS: LIQUID LIMIT (%)	ATTERBERG LIMITS: PLASTICITY INDEX (%)	STRENGTH TEST DATA: TYPE OF TEST	STRENGTH TEST DATA: NORMAL OR CONFINING PRESSURE (PSF)	STRENGTH TEST DATA: SHEAR STRENGTH (PSF)	STRENGTH TEST DATA: DEVIATOR STRESS (PSF)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	BLOWS/FT. SAMPLES
0										
10										
20										
30										
40										
50										
60										
70										
80										
90										
100										
110										
120										
130										
140										
150										
160										

SYMBOLS	DESCRIPTION
CL	REDDISH-BROWN SILTY CLAY, TRACE OF MEDIUM TO COARSE SAND AS BLEBS AND THIN INTERBEDS
▼	WATER LEVEL 14.1 FEET B.G. 10/18/81
SC	PINKISH-PURPLE, SLIGHTLY SANDY (FINE) CLAY
SH	VARIEGATED SILTY SHALE, REDDISH BROWN GRADING TO GREEN AND LIGHT PURPLE
CL	REDDISH-BROWN SILTY CLAY, FIRM
LS/SH	VARIEGATED LIGHT GREEN AND DARK RED LIMESTONE INTERBEDDED WITH SHALE
SH	REDDISH-ORANGE SHALE
LS	LIGHT-GREEN LIMESTONE DENSE, HARD
SS	LIGHT GREENISH-GRAY, MEDIUM TO FINE, LOOSELY CEMENTED SANDSTONE INTERBEDDED WITH LIGHT GRAY, LOOSE CLAY
SH	REDDISH-PURPLE SHALE

BORING COMPLETED AT 130.4 FEET ON 10/14/81.

SCREENED INTERVAL

FIGURE 30.2-1

MONITORING WELL MW-2

SURFACE ELEVATION: 6877 FEET
(Unsurveyed)

LABORATORY TEST DATA

DEPTH IN FEET	TESTS REPORTED ELSEWHERE	ATTERBERG LIMITS: LIQUID LIMIT (%)	ATTERBERG LIMITS: PLASTICITY INDEX (%)	STRENGTH TEST DATA: TYPE OF TEST	STRENGTH TEST DATA: NORMAL OR CONFINING PRESSURE (PSF)	STRENGTH TEST DATA: SHEAR STRENGTH (PSF)	STRENGTH TEST DATA: DEVIATOR STRESS (PSF)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)
0									
10									
20									
30									
40									
50									
60									
70									
80									
90									
100									
110									
120									
130									
140									
150									
160									

BLOWS/FT.

SAMPLES

SYMBOLS	DESCRIPTION
CL	REDDISH-BROWN SILTY CLAY, TRACE MEDIUM TO COARSE SAND AS LOOSE TO FIRM BLEBS
▼	WATER LEVEL 9.1 FEET B.G. 10/18/81
SC	PINKISH-PURPLE, SLIGHTLY SANDY (FINE) CLAY
SH	VARIEGATED REDDISH-BROWN, GREEN AND LIGHT PURPLE, SANDY TO SILTY SHALE
CL	REDDISH-BROWN SILTY CLAY, FIRM
LS/SH	LIGHT GREEN TO DARK RED LIMESTONE INTERBEDDED WITH SHALE
LS	LIGHT GREEN LIMESTONE, HARD
SS	WHITE TO LIGHT-GRAY, FINE TO MEDIUM SAND; SOME CLAY; GRADES GREENISH GRAY TO PINK, COARSE TO MEDIUM SAND
SH	DEEP PURPLE SHALE, FIRM

BORING COMPLETED AT 138.0 FEET ON 10/15/81.

SCREENED INTERVAL

FIGURE 30.2-2

MONITORING WELL MW-4

SURFACE ELEVATION: 6883 FEET
(Unsurveyed)

LABORATORY TEST DATA

DEPTH IN FEET	TESTS REPORTED ELSEWHERE	ATTERBERG LIMITS: LIQUID LIMIT (%)	ATTERBERG LIMITS: PLASTICITY INDEX (%)	STRENGTH TEST DATA: TYPE OF TEST	STRENGTH TEST DATA: NORMAL OR CONFINING PRESSURE (PSF)	STRENGTH TEST DATA: SHEAR STRENGTH (PSF)	STRENGTH TEST DATA: DEVIATOR STRESS (PSF)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	BLOWS/FT. SAMPLES
0										
10										
20										
30										
40										
50										
60										
70										
80										
90										
100										
110										
120										
130										
140										
150										
160										

SYMBOLS	DESCRIPTION
CL	REDDISH-BROWN SILTY CLAY, LOOSE
CL	REDDISH-BROWN CLAY, FIRM WATER LEVEL 8.7 FEET B.G. 10/18/81 GRADES SILTY AND SANDY (COARSE) 20-25 FEET
SH	VARIEGATED REDDISH-BROWN, GREEN AND LIGHT PURPLE SILTY SHALE GRADES REDDISH-BROWN TO RED-ORANGE, 65-70 FEET
SH/LS	VARIEGATED LIGHT GREEN TO DARK RED SHALE AND THIN LIMESTONE BED
SH	REDDISH-ORANGE, SLIGHTLY SANDY SHALE
SS	WHITE TO LIGHT GRAY, CLAYEY SANDSTONE
SH	PURPLE SANDY SHALE
SS	WHITE TO LIGHT GRAY SANDSTONE, HARD
SH	PURPLE SHALE WITH THIN LENSES OF CLAYEY SAND

BORING COMPLETED AT 120.0 FEET ON 10/16/81.

SCREENED INTERVAL

FIGURE 30.2-4

GCL

WELL LOGGING FO

Client Giant Well Number MW-5

___1/4___1/4___1/4___1/4 S___T___R___ State New Mexico

County _____ Contractor Stewart Bros.

Spud Date 7/23/86 Completion Date 7/28/86

Logs Run Lithology Logged By Selke

Elevation _____ Spud In (Fm.) Chinle Formation

Remarks Drilled w/failing F-10 rig - hollow stem auger to 65' and rotary core to 135'. Rig and all tools steam cleaned prior to drilling split spoon and cutting samples w/auger - core w/rotary

DEPTH	LITHO.	RECOV.	RUN	FROM	TO	SAMPLE DEPTH	REMARKS
0			1	0	3.5	0.0 3.5	0-30.0 Reddish-brown, silty clay w/minor sandy lenses.
5			2	3.5	8.5	8.5-10.0 38 blows	
10			3	8.5	13.5	13.5	
15			4	13.5	18.5	18.5-20 90 blows	
20			5	18.5	23.5	23.5	
25			6	23.5	28.5	28.5-30.0 26 blows	
			7	28.5	30.0	30.0-31.5	
30			8	30.0	31.5	31.5-33.0	30.0-35.0 fn-med grained grading to slightly clayey silt to fn sand w/minor clay lenses
			9	31.5	33.0	33.0-34.5	
35			10	33.0	34.5	34.5-36.0	
			11	34.5	36.0	36.0-37.5	35.0-50 Reddish-brown clay w/locally minor silt and silty clay
40			12	36.0	37.5	37.5-39.0	
			13	37.5	40.0	40.0-41.5	
			14	40.0	42.5	42.5-44.0	
45							

GCL

WELL LOGGING L. A

Client Giant Well Number MW-5

1/4 1/4 1/4 1/4 S T R State New Mexico

County Contractor Stewart Bros.

Spud Date 7/23/86 Completion Date 7/29/86

Logs Run Lithology Logged By Selke

Elevation Spud In (Fm.) Chinle Formation

Remarks

DEPTH	LITHO.	RECOV.	RUN	FROM	TO	SAMPLE DEPTH	REMARKS
45							
			15	42.5	45.0	45.0-46.5	
			16	45.0	47.5	47.5-49.8 57 blows	
50			17	47.5	50.0	50.0-51.5 43 blows	
			18	50.0	52.5	52.5-54.0 53 blows	50-53 Reddish-brown clay w/minor sand/gravel lenses
			19	52.5	55.0	55.0-56.5 54 blows	
55			20	55.0	57.5	57.5-59.0 100 blows	53-97 Reddish to purple shale and/or clay w/greenish colored blebs
60			21	57.5	60.0	60.0-61.5	
			22	60.0	68.5		
65			23	68.5	77	68.5-77	
70							
75							
80			24	77	87	77-87	
85							
90							

GCL

WELL LOGGING R.

Client Giant Well Number MW-5

___1/4___1/4___1/4___1/4 S___T___R___ State New Mexico

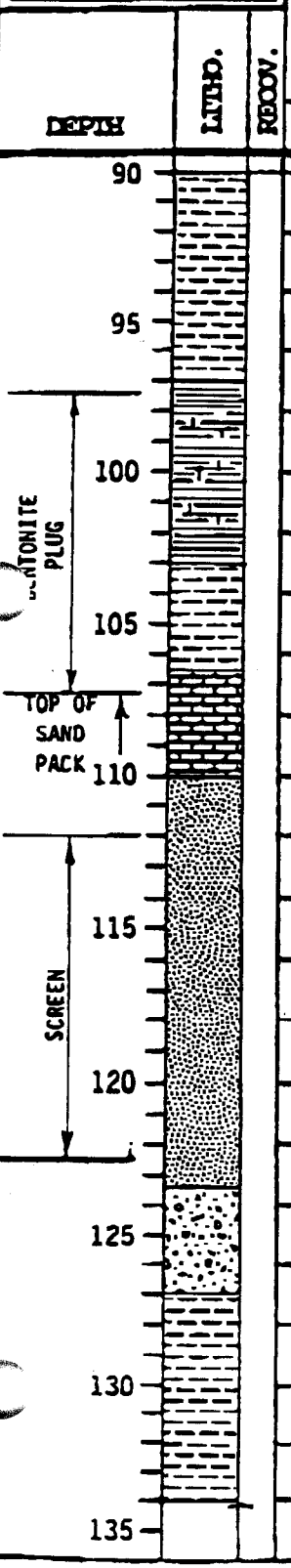
County _____ Contractor Stewart Bros

Spud Date 7/23/86 Completion Date 7/29/86

Logs Run Lithology Logged By Selke

Elevation 6861.8 Spud In (Fm.) Chinle Formation

Remarks TOC

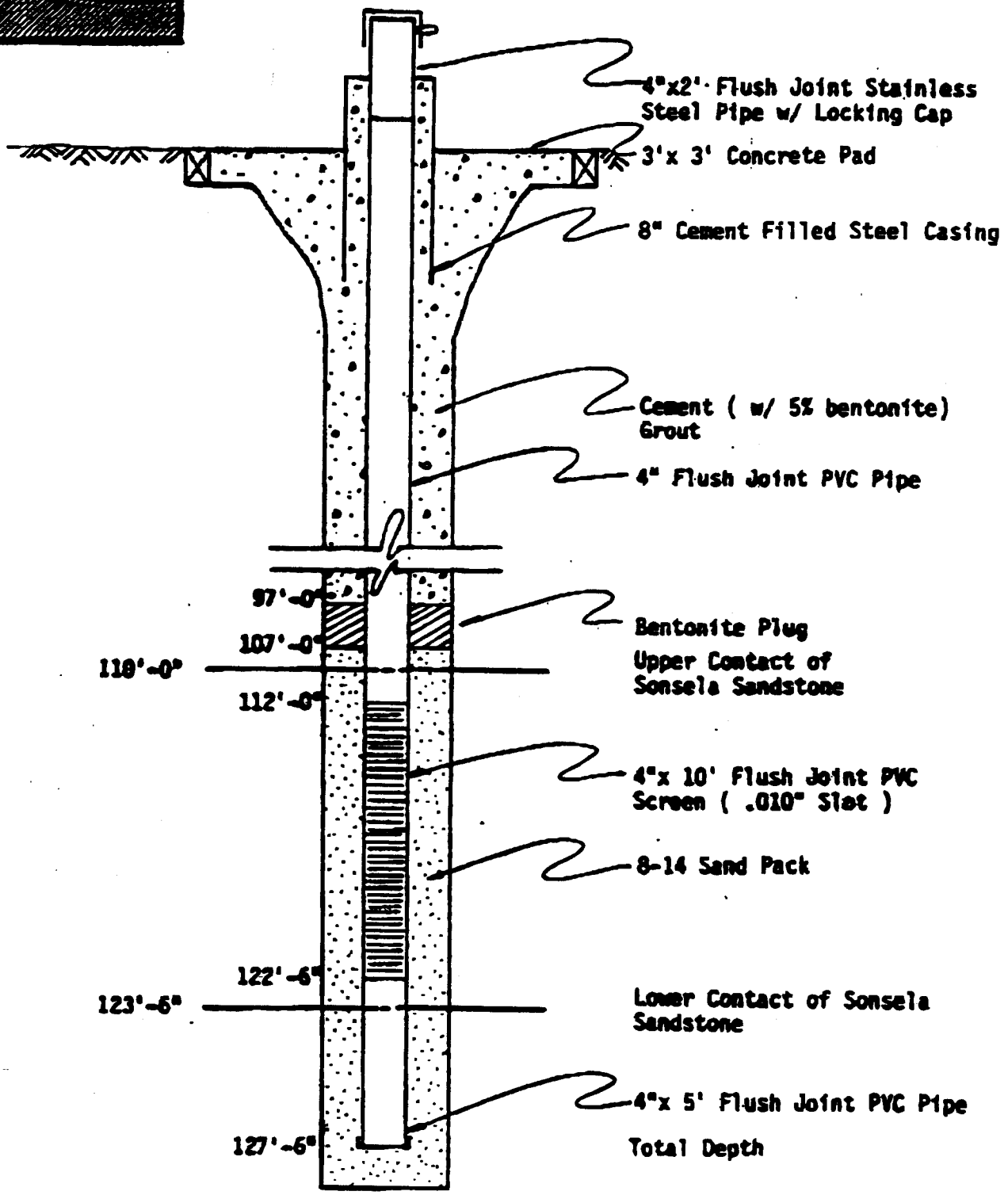


RUN	FROM	TO	SAMPLE DEPTH	REMARKS
25	97	107	97-107	97-103 Reddish shale w/limestone stringers
				103-106.5 red shale/clay
25	107	117	107-117	106.5-110 reddish colored limestone w/greenish white blebs
				110-123.5 grayish to reddish (?) colored, fine to medium grained, subrounded to rounded, moderately well sorted, moderately well indurated, quartz sandstone. Bedding planes dipping approx. 15°.
27	117	125	117.0-125.0	
				123.5-127 Basal conglomerate is similar colored to above sandstone but less consolidated than sandstone.
28	125	134	125.0-134	
				127-134 dk red clay/shale

GCL

COMPLETION DIAGRAM

MW-5



MAJOR DIVISIONS			GRAPHIC SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL SAND-CLAY MIXTURES
MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	SAND AND SANDY SOILS	CLEAN SAND (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND-SILT MIXTURES
				SC	CLAYEY SANDS, SAND-CLAY MIXTURES
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

UNIFIED SOIL CLASSIFICATION SYSTEM

FIGURE 30.2-5

APPENDIX H

Financial Test and Corporate Guarantee (Closure and Post-Closure)

GIANT
INDUSTRIES, INC.

23733 NORTH
SCOTTSDALE ROAD
SCOTTSDALE
ARIZONA 85255

P. O. BOX 12999
SCOTTSDALE
ARIZONA 85267

PHONE
480-585-8888
INTERNET
WWW.GIANT.COM

March 22, 2000

Mr. James Bearzi
New Mexico Environment Department
Hazardous & Radioactive Material Bureau
P.O. Box 26110
Santa Fe, New Mexico 87502

Re: Financial Assurance for Giant Industries Arizona, Inc. and San Juan Refining Company

Dear Mr. Chacone:

I am the Financial Officer of Giant Industries Inc. This letter is in support of this firm's use of the financial test to demonstrate financial assurance for closure and post-closure costs, as specified in subpart H of 40 CFR parts 264 and 265.

1. This firm is the owner or operator of the following facilities for which financial assurance for closure care is demonstrated through the financial test specified in subpart H of 40 CFR parts 264 and 265. The current closure and /or post -closure cost estimates covered by the test are shown for each facility:

Giant Refining Company - Ciniza Refinery
EPA ID Number: NMD 000333211
Exit 39, East Interstate Highway 40
Gallup, New Mexico 87301

Closure cost estimate -	$
Post-closure cost estimate -	$
Total closure/post-closure cost estimate-	$371,756

San Juan Refining Company - Bloomfield Refinery
EPA ID Number: NMD 089416416

#50 County Road 4990
Bloomfield, New Mexico 87413
Closure cost estimate - $ 24,954
Post-closure cost estimate - $
Total closure/post-closure cost estimate- $ 24,954

2. This firm guarantees, through the guarantee specified in subpart H of 40 CFR parts 264 and 265, the closure or post-closure care of the following facility owned or operated by the guaranteed party. The current cost estimates for the closure or post-closure so guaranteed are shown for each facility:

Giant Refining Company - Ciniza Refinery
EPA ID Number: NMD 000333211
Exit 39, East Interstate Highway 40
Gallup, New Mexico 87301
Closure cost estimate - $371,756

San Juan Refining Company - Bloomfield Refinery
EPA ID Number: NMD 089416416
#50 County Road 4990
Bloomfield, New Mexico 87413
Closure cost estimate - $24,954

The firm identified above (Giant Industries Inc.) is the direct or higher-tier parent corporation of the owner or operator (San Juan Refining Company and Giant Refining Company).

3. In States where EPA is not administering the financial requirements of subpart H of 40 CFR parts 264 or 265, this firm, as owner or operator or guarantor, is demonstrating financial assurance for the closure or post-closure care of the following facilities through the use of a test equivalent or substantially equivalent to the financial test specified in subpart H of 40 CFR parts 264 and 265. The current closure and/or post-closure cost estimates covered by such a test are shown for this facility:

None

4. This firm is the owner or operator of the following hazardous waste management facilities for which financial assurance for closure or, if a disposal facility, post-closure care is not demonstrated either to EPA or a State through the financial test or any other financial assurance mechanism specified in subpart H of 40 CFR parts 264 and 265 or equivalent or substantially equivalent State mechanisms. The current closure and/or post-closure cost estimates not covered by such financial assurance are shown for each facility:

None

5. This firm is the owner or operator of the following UIC facilities for which financial assurance for plugging and abandonment is required under part 144. The current closure cost estimates as required by 40 CFR 144.62 are shown for each facility:

None

The firm is required to file a Form 10K with the Securities and Exchange Commission (SEC) for the latest fiscal year.

The fiscal year of this firm ends on December 31. The figures of the following items marked with an asterisk are derived from this firm's independently audited, year-end financial statements for the latest completed fiscal year, ended December 31, 1999.

1.	Sum of current closure and post-closure cost estimate:	$396,710
*2.	Total liabilities:	$414,336,000
*3.	Tangible net worth:	$132,462,000
*4.	Net worth:	$132,462,000
*5.	Current assets:	$171,983,000
*6.	Current liabilities:	$122,587,000
7.	Net working capital (line 5 minus line 6)	$ 49,396,000
*8.	The sum of net income plus depreciation, depletion, and amortization:	$41,907,000
*9.	Total assets in U.S. (required only if less than 90% of firm's assets are located in the U.S.):	Not required
10.	Is line 3 at least $10 million?	Yes
11.	Is line 3 at least 6 times line 1?	Yes
12.	Is line 7 at least 6 times line 1?	Yes

*13.	Are at least 90% of the firm's assets located in the U.S.? If not, complete line 14.	Yes
14.	Is line 9 at least 6 times line 1?	Not required
15.	Is line 2 divided by line 4 less than 2.0?	No
16.	Is line 8 divided by line 2 greater than 0.1?	Yes
17.	Is line 5 divided by line 6 greater than 1.5?	No

I hereby certify that the wording of this letter is substantially identical to the wording specified in 40 CFR 264.151 (f) as such regulations were constituted on the date shown immediately below.

Mark B. Cox
Financial Officer

4/15/00
Date

cc: Sarah Allen

CORPORATE GUARANTEE FOR CLOSURE OR POST-CLOSURE CARE

Guarantee made this January 1, 1997 by Giant Industries, Inc., a business corporation organized under the laws of the State of Delaware, herein referred to as guarantor. This guarantee is made on behalf of the owner or operator of:

Giant Industries Arizona, Inc. - Ciniza Refinery
Exit 39, East Interstate Highway 40
Gallup, New Mexico 87301

Giant Industries Arizona, Inc. - Bloomfield Refinery
#50 County Road 4990
Bloomfield, New Mexico 87413

which is our subsidiary to the New Mexico Environment Department.

RECITALS

1. Guarantor meets or exceeds the financial test criteria and agrees to comply with the reporting requirements for guarantors as specified in 40 CFR 264.143(f), 264.145(f), 265.143(e) , and 265.145(e).

2. Giant Industries Arizona, Inc. owns or operates the following hazardous waste management facilities covered by this guarantee:

   Giant Industries Arizona, Inc. - Ciniza Refinery
   EPA ID Number: NMD 000333211
   Exit 39, East Interstate Highway 40
   Gallup, New Mexico 87301
   Guarantee is for both closure and post-closure

   Giant Industries Arizona, Inc. - Bloomfield Refinery
   EPA ID Number: NMD 089416416
   #50 County Road 4990
   Bloomfield, New Mexico 87413
   Guarantee is for both closure and post-closure

3. "Closure plans" and "post-closure plans" as used below refer to the plans maintained as required by subpart G of 40 CFR parts 264 and 265 for the closure and post-closure care of facilities as identified above.

4. For value received from Giant Industries Arizona, Inc., guarantor guarantees to EPA that in the event that Giant Industries Arizona, Inc. fails to perform closure and post-closure care of the above facilities in accordance with the closure or post-closure

plans and other permit or interim status requirements whenever required to do so, the guarantor shall do so or establish a trust fund as specified in subpart H of 40 CFR part 264 or 265, as applicable, in the name of Giant Industries Arizona, Inc. in the amount of the current closure or post-closure cost estimates as specified in subpart H of 40 CFR parts 264 and 265

5. Guarantor agrees that if, at the end of any fiscal year before termination of this guarantee, the guarantor fails to meet the financial test criteria, guarantor shall send within 90 days, by certified mail, notice to the EPA Regional Administrator(s) for the Region(s) in which the facilities are located and to Giant Industries Arizona, Inc. that he intends to provide alternate financial assurance as specified in subpart H of 40 CFR part 264 or 265 , as applicable, in the name of Giant Industries Arizona, Inc. Within 120 days after the end of such fiscal year, the guarantor shall establish such financial assurance unless Giant Industries Arizona, Inc. has done so.

6. The guarantor agrees to notify the EPA Regional Administrator by certified mail, of a voluntary or involuntary proceeding under Title 11 (Bankruptcy), U.S. Code, naming guarantor as debtor, within 10 days after commencement of the proceeding.

7. Guarantor agrees that within 30 days after being notified by an EPA Regional Administrator of a determination that guarantor no longer meets the financial test criteria or that he is disallowed from continuing as a guarantor of closure or post-closure care, he shall establish alternate financial assurance as specified in subpart H of 40 CFR part 264 or 265 , as applicable, in the name of Giant Industries Arizona, Inc. unless Giant Industries Arizona, Inc. has done so.

8. Guarantor agrees to remain bound under this guarantee notwithstanding any or all of the following: amendment or modification of the closure or post-closure plan, amendment or modification of the permit, the extension or reduction of the time of performance of closure or post- closure, or any other modification or alteration of an obligation of the Giant Industries Arizona, Inc. pursuant to 40 CFR part 264 or 265.

9. Guarantor agrees to remain bound under this guarantee for as long as Giant Industries Arizona, Inc. must comply with the applicable financial assurance requirements of subpart H of 40 CFR parts 264 and 265 for the above-listed facilities, except as provided in paragraph 10 of this agreement.

10. Guarantor may terminate this guarantee by sending notice by certified mail to the EPA Regional Administrator(s) for the Region(s) in which the facility(ies) is(are) located and to Giant Industries Arizona, Inc., provided that this guarantee may not be terminated unless and until Giant Industries Arizona, Inc. obtains, and the EPA Regional Administrator(s) approve(s), alternate closure and/or post-closure care coverage complying with 40 CFR 264.143, 264.145, 265.143 , and/or 265.145.

11. Guarantor agrees that if Giant Industries Arizona, Inc. fails to provide alternate financial assurance as specified in subpart H of 40 CFR part 264 or 265, as applicable, and obtain written approval of such assurance from the EPA Regional Administrator(s) within 90 days after a notice of cancellation by the guarantor is received by an EPA Regional Administrator from guarantor, guarantor shall provide such alternate financial assurance in the name of Giant Industries Arizona, Inc.
12. Guarantor expressly waives notice of acceptance of this guarantee by the EPA or by Giant Industries Arizona, Inc. Guarantor also expressly waives notice of amendments or modifications of the closure and/or post-closure plan and of amendments or modifications of the facility permit(s).

I hereby certify that the wording of this guarantee is identical to the wording specified in 40 CFR 264.151(h) as such regulations were constituted on the date first above written.
Effective date:

Giant Industries, Inc.

Mark Cox
Treasurer

Signature of witness or notary:

Acknowledged before me this 22nd day of July, 1997.

Joan M. Moore

OFFICIAL SEAL
JOAN M. MOORE
Notary Public - State of Arizona
MARICOPA COUNTY
My Comm. Expires Aug. 11, 2000

HRMB LIBRARY COPY 3/3

RCRA
PART A AND PART B
POST-CLOSURE
PERMIT APPLICATION

LAND TREATMENT UNIT
GIANT REFINING COMPANY
CINIZA REFINERY

VOLUME III
APPENDICES I-1 THROUGH I-13

SUBMITTED TO: NEW MEXICO ENVIRONMENT DEPARTMENT
HAZARDOUS AND RADIOACTIVE MATERIALS BUREAU
P.O. BOX 26110
SANTA FE, NEW MEXICO 87502

DATE SUBMITTED: APRIL 24, 1998

PREPARED BY: CINIZA REFINERY
ROUTE 3, BOX 7
GALLUP, NEW MEXICO 87301

APPENDICES

Appendix

I-1 Aeration Basin - SWMU No. 1 Summary

I-2 Evaporation Ponds - SWMU No. 2 Summary

I-3 Empty Container Storage Area - SWMU No. 3 Summary

I-4 Old Burn Pit - SWMU No. 4 Summary

I-5 Landfill Areas - SWMU No. 5 Closure Certification

I-6 Tank Farm—Leaded Gasoline Tanks - SWMU No. 6 Summary

I-7 Fire Training Area - SWMU No. 7 Summary

I-8 Railroad Rack Lagoon - SWMU No. 8 Summary

I-9 Drainage Ditch and the Inactive Land Farm - SWMU No. 9 and No. 14 Summary

I-10 Sludge Pits - SWMU No. 10 Summary

I-11 Secondary Oil Skimmer - SWMU No. 11 Summary

I-12 Contact Wastewater Collection System - SWMU No. 12 Summary

I-13 Drainage Ditch Between API Evaporation Ponds and Neutralization Tank Evaporation Ponds - SWMU No. 13 Summary

APPENDIX I-1

Aeration Basin - SWMU No. 1 Summary

SWMU # 1 Summary Report

Aeration Basins

Ciniza Refinery
McKinley County, New Mexico

Prepared for:

Ciniza Refinery
Giant Refining Company
Route 3, Box 7
Gallup, New Mexico 87301

Prepared by:

Practical Environmental Services, Inc.
1444 Wazee Street, Suite 225
Denver, Colorado 80202

Job No. 98-205-03

April 23, 1998

1.0 EXECUTIVE SUMMARY

Practical Environmental Services, Inc. (PES) has been retained by Giant-Ciniza Refinery (Ciniza) to perform a visual inspection, data evaluation, and status assessment for the aeration basins located within the Ciniza Refinery, in McKinley County, New Mexico.

The aeration basins site was identified as a Solid Waste Management Unit (SWMU), and designated as SWMU #1, during a RCRA Facility Investigation conducted at the refinery in the early 1990's. This investigation included soil sampling and analysis, determined that no significant impact had occurred, and recommended no further action (NFA).

In 1994, the Environmental Protection Agency Region VI Office (EPA) concurred in this finding, approved cessation of the investigative process, but requested ongoing soil monitoring. Monitoring samples were collected and analyzed in 1996, and the results confirmed that no significant impact has occurred.

This summary report for SWMU #1 has been prepared in conjunction with submittal of a Resource Conservation and Recovery Act (RCRA) Part B permit application covering post closure care of the Ciniza Refinery Land Treatment Unit. All investigative activities for SWMU #1 have been completed. This assessment is summarized as follows.

- ⇒ The aeration basins continue in active service treating wastewater at the refinery and are functioning normally.
- ⇒ Containment berms and basin sidewalls have been inspected and are intact and stable.
- ⇒ Local soil underlying the basins predominantly consists of bentonitic clays and silts having a very low hydraulic conductivity.
- ⇒ Soil sampling and analysis was conducted during an initial site investigation and subsequent monitoring assessment. Trace organic contaminants were detected below corrective action levels. The site was recommended for NFA and approved by the EPA.
- ⇒ SWMU #1 has been characterized in accordance with current applicable state and federal regulations, and the available data indicate that no significant environmental impact or migration has occurred.

2.0 BACKGROUND

During 1987, a RCRA Facility Assessment was conducted at the Ciniza Refinery. This assessment identified various "units of concern" and recommended further evaluation. A RCRA Facility Investigation (RFI) was subsequently conducted and the aeration basins site was identified as SWMU #1.

Applied Earth Sciences (AES) investigated the aeration basins site during the early 1990s. Soil samples were collected and analyzed. No organic contaminants were detected in any sample. Trace metals were detected in all samples; of which, a few samples indicated levels slightly above ambient background concentration.

As a result of the investigation, AES recommended no further action for this SWMU. Results and recommendations were reported to the EPA in 1991. The EPA approved the NFA finding in 1994, with the added provision that soil monitoring be performed every five years.

3.0 SITE LOCATION AND DESCRIPTION

SWMU #1 is located within the Ciniza Refinery's property boundary. This refinery is located on the north side of Interstate 40, approximately 17 miles east of Gallup, New Mexico. Within the refinery, SWMU #1 is located west of the tank farm, northwest of the flare, and adjacent to the API separator. See Figure No. 1 for location details.

The aeration basins are a component of the refinery wastewater treatment system. Effluent water from the API separator is directed to an air stripper for removal of VOCs and then passed on to the aeration basins for oxygenation and biological stimulation prior to evaporation.

SWMU #1 consists of three man-made earthen basins connected in series. The first two basins are equipped with aeration pumps which are used to oxygenate the water. The last basin serves as a holding pond upstream of the evaporation ponds. The three basins are located adjacent to each other on a site measuring approximately 500 feet by 450 feet. Total hydraulic holding capacity is approximately 2 million gallons.

The aeration basins were constructed in 1987 and have been in continuous operation since that time.

4.0 SITE INSPECTION

During the week of March 23, 1998, an on-site inspection was performed. Photographs are included in the appendix to this report. Observations are noted as follows:

- The aeration basins were observed in active service treating effluent wastewater from the air strippers. Aeration pumps were observed running and the system was functioning normally.

- Berms and sidewalls were visually inspected on all three basins. All were found to be intact and stable. No erosion, damage, or sign of containment failure was observed. A dark mineral dust coating was observed around the interior perimeter of the basins.

- Native shrubs and grasses were observed growing around the perimeter of all basins. Downwind vegetation was also discolored by the dark mineral dust, but otherwise was not found to be distressed.

- Local soil in the vicinity of the aeration basins presented as bentonitic clays and silts. Similar soil strata from a neighboring SWMU exhibited a hydraulic conductivity of less than 10^{-7} cm/sec.

5.0 DATA REVIEW

Soil samples from around the perimeter of the aeration basin site were collected and analyzed during the initial site investigation and a subsequent monitoring assessment. Samples were collected at multiple depths and at both upgradient and downgradient locations. Several borings were angled to collect samples from beneath the basins.

In 1991, the initial site investigation collected samples from six locations and four depths ranging from 4 to 16 feet below ground surface. Analysis found no detection of VOCs or SVOCs in any sample. Trace metals were detected in all samples; of which, six samples indicated levels slightly above ambient background concentration.

In 1996, monitoring samples were collected and analyzed. Six locations were sampled at depths ranging from 4 to 20 feet below ground surface. Analysis again found no detection of VOCs and SVOCs in 25 of the samples. However, two samples collected adjacent to the inlet aeration basin at a depth of 4 feet detected trace quantities of BTEX; of which, xylenes at 2.2 mg/kg was the highest detection. Confirmatory samples were subsequently collected and analyzed. One resample showed non-detect and the other detected trace ethylbenzene at 0.61 mg/kg.

State of New Mexico corrective action levels for BTEX in soil is 50 mg/kg total and 10 mg/kg of benzene. Three of 53 samples indicated trace BTEX, the highest of which was less than 5 mg/kg total; well below the 50 mg/kg action level.

6.0 ASSESSMENT

Based on the site inspection and data review, the aeration basins site is assessed as follows.

- The aeration basins are in active service, functioning normally, and performing the necessary task of oxygenating wastewater and stimulating biological activity.

- The aeration basins are properly designed and located in an appropriate geologic setting in which the underlying bentonitic soil has a very low hydraulic conductivity which effectively serves as an aquiclude.

- Trace detection of BTEX constituents near the sidewalls of the inlet aeration basin is common and predictable for this service. The absence of BTEX at depth and at all other locations is confirmatory of the highly impermeable characteristic of the confining soil. This location and low level of detection are indicative of no significant impact or migration.

- Trace detection of metals at levels slightly above ambient background concentration is likely due to normal soil variation.

- The no further action finding that was recommended by AES and approved by the EPA is appropriate for this site.

- The next soil monitoring event is scheduled for 2001. If this sampling and analysis confirms previous findings, further monitoring is unnecessary and should be discontinued.

7.0 PROFESSIONAL ENGINEER'S CERTIFICATION

This summary report for SWMU #1 has been prepared under the direct supervision and control of a Registered Professional Engineer.

Client: Ciniza Refinery
Giant Refining Company
Route 3, Box 7
Gallup, New Mexico 87301

Job No.: 98-205-03

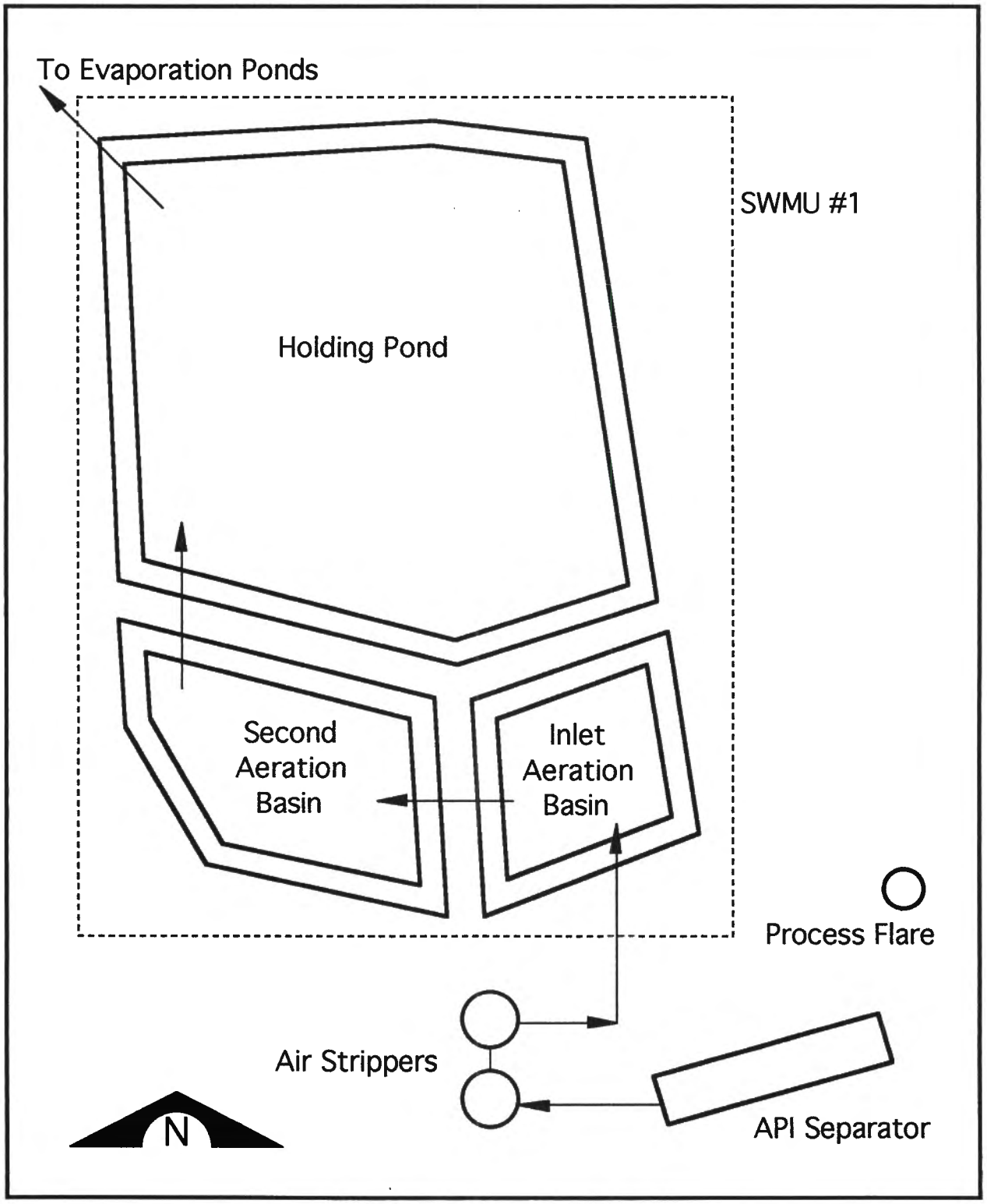
Date: April 23, 1998

Prepared and Certified by:

COLORADO REGISTERED
THOMAS D. ATWOOD
22866
PROFESSIONAL ENGINEER

Thomas D. Atwood, P.E.
Colorado Registration No. 22866

Figure No. 1
Aeration Basin Site



View of Aeration Basin

Close-up of Aeration Pumps

APPENDIX I-2

Evaporation Ponds - SWMU No. 2 Summary

SWMU #2 Summary Report

Evaporation Ponds
Ciniza Refinery
McKinley County, New Mexico

Prepared for:

Ciniza Refinery
Giant Refining Company
Route 3, Box 7
Gallup, New Mexico 87301

Prepared by:

Practical Environmental Services, Inc.
1444 Wazee Street, Suite 225
Denver, Colorado 80202

Job No. 98-205-03

April 23, 1998

1.0 EXECUTIVE SUMMARY

Practical Environmental Services, Inc. (PES) has been retained by Giant-Ciniza Refinery (Ciniza) to perform a visual inspection, data evaluation, and status assessment for the evaporation ponds located within the Ciniza Refinery, in McKinley County, New Mexico.

The evaporation pond area was identified as a Solid Waste Management Unit (SWMU), and designated as SWMU #2, during a RCRA Facility Investigation (RFI) conducted at the refinery in the early 1990's. This investigation included both soil and groundwater sampling and analysis, determined that no significant impact had occurred, and recommended no further action (NFA).

In 1994, the Environmental Protection Agency Region VI Office (EPA) concurred in this finding, approved cessation of the investigative process, and requested follow-up monitoring at seven groundwater wells. Monitoring samples are scheduled to be collected and analyzed during May 1998.

This summary report for SWMU #2 has been prepared in conjunction with submittal of a Resource Conservation and Recovery Act (RCRA) Part B permit application covering post closure care of the Ciniza Refinery Land Treatment Unit. All investigative activities for SWMU #2 have been completed. This assessment is summarized as follows.

- ⇒ The evaporation ponds continue in active service evaporating waste-water at the refinery and are functioning normally.
- ⇒ Containment berms and basin sidewalls have been inspected and are intact and stable.
- ⇒ Local soil underlying the ponds predominantly consists of bentonitic clays and silts having a very low hydraulic conductivity.
- ⇒ Soil and groundwater sampling and analysis was conducted during an initial site investigation. Trace organic contaminants were detected below corrective action levels. The site was recommended for NFA and approved by the EPA.
- ⇒ SWMU #2 has been characterized in accordance with current applicable state and federal regulations, and the available data indicate that no significant environmental impact or migration has occurred.

2.0 BACKGROUND

During 1987, a RCRA Facility Assessment was conducted at the Ciniza Refinery. This assessment identified various "Solid Waste Management Units" and recommended further evaluation. A RCRA Facility Investigation was subsequently conducted and the evaporation ponds site was identified as SWMU #2.

Applied Earth Sciences (AES) investigated the evaporation pond area during the early 1990s. Soil and groundwater samples were collected and analyzed. No organic contaminants were detected in any groundwater sample. Similarly, most soil samples indicated no detection of organics; however, trace amounts of toluene were detected in a few samples.

Trace metals were detected in both soil and groundwater samples; of which, a few samples indicated levels slightly above ambient background concentration.

As a result of the investigation, AES recommended no further action for this SWMU. Results and recommendations were reported to the EPA in 1991. The EPA approved the NFA finding in 1994, with the provision that on-going groundwater monitoring be performed every five years.

3.0 SITE LOCATION AND DESCRIPTION

SWMU #2 is located within the Ciniza Refinery's property boundary. This refinery is located on the north side of Interstate 40, approximately 17 miles east of Gallup, New Mexico. Within the refinery, SWMU #2 is located to the west of the process unit and tankfarm area on a lower flat plain. See Figure No. 1 for location details.

The evaporation ponds are part of the refinery wastewater treatment system. Effluent water from the aeration basins is directed to these ponds and allowed to evaporate.

There are 15 ponds of varying size having a total surface area of approximately 110 acres. All are man-made earthen basins with bermed sidewalls. Water depth typically ranges from 2 to 4 feet, with an average of 3 feet. Total hydraulic holding capacity is approximately 100 million gallons. Some berms incorporate a perimeter road.

The initial evaporation ponds were constructed in the late 1950's. Additional ponds were constructed at various times thereafter. The evaporation ponds have been in continuous service since initial construction.

4.0 SITE INSPECTION

During the week of March 23, 1998, an on-site inspection was performed. Photographs are included in the appendix to this report. Observations are noted as follows:

- The evaporation ponds were observed in active service treating effluent wastewater from the aeration basins. All 15 ponds contained water. Freeboard space was evident on all ponds.

- Containment berms and sidewalls were visually inspected on all ponds. All were found to be intact and stable. No erosion, damage, or sign of containment failure was observed.

- No soil staining or distressed vegetation was observed at or in the vicinity of any pond. No discoloration or hydrocarbon sheen was evident on any of the ponds.

- Local soil in the vicinity of the evaporation ponds presents as bentonitic clays and silts. Similar soil strata from a neighboring SWMU exhibited a hydraulic conductivity of less than 10^{-7} cm/sec.

- Perimeter roads are located on the berms surrounding several of the ponds. These roads are used for access and inspection.

5.0 DATA REVIEW

Soil samples from around the perimeter of the evaporation ponds were collected and analyzed during the initial site investigation. Samples were collected at multiple depths and at both upgradient and downgradient locations. Several borings were angled to collect samples from beneath the ponds.

The initial site investigation found no detection of VOCs or SVOCs in 46 of the 54 soil samples collected. Trace amounts of toluene were detected in eight samples; of which, 5 mg/kg is the highest reported detection and the remaining seven samples detected less than 0.5 mg/kg. Trace butylbenzylphthalate was also detected in one sample at a concentration of 0.3 mg/kg.

State of New Mexico corrective action levels for BTEX in soil is 50 mg/kg total and 10 mg/kg of benzene. Eight of 54 samples indicated trace BTEX, the highest of which was 5 mg/kg total; well below the 50 mg/kg action level.

Trace metals were also detected in all soil samples; of which, most tested within the range of normal background concentration. A few samples indicated slightly elevated levels of chromium and nickel.

Groundwater samples were collected from seven monitoring wells in the vicinity of the evaporation ponds. Sampling points included upgradient and downgradient locations.

The initial site investigation found no detection of VOCs or SVOCs in any of the groundwater samples collected.

Trace metals were detected in all groundwater samples. A few samples indicated slightly elevated levels of cadmium and selenium.

Per EPA request, groundwater monitoring samples are scheduled to be collected and analyzed during May 1998.

6.0 ASSESSMENT

Based on the site inspection and data review, the evaporation pond area is assessed as follows.

- The evaporation ponds are in active service, functioning normally, and performing the necessary task of evaporating wastewater.

- The evaporation ponds are properly designed and located in an appropriate geologic setting in which the underlying bentonitic soil has a very low hydraulic conductivity which effectively serves as an aquiclude.

- Trace detection of toluene and butylbenzylphthalate in various soil samples presents no logical or consistent pattern of release, is well is below action levels, and may represent anomalous data. This low level of contaminant detection is indicative of no significant impact or migration.

- Trace detection of metals at levels slightly above ambient background concentration is likely due to normal soil variation.

- The absence of organic contaminants in underlying groundwater is confirmatory of the highly impermeable characteristic of the confining soil.

- The no further action finding that was recommended by AES and approved by the EPA is appropriate for this site.

- The next groundwater monitoring event is scheduled for 2003. If this sampling and analysis confirms previous findings, further monitoring is unnecessary and should be discontinued.

7.0 PROFESSIONAL ENGINEER'S CERTIFICATION

This summary report for SWMU #2 has been prepared under the direct supervision and control of a Registered Professional Engineer.

Client: Ciniza Refinery
Giant Refining Company
Route 3, Box 7
Gallup, New Mexico 87301

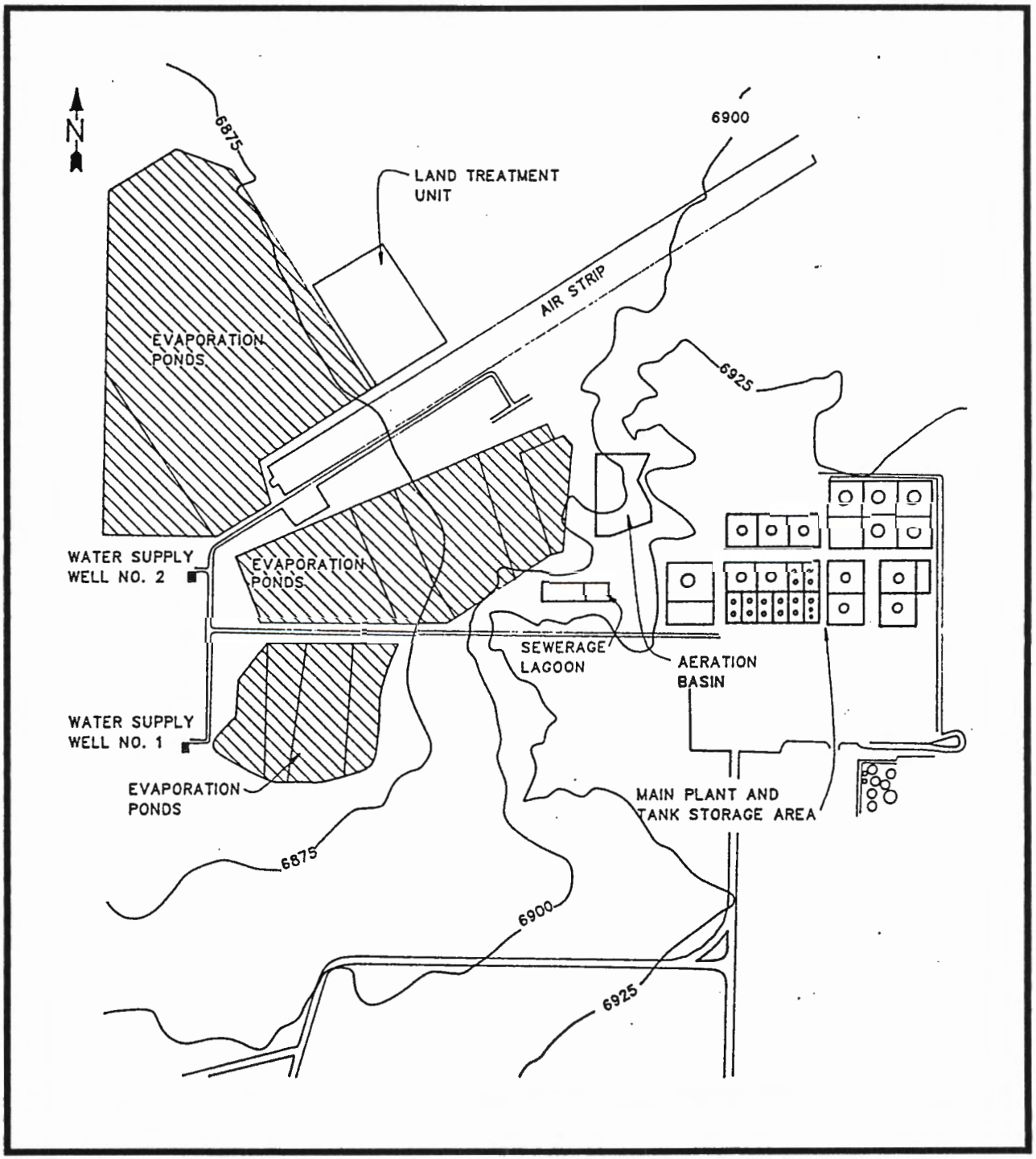
Job No.: 98-205-03

Date: April 23, 1998

Prepared and Certified by:

Thomas D. Atwood, P.E.
Colorado Registration No. 22866

Figure No. 1
Evaporation ponds Site



Site Inspection Photographs

Evaporation Ponds Overview – Looking Northwest

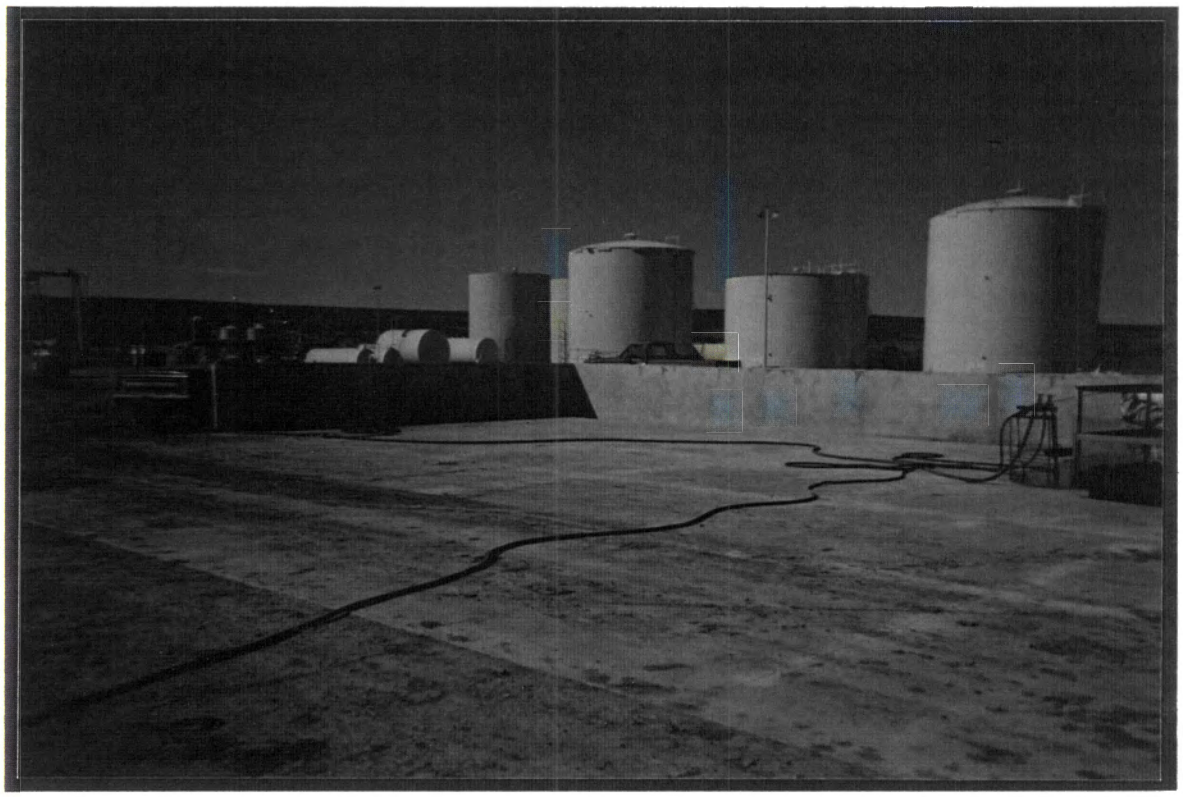
Evaporation Pond – South Section

APPENDIX I-3

Empty Container Storage Area - SWMU No. 3 Summary

SWMU #3 Summary Report

Empty Container Storage Area
Ciniza Refinery
McKinley County, New Mexico



Prepared for:

Ciniza Refinery
Giant Refining Company
Route 3, Box 7
Gallup, New Mexico 87301

Prepared by:

Practical Environmental Services, Inc.
1444 Wazee Street, Suite 225
Denver, Colorado 80202

Job No. 98-205-03

April 23, 1998

1.0 EXECUTIVE SUMMARY

Practical Environmental Services, Inc. (PES) has been retained by Giant-Ciniza Refinery (Ciniza) to perform a visual inspection, data evaluation, and status assessment for the empty container storage area located within the Ciniza Refinery, in McKinley County, New Mexico.

The empty container storage area was identified as a Solid Waste Management Unit (SWMU), and designated as SWMU #3, during a RCRA Facility Investigation (RFI) conducted at the refinery in the early 1990's. This investigation included soil sampling and analysis, determined that no significant impact had occurred, and recommended no further action (NFA).

In 1994, the Environmental Protection Agency Region VI Office (EPA) concurred in this finding and approved cessation of the investigative process.

This summary report for SWMU #3 has been prepared in conjunction with submittal of a Resource Conservation and Recovery Act (RCRA) Part B permit application covering post closure care of the Ciniza Refinery Land Treatment Unit. All investigative activities for SWMU #3 have been completed. This assessment is summarized as follows.

- ⇒ The empty container storage area identified in the RFI has been closed. A new empty container storage area is now in service at an adjoining location.
- ⇒ All drums were removed from the old site in the early 1990's. The site was then cleared and a new concrete containment pad was installed. The new pad is used for cleaning heat exchanger bundles.
- ⇒ Local soil underlying both the old and new empty container storage areas predominantly consists of bentonitic clays and silts having a very low hydraulic conductivity.
- ⇒ Soil sampling and analysis was conducted during the initial site investigation. Trace organic contaminants were detected below corrective action levels. The site was recommended for NFA and approved by the EPA.
- ⇒ SWMU #3 has been characterized in accordance with current applicable state and federal regulations, and the available data indicate that no significant environmental impact or migration has occurred.

2.0 BACKGROUND

During 1987, a RCRA Facility Assessment was conducted at the Ciniza Refinery. This assessment identified various "units of concern" and recommended further evaluation. A RCRA Facility Investigation was subsequently conducted and the empty container storage area was identified as SWMU #3.

Applied Earth Sciences (AES) investigated the empty container storage area during the early 1990s. Soil samples were collected and analyzed. Trace organic contaminants were found in three surface samples and non detect in all subsurface samples.

As a result of the investigation, AES recommended no further action for this SWMU. Results and recommendations were reported to the EPA in 1992. The EPA approved the NFA finding in 1994.

3.0 SITE LOCATION AND DESCRIPTION

SWMU #3 is located within the Ciniza Refinery's property boundary. This refinery is located on the north side of Interstate 40, approximately 17 miles east of Gallup, New Mexico. Within the refinery, SWMU #3 is located approximately 100 feet west of the maintenance shop. See Figure No. 1 for location details.

The old empty container storage area is a rectangular flat site measuring approximately 50 feet by 80 feet. When previously in service, it was reportedly surfaced with gravel. The site was used for storing empty 55 gallon drums prior to recycling.

The new empty container storage area is located adjacent to and west of the old site. Drums are emptied and triple rinsed prior to being placed in this new storage area.

4.0 SITE INSPECTION

During the week of March 23, 1998, an on-site inspection was performed. Photographs are included in the appendix to this report. Observations are noted as follows:

- The empty container storage area identified in the RFI has been closed. It is reported that all drums formerly located on this site were removed and recycled in the early 1990's. A new empty container storage area is now in service at an adjoining location.

- The old empty container storage area site has been cleared and a new concrete containment pad has been installed. The new pad is used for cleaning heat exchanger bundles. This pad overlays the SWMU #3 site.

- Local soil in the vicinity of the empty container storage area presents as bentonitic clays and silts. Similar soil strata from a neighboring SWMU exhibited a hydraulic conductivity of less than 10^{-7} cm/sec.

- No soil staining or distressed vegetation is present at the old empty container storage area site. Most of this site is now covered by the new heat exchanger cleaning pad.

- Rainwater run-off from the old empty container storage area is now collected within the new heat exchanger cleaning pad and directed to the refinery wastewater treatment system. Rainwater run-off from the new empty container storage area and surronding vicinity is similarly collected and directed to the refinery wastewater treatment system.

5.0 DATA REVIEW

Soil samples from within the empty container storage area were collected and analyzed during the initial site investigation. Samples were collected at four locations and three depths; surface, 3 feet, and 4.5 feet below ground surface.

Three of four surface samples detected trace hydrocarbon and solvent constituents; of which, xylenes at 8.6 mg/kg was the highest detection. Most of the remaining constituents were detected in much lower concentrations, typically less than 1 mg/kg. All subsurface samples found no detection of VOCs and SVOCs.

State of New Mexico corrective action levels for BTEX in soil is 50 mg/kg total and 10 mg/kg of benzene. Three of 12 samples indicated trace BTEX, the highest of which was less than 10 mg/kg total; well below the 50 mg/kg action level.

6.0 ASSESSMENT

Based on the site inspection and data review, the empty container storage area is assessed as follows.

- The old empty container storage area (SWMU #3) is closed and the site is now occupied by a heat exchanger cleaning pad. A new empty container storage area is now in service and drums are triple rinsed prior to being placed in the new storage area. The probability of a new contaminant release in this area is very low.

- The soil underlying this former SWMU has a very low hydraulic conductivity which effectively inhibits downward migration of contaminants. As such, any spill, either past or present, is likely to be confined near the surface.

- Trace detection of hydrocarbon and solvent constituents in surface samples at the old site is common for storage areas of this type and era. The absence of subsurface contaminants is confirmatory of the highly impermeable characteristic of the underlying soil. The low level of contaminant detection is indicative of no significant impact.

- A rainwater collection system has been installed to serve this area. Run-off is now directed to the refinery wastewater treatment system.

- The no further action finding that was recommended by AES and approved by the EPA is appropriate for this site.

7.0 PROFESSIONAL ENGINEER'S CERTIFICATION

This summary report for SWMU #3 has been prepared under the direct supervision and control of a Registered Professional Engineer.

Client: Ciniza Refinery
Giant Refining Company
Route 3, Box 7
Gallup, New Mexico 87301

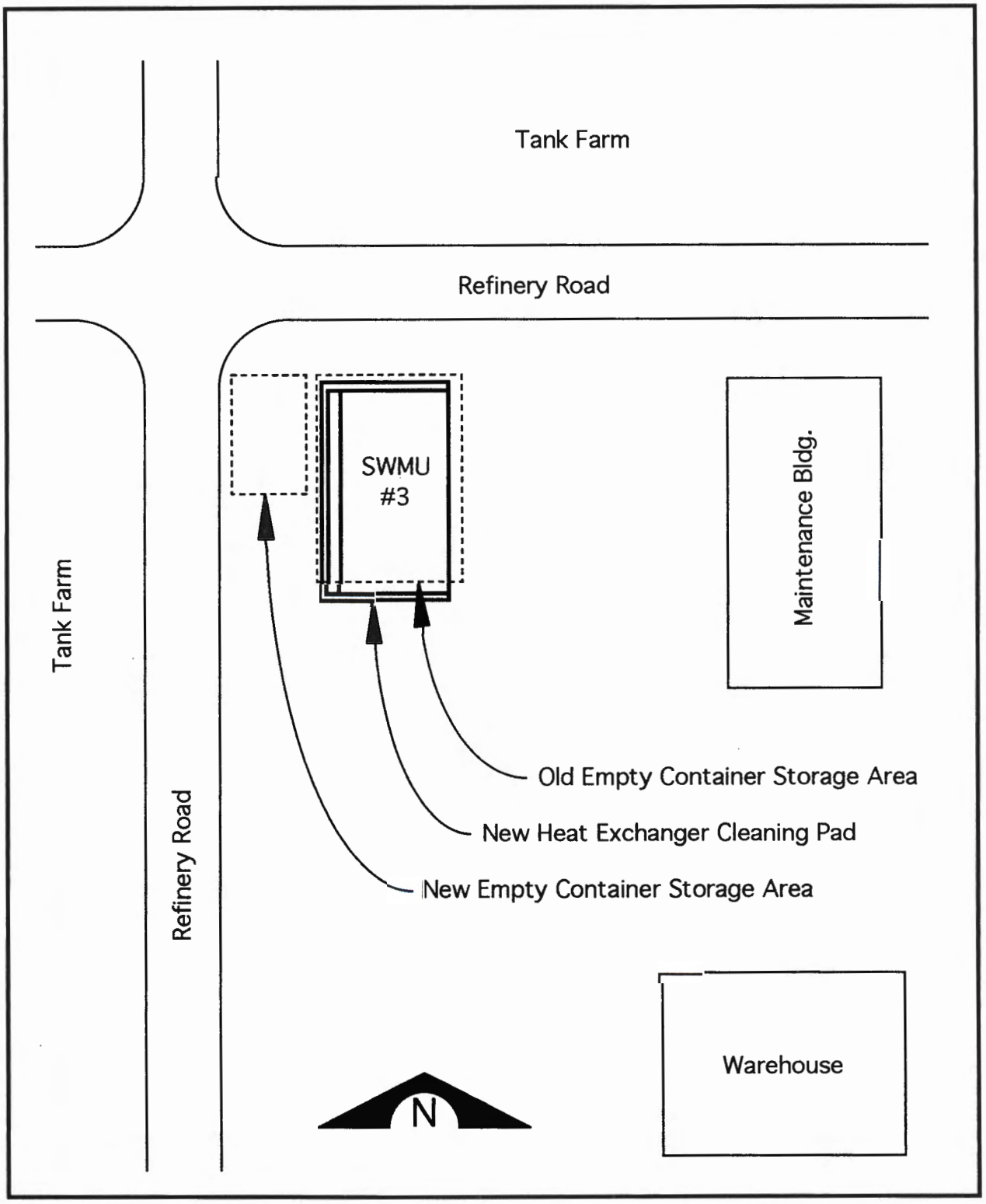
Job No.: 98-205-03

Date: April 23, 1998

Prepared and Certified by:

Thomas D. Atwood, P.E.
Colorado Registration No. 22866

Figure No. 1
Empty Container Storage Area Site



New Empty Container Storage Area

Run-off Collection Trough – New Heat Exchanger Cleaning Pad

APPENDIX I-4

Old Burn Pit - SWMU No. 4 Summary

SWMU #4 Summary Report

Old Burn Pit Area
Ciniza Refinery
McKinley County, New Mexico

Prepared for:

Ciniza Refinery
Giant Refining Company
Route 3, Box 7
Gallup, New Mexico 87301

Prepared by:

Practical Environmental Services, Inc.
1444 Wazee Street, Suite 225
Denver, Colorado 80202

Job No. 98-205-03

April 23, 1998

1.0 EXECUTIVE SUMMARY

Practical Environmental Services, Inc. (PES) has been retained by Giant-Ciniza Refinery (Ciniza) to perform a visual inspection, data evaluation, and status assessment for the old burn pit located within the Ciniza Refinery, in McKinley County, New Mexico.

The old burn pit area was identified as a Solid Waste Management Unit (SWMU), and designated as SWMU #4, during a RCRA Facility Investigation (RFI) conducted at the refinery in the early 1990's. This investigation included soil sampling and analysis, detected trace organics and metals, and recommended tilling and capping the site.

In 1994, the Environmental Protection Agency Region VI Office (EPA) requested additional sampling at greater depth. Results confirmed previous findings. The site was capped in 1997 in conjunction with the closure of SWMU #5.

This summary report for SWMU #4 has been prepared in conjunction with submittal of a Resource Conservation and Recovery Act (RCRA) Part B permit application covering post closure care of the Ciniza Refinery Land Treatment Unit. All investigative activities for SWMU #4 have been completed. This assessment is summarized as follows.

- ⇒ An engineered earthen cap composed of low hydraulic conductivity, native soil has been installed over the site. The surface has been crowned to prevent ponding and gradually sloped to inhibit erosion. Native manure, amendments, and a revegetation seed mix have been applied, tilled into the surface, and watered.

- ⇒ Soil underlying the old burn pit area predominantly consists of bentonitic clays and silts having a very low hydraulic conductivity.

- ⇒ Soil sampling and analysis was conducted during an initial site investigation and subsequent re-investigation at greater depth. Trace organic contaminants were detected below corrective action levels. The site was recommended for remedial action and capping.

- ⇒ SWMU #4 has been characterized in accordance with current applicable state and federal regulations, and the available data indicate that no significant environmental impact or migration has occurred.

- ⇒ The implemented remedy is appropriate for this site.

2.0 BACKGROUND

During 1987, a RCRA Facility Assessment was conducted at the Ciniza Refinery. This assessment identified various "Solid Waste Management Units" and recommended further evaluation. A RCRA Facility Investigation was subsequently conducted and the old burn pit area was identified as SWMU #4.

Applied Earth Sciences (AES) investigated the old burn pit area during the early 1990s. Soil samples were collected and analyzed. Trace VOCs, SVOCs, and metals were detected in several of the samples.

As a result of the investigation, AES recommended tilling the site to promote natural attenuation of organics, followed by capping to contain residual metal contaminants. Results and recommendations were reported to the EPA in 1992. The EPA requested additional sampling at greater depth. Follow-up sampling and analysis confirmed the original findings. In 1997, SWMU #4 was capped in conjunction with similar work being performed at SWMU #5.

3.0 SITE LOCATION AND DESCRIPTION

SWMU #4 is located within the Ciniza Refinery's property boundary. This refinery is located on the north side of Interstate 40, approximately 17 miles east of Gallup, New Mexico. Within the refinery, SWMU #4 is located approximately 700 feet north of the tank farm and west of the fire training area. See Figure No. 1 for location details.

The old burn pit area is a triangular site measuring approximately 20 feet by 40 feet. Within this area, an earthen pit was used as a safe location for combusting waste oil.

4.0 SITE INSPECTION

During the week of March 23, 1998, an on-site inspection was performed. Observations are noted as follows:

- The old burn pit area has been capped utilizing methods and materials as described in the Closure Certification Report for SWMU #5. Cap thickness is estimated at greater than three feet.

- Final installed surface contours and side slopes are adequate to inhibit ponding and erosion.

- Local soil in the vicinity of the old burn pit area presents as bentonitic clays and silts. Similar soil strata from a neighboring SWMU exhibited a hydraulic conductivity of less than 10^{-7} cm/sec.

- No soil staining or distressed vegetation was present at or in the vicinity of the old burn pit site.

5.0 DATA REVIEW

Soil samples from within the old burn pit area were collected and analyzed during the initial site investigation. Samples were collected at three locations and three depths; surface, 3 feet, and 4.5 feet below ground surface.

All samples detected trace VOCs and SVOCs; of which, di methyl phthalate at 18 mg/kg was the highest detection. Most of the remaining constituents were detected in much lower concentrations, typically less than 3 mg/kg.

Per EPA request, a second round of sampling and analysis was conducted at depths of 6 and 10 feet below ground surface. Methyl ethyl ketone was detected in one sample at 1.2 mg/kg and at a depth of 6 feet. All other samples found no detection of VOCs or SVOCs; including all samples collected at 10 feet below ground surface.

All samples detected trace metals; of which, chromium and nickel were detected at levels slightly above ambient background concentration.

6.0 ASSESSMENT

Based on the site inspection and data review, the old burn pit area is assessed as follows.

- The old burn pit area has been covered with an earthen cap using methods and materials consistent with State of New Mexico Environment Department requirements and regulations as set forth in 20 NMAC 9.1 Section 502.

- Residual organic contaminants are present in very low concentrations, confined to a 6 foot soil layer within the SWMU, and substantially consist of heavy molecular weight compounds with low mobility. These compounds are resistant to biodegradation and, as a result, containment is a preferred remedy to natural attenuation via tilling and aeration. The latter technique will expose soil metals to oxidation and precipitation; thereby mobilizing these contaminants and promoting migration.

- Residual metal contaminants are also present at very low levels; most of which fall within the range of ambient background concentration. However, chromium and nickel are present at slightly elevated levels and, as a result, isolation and containment is the preferred remedy.

- Local soil underlying this site has a very low hydraulic conductivity which effectively inhibits outward migration of contaminants. Similar low hydraulic conductivity soil has been used to cap the site and inhibit the infiltration of precipitation.

- The installation of the soil cap represents an appropriate remedy for the site.

7.0 PROFESSIONAL ENGINEER'S CERTIFICATION

This summary report for SWMU #4 has been prepared under the direct supervision and control of a Registered Professional Engineer.

Client: Ciniza Refinery
Giant Refining Company
Route 3, Box 7
Gallup, New Mexico 87301

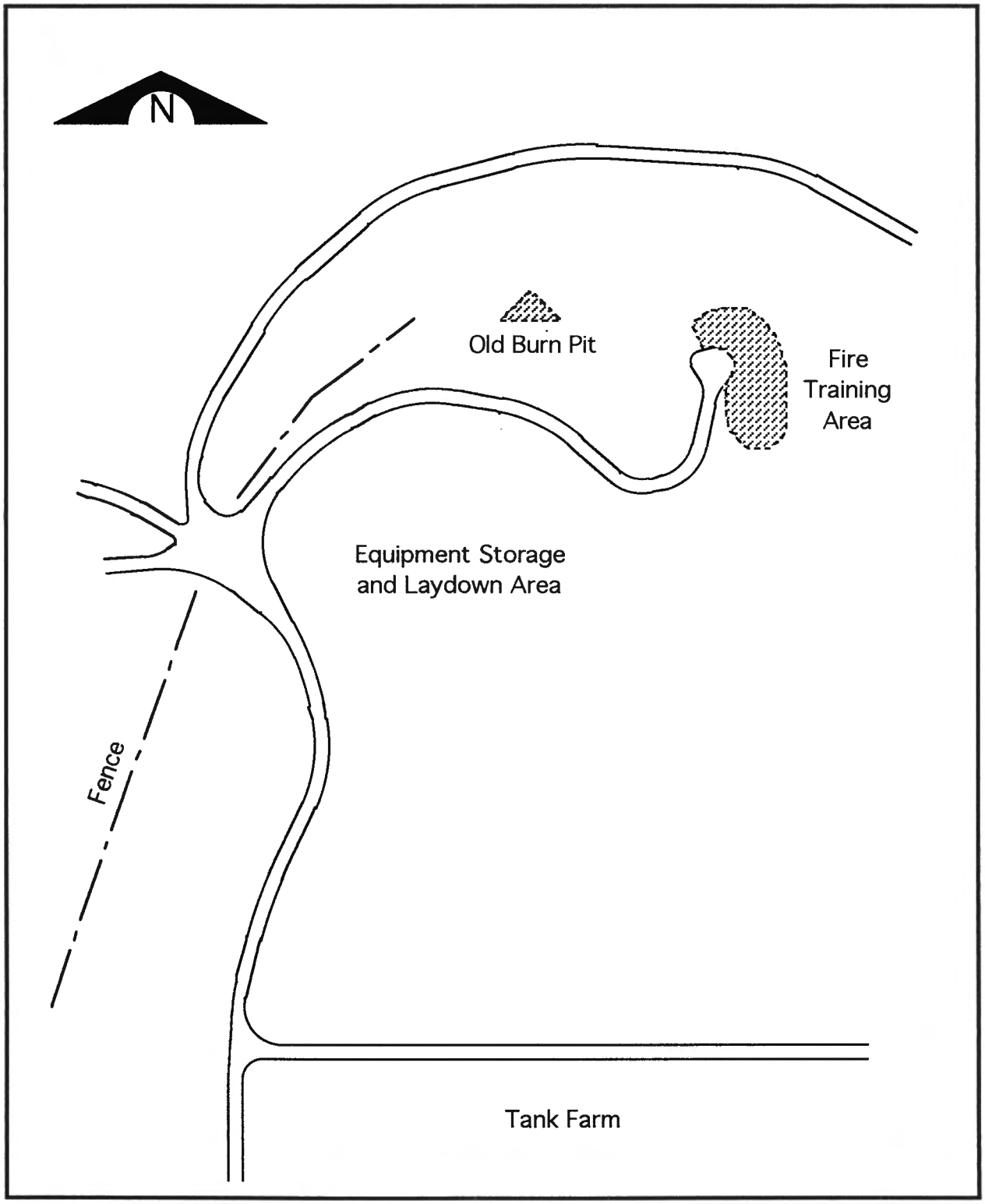
Job No.: 98-205-03

Date: April 23, 1998

Prepared and Certified by:

Thomas D. Atwood, P.E.
Colorado Registration No. 22866

Figure No. 1
Old Burn Pit Area



APPENDIX I-5

Landfill Areas - SWMU No. 5 Closure Certification

SWMU #5 Closure Certification Report

Solid Waste Landfill Areas
Ciniza Refinery
McKinley County, New Mexico

Prepared for:

Ciniza Refinery
Giant Refining Company
Route 3, Box 7
Gallup, New Mexico 87301

Prepared by:

Practical Environmental Services, Inc.
1444 Wazee Street, Suite 225
Denver, Colorado 80202

Job No. 98-205-03

April 23, 1998

1.0 EXECUTIVE SUMMARY

Practical Environmental Services, Inc. (PES) has been retained by Giant-Ciniza Refinery (Ciniza) to perform detailed engineering design, construction oversight, and installation verification of a cap and related closure requirements for several solid waste landfill areas located within the Ciniza Refinery, in McKinley County, New Mexico.

These solid waste landfill areas were identified as a Solid Waste Management Unit (SWMU), and designated as SWMU #5, during a RCRA Facility Investigation conducted at the refinery in the early 1990's. This investigation included soil sampling and analysis, detected trace metals, and recommended corrective action.

In 1994, the Environmental Protection Agency Region VI Office (EPA) requested additional sampling at greater depth. Results confirmed previous findings. A voluntary corrective action plan (CAP) was prepared by Ciniza and approved by the EPA in 1994. The approved CAP was implemented in 1998.

Closure of SWMU #5 is now being performed in conjunction with submittal of a Resource Conservation and Recovery Act (RCRA) Part B permit application covering post closure care of the Ciniza Refinery Land Treatment Unit. Closure certification findings are summarized as follows.

- ⇒ The boundaries of the landfill areas have been delineated.
- ⇒ An engineered earthen cap composed of low hydraulic conductivity, native soil has been installed over the surface.
- ⇒ Run-on and run-off controls have been installed. The surface has been crowned to prevent ponding and gradually sloped to inhibit erosion. A perimeter ditch and culvert have been installed to redirect run-on.
- ⇒ Native manure, amendments, and a revegetation seed mix have been applied, tilled into the surface, and watered. Supplemental watering is planned until initial growth is well established.
- ⇒ Access roads in the vicinity of the landfill areas have been removed and redirected away from the site. Forbidden entry signs have been posted.
- ⇒ A post-closure care program is being implemented.

2.0 BACKGROUND

During 1987, a RCRA Facility Assessment was conducted at the Ciniza Refinery. This assessment identified various "solid waste management units" including five former solid waste landfill areas. No further action was recommended at one site. Further evaluation was recommended at four sites.

A RCRA Facility Investigation was subsequently conducted. The four sites recommended for further study were collectively designated as SWMU #5.

Applied Earth Sciences (AES) conducted the follow-up investigation. Soil samples were collected and analyzed. No organic contaminants were detected in any sample. Trace metals were detected in most samples; of which, a few samples indicated levels slightly above ambient background concentration. One surface soil sample indicated an elevated chromium concentration. As a result, AES recommended capping these areas. A voluntary corrective action plan was prepared and submitted to the EPA; which approved the plan in 1994.

These landfill areas are reported to contain inorganic, non-hazardous solid waste and debris from refinery construction, maintenance, and operational activities. No organic materials are known to be present in any of these areas.

All four landfill sites are located in close proximity to each other and are collectively identified as SWMU #5. Three of these sites are contiguous and therefore have been grouped under a single large cap. The fourth site is small and isolated, and has been capped separately. It is located approximately 50 feet north of the main area.

3.0 SITE LOCATION AND DESCRIPTION

SWMU #5 is located within the Ciniza Refinery's property boundary. This refinery is located on the north side of Interstate 40, approximately 17 miles east of Gallup, New Mexico. Within the refinery, SWMU #5 is located northwest of the tank farm, approximately 500 feet from Tank 337. See Drawing X1 in Appendix A for location details.

The main landfill cap is approximately kidney-shaped and borders an access road adjacent to an equipment laydown area. A 15 foot by 15 foot fenced storage area is located immediately to the east of the cap and is the most noteworthy local landmark. This area is located on an elevated bench. To the north and west of the cap is a flat plain at an elevation approximately 15 feet below the bench. The smaller, remote landfill area is located on the lower plain approximately 50 feet north of the main landfill cap.

4.0 CLOSURE REQUIREMENTS

State of New Mexico regulations (20 NMAC 9.1 Section 502) specify the following criteria for landfill closure:

- Installation of a final cover system to include a minimum 18 inch thick infiltration prevention layer of earthen material having a saturated hydraulic conductivity of less than or equal to natural subsoils or 10^{-5} cm/sec, whichever is less; plus a minimum 6 inch thick erosion layer capable of sustaining native plant growth; maximum 25% grade side slopes, and a final surface contour sufficient to prevent ponding.

- A written description of the final cover as installed, an estimate of the covered surface area and contained waste volume, and plan drawings showing the final contours and reclamation areas.

In addition, the approved corrective action plan also specifies closure criteria as follows:

- A soil cap shall be installed over the landfill areas to isolate waste material and prevent infiltration of precipitation. The cap shall be composed of native soil; properly wetted and compacted to achieve a low hydraulic conductivity.

- The site shall be graded and contoured to eliminate local depressions and achieve positive drainage.

- The surface soil shall be amended and seeded to promote revegetation.

- Post-closure care shall incorporate annual site inspections and maintenance of the soil cap.

5.0 DESIGN AND CONSTRUCTION

The four landfill areas associated with SWMU #5 have been located in the field. Due to close proximity to each other, a single contiguous cap has been specified for the three upper bench landfill areas. A small secondary cap has been specified for the remote landfill area located north of the main area.

Neighboring native soil, similar in composition to landfill area subsoils, has been specified and used for cap construction. This soil is predominantly bentonitic clays and silt, and has a very low hydraulic conductivity of less than 10^{-7} cm/sec. The use of locally derived soil also promotes a consistent appearance and character of the reclaimed areas vis-à-vis surrounding terrain.

Minimum depth of cover has been specified at two feet final compacted thickness. However, due to grading and surface contouring considerations, actual installed thickness ranges from four to eight feet.

Cap construction has been specified as building upward from existing grade by progressive placement of soil layers 6 to 8 inches thick; followed by wetting and compaction to 95 percent of Standard Proctor maximum dry density. Grading and contouring has been specified and conducted to achieve a finished slope of not greater than 25% (4:1) over any area of the landfill. Caps have been specified and installed as crowned masses with sustained downward slope and no local depressions.

A perimeter ditch has been specified and installed along the interior curve of the main cap adjacent to the access road. This ditch collects run-off from the adjoining equipment laydown area and funnels collected water to a low point invert as shown on Drawing X2. The ditch has been specified as not less than 2 feet wide by 2 feet deep, and sloped not less than 1/8th inch per foot downward to the invert.
In addition, a buried culvert is required to transmit collected water from the east side perimeter ditch to a west side outfall. This culvert has been specified and installed as 2 feet in diameter and sloped not less than 1/16th inch per foot downward to the outfall. The culvert has been buried within the built-up cap soil layer and above the landfill's solid waste zone.

Existing access roads, which traversed the main landfill area, have been covered over and eliminated. Access to the capped area has been restricted by road removal and realignment; plus installation of a new road which routes traffic around the landfill area. Forbidden access signs have also been posted adjacent to the remaining access road.

The surface of the cap has been amended to promote revegetation. Locally generated manure and appropriate grass seed have been tilled into soil and watered. Dryland Pasture Mix was used, consisting of various wheat and rye grass species.

Due to a lack of organic matter within the landfill areas, gas generation is not considered likely and therefore no venting system has been specified or installed.

6.0 SITE INSPECTION

During the week of January 20, 1998, while construction of the landfill caps and related facilities was in progress, an on-site inspection was performed. Photographs are presented in Appendix B. Observations are noted as follows:

- A small triangular portion of the equipment laydown area was eliminated in order to reshape the main landfill cap and improve the surface slope. This allowed consolidation of the main cap over the three landfill areas located on the upper bench.

- The main landfill cap has been crowned at high point west of the fenced storage area and then sloped progressively to the west and north until intersection with the lower plain. This has produced a gradual side slope which is less susceptible to erosion.

- A small, standalone cap was installed over the remote landfill area located north of the main cap.

- Two access roads in the area were eliminated and replaced by a new access road which routes traffic away from and around the main landfills area.

- Cap thickness was increased in several areas in order to accommodate contouring requirements. Installed thickness ranges from approximately four feet in some areas to over eight feet in other areas.

7.0 POST-CLOSURE CARE

A five year post-closure care period is proposed for the capped areas. During this time, the following activities shall be performed.

- During the first year's growing season, the site shall be watered monthly to promote initial rooting and plant growth. One gallon per square foot shall be spray applied.

- The site shall be visually inspected on an annual basis to detect erosion or deterioration of the caps, operability of the drainage ditch and culvert, health and coverage of the vegetation, and signs of unauthorized access.

- As necessary, maintain and repair the caps and drainage system. As necessary, re-seed areas where vegetation has not established. As necessary, prevent unauthorized access or other use of the landfill areas.

At the end of the five year post-closure care period, the site shall be inspected to confirm compliance with regulations and successful reclamation.

8.0 PROFESSIONAL ENGINEER'S CERTIFICATION

This landfill closure certification report has been prepared under the direct supervision and control of a Registered Professional Engineer.

Client: Ciniza Refinery
Giant Refining Company
Route 3, Box 7
Gallup, New Mexico 87301

Job No.: 98-205-03

Date: April 23, 1998

Prepared and Certified by:

Thomas D. Atwood, P.E.
Colorado Registration No. 22866

Site Inspection Photographs

Side Slope Construction

Side Slope Profile

Clean Soil Being Trucked To Site

Soil Layer Placement

Site Inspection Photographs

Access Road Being Removed From Site

View of Landfill Site From Lower Flat

View of Adjacent Equipment Laydown Area

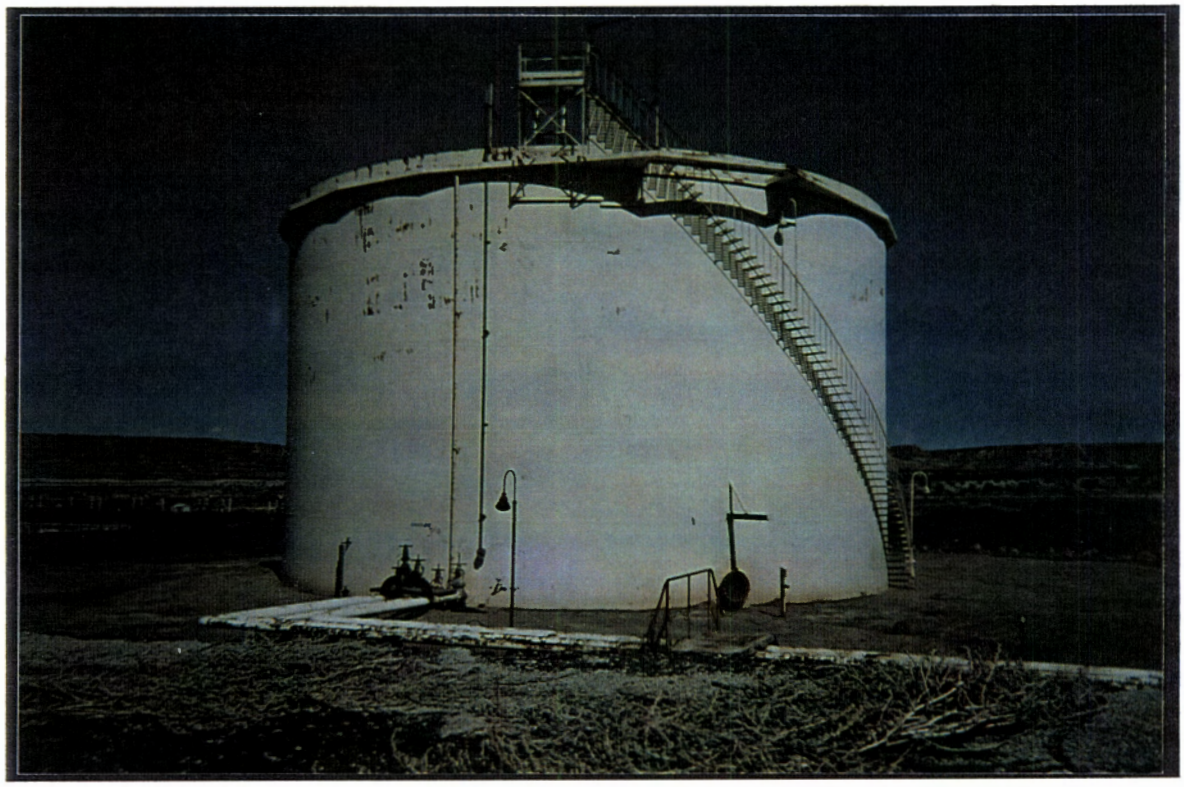
View of Storage Trailers

APPENDIX I-6

Tank Farm—Leaded Gasoline Tanks - SWMU No. 6 Summary

SWMU #6 Summary Report

Tank Farm
Ciniza Refinery
McKinley County, New Mexico



Prepared for:

Ciniza Refinery
Giant Refining Company
Route 3, Box 7
Gallup, New Mexico 87301

Prepared by:

Practical Environmental Services, Inc.
1444 Wazee Street, Suite 225
Denver, Colorado 80202

Job No. 98-205-03

April 23, 1998

1.0 EXECUTIVE SUMMARY

Practical Environmental Services, Inc. (PES) has been retained by Giant-Ciniza Refinery (Ciniza) to perform a visual inspection, data evaluation, and status assessment for the tank farm located within the Ciniza Refinery, in McKinley County, New Mexico.

The tank farm area was identified as a Solid Waste Management Unit (SWMU), and designated as SWMU #6, during a RCRA Facility Investigation (RFI) conducted at the refinery in the early 1990's. This investigation included soil sampling and analysis, detected trace organics and metals, and recommended no further action (NFA).

In 1994, the Environmental Protection Agency Region VI Office (EPA) requested additional sampling at greater depth. BTEX and gasoline free product were detected under the tank farm. Interim corrective action to recover free product and contain plume spread was initiated and is ongoing at this time.

This summary report for SWMU #6 has been prepared in conjunction with submittal of a Resource Conservation and Recovery Act (RCRA) Part B permit application covering post closure care of the Ciniza Refinery Land Treatment Unit. All investigative activities for SWMU #6 have been completed. This assessment is summarized as follows.

- ⇒ The tank farm was identified as a SWMU because leaded gasoline was previously stored within seven tanks at this site.
- ⇒ Soil sampling and analysis was conducted during an initial site investigation and subsequent re-investigation at greater depth. BTEX and gasoline free product were detected in both soil and groundwater.
- ⇒ Contaminant plume boundaries have been investigated and defined.
- ⇒ Interim corrective action, consisting of a pump & treat extraction system, has been implemented and is in ongoing service.
- ⇒ A corrective action plan has been developed and submitted to the New Mexico Oil Conservation Division (NMOCD).

2.0 BACKGROUND

During 1987, a RCRA Facility Assessment was conducted at the Ciniza Refinery. This assessment identified various "Solid Waste Management Units" and recommended further evaluation. A RCRA Facility Investigation was subsequently conducted and the tank farm area was identified as SWMU #6.

Applied Earth Sciences (AES) investigated the tank farm area during the early 1990s. Soil samples were collected and analyzed. Trace BTEX and metals were detected in several of the samples.

As a result of the investigation, AES recommended no further action for this SWMU. Results and recommendations were reported to the EPA in 1990. In 1994, the EPA requested additional sampling at greater depth. Follow-up sampling and analysis revealed the presence of gasoline free product beneath the tank farm.

3.0 SITE LOCATION AND DESCRIPTION

SWMU #6 is located within the Ciniza Refinery's property boundary. This refinery is located on the north side of Interstate 40, approximately 17 miles east of Gallup, New Mexico. Within the refinery, SWMU #6 is located north of the office building and process unit area. See Figure No. 1 for location details.

The tank farm area encompasses a group of large, steel aboveground storage tanks located within bermed containment basins. These tanks store various refinery products and feedstocks. SWMU #6 consists of seven of hydrocarbon storage tanks which formerly contained leaded gasoline and are currently storing other refinery feedstocks and additives.

4.0 SITE INSPECTION

During the week of March 23, 1998, an on-site inspection was performed. Observations are noted as follows:

- The tank farm is in active service storing feedstocks and products. Leaded gasoline is no longer produced or stored within the refinery.
- Containment basins and bermed sidewalls were inspected and found to be intact and stable. No erosion, damage, or sign of containment failure was observed.
- Local soil in the vicinity of the tank farm presents as bentonitic clays and silts. Similar soil strata from a neighboring SWMU exhibited a hydraulic conductivity of less than 10^{-7} cm/sec.

5.0 DATA REVIEW

Soil samples from within the tank farm area were collected and analyzed during the initial site investigation and subsequent re-investigation at greater depth.

In 1990, the initial site investigation collected samples adjacent to each tank and at multiple depths; including surface, 4 feet, 7 feet, and 11 feet below ground surface. Trace BTEX and metals were detected in most samples.

In 1995, a second round of sampling and analysis was conducted at depths of 16 and 20 feet below ground surface. During this investigation, significant BTEX and gasoline free product was detected in both soil and groundwater.

6.0 ASSESSMENT

Based on the site inspection and data review, the tank farm area is assessed as follows.

- The tank farm area is in active remediation at this time. A pump & treat recovery system has been installed as an interim corrective action.
- A corrective action plan has been developed and submitted to the NMOCD for review and approval.

7.0 PROFESSIONAL ENGINEER'S CERTIFICATION

This summary report for SWMU #6 has been prepared under the direct supervision and control of a Registered Professional Engineer.

Client: Ciniza Refinery
Giant Refining Company
Route 3, Box 7
Gallup, New Mexico 87301

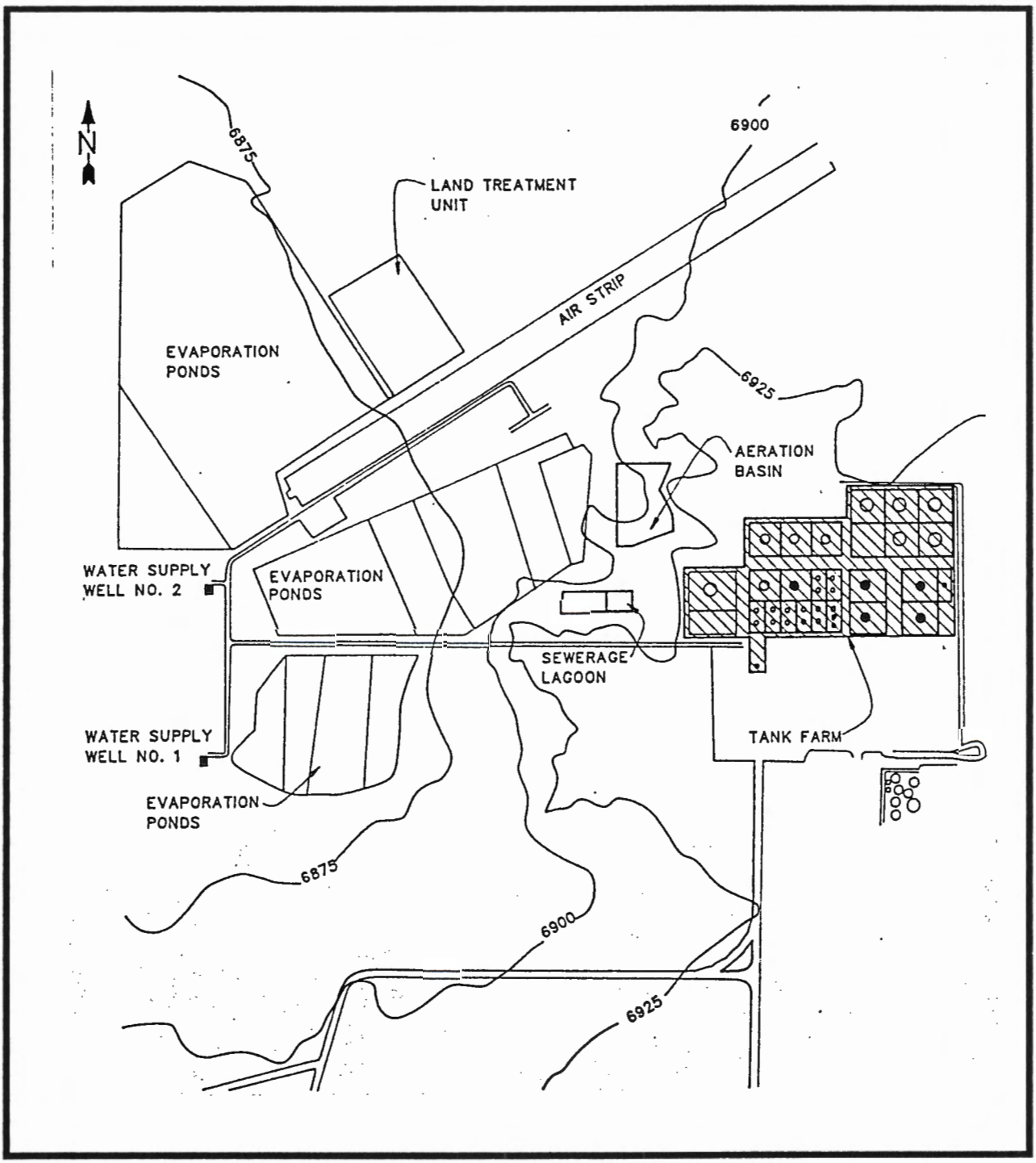
Job No.: 98-205-03

Date: April 23, 1998

Prepared and Certified by:

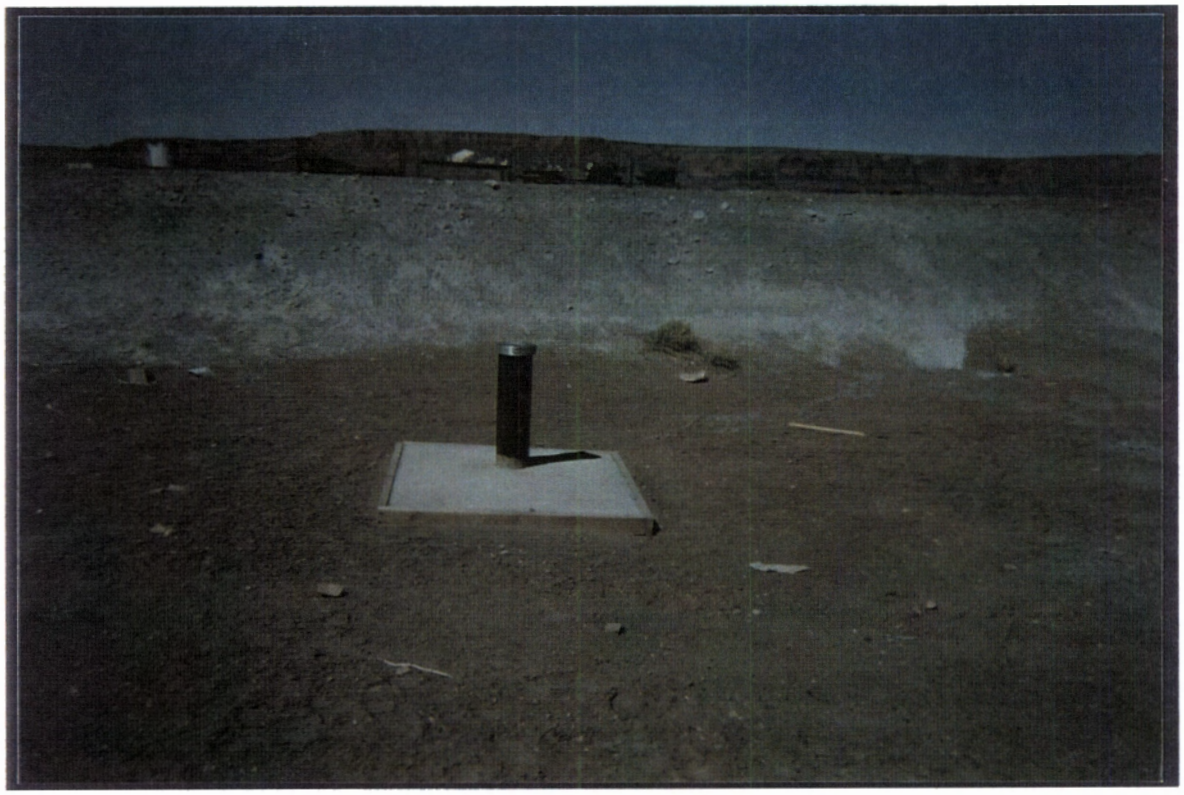
Thomas D. Atwood, P.E.
Colorado Registration No. 22866

Figure No. 1
Tank farm Area



Site Inspection Photographs

Pump & Treat Recovery System



Groundwater Monitoring Well

APPENDIX I-7

Fire Training Area - SWMU No. 7 Summary

SWMU #7 Summary Report

Fire Training Area
Ciniza Refinery
McKinley County, New Mexico

Prepared for:

Ciniza Refinery
Giant Refining Company
Route 3, Box 7
Gallup, New Mexico 87301

Prepared by:

Practical Environmental Services, Inc.
1444 Wazee Street, Suite 225
Denver, Colorado 80202

Job No. 98-205-03

April 23, 1998

1.0 EXECUTIVE SUMMARY

Practical Environmental Services, Inc. (PES) has been retained by Giant-Ciniza Refinery (Ciniza) to perform a visual inspection, data evaluation, and status assessment for the fire training area located at the Ciniza Refinery, in McKinley County, New Mexico.

The fire training area was identified as a Solid Waste Management Unit (SWMU), and designated as SWMU #7, during a RCRA Facility Investigation (RFI) conducted at the refinery in the early 1990's. This investigation included soil sampling and analysis, detected hydrocarbon contaminants, and recommended corrective action.

In 1994, the Environmental Protection Agency Region VI Office (EPA) requested additional sampling at greater depth. These results demonstrated that hydrocarbon contaminants were confined to near-surface soils adjacent to a tank.

This summary report for SWMU #7 has been prepared in conjunction with submittal of a Resource Conservation and Recovery Act (RCRA) Part B permit application covering post closure care of the Ciniza Refinery Land Treatment Unit. All investigative activities for SWMU #7 have been completed. This assessment is summarized as follows.

- ⇒ The fire training area remains in active service at the refinery and is used to train employees in safe firefighting techniques.
- ⇒ Soil sampling and analysis was conducted during an initial site investigation and subsequent re-investigation at greater depth. Diesel fuel was detected in surface soil at the site.
- ⇒ Contaminated soil should be removed from the site and replaced with clean fill dirt prior to closure.

2.0 BACKGROUND

During 1987, a RCRA Facility Assessment was conducted at the Ciniza Refinery. This assessment identified various "units of concern" and recommended further evaluation. A RCRA Facility Investigation was subsequently conducted and the fire training area was identified as SWMU #7.

Applied Earth Sciences (AES) investigated the fire training area during the early 1990s. Soil samples were collected and analyzed. Hydrocarbon contaminants were detected above State of New Mexico corrective action levels.

As a result of the investigation, AES recommended in-situ bioremediation for this SWMU. Results and recommendations were reported to the EPA in 1992. In 1994, the EPA requested additional sampling at greater depth. Follow-up sampling and analysis demonstrated that hydrocarbon contaminants were confined to near-surface soils adjacent to a firefighting training tank.

3.0 SITE LOCATION AND DESCRIPTION

SWMU #7 is located within the Ciniza Refinery's property boundary. This refinery is located on the north side of Interstate 40, approximately 17 miles east of Gallup, New Mexico. Within the refinery, SWMU #7 is located approximately 700 feet north of the tank farm. See Figure No. 1 for location details.

The fire training area is a rectangular flat site measuring approximately 50 feet wide by 80 feet long. Within this area, several firefighting demonstration apparatus are located; including a tank, pump, column, and piping manifold. Approximately twice a year, diesel fuel is used to create fires within this equipment and refinery employees train in proper techniques for extinguishing the fires.

4.0 SITE INSPECTION

During the week of March 23, 1998, an on-site inspection was performed. Photographs are included in the appendix to this report. Observations are noted as follows:

- The fire training area remains in active service at the refinery.
- At the time of the inspection, no soil staining or distressed vegetation was present at or in the vicinity of the fire training equipment.
- Local soil in the vicinity of the fire training area presents as bentonitic clays and silts. Similar soil strata from a neighboring SWMU exhibited a hydraulic conductivity of less than 10^{-7} cm/sec.

5.0 DATA REVIEW

Soil samples from within the fire training area were collected and analyzed during the initial site investigation and subsequent re-sampling at greater depth.

In 1992, the initial site investigation collected samples at four locations and three depths; surface, 3 feet, and 4.5 feet below ground surface. Diesel fuel, analyzed as oil & grease, was detected in 10 of 12 samples. Surface samples collected adjacent to the tank indicated the highest levels of detection at approximately 3 percent.

In 1994, a second round of sampling and analysis was conducted at two locations and depths of 7 and 11 feet below ground surface. Oil & Grease and Total Petroleum Hydrocarbon (TPH) were not detected in any sample. Trace di-n-butyl phthalate, a diesel constituent, was detected in two samples.

The State of New Mexico corrective action level for diesel fuel in soil is 100 mg/kg; measured as TPH.

6.0 ASSESSMENT

Based on the site inspection and data review, the fire training area is assessed as follows.

- The fire training area remains in active service and is a necessary component of the refinery's safety program.
- Soil sampling and analysis has detected spilled diesel fuel in surface soil adjacent to the firefighting demonstration tank.
- Continuing releases of diesel fuel can be expected as long as firefighting demonstration equipment is located on bare earth. Relocation of this equipment to a concrete curbed pad will minimize future releases.
- Contaminated soil from beneath and surrounding the tank should be removed and replaced with clean fill dirt prior to site closure.

7.0 PROFESSIONAL ENGINEER'S CERTIFICATION

This summary report for SWMU #7 has been prepared under the direct supervision and control of a Registered Professional Engineer.

Client: Ciniza Refinery
Giant Refining Company
Route 3, Box 7
Gallup, New Mexico 87301

Job No.: 98-205-03

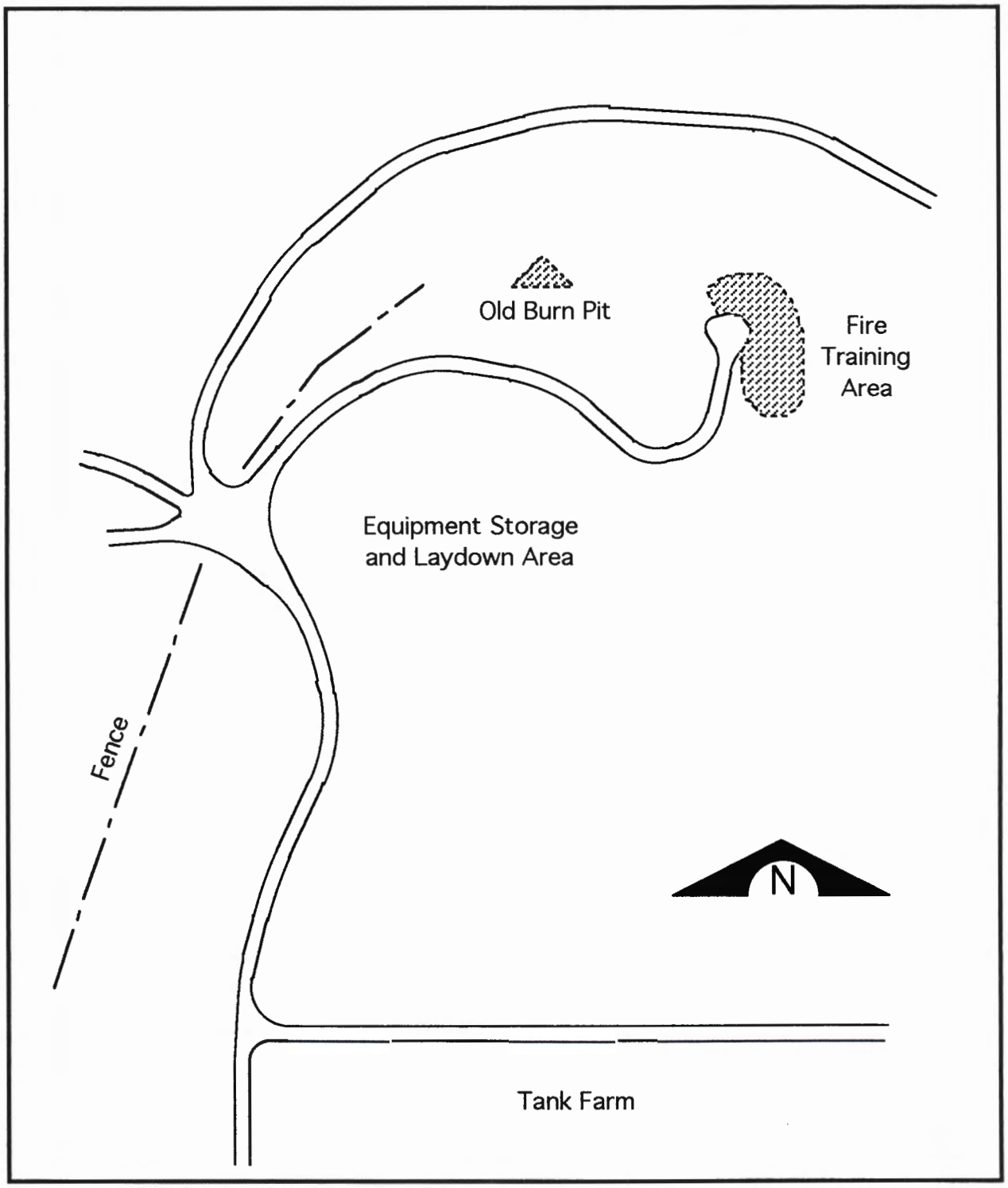
Date: April 23, 1998

Prepared and Certified by:

COLORADO REGISTERED
THOMAS D. ATWOOD
22866
PROFESSIONAL ENGINEER

Thomas D. Atwood, P.E.
Colorado Registration No. 22866

Figure No. 1
Fire Training Area



Firefighting Demonstration Equipment – Piping Manifold

Firefighting Demonstration Equipment – Pump & Column

APPENDIX I-8

Railroad Rack Lagoon - SWMU No. 8 Summary

SWMU #8 Summary Report

Railroad Loading Rack Lagoon & Fanout Area

Ciniza Refinery
McKinley County, New Mexico

Prepared for:

Ciniza Refinery
Giant Refining Company
Route 3, Box 7
Gallup, New Mexico 87301

Prepared by:

Practical Environmental Services, Inc.
1444 Wazee Street, Suite 225
Denver, Colorado 80202

Job No. 98-205-03

April 23, 1998

1.0 EXECUTIVE SUMMARY

Practical Environmental Services, Inc. (PES) has been retained by Giant–Ciniza Refinery (Ciniza) to perform a visual inspection, data evaluation, and status assessment for the railroad rack lagoon and associated fanout area located within the Ciniza Refinery, in McKinley County, New Mexico.

The railroad rack lagoon and fanout area was identified as a Solid Waste Management Unit (SWMU), and designated as SWMU #8, during a RCRA Facility Investigation (RFI) conducted at the refinery in the early 1990's. This investigation included soil sampling and analysis, detected organic contaminants, and recommended corrective action.

In 1994, the Environmental Protection Agency Region VI Office (EPA) concurred in this finding, but requested additional soil monitoring after the lagoon had been removed from service. A corrective action plan (CAP) was prepared by Ciniza and approved by the EPA.

This summary report for SWMU #8 has been prepared in conjunction with submittal of a Resource Conservation and Recovery Act (RCRA) Part B permit application covering post closure care of the Ciniza Refinery Land Treatment Unit. This assessment is summarized as follows.

- ⇒ In 1990, soil sampling and analysis was conducted during the initial site investigation. Trace organic contaminants and metals were detected.
- ⇒ In 1993, the railroad rack lagoon was taken out of service. Drainage from the loading rack was diverted from the lagoon to the refinery wastewater treatment system. The sewer line from the rack to the lagoon was plugged. Water and sludge from the lagoon were transported to the API spearator.
- ⇒ Additional soil sampling and analysis is scheduled for 1998.
- ⇒ The approved CAP recommends bioremediation for this site.
- ⇒ If additional soil monitoring confirms the initial finding of very low level contaminant detection, installation of an engineered earthen cap is a preferred alternative.

2.0 BACKGROUND

During 1987, a RCRA Facility Assessment was conducted at the Ciniza Refinery. This assessment identified various "solid waste management units" and recommended further evaluation. A RCRA Facility Investigation was subsequently conducted and the railroad rack lagoon and associated fanout area were identified as SWMU #8.

Applied Earth Sciences (AES) investigated the railroad rack lagoon and fanout area during the early 1990s. Soil samples were collected and analyzed. Trace VOC and SVOC contaminants were detected. Trace metals were also detected; of which, a few samples indicated levels slightly above ambient background concentration.

As a result of the investigation, AES recommended bioremediation via in-situ land treatment and mound composting to attenuate organics. Results and recommendations were reported to the EPA in 1990. A voluntary corrective action plan was prepared and submitted to the EPA in 1992. In 1994, the EPA approved the CAP and requested additional sampling after the lagoon had been removed from service.

3.0 SITE LOCATION AND DESCRIPTION

SWMU #8 is located within the Ciniza Refinery's property boundary. This refinery is located on the north side of Interstate 40, approximately 17 miles east of Gallup, New Mexico. Within the refinery, SWMU #8 is located approximately 200 feet northwest of the railcar loading rack. See Figure No. 1 for location details.

Formerly, wastewater from the railroad loading rack flowed via a dedicated sewer line to a settling and separation lagoon south of the rack. In 1993, the sewer system was changed and this wastewater was redirected to the refinery wastewater treatment system. The old sewer line to the lagoon was then plugged with concrete.

The railroad rack lagoon is an earthen basin measuring approximately 40 feet wide by 130 feet long by 6 feet deep. Wastewater formerly entered the lagoon at the south end via an 18 inch diameter concrete sewer pipe and then exited at the north end via an overflow ditch. Water leaving the lagoon was distributed across a flat open site known as the fanout area; which measured approximately 200 feet wide by 200 long.

The railroad rack lagoon is thought to have been placed in service during the late 1950's or early 1960's and operated for approximately 35 years.

4.0 SITE INSPECTION

During the week of March 23, 1998, an on-site inspection was performed. Observations are noted as follows:

- The railroad rack lagoon was observed inactive and empty. No standing water was present, but residual oily sludge was evident on the bottom.

- Native shrubs and grasses were observed growing around the basin and throughout the general vicinity. No signs of distress were evident.

- The overflow ditch and fanout area were also inspected. Native shrubs and grasses were observed growing throughout the general vicinity. No signs of distress or soil staining were evident.

- Local soil in the vicinity of the railroad rack lagoon presents as bentonitic clays and silts. Similar soil strata from a neighboring SWMU exhibited a hydraulic conductivity of less than 10^{-7} cm/sec.

5.0 DATA REVIEW

Soil samples from adjacent and under the railroad rack lagoon and within the overflow ditch and fanout area were collected and analyzed during the initial site investigation.

In 1990, the initial site investigation collected samples at 13 locations and multiple depths ranging from surface to 10 feet below ground surface. VOCs were detected in 4 of 39 samples; of which, xylenes at 6.6 mg/kg represented the highest detection. SVOCs were detected in 8 of 39 samples; of which, methylnaphthalene at 71 mg/kg represented the highest detection. The highest detection of total VOC/SVOC was 131 mg/kg.

State of New Mexico corrective action levels for Total Petroleum Hydrocarbons (TPH) and BTEX in soil is 100 mg/kgl and 50 mg/kg, respectively.

All samples detected trace metals; of which, several metals were detected at levels slightly above ambient background concentration.

6.0 ASSESSMENT

Based on the site inspection and data review, the railroad rack lagoon area is assessed as follows.

- The railroad rack lagoon and associated fanout area are no longer in service. Wastewater is no longer flowing to this area and therefore no new contaminants are being introduced to the site.

- A residual sludge layer is present on the bottom on the lagoon and should be removed prior to closure.

- Residual subsurface organic contaminants are present in very low concentrations and substantially below corrective action levels.

- The currently approved CAP recommends two bioremediation techniques to enhance attenuation of organics. This remedy will expose soil metals to oxidation and precipitation; thereby mobilizing these contaminants and promoting migration.

- Local soil underlying this site has a very low hydraulic conductivity which effectively inhibits outward migration of contaminants.

- An alternative corrective action is recommended. Installation of an engineered soil cap represents a preferred and appropriate remedy for this site.

7.0 PROFESSIONAL ENGINEER'S CERTIFICATION

This summary report for SWMU # has been prepared under the direct supervision and control of a Registered Professional Engineer.

Client: Ciniza Refinery
Giant Refining Company
Route 3, Box 7
Gallup, New Mexico 87301

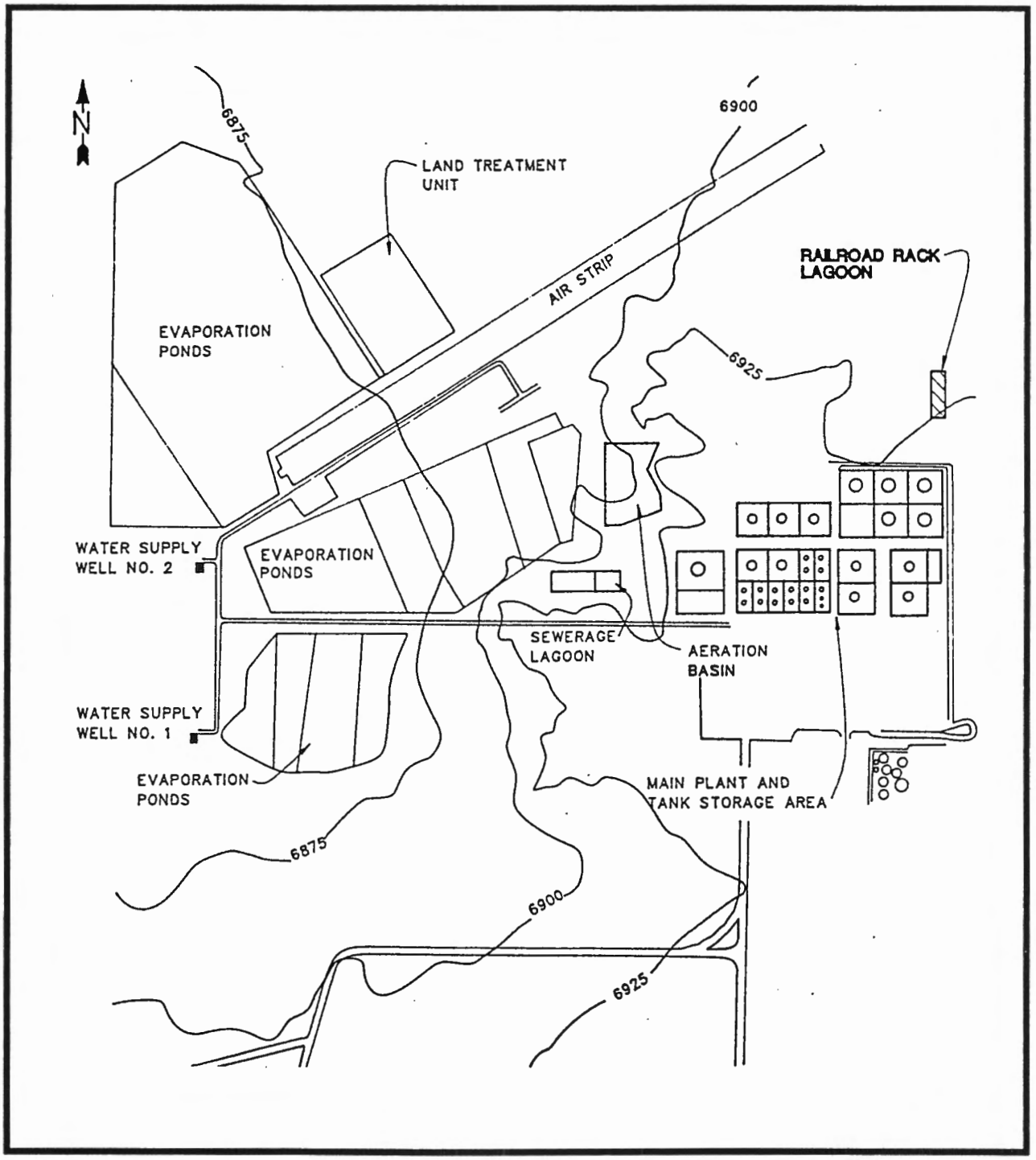
Job No.: 98-205-03

Date: April 23, 1998

Prepared and Certified by:

Thomas D. Atwood, P.E.
Colorado Registration No. 22866

Figure No. 1
Railroad Rack Lagoon Area



APPENDIX I-9

Drainage Ditch and the Inactive Land Farm - SWMU No. 9 and No. 14 Summary

SWMUs # 9 & #14 Summary Report

Inactive Land Treatment Area & Drainage Ditch

Ciniza Refinery
McKinley County, New Mexico

Prepared for:

Ciniza Refinery
Giant Refining Company
Route 3, Box 7
Gallup, New Mexico 87301

Prepared by:

Practical Environmental Services, Inc.
1444 Wazee Street, Suite 225
Denver, Colorado 80202

Job No. 98-205-03

April 23, 1998

1.0 EXECUTIVE SUMMARY

Practical Environmental Services, Inc. (PES) has been retained by Giant-Ciniza Refinery (Ciniza) to perform a visual inspection, data evaluation, and status assessment for the inactive land treatment area and associated drainage ditch located within the Ciniza Refinery, in McKinley County, New Mexico.

The inactive land treatment area and drainage ditch sites were identified as a Solid Waste Management Units (SWMU), and designated as SWMU #9 and #14 respectively, during a RCRA Facility Investigation conducted at the refinery in the early 1990's. This investigation included soil sampling and analysis, determined that no significant impact had occurred, and recommended no further action (NFA).

Findings and recommendations were reported to the Environmental Protection Agency Region VI Office (EPA) in 1991 and 1992.

This summary report for SWMUs #9 and #14 has been prepared in conjunction with submittal of a Resource Conservation and Recovery Act (RCRA) Part B permit application covering post closure care of the Ciniza Refinery Land Treatment Unit. All investigative activities for SWMUs #9 and #14 have been completed. This assessment is summarized as follows.

- ⇒ The inactive land treatment area and associated drainage ditch remain inactive and vacant. No indication of current waste treatment was evident. No soil staining or residual waste material was observed.
- ⇒ The site is naturally revegetating. No distressed vegetation was evident.
- ⇒ Local soil underlying the site predominantly consists of bentonitic clays and silts having a very low hydraulic conductivity.
- ⇒ Soil sampling and analysis was conducted during an initial site investigation. Trace organic contaminants were detected below corrective action levels. The site was recommended for NFA.
- ⇒ SWMUs #9 and #14 have been characterized in accordance with current applicable state and federal regulations, and the available data indicate that no significant environmental impact or migration has occurred.

2.0 BACKGROUND

During 1987, a RCRA Facility Assessment was conducted at the Ciniza Refinery. This assessment identified various "solid waste management units" and recommended further evaluation. A RCRA Facility Investigation (RFI) was subsequently conducted and the inactive land treatment area and associated drainage ditch were identified as SWMU #9 and SWMU #14, respectively.

Applied Earth Sciences (AES) investigated the inactive land treatment area and drainage ditch sites during the early 1990s. Soil samples were collected and analyzed. Trace organic contaminants were detected in a few samples. Trace metals were detected in all samples; all of which indicated levels within the range of ambient background concentration.

As a result of the investigation, AES recommended no further action for these SWMUs. Results and recommendations were reported to the EPA in 1991 and 1992.

3.0 SITE LOCATION AND DESCRIPTION

SWMUs #9 and #14 are located within the Ciniza Refinery's property boundary. This refinery is located on the north side of Interstate 40, approximately 17 miles east of Gallup, New Mexico. Within the refinery, SWMUs #9 and #14 are contiguous and located approximately 200 feet north of the tank farm and 300 feet west of the railcar loading spur. See Figure No. 1 for location details.

The inactive land treatment area is a rectangular flat site measuring approximately 80 feet wide by 130 feet long. Oily wastes were formerly biodegraded on this site.

The associated drainage ditch is a man-made shallow channel cut into the earth along the western boundary of the inactive land treatment area. The ditch is approximately 3 feet wide by 2 feet deep by 150 feet long.

The inactive land treatment area and associated drainage ditch were placed in service in 1958. Land treatment area operations were discontinued in the early 1980's.

4.0 SITE INSPECTION

During the week of March 23, 1998, an on-site inspection was performed. Observations are noted as follows:

- The inactive land treatment area and associated drainage ditch were observed vacant and inactive. No sign of soil staining or residual waste was evident in either location.

- Native shrubs and grasses were observed growing throughout the general vicinity and thickly within the drainage ditch. No signs of distress were evident.

- Local soil in the vicinity of these SWMUs presented as bentonitic clays and silts. Similar soil strata from a neighboring SWMU exhibited a hydraulic conductivity of less than 10^{-7} cm/sec.

5.0 DATA REVIEW

Soil samples from within the inactive land treatment area and along the associated drainage ditch were collected and analyzed during the initial site investigation.

In 1990, the initial site investigation collected samples from seven locations and four depths; surface, 3, 5, and 7 feet below ground surface. Four of these locations were within the inactive land treatment area and three were along the drainage ditch.

Analysis detected trace VOC (ethanol) in six samples and trace SVOC in one sample. The highest detection of VOC was 24 mg/kg and the highest detection of SVOC was 26 mg/kg. The VOC was detected in several subsurface samples and the SVOC was detected in a single surface sample. The remaining 21 samples indicated no detection of either VOCs or SVOCs.

State of New Mexico corrective action levels for total hydrocarbons and BTEX in soil is 100 mg/kg and 50 mg/kg, respectively. All samples were below these action levels.

Trace metals were detected in all samples; all of which indicated levels within the range of ambient background concentration.

6.0 ASSESSMENT

Based on the site inspection and data review, the inactive land treatment area and drainage ditch site is assessed as follows.

- The inactive land treatment area and associated drainage ditch are inactive, vacant, and naturally revegetating.

- The inactive land treatment area and associated drainage ditch are located in a geologic setting in which the underlying bentonitic soil has a very low hydraulic conductivity which effectively serves as an aquiclude.

- Trace detection of VOC (ethanol) is below action levels. Also, ethanol is readily biodegradable and will naturally attenuate. Trace detection of SVOC is also below action levels. This detection is from a single surface sample and may represent an anomalous data point. The low level of detection for these contaminants is indicative of no significant impact.

- The no further action finding that was recommended by AES is appropriate for this site.

7.0 PROFESSIONAL ENGINEER'S CERTIFICATION

This summary report for SWMUs #9 and #14 has been prepared under the direct supervision and control of a Registered Professional Engineer.

Client: Ciniza Refinery
Giant Refining Company
Route 3, Box 7
Gallup, New Mexico 87301

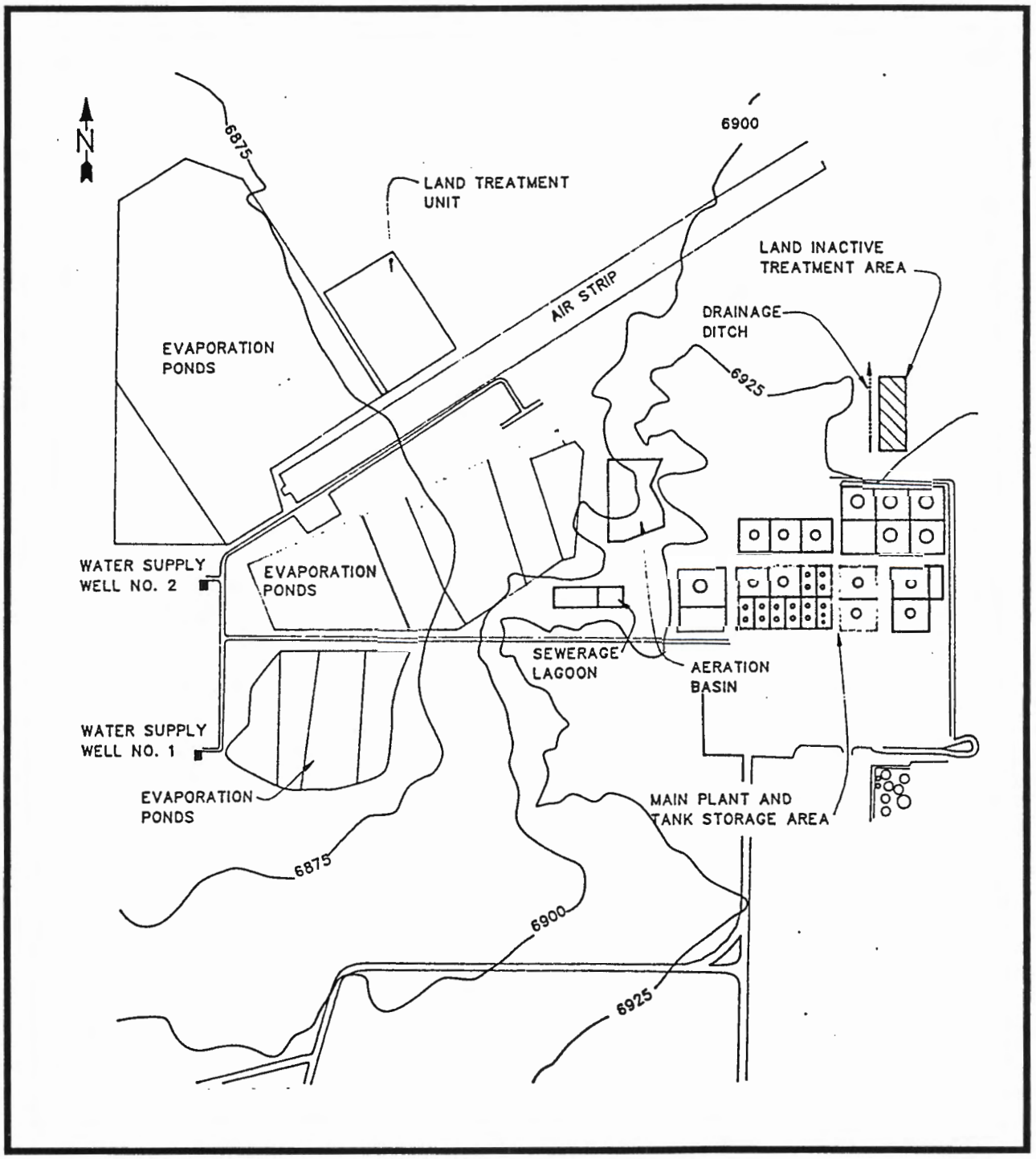
Job No.: 98-205-03

Date: April 23, 1998

Prepared and Certified by:

Thomas D. Atwood, P.E.
Colorado Registration No. 22866

Figure No. 1
Inactive Land Treatment Area & Drainage Ditch Site

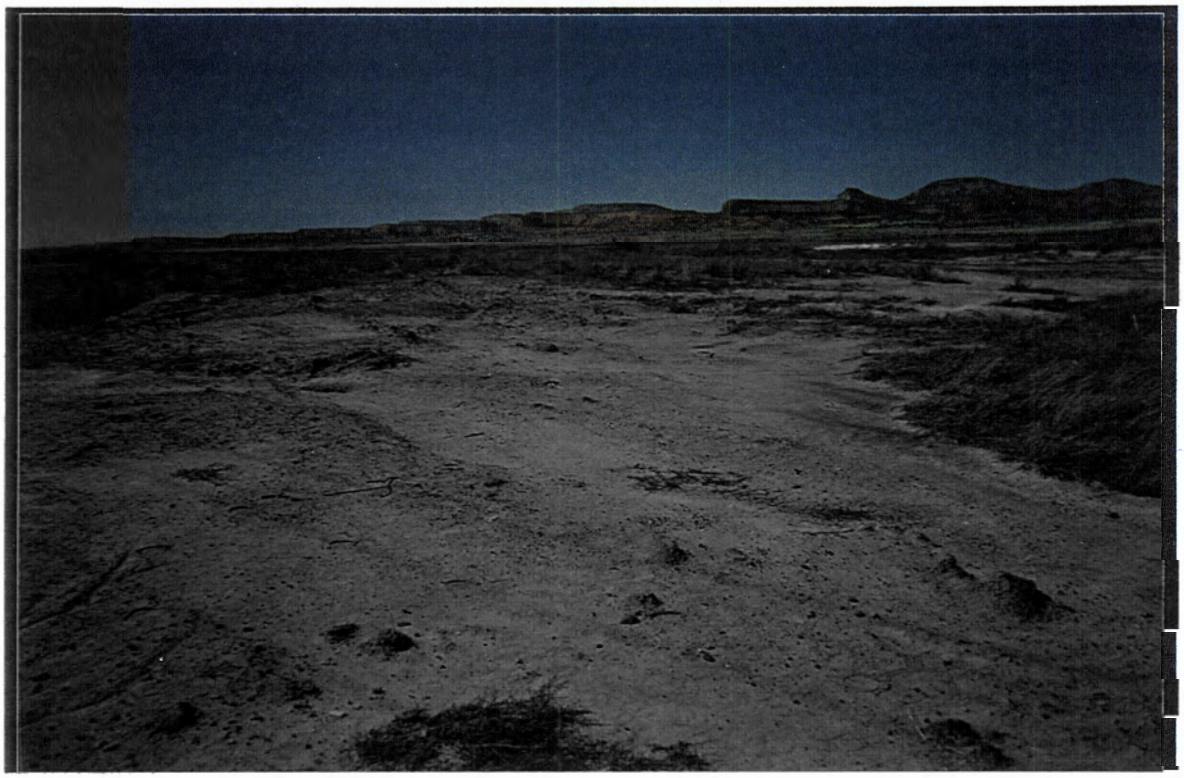


APPENDIX I-10

Sludge Pits - SWMU No. 10 Summary

SWMU #10 Summary Report

Sludge Pits
Ciniza Refinery
McKinley County, New Mexico



Prepared for:

Ciniza Refinery
Giant Refining Company
Route 3, Box 7
Gallup, New Mexico 87301

Prepared by:

Practical Environmental Services, Inc.
1444 Wazee Street, Suite 225
Denver, Colorado 80202

Job No. 98-205-03

April 23, 1998

1.0 EXECUTIVE SUMMARY

Practical Environmental Services, Inc. (PES) has been retained by Giant-Ciniza Refinery (Ciniza) to perform a visual inspection, data evaluation, and status assessment for the sludge pits located at the Ciniza Refinery, in McKinley County, New Mexico.

The sludge pits area was identified as a Solid Waste Management Unit (SWMU), and designated as SWMU #10, during a RCRA Facility Investigation (RFI) conducted at the refinery in the early 1990's. This investigation included soil sampling and analysis, detected organic contaminants, and recommended corrective action.

In 1994, the Environmental Protection Agency Region VI Office (EPA) requested additional sampling at greater depth. Results confirmed previous findings. A corrective plan was prepared by Ciniza and approved by the EPA.

This summary report for SWMU #10 has been prepared in conjunction with submittal of a Resource Conservation and Recovery Act (RCRA) Part B permit application covering post closure care of the Ciniza Refinery Land Treatment Unit. All investigative activities for SWMU #10 have been completed. This assessment is summarized as follows.

- ⇒ Sludge was removed from the pits in 1980 and replaced with clean soil. The site was then covered with a layer of clean soil.
- ⇒ Soil sampling and analysis was conducted during an initial site investigation and subsequent re-investigation at greater depth. Organic contaminants were detected above corrective action levels.
- ⇒ SWMU #10 has been characterized in accordance with current applicable state and federal regulations.
- ⇒ Installation of an engineered earthen cap is recommended as corrective action for this site.

2.0 BACKGROUND

During 1987, a RCRA Facility Assessment was conducted at the Ciniza Refinery. This assessment identified various "solid waste management units" and recommended further evaluation. A RCRA Facility Investigation was subsequently conducted and the sludge pits area was identified as SWMU #10.

Applied Earth Sciences (AES) investigated the sludge pits area during the early 1990s. Soil samples were collected and analyzed. Organic contaminants were detected above State of New Mexico corrective action levels. Trace metals were also detected; of which, a few samples indicated levels slightly above ambient background concentration.

As a result of the investigation, AES recommended tilling the site to promote natural attenuation of organics, followed by capping to contain residual metals. Results and recommendations were reported to the EPA in 1990. In 1994, the EPA requested additional sampling at greater depth. Follow-up sampling and analysis confirmed the original findings.

3.0 SITE LOCATION AND DESCRIPTION

SWMU #10 is located within the Ciniza Refinery's property boundary. This refinery is located on the north side of Interstate 40, approximately 17 miles east of Gallup, New Mexico. Within the refinery, SWMU #10 is located approximately 200 feet southwest of the API separator. See Figure No. 1 for location details.

The sludge pits area is an oblong flat site measuring approximately 120 feet wide by 200 feet long. Within this area, two pits were previously excavated and filled with oily waste from the API separator.

In 1980, the sludge was removed from the pits and replaced with clean fill soil. The site was then covered with a layer of clean soil.

4.0 SITE INSPECTION

During the week of March 23, 1998, an on-site inspection was performed. Observations are noted as follows:

- The sludge pits area was observed vacant and inactive. No sign of soil staining or residual waste was evident at or in the vicinity of the site.
- Native shrubs and grasses were observed growing throughout the general vicinity. No signs of distress were evident.
- Local soil in the vicinity of the sludge pits presents as bentonitic clays and silts. Similar soil strata from a neighboring SWMU exhibited a hydraulic conductivity of less than 10^{-7} cm/sec.

5.0 DATA REVIEW

Soil samples from within the sludge pits area were collected and analyzed during the initial site investigation and subsequent re-sampling at greater depth.

In 1990, the initial site investigation collected samples at eight locations and multiple depths; including surface, 3, 6, 9, and 12.5 feet below ground surface. VOCs were detected in 7 of 27 samples; of which, xylenes at 540 mg/kg represented the highest detection. SVOCs were detected in 10 of 27 samples; of which, methylnaphthalene at 1,400 mg/kg represented the highest detection.

In 1995, a second round of sampling and analysis was conducted at eight locations and depths of 19 and 25 feet below ground surface. No VOCs were detected in any sample. Trace SVOCs were detected in four samples; of which, di-n-butyl phthalate at 13 mg/kg represents the highest detection.

State of New Mexico corrective action levels for BTEX in soil is 50 mg/kg total and 10 mg/kg of benzene. Seven of 43 samples indicated BTEX constituents, the highest of which was over 900 mg/kg total; which is above the 50 mg/kg action level.

All samples detected trace metals; of which, chromium and lead were detected at levels above ambient background concentration.

6.0 ASSESSMENT

Based on the site inspection and data review, the sludge pits area is assessed as follows.

- Oily waste originally placed in the sludge pits has been substantially removed and the pits now contain a mixture of residual waste and backfilled clean soil.

- Residual organic contaminants, consisting of both VOCs and SVOCs, are present in moderate concentrations and substantially confined to a 20 foot soil layer beneath the surface cover.

- Residual metal contaminants, consisting primarily of chromium and lead, are present in the same soil layer at elevated levels.

- The currently approved CAP recommends excavation and tilling to enhance biodegradation of organics. This technique will expose soil metals to oxidation and precipitation; thereby mobilizing these contaminants and promoting migration.

- Local soil underlying this site has a very low hydraulic conductivity which effectively inhibits outward migration of contaminants.

- An alternative corrective action is recommended. Installation of an engineered soil cap represents a preferred and appropriate remedy for this site.

7.0 PROFESSIONAL ENGINEER'S CERTIFICATION

This summary report for SWMU #10 has been prepared under the direct supervision and control of a Registered Professional Engineer.

Client: Ciniza Refinery
Giant Refining Company
Route 3, Box 7
Gallup, New Mexico 87301

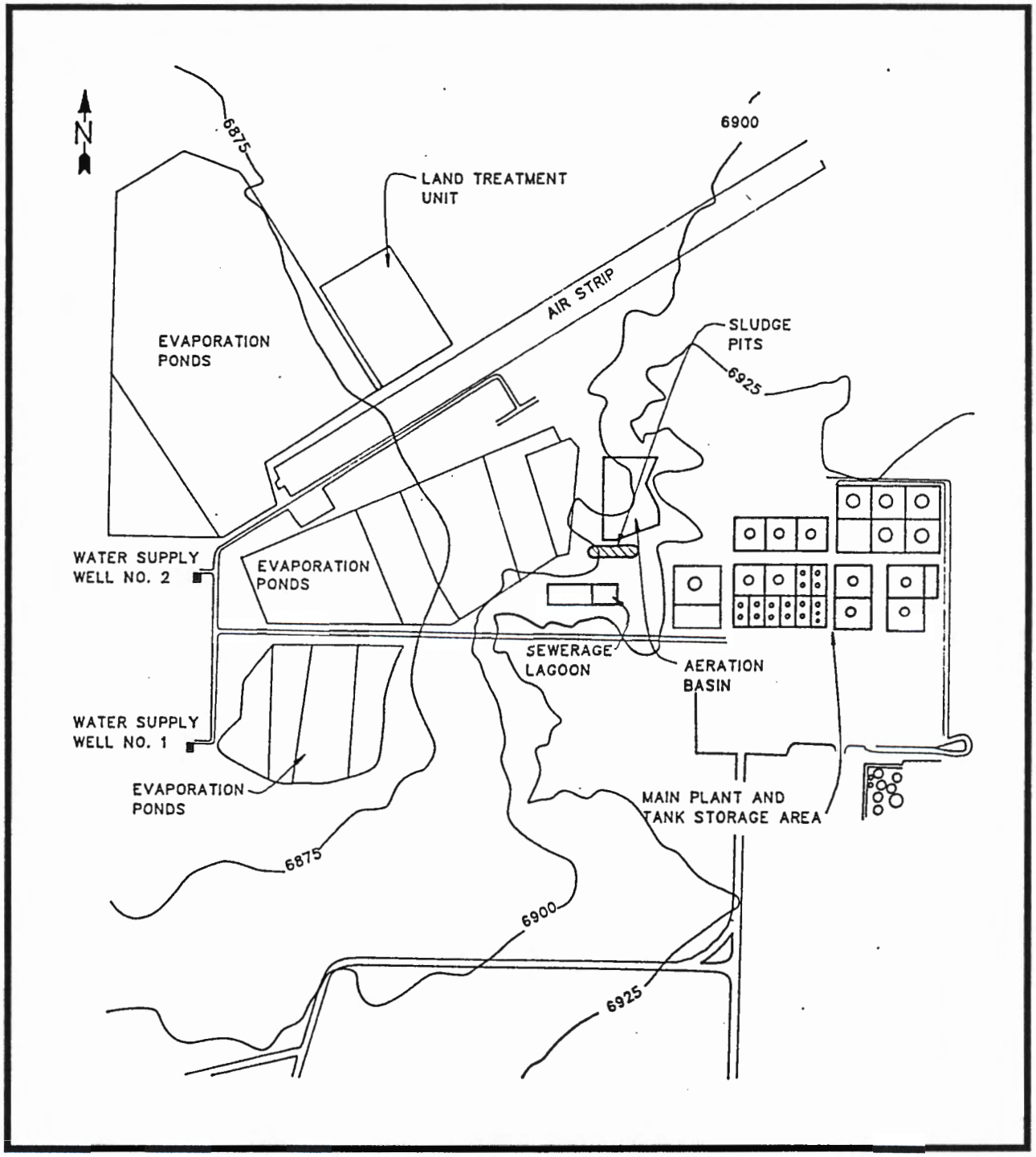
Job No.: 98-205-03

Date: April 23, 1998

Prepared and Certified by:

Thomas D. Atwood, P.E.
Colorado Registration No. 22866

Figure No. 1
Sludge Pits Area



APPENDIX I-11

Secondary Oil Skimmer - SWMU No. 11 Summary

SWMU #11 Summary Report

Secondary Oil Skimmer
Ciniza Refinery
McKinley County, New Mexico

Prepared for:

Ciniza Refinery
Giant Refining Company
Route 3, Box 7
Gallup, New Mexico 87301

Prepared by:

Practical Environmental Services, Inc.
1444 Wazee Street, Suite 225
Denver, Colorado 80202

Job No. 98-205-03

April 23, 1998

1.0 EXECUTIVE SUMMARY

Practical Environmental Services, Inc. (PES) has been retained by Giant-Ciniza Refinery (Ciniza) to perform a visual inspection, data evaluation, and status assessment for the secondary oil skimmer located at the Ciniza Refinery, in McKinley County, New Mexico.

The secondary oil skimmer site was identified as a Solid Waste Management Unit (SWMU), and designated as SWMU #11, during a RCRA Facility Investigation (RFI) conducted at the refinery in the early 1990's. This investigation included soil sampling and analysis, detected organic contaminants, and recommended no further action (NFA).

In 1994, the Environmental Protection Agency Region VI Office (EPA) requested additional sampling at greater depth. Trace organic contaminants were again detected and remediation by natural attenuation was recommended.

This summary report for SWMU #11 has been prepared in conjunction with submittal of a Resource Conservation and Recovery Act (RCRA) Part B permit application covering post closure care of the Ciniza Refinery Land Treatment Unit. All investigative activities for SWMU #11 have been completed. This assessment is summarized as follows.

- ⇒ The secondary oil skimmer enclosure has been removed and is no longer present in the drainage ditch adjoining Evaporation No. 4.
- ⇒ Soil sampling and analysis was conducted during an initial site investigation and subsequent re-investigation at greater depth. Organic contaminants were detected in both investigations.
- ⇒ BTEX constituents have been detected at levels exceeding New Mexico corrective action levels.
- ⇒ Contaminated soil should be removed from the site and replaced with clean fill dirt prior to closure.

2.0 BACKGROUND

During 1987, a RCRA Facility Assessment was conducted at the Ciniza Refinery. This assessment identified various "units of concern" and recommended further evaluation. A RCRA Facility Investigation was subsequently conducted and the secondary oil skimmer site was identified as SWMU #11.

Applied Earth Sciences (AES) investigated the secondary oil skimmer site during the early 1990s. Soil samples were collected and analyzed. Organic contaminants, including BTEX constituents, were detected.

As a result of the investigation, AES recommended no further action for this SWMU. Results and recommendations were reported to the EPA in 1992.

In 1994, the EPA requested additional sampling at greater depth. Follow-up sampling and analysis again detected organic contaminants.

3.0 SITE LOCATION AND DESCRIPTION

SWMU #11 is located within the Ciniza Refinery's property boundary. This refinery is located on the north side of Interstate 40, approximately 17 miles east of Gallup, New Mexico. Within the refinery, SWMU #11 is located along the drainage ditch south of Evaporation Pond No. 5. See Figure No. 1 for location details.

The secondary oil skimmer site is a rectangular area measuring approximately 10 feet wide by 25 feet long, and centered over an earthen stormwater drainage ditch. Within this area, a steel box was previously installed and used to collect suspended oil and sediment from stormwater flowing through the ditch. This box was known as the secondary oil skimmer.

4.0 SITE INSPECTION

During the week of March 23, 1998, an on-site inspection was performed. Observations are noted as follows:

- The secondary oil skimmer box has been removed and is no longer present at the site.
- At the time of the inspection, no water was present in the ditch.
- Local soil in the vicinity of the secondary oil skimmer site presents as bentonitic clays and silts. Similar soil strata from a neighboring SWMU exhibited a hydraulic conductivity of less than 10^{-7} cm/sec.
- No soil staining or distressed vegetation was present at or in the vicinity of the secondary oil skimmer site.

5.0 DATA REVIEW

Soil samples from within the secondary oil skimmer site were collected and analyzed during the initial site investigation and subsequent re-sampling at greater depth.

In 1992, the initial site investigation collected samples at two locations and two depths; surface and 3 feet below ground surface. Trace VOCs and SVOCs were detected in three of four samples; of which, xylenes at 98 mg/kg and ethylbenzene at 15 mg/kg represented the highest detections. Most of the remaining constituents were detected in much lower concentrations, typically less than 5 mg/kg.

In 1994, a second round of sampling and analysis was conducted at two locations and depths of 6 and 10 feet below ground surface. Xylenes were detected in one sample at 5 mg/kg at a depth of 6 feet and 0.5 mg/kg at a depth of 10 feet.

State of New Mexico corrective action levels for BTEX in soil is 50 mg/kg total and 10 mg/kg of benzene. Four of six samples indicated BTEX constituents, the highest of which was over 100 mg/kg total; which is above the 50 mg/kg action level.

6.0 ASSESSMENT

Based on the site inspection and data review, the secondary oil skimmer site is assessed as follows.

- The secondary oil skimmer is no longer present in the drainage ditch. Oily stormwater no longer flows in the drainage ditch.
- Soil sampling and analysis has detected organic contaminants, primarily BTEX constituents, at the site. Significant contamination is localized to single "hot spot" underlying the former location of the skimmer box.
- Contaminated soil should be removed from the site and replaced with clean fill dirt prior to closure.

7.0 PROFESSIONAL ENGINEER'S CERTIFICATION

This summary report for SWMU #11 has been prepared under the direct supervision and control of a Registered Professional Engineer.

Client: Ciniza Refinery
Giant Refining Company
Route 3, Box 7
Gallup, New Mexico 87301

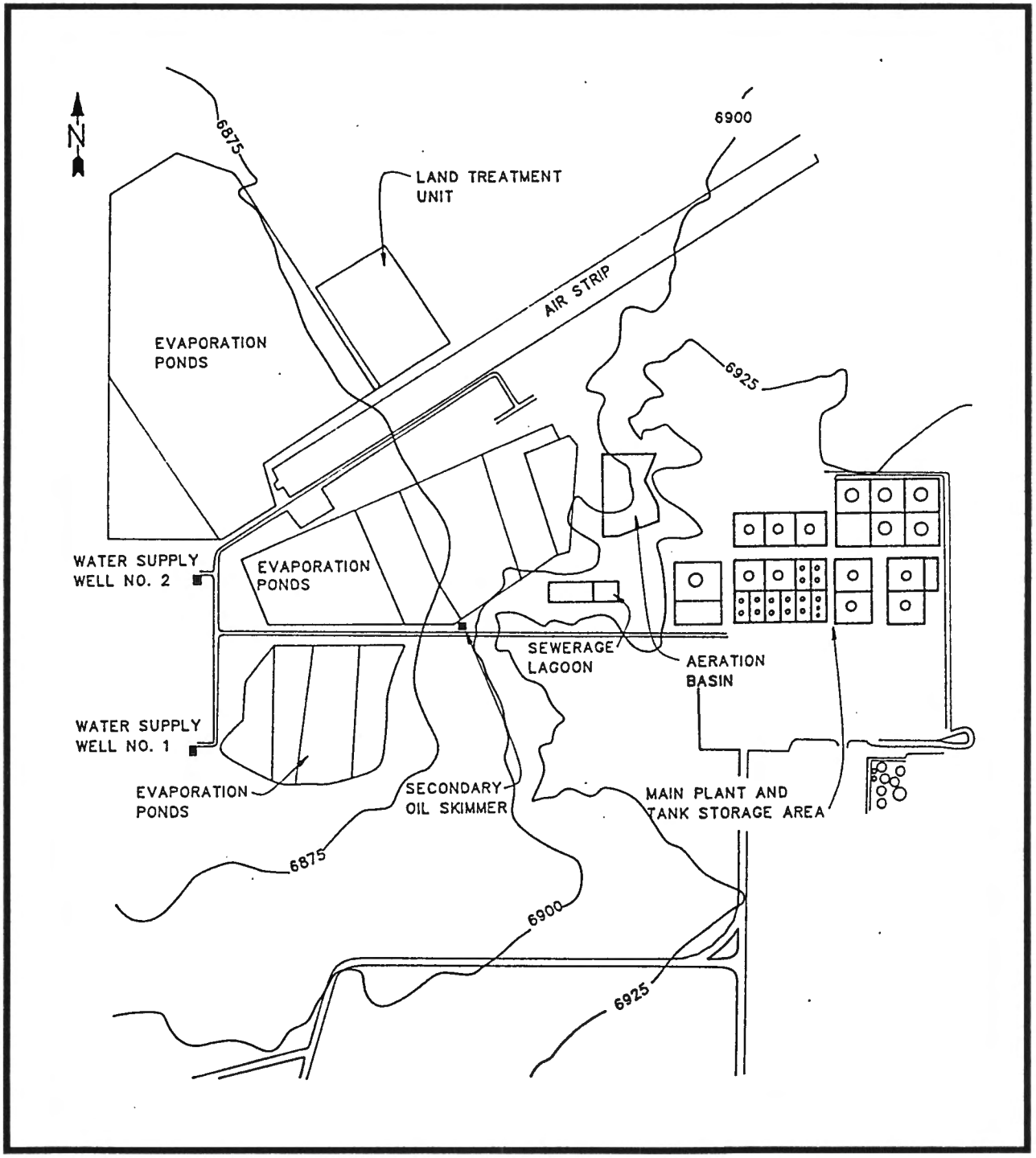
Job No.: 98-205-03

Date: April 23, 1998

Prepared and Certified by:

Thomas D. Atwood, P.E.
Colorado Registration No. 22866

Figure No. 1
Secondary Oil Skimmer Area



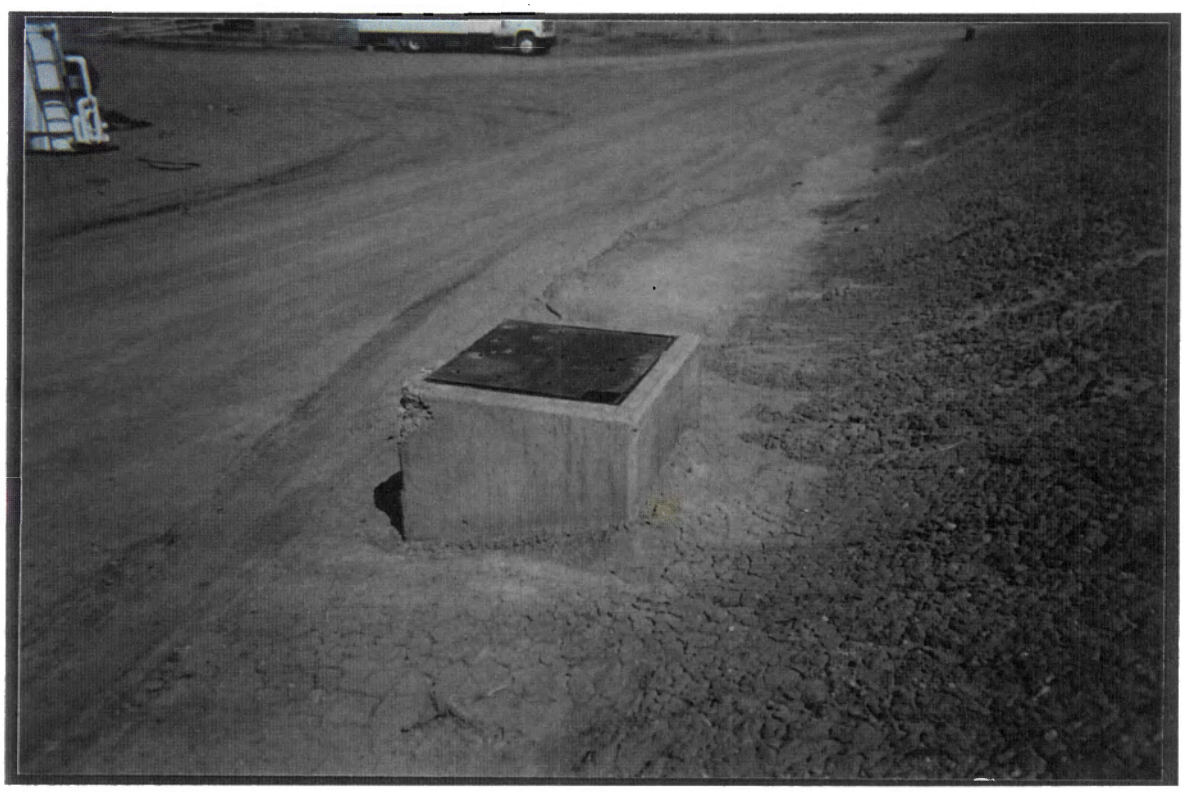
APPENDIX I-12

Contact Wastewater Collection System - SWMU No. 12 Summary

SWMU #12 Summary Report

Contact Wastewater Collection System

Ciniza Refinery
McKinley County, New Mexico



Prepared for:

Ciniza Refinery
Giant Refining Company
Route 3, Box 7
Gallup, New Mexico 87301

Prepared by:

Practical Environmental Services, Inc.
1444 Wazee Street, Suite 225
Denver, Colorado 80202

Job No. 98-205-03

April 23, 1998

1.0 EXECUTIVE SUMMARY

Practical Environmental Services, Inc. (PES) has been retained by Giant-Ciniza Refinery (Ciniza) to perform a visual inspection, data evaluation, and status assessment for the contact wastewater collection system located within the Ciniza Refinery, in McKinley County, New Mexico.

The contact wastewater collection system was identified as a Solid Waste Management Unit (SWMU), and designated as SWMU #12, during a RCRA Facility Investigation (RFI) conducted at the refinery in the early 1990's. This investigation included a visual inspection of underground piping and catch basins, determined that no leakage had occurred, and recommended no further action (NFA).

In 1994, the Environmental Protection Agency Region VI Office (EPA) requested that inspections be performed every five years.

This summary report for SWMU #12 has been prepared in conjunction with submittal of a Resource Conservation and Recovery Act (RCRA) Part B permit application covering post closure care of the Ciniza Refinery Land Treatment Unit. This assessment is summarized as follows.

- ⇒ In 1992, a video camera inspection of the underground piping and catch basins was conducted. No indications of leakage were detected.
- ⇒ The stormwater collection system within the refinery was replaced in 1997. The process wastewater collection system is scheduled to be replaced during 1999.
- ⇒ Routine surveillance of the wastewater collection system is mandated as a condition of New Mexico Oil Conservation Division (NMOCD) Discharge Plan GW-032.

2.0 BACKGROUND

During 1987, a RCRA Facility Assessment was conducted at the Ciniza Refinery. This assessment identified various "units of concern" and recommended further evaluation. A RCRA Facility Investigation was subsequently conducted and the contact wastewater system was identified as SWMU #12.

Cook Construction Company conducted a comprehensive video surveillance of the contact wastewater collection system during 1992. All underground piping and catch basins were examined. No indications of leakage were detected.

As a result of the investigation, no further action was recommended for this SWMU. Results and recommendations were reported to the EPA in 1992. In 1994, the EPA requested that inspections be performed every five years.

3.0 SITE LOCATION AND DESCRIPTION

SWMU #12 is located within the Ciniza Refinery's property boundary. This refinery is located on the north side of Interstate 40, approximately 17 miles east of Gallup, New Mexico. Within the refinery, SWMU #12 is located predominantly within the process unit area and includes a main trunk line running to the API Separator. See Figure No. 1 for location details.

The contact wastewater collection system is a component of the refinery wastewater treatment system. It consists of a network of underground piping and catch basins which are located beneath various refinery processing units and used to collect process wastewater. This wastewater flows by gravity through the system and to the API separator.

This system was installed in 1957 when the refinery was constructed and has operated continuously since that time.

4.0 SITE INSPECTION

During the week of March 23, 1998, an on-site inspection was performed. Observations are noted as follows:

- The piping component of the contact wastewater collection system is located below grade and cannot be directly viewed. A representative number of catch basins were opened and inspected. No signs of waste accumulation, deterioration, or leakage were evident.

- Local soil in the vicinity of the contact wastewater system presents as bentonitic clays and silts. Similar soil strata from a neighboring SWMU exhibited a hydraulic conductivity of less than 10^{-7} cm/sec.

5.0 DATA REVIEW

Soil sampling and analysis was not performed at this site.

6.0 ASSESSMENT

Based on the site inspection and data review, the railroad rack lagoon area is assessed as follows.

- The contact wastewater collection system is scheduled for replacement in 1999. At that time, subsurface soil will be exposed for inspection. If contaminated soil is detected, it should excavated and removed prior to installation of the new piping and catch basins.

7.0 PROFESSIONAL ENGINEER'S CERTIFICATION

This summary report for SWMU #12 has been prepared under the direct supervision and control of a Registered Professional Engineer.

Client: Ciniza Refinery
Giant Refining Company
Route 3, Box 7
Gallup, New Mexico 87301

Job No.: 98-205-03

Date: April 23, 1998

Prepared and Certified by:

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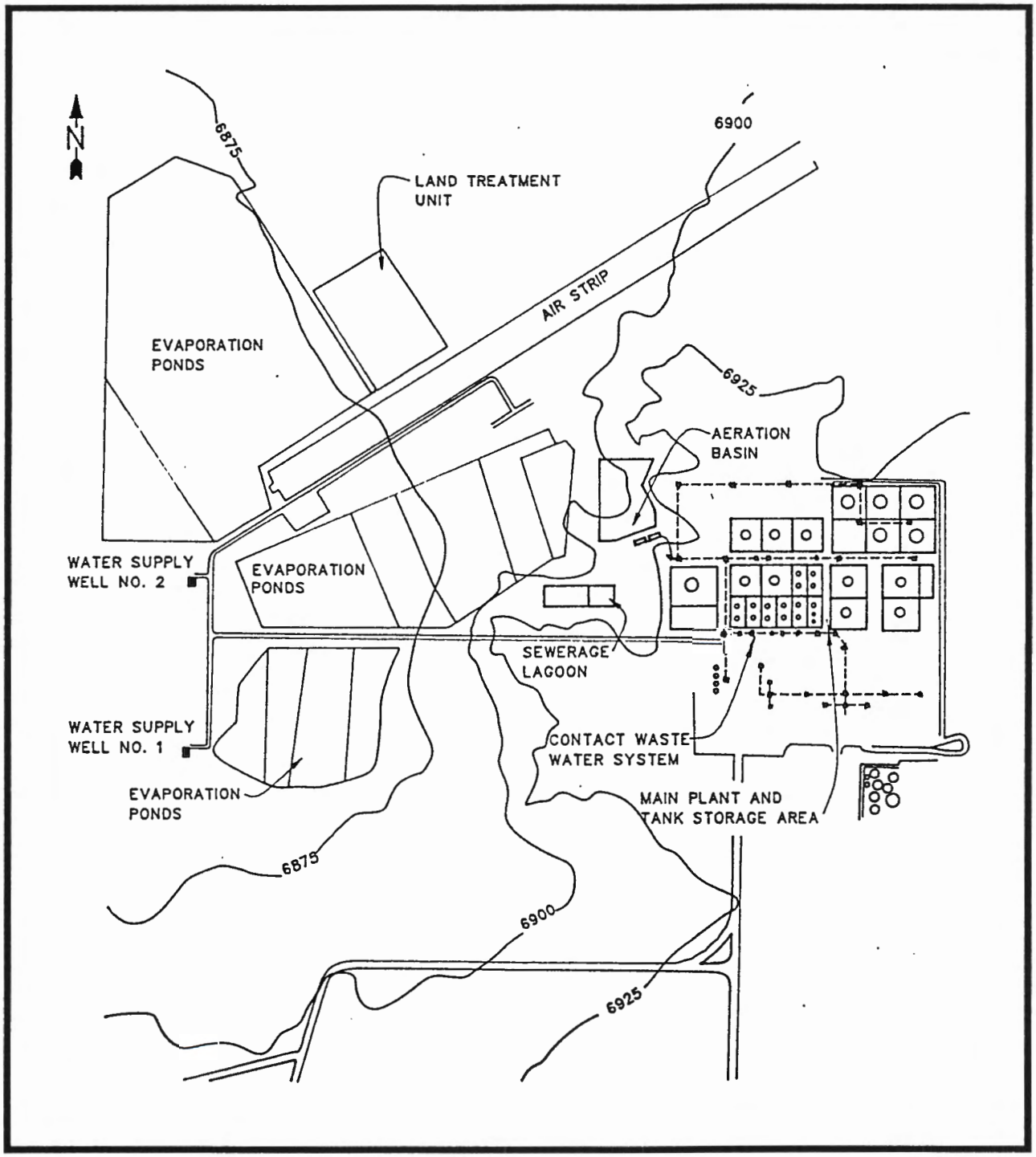
Colorado Registration No. 22866

Figure No. 1
Contact Wastewater Collection System



APPENDIX I-13

Drainage Ditch Between API Evaporation Ponds and Neutralization Tank Evaporation Ponds - SWMU No. 13 Summary

SWMU # 13 Summary Report

Drainage Ditch at Evaporation Ponds

Ciniza Refinery
McKinley County, New Mexico

Prepared for:

Ciniza Refinery
Giant Refining Company
Route 3, Box 7
Gallup, New Mexico 87301

Prepared by:

Practical Environmental Services, Inc.
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Job No. 98-205-03

April 23, 1998

1.0 EXECUTIVE SUMMARY

Practical Environmental Services, Inc. (PES) has been retained by Giant-Ciniza Refinery (Ciniza) to perform a visual inspection, data evaluation, and status assessment for the drainage ditch located at the evaporation ponds within the Ciniza Refinery, in McKinley County, New Mexico.

This drainage ditch site was identified as a Solid Waste Management Unit (SWMU), and designated as SWMU #13, during a RCRA Facility Investigation conducted at the refinery in the early 1990's. This investigation included soil sampling and analysis, determined that no significant impact had occurred, and recommended no further action (NFA).

In 1994, the Environmental Protection Agency Region VI Office (EPA) concurred in this finding, approved cessation of the investigative process, and requested follow-up soil monitoring. Monitoring samples were collected and analyzed in 1996, and the results confirmed that no significant impact has occurred.

This summary report for SWMU #13 has been prepared in conjunction with submittal of a Resource Conservation and Recovery Act (RCRA) Part B permit application covering post closure care of the Ciniza Refinery Land Treatment Unit. All investigative activities for SWMU #13 have been completed. This assessment is summarized as follows.

- ⇒ The drainage ditch located at the evaporation ponds continues in active service conveying wastewater to north area evaporation ponds.
- ⇒ Local soil underlying the drainage ditch predominantly consists of bentonitic clays and silts having a very low hydraulic conductivity.
- ⇒ Soil sampling and analysis was conducted during an initial site investigation and subsequent monitoring assessment. No organic contaminants were detected in any sample. Trace metals were detected within ambient background concentration. The site was recommended for NFA and approved by the EPA.
- ⇒ SWMU #13 has been characterized in accordance with current applicable state and federal regulations, and the available data indicate that no significant environmental impact or migration has occurred.

2.0 BACKGROUND

During 1987, a RCRA Facility Assessment was conducted at the Ciniza Refinery. This assessment identified various "units of concern" and recommended further evaluation. A RCRA Facility Investigation (RFI) was subsequently conducted and this drainage ditch site was identified as SWMU #13.

Applied Earth Sciences (AES) investigated this drainage ditch site during the early 1990s. Soil samples were collected and analyzed. No organic contaminants were detected in any sample. Trace metals were detected in all samples; all of which indicated levels within the range of ambient background concentration.

As a result of the investigation, AES recommended no further action for this SWMU. Results and recommendations were reported to the EPA in 1991. The EPA approved the NFA finding in 1994, with the added provision that on-going soil monitoring be performed every five years.

3.0 SITE LOCATION AND DESCRIPTION

SWMU #13 is located within the Ciniza Refinery's property boundary. This refinery is located on the north side of Interstate 40, approximately 17 miles east of Gallup, New Mexico. Within the refinery, SWMU #13 is located within the evaporation pond area and north of Evaporation Pond No. 2. See Figure No. 1 for location details.

The referenced drainage ditch is a component of the refinery wastewater treatment system. Effluent water from Evaporation Pond No. 10 is conveyed along the ditch and distributed to north area evaporation ponds.

SWMU #13 consists of a man-made earthen channel measuring approximately 20 feet wide by 120 feet long. Nominal water depth ranges from 1 to 4 feet. Total hydraulic holding capacity is approximately 50,000 gallons.

This drainage ditch was constructed in 1970's and has been in continuous operation since that time.

4.0 SITE INSPECTION

During the week of March 23, 1998, an on-site inspection was performed. Observations are noted as follows:

- The referenced drainage ditch was observed in active service conveying wastewater to north area evaporation ponds.
- Ditch sidewalls were visually inspected and found to be intact and stable. No erosion, damage, or sign of containment failure was observed.
- Native shrubs and grasses were observed growing around the perimeter of the ditch. No signs of distress were evident.
- Local soil in the vicinity of the drainage ditch presented as bentonitic clays and silts. Similar soil strata from a neighboring SWMU exhibited a hydraulic conductivity of less than 10^{-7} cm/sec.

5.0 DATA REVIEW

Soil samples from around the perimeter of the drainage ditch site were collected and analyzed during the initial site investigation and a subsequent monitoring assessment. Samples were collected at multiple locations and depths. Angled borings were made during the monitoring assessment to obtain samples from beneath the ditch.

In 1991, the initial site investigation collected samples from four locations and depths of 2 and 4 feet below ground surface. Analysis found no detection of VOCs or SVOCs in any sample. Trace metals were detected in all samples; all of which indicated levels within ambient background concentration.

In 1996, monitoring samples were collected at three locations at a depth of 6 feet below ground surface. As with the previous investigation, analysis found no detection of VOCs or SVOCs in any sample. Trace metals were detected in all samples; all of which indicated levels within ambient background concentration

6.0 ASSESSMENT

Based on the site inspection and data review, the aeration basins site is assessed as follows.

- The drainage ditch remains in active service conveying and distributing wastewater to north area evaporation ponds.
- The drainage ditch is located in a geologic setting in which the underlying bentonitic soil has a very low hydraulic conductivity which effectively serves as an aquiclude.
- The no further action finding that was recommended by AES and approved by the EPA is appropriate for this site.
- The next soil monitoring event is scheduled for 2001. If this sampling and analysis confirms previous findings, further monitoring is unnecessary and should be discontinued.

7.0 PROFESSIONAL ENGINEER'S CERTIFICATION

This summary report for SWMU #13 has been prepared under the direct supervision and control of a Registered Professional Engineer.

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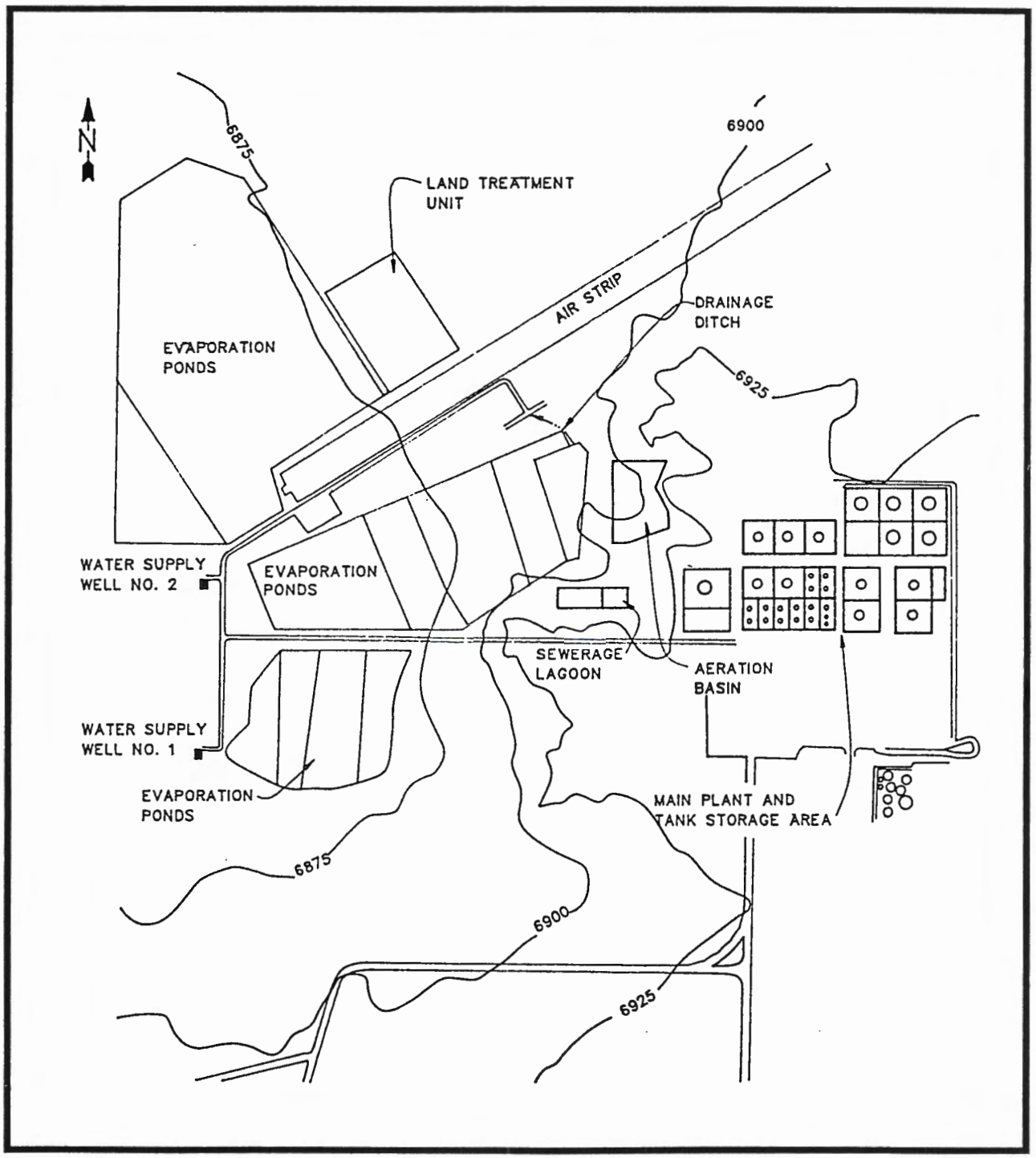
Figure No. 13
Drainage Ditch Site