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STAGE 1 & 2 REPORTS

DATE:
May 2000

WESTGATE SUBDIVISION
GRIMES BATTERY & TASKER ROAD

Stage 2 Abatement Plan Report

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ENVIRONMENTAL BUREAU
OIL CONSERVATION DIVISION

May 2000

SHELL EXPLORATION & PRODUCTION COMPANY
HOBBS, NEW MEXICO

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1.0 INTRODUCTION

This Stage 2 Abatement Plan for the Westgate Subdivision, Grimes Battery and Tasker Road, addresses the deficiencies noted by the New Mexico Oil Conservation Division (NMOCD) in their letter dated February 9, 2000.

The format of this Plan responds to each of the ten deficiencies listed by the NMOCD in the order listed in the letter. Additional information is also provided concerning the proposed test excavation and air sampling activities.

2.0 NMOCD DEFICIENCIES

2.1 Deficiency No. 1 – TPH Cleanup Levels Calculations

Risk-based screening of the site analytical data for both organic chemicals and TPH was completed in several steps:

- **#1. Individual Chemical Species.** Risk-based screening levels (RBSLs) were developed for individual chemical species in soil. These values and other relevant concentration criteria were compared to the soil concentrations for individual chemical species measured on the site.
- **#2. Total Petroleum Hydrocarbon (TPH) – Chemical Mixtures.** Site-specific RBSLs were developed for the fractionated TPH composition measured in nine soil samples from the site. The applicable lower limit derived from the nine fractionated TPH samples was used to screen the set of 110 measured analyses for TPH (method 418.1 and simulated distillation) in soil.
- **#3. Conservatism of TPH Screening Relative to Individual Chemical Species.** Co-located measured concentrations for both the individual indicator chemical species in soil and TPH in soil were compared to insure that the TPH RBSL value from point #2 would also be a protective level for any of the organic individual chemical indicator comparisons of point #1.

The purpose of discussion for this item is to illustrate the calculations used in deriving the TPH screening level. This screening level depends on the composition of the oil. Results from the nine soil sample analyses completed either using the TX1006 method or in the analysis by A. D. Little are shown in the following table.

Six of the nine fractionated TPH analyses were completed with an additional analysis of TPH (418.1) from the same co-located sample. For the remaining three samples, the nearest TPH 418.1 sample (spatially) is identified in this same table.

The TX1006 method showed non-detect for the benzene and toluene cut fractions. The nearest spatial sample analyzed using the more sensitive GC/MS analysis (EPA 8260) is also included in the following table. If a detected value for benzene or toluene was indicated from the EPA 8260 analysis, this value was substituted for the non-detected value from the TX1006 analysis in estimating the oil composition.

Sample location:	**TSB-7A**	**GBN-4**	**GBN-3**	**GBN-1**	**GBN-2**	**GSB-10 (BP)**	**GSB-9**	**TSB-7**	**TSB-8**
field sample ID:	T119262	T119263	T117628	T117626	T117627	T118813	T118812	(ADL)	(ADL)
Sample interval:	(2-3')	(6"-8")	(6")	(6")	(6")	(2-3')	(2-3')	2-3 ft	2-3 ft
Mass fraction analysis:	TX1006	TX1006	TX1006	TX1006	TX1006	TX1006	TX1006	ADLittle	ADLittle
Mass fraction distribution results:	(g/g-oil)	(g/g-oil)	(g/g-oil)	(g/g-oil)	(g/g-oil)	(g/g-oil)	(g/g-oil)	(g/g-oil)	(g/g-oil)
EC =&>6 to 8 aliphatic	0.013828	0	0	0	0	0.007856	0		
EC >8 to 10 aliphatic	0.026045	0	0	0	0	0.072009	0	0.00394	0.005778
EC >10 to 12 aliphatic	0.025705	0	0	0	0	0.071982	0	0	0
EC >12 to 16 aliphatic	0.077687	0	0.022038	0.024825	0	0.215708	0	0	0.02832
EC >16 to 35 aliphatic	0.161195	0.388765	0.580647	0.664856	0.601172	0.419922	0	0.117036	0.11603
Benzene (EC <6 to 7) arom.	0	0	0	0	0	0	0	1.52E-06	1.07E-06
Toluene (EC >7 to 8) arom.	0.000155	0	0	0	0	0	0	9.14E-07	7.12E-07
EC > 8 to 10 aromatic	0.006705	0	0.001038	0	0	0.01067	0	0.001166	0.006488
EC > 10 to 12 aromatic	0.008563	0	0	0	0	0.009343	0	0	0
EC >12 to 16 aromatic	0.037814	0	0.00736	0	0	0.037318	0.45629	0.02684	0.026732
EC >16 to 21 aromatic	0.422577	0.610494	0.388917	0.235583	0.382694	0.153865	0.4371	0.038949	0.029394
EC >21 to 35 aromatic	0.219727	0.000741	0	0.074735	0.016134	0.001327	0.10661	0.006494	0.004108
>C35 total								0.805573	0.783149
sum	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**

all values in (mg/kg-soil):

Closest available sample location for 418.1 TPH, otherwise same sample	**TSB-7, 2-3'**, SAMPLE: 106036, Table 3	**GMW-9, 8-10'**, SAMPLE: 106457, Table 3		**GSB-5, 2-3'**, SAMPLE: 106262, Table 3					
TPH (418.1)	20000	11900		<10		1960	24	57000	32000
Aliphatic and arom (C35<) sum	6457.9	6742	24185.1	3780.6	981	3762	41.9		
Unfractionated analysis	9413	9901	21841	5322	1217	6257	51	12749	9013.1

Measured values from benzene and toluene for method TX1006 (all values were non-detect):

Benzene	<10	<10	<10	<10	<10	<10	<10		
Toluene (TX1006)	<10	<10	<10	<10	<10	<10	<10		
Closest available sample Location for method EPA 8260, otherwise same sample value is shown:	**TSB-7, 2-3'**, SAMPLE: 106036, Table 3	**GMW-9, 8-10'**, SAMPLE: 106457, Table 3	**GMW-2, 13-15'**, SAMPLE: 103766, Table 3	**GSB-5, 2-3'**, SAMPLE: 106262, Table 3	**CSS # 1 to 5, 7, 8** (0-1ft) SAMPLE: 103639 to 44, 46	**GSB-8,11 (2-3')**, SAMPLE: 107016, 107159	**GSB-2 (5-6'), 3, 4 (2-3')**, SAMPLE: 105224, 107012, 107002		
Benzene (EPA 8260)	<0.232	<0.025	<0.025	<0.025	ND	<0.087	ND	0.02	0.0098
Toluene (EPA 8260)	1	<0.025	<0.025	<0.025	ND	<0.087	ND	0.012	0.0065

Calculation of Criteria:

This section illustrates the calculations that have been used in deriving the site-specific TPH screening criteria. The assumptions used identically match the 17 Sept report. Since the completion of the 17 Sept report, additional information has become available which could be used to change some of the prior risk assessment assumptions. This includes:

(#a) The Texas Natural Resource Conservation Commission (TNRCC) Risk Reduction Program Rule (30 TAC 350) assigns a hazard index target for chemical mixtures, including petroleum, of HI = 10 and HI = 1 for each individual cut. We have used HI = 1 for the total mixture as an assumption in this analysis.

(#b) The USEPA, Region 9 Preliminary Remediation Goals (PRGs) [1 Oct 1999], use recent guidance for dermal relative exposure factors for VOCs of zero, and SVOCs of 0.1. Using this updated guidance would set the dermal exposure for the volatile petroleum fraction to zero. [http://www.epa.gov/region09/waste/sfund/prg/]

(#c) The child dermal exposure factors for surface area and body weight used in the 17 Sept 1999 report could be modified. For the oil composition at this site the dermal exposure is small (1.2% of the total exposure for the TSB-7 2-3ft (ADL) sample). Changes to the dermal exposure factors would not significantly change the recommended screening level.

If these new assumptions were applied individually (compared to the values in the 17 Sept 1999 report), the derived TPH screening levels would either rise (point (#a); rise by up to several percent (point (#b); or (point (#c) decrease by up to several percent.

Detail of Calculations – Surficial Soil

The values for TPH screening for surficial soil were derived for each of nine soil analyses. The following detailed calculations are shown for sample TSB-7 2-3ft (ADL) which produced the surficial soil RBSL value used in the 17 Sept 1999 report. This derived surficial soil screening criteria was calculated as 2600 mg/kg (or 2650 mg/kg without roundoff).

For surficial soil, the controlling assumptions are for child receptor. The calculations correspond to a hazard index of one, HI = 1. Estimated exposure is due to summed:

- direct ingestion of soil
- dermal contact with soils
- inhalation of dust from soils
- inhalation of vapors from surface soils

The calculations in the Sept 17 report were done with the aid of an Excel spreadsheet, which included extensive macro calculations. The following numbers were taken from the spreadsheet with the calculations repeated individually for sample TSB-7 2-3ft (ADL).

The measured mass of TPH in soil for sample TSB-7 2-3ft (ADL) was 12749 mg/kg. The relative composition of this sample is used in these calculations, not the total value. The calculations are iterated for a high to low range of soil concentrations to converge to a soil concentration level for which HI = 1. In this case, for the child surficial soil residential exposure, the resulting soil concentration level after convergence is 2650 mg/kg at HI = 1. The measured sample concentration of 12749 mg/kg is above the calculated risk-based screening level of 2650 and this sample would not meet the estimated hazard criteria (HI = 1) for this exposure scenario. Concentrations of similar TPH composition which are less than 2650 mg/kg would meet the HI = 1 criteria.

The following detailed calculations are shown only for the resulting RBSL criteria of 2650 mg/kg (after the iteration and convergence step). The concentration distribution of cuts for sample TSB-7 2-3ft (ADL) at the level of 2650 mg/kg (for which HI = 1) is given by:

	chemical name	mass fraction (g/g-oil)		soil concentration (mg-oil/kg-soil)		mass concentration of cut in soil (mg/kg-soil)
1.	EC >8 to 10 aliphatic	3.94E-03	x	2650.1	=	10.4
2.	EC >16 to 35 aliphatic	1.17E-01	x	2650.1	=	310.2
3.	Benzene (EC <6 to 7) aromatic	1.52E-06	x	2650.1	=	4.0E-3
4.	Toluene (EC >7 to 8) aromatic	9.14E-07	x	2650.1	=	2.4E-3
5.	EC > 8 to 10 aromatic	1.17E-03	x	2650.1	=	3.1
6.	EC >12 to 16 aromatic	2.68E-02	x	2650.1	=	71.1
7.	EC >16 to 21 aromatic	3.89E-02	x	2650.1	=	103.2
8.	EC >21 to 35 aromatic	6.49E-03	x	2650.1	=	17.2
9.	EC > 35	8.06E-01	x	2650.1	=	2134.9
	sum total:	1				**2650.1**

Direct Ingestion of Soil

For a child receptor, the average daily uptake rate of soil due to ingestion is given by:

(exposure frequency) · (ingestion rate of soil) · (relative oral absorption factor) /
[(body weight) · (365 dy/yr)] =

(350 dy/yr) (200 mg/dy) (1.0) / [(15 kg) (365 dy/yr)] · (1.0E-6 kg/mg) = 1.28E-05 kg/(kg-dy)

The calculation of hazard quotient is:

	chemical name	mass concentration of cut in soil (mg/kg-soil)		oral reference dose RfDo (mg/kg-day)		average daily uptake rate - child (kg/kg-day)		hazard quotient
1.	EC >8 to 10 aliphatic	10.4	/	0.1	x	1.2785E-05	=	1.33E-03
2.	EC >16 to 35 aliphatic	310.2	/	2	x	1.2785E-05	=	1.98E-03
3.	Benzene (EC <6 to 7) aromatic	4.0E-3	/	0.2	x	1.2785E-05	=	2.58E-07
4.	Toluene (EC >7 to 8) aromatic	2.4E-3	/	0.2	x	1.2785E-05	=	1.55E-07
5.	EC > 8 to 10 aromatic	3.1	/	0.04	x	1.2785E-05	=	9.88E-04
6.	EC >12 to 16 aromatic	71.1	/	0.04	x	1.2785E-05	=	2.27E-02
7.	EC >16 to 21 aromatic	103.2	/	0.03	x	1.2785E-05	=	4.40E-02
8.	EC >21 to 35 aromatic	17.2	/	0.03	x	1.2785E-05	=	7.33E-03
9.	EC > 35	2134.9	/	0.03	x	1.2785E-05	=	9.10E-01
	sum total:	**2650.1**		**(ingestion) hazard index**			**=**	**9.88E-01**

This shows that the direct ingestion exposure for surficial soil comprises 98.8% (HI=0.988) of the total exposure for this oil composition, at 2650 mg/kg soil concentration, with a target hazard index, HI = 1. The other surficial soil exposure routes (dermal contact, inhalation of dust, and inhalation of vapors from surface soils) comprise the remaining 1.2% of the exposure. The calculations for the remaining surficial soil exposure routes are detailed in the following sections.

Dermal Soil Uptake

For a child receptor, the average daily uptake rate of soil due to dermal contact in the 17 Sept 1999 RBCA Tier 1 Summary Assessment Report is taken as

(exposure frequency) · (surface area) · (soil to skin adherence factor) · (dermal relative absorption factor) / [(body weight) · (365 dy/yr)] =

<u>or</u>

(350 dy/yr) (1567 cm^2/dy) (0.5 mg/cm^2) (dermal relative absorption factor) / [(70 kg) (365 dy/yr)]

The dermal relative absorption factor and thus the daily uptake rate depends on the cut of oil. These values effectively are:

		dermal relative absorption factor	average daily uptake rate – child - dermal contact
1.	EC >8 to 10 aliphatic	0.1	1.0733E-06
2.	EC >16 to 35 aliphatic	0.1	1.0733E-06
3.	Benzene (EC <6 to 7) aromatic	0.1	1.0733E-06
4.	Toluene (EC >7 to 8) aromatic	0.1	1.0733E-06
5.	EC > 8 to 10 aromatic	0.1	1.0733E-06
6.	EC >12 to 16 aromatic	0.1	1.0733E-06
7.	EC >16 to 21 aromatic	0.1	1.0733E-06
8.	EC >21 to 35 aromatic	0.1	1.0733E-06
9.	EC > 35	0.00375	4.0248E-08

The dermal relative absorption factor, RAFd, for cut no. 9 (EC > 35) is due to the lower dermal toxicity (RfDd = 0.8 mg/kg-day) than oral toxicity (RfDo = 0.03 mg/kg-day) for this cut. The effective tabulated value is RAFd (effective) = RAFd · RfDo/RfDd = 0.1 · (0.03 / 0.8). The calculation of hazard quotient for the dermal exposure route is:

	chemical name	mass concentration *of cut in soil* (mg/kg-soil)		oral reference dose RfDo (mg/kg-day)		average daily uptake rate – *child* (mg/kg-day)		*hazard quotient*
1.	EC >8 to 10 aliphatic	10.4	/	0.1	x	1.0733E-06	=	1.12E-04
2.	EC >16 to 35 aliphatic	310.2	/	2	x	1.0733E-06	=	1.66E-04
3.	Benzene (EC <6 to 7) aromatic	4.0E-3	/	0.2	x	1.0733E-06	=	2.17E-08
4.	Toluene (EC >7 to 8) aromatic	2.4E-3	/	0.2	x	1.0733E-06	=	1.30E-08
5.	EC > 8 to 10 aromatic	3.1	/	0.04	x	1.0733E-06	=	8.29E-05
6.	EC >12 to 16 aromatic	71.1	/	0.04	x	1.0733E-06	=	1.91E-03
7.	EC >16 to 21 aromatic	103.2	/	0.03	x	1.0733E-06	=	3.69E-03
8.	EC >21 to 35 aromatic	17.2	/	0.03	x	1.0733E-06	=	6.16E-04
9.	EC > 35	2134.9	/	0.03	x	4.0248E-08	=	2.86E-03
	sum total:	**2650.1**				**(dermal) hazard index**	**=**	**9.44E-03**

With these calculations, the dermal *fraction of the surficial soil exposure* is 0.94% (HI = 0.0094) of the total at 2650 mg/kg TPH.

Dust Inhalation From Soils

For the inhalation exposure route, the ratio of inhalation rate to body weight is relatively independent of age, therefore adult inhalation rate and body weight are used in the calculation (consistent with the development of the inhalation reference concentration).

The concentration of chemical in soil dust is directly proportional to the concentration in soil. A factor, VF_p, relating soil concentration to dust concentration is given by:

VF_p = (particulate emission rate) · (surface area) / [(air velocity) · (source width) · (mixing height)]

(6.9E-14 g/cm^2-sec) (20250000 cm^2) / [(225 cm/s) (4500 cm) (200 cm)] = 6.9E-15 g-soil/cm^3-air

Dust concentration is related to soil concentration

Cair,dust = VF_p · Csoil · (10^3 cm^3 – kg / m^3-g)

For each of the petroleum cuts (note the unit conversion):

	chemical name	mass concentration of cut in soil (mg/kg-soil)		particulate emission actor (g-soil/cm^3-air)		mass concentration of cut in air - dust (mg/m^3)
1.	EC >8 to 10 aliphatic	10.4	x	6.9E-15	=	7.20E-11
2.	EC >16 to 35 aliphatic	310.2	x	6.9E-15	=	2.14E-09
3.	Benzene (EC <6 to 7) aromatic	4.0E-3	x	6.9E-15	=	2.79E-14
4.	Toluene (EC >7 to 8) aromatic	2.4E-3	x	6.9E-15	=	1.67E-14
5.	EC > 8 to 10 aromatic	3.1	x	6.9E-15	=	2.13E-11
6.	EC >12 to 16 aromatic	71.1	x	6.9E-15	=	4.91E-10
7.	EC >16 to 21 aromatic	103.2	x	6.9E-15	=	7.12E-10
8.	EC >21 to 35 aromatic	17.2	x	6.9E-15	=	1.19E-10
9.	EC > 35	2134.9	x	6.9E-15	=	1.47E-08
	sum total:	**2650.1**				**1.83E-08**

For non-carcinogenic inhalation exposure, a reference concentration is used. A hazard index is calculated as the ratio of the actual (or estimated) air concentration to the reference concentration, with an adjustment for exposure frequency of:

EF / 365 = (exposure frequency) / (365 dy/yr) = (350 dy/yr / 365 dy/yr)

For each of the petroleum cuts:

	chemical name	mass concentration of cut in air - dust (mg/m^3)		reference concentration (mg/m^3)		exposure frequency fraction (EF/365)		hazard quotient
1.	EC >8 to 10 aliphatic	7.20E-11	/	1.05	x	0.9589	=	6.58E-11
2.	EC >16 to 35 aliphatic	2.14E-09	/	7	x	0.9589	=	2.93E-10
3.	Benzene (EC <6 to 7) aromatic	2.79E-14	/	0.35	x	0.9589	=	7.64E-14
4.	Toluene (EC >7 to 8) aromatic	1.67E-14	/	0.35	x	0.9589	=	4.58E-14
5.	EC > 8 to 10 aromatic	2.13E-11	/	0.175	x	0.9589	=	1.17E-10
6.	EC >12 to 16 aromatic	4.91E-10	/	0.175	x	0.9589	=	2.69E-09
7.	EC >16 to 21 aromatic	7.12E-10	/	0.105	x	0.9589	=	6.50E-09
8.	EC >21 to 35 aromatic	1.19E-10	/	0.105	x	0.9589	=	1.08E-09
9.	EC > 35	1.47E-08	/	0.105	x	0.9589	=	1.35E-07
	sum total:					**(dust inhalation) hazard index**	**=**	**1.45E-07**

Vapor Inhalation From Soils

The concentration of chemical vapor adjacent to soils containing crude oil can be described by a mixing factor relating soil concentrations to vapor concentrations in the breathing zone above the soil. This is a function of:

- the volatility, or vapor pressure, of the cut.
- the mixture composition.
- the mass of crude oil in the surface soil layer.

For each of the petroleum cuts (note the unit conversion):

	chemical name	mass concentration of cut in soil (mg/kg-soil)		vapor emission factor ($g\text{-soil}/cm^3\text{-air}$)		mass concentration of cut in air - vapor (mg/m^3)
1.	EC >8 to 10 aliphatic	10.4	x	1.80E-08	=	1.88E-04
2.	EC >16 to 35 aliphatic	310.2	x	4.82E-10	=	1.50E-04
3.	Benzene (EC <6 to 7) aromatic	4.0E-3	x	1.80E-08	=	7.26E-08
4.	Toluene (EC >7 to 8) aromatic	2.4E-3	x	1.80E-08	=	4.35E-08
5.	EC > 8 to 10 aromatic	3.1	x	1.80E-08	=	5.55E-05
6.	EC >12 to 16 aromatic	71.1	x	3.62E-09	=	2.58E-04
7.	EC >16 to 21 aromatic	103.2	x	4.83E-10	=	4.99E-05
8.	EC >21 to 35 aromatic	17.2	x	1.19E-11	=	2.05E-07
9.	EC > 35	2134.9	x	4.35E-14	=	9.29E-08
	sum total:	**2650.1**				**7.01E-04**

For each of the petroleum cuts, relating vapor concentration in air to a hazard quotient:

	chemical name	mass concentration of cut in air - vapor (mg/m³)		reference concentration (mg/m³)		exposure frequency fraction (EF/365)		hazard quotient
1.	EC >8 to 10 aliphatic	1.88E-04	/	1.05	x	0.9589	=	1.71E-04
2.	EC >16 to 35 aliphatic	1.50E-04	/	7	x	0.9589	=	2.05E-05
3.	Benzene (EC <6 to 7) aromatic	7.26E-08	/	0.35	x	0.9589	=	1.99E-07
4.	Toluene (EC >7 to 8) aromatic	4.35E-08	/	0.35	x	0.9589	=	1.19E-07
5.	EC > 8 to 10 aromatic	5.55E-05	/	0.175	x	0.9589	=	3.04E-04
6.	EC >12 to 16 aromatic	2.58E-04	/	0.175	x	0.9589	=	1.41E-03
7.	EC >16 to 21 aromatic	4.99E-05	/	0.105	x	0.9589	=	4.56E-04
8.	EC >21 to 35 aromatic	2.05E-07	/	0.105	x	0.9589	=	1.87E-06
9.	EC > 35	9.29E-08	/	0.105	x	0.9589	=	8.49E-07
						(vapor inhalation) hazard index	**=**	**2.37E-03**

Summary

For sample TSB-7 2-3ft (ADL), and repeating from the distribution of hazard indices calculated above, we have a summary table, at a specified concentration level of 2650 mg/kg, of:

cut:	ingestion fraction:	dermal fraction:	particulate inhalation fraction:	vapor inhalation fraction:	total:
1.	1.33E-03	1.12E-04	1.71E-04	6.58E-11	1.62E-03
2.	1.98E-03	1.66E-04	2.04E-05	2.93E-10	2.17E-03
3.	2.58E-07	2.17E-08	1.99E-07	7.64E-14	4.79E-07
4.	1.55E-07	1.30E-08	1.19E-07	4.58E-14	2.87E-07
5.	9.88E-04	8.29E-05	3.04E-04	1.17E-10	1.37E-03
6.	2.27E-02	1.91E-03	1.40E-03	2.69E-09	2.60E-02
7.	4.40E-02	3.69E-03	4.53E-04	6.50E-09	4.81E-02
8.	7.33E-03	6.16E-04	1.86E-06	1.08E-09	7.95E-03
9.	9.10E-01	2.86E-03	8.44E-07	1.35E-07	9.13E-01
total:	**9.88E-01**	**9.44E-03**	**2.35E-03**	**1.45E-07**	**1.00**

The total hazard index in the above table is HI = 1. The contributions of the measured petroleum cuts and exposure pathways are shown in the table matrix.

The above illustrated TPH calculation was for the residential child, surficial soil exposure pathway and Sample TSB-7 2-3ft (ADL). A composite table of TPH analysis values and derived screening levels follows for each of the nine fractionated TPH samples. This shows the soil mass concentrations of TPH and the derived Risk-Based Screening levels for the residential exposure scenario.

sample location:	**TSB-7A**	**GBN-4**	**GBN-3**	**GBN-1**	**GBN-2**	**GSB-10 (BP)**	**GSB-9**	**TSB-7**	**TSB-8**
field sample ID:	T119262	T119263	T117628	T117626	T117627	T118813	T118812	(ADL)	(ADL)
sample interval:	(2-3')	(6"-8")	(6")	(6")	(6")	(2-3')	(2-3')	2-3 ft	2-3 ft
mass fraction analysis:	TX1006	TX1006	TX1006	TX1006	TX1006	TX1006	TX1006	ADLittle	ADLittle

all values in (mg/kg-soil):

TPH (418.1)	20000	11900		<10		1960	24	57000	32000
aliphatic and arom (C35<) sum	6457.9	6742	24185.1	3780.6	981	3762	41.9		
unfractionated analysis	9413	9901	21841	5322	1217	6257	51	12749	9013.1

surficial soil exposure (HI = 1):

residential - child	■ 2955	■ 3483	■ 5236	□ 6576	□ 5278	□ 6736	□ 2388	■ 2650	■ 2711
residential - adult	■ 11414	□ 13584	■ 20429	□ 25730	□ 20620	□ 25881	□ 9175	■ 21060	■ 21323

soil leaching to groundwater ingestion (HI = 1):

residential	NA	NA	NA	NA	NA	NA	NA	NA	NA

subsurface soil volatilization (HI = 1):

to enclosed space - residential	□ NA	□ NA	□ NA	□ NA	□ NA	■ 1425 (a)	□ NA	□ NA	□ NA
to ambient air - residential	NA	NA	NA	NA	NA	NA	NA	NA	NA

(a) addressed in refined analysis for soil vapor exposure pathway.

The measured TPH values in the above table are compared to the calculated RBSL values in an exposure-pathway-specific comparison. The RBSL values exceeded by the lowest measured sample concentration at the same point are indicated by a filled square (□), while the values that are not exceeded are indicated by a blank square (□).

To further simplify the application of this result, we use the lowest calculated surficial soil value (2388 mg/kg, or 2400 mg/kg) in screening all of the measured TPH concentrations throughout the site. Repeating the above measured concentrations, and using the limiting residential child surficial soil exposure value of 2400 mg/kg as a screening level, we have:

sample location:	**TSB-7A**	**GBN-4**	**GBN-3**	**GBN-1**	**GBN-2**	**GSB-10 (BP)**	**GSB-9**	**TSB-7**	**TSB-8**
field sample ID:	T119262	T119263	T117628	T117626	T117627	T118813	T118812	(ADL)	(ADL)
sample interval:	(2-3')	(6"-8")	(6")	(6")	(6")	(2-3')	(2-3')	2-3 ft	2-3 ft
mass fraction analysis:	TX1006	TX1006	TX1006	TX1006	TX1006	TX1006	TX1006	ADLittle	ADLittle

all values in (mg/kg-soil):

TPH (418.1)	20000	11900		<10		1960	24	57000	32000
aliphatic and arom (C35<) sum	6457.9	6742	24185.1	3780.6	981	3762	41.9		
unfractionated analysis	9413	9901	21841	5322	1217	6257	51	12749	9013.1

surficial soil exposure (HI = 1):

lower limit of the set of values residential - child	■ 2400	■ 2400	■ 2400	■ 2400	□ 2400	■ 2400	□ 2400	■ 2400	■ 2400

Two samples, which met the sample-specific screening level, do not meet the more conservative overall 2400 mg/kg screening level.

For additional information see **Appendix I** (Risk-Based Corrective Action, Summary Report, Tier 1 Assessment Report) and **Appendix II** (Risk-Based Corrective Action Plan Data Worksheets).

2.2 Deficiency No. 2 – Lower TPH Risk Based Cleanup Level

The TPH calculations in this document are intended to be conservative. The calculations in the 17 Sept 1999 report and illustrated in **Item 1** use USEPA recommended 95% upper bound estimates for most exposure parameters (exposure duration, exposure frequency, etc.). The toxicity parameters (reference dose, reference concentration) include conservative safety factors ranging from 300 to 1000 times below measured no observed adverse effects levels. In this context the difference between the lowest calculated 2400 mg/kg and the 2600 mg/kg used in the 17 Sept 1999 is negligible.

The 17 Sept 1999 report indicates that individual indicator chemical RBSLs in soil were met for cases in which co-located TPH concentrations were below the 2600 mg/kg level. The same conclusion is reached for the 2400 mg/kg TPH screening level.

The 2400 mg/kg screening level for measured TPH has been used throughout the site.

For additional information see **Appendix I** (Risk-Based Corrective Action, Summary Report, Tier 1 Assessment Report) and **Appendix II** (Risk-Based Corrective Action Plan Data Worksheets).

2.3 Deficiency No. 3 – Residential vs. Non-residential Cleanup Levels

Comparison of site data to criteria based on exposure parameters other than residential use was done for completeness in the assessment. Future restrictions on the use of portions of the site within a residential area to non-residential use (that is, a park) would limit the potential exposure for those parts of the site to levels less than that expected in residential land use.

Residential soil cleanup levels will be applied in the remediation design throughout the site including a proposed park area. Appropriate notes and changes have been made to the report.

For additional information see **Appendix I** (Risk-Based Corrective Action, Summary Report, Tier 1 Assessment Report) and **Appendix II** (Risk-Based Corrective Action Plan Data Worksheets).

2.4 Deficiency No. 4 – Metals Cleanup Levels

The assessment of the Westgate site included analysis of over 100 soil samples for metals (using method 6010B and method S7471 for total mercury), including three background soil samples. The first step in the RBCA assessment was comparison of the maximum measured soil concentration in this data set (including site background) to surficial soil screening criteria. If the measured soil maximum concentration for a chemical was below the screening criteria, no further refinement of the assessment was warranted. **Chromium** and **arsenic** were the only metals for which the maximum measured value was greater than a surficial soil screening level.

Chromium

Appropriate surficial soil risk-based screening levels for chromium in residential soils from USEPA Regions are:

	Region 9	**Region 6**	**Region 9**	**Region 6**	**Region 3**
	Risk = 1E-6	Risk = 1E-6	HQ = 1	HQ = 1	HQ = 1
Total Chromium (1:6 ratio Cr VI:Cr III)	210	210			
Chromium III			12000	117321	117321
Chromium VI	30	30	230	391	235

The minimum of these values is 30 mg/kg for hexavalent chromium (Cr+6).

The RBCA surficial soil screening value used in the 17 Sept 1999 RBCA report (1.6E-02 mg/kg) presumes hexavalent chromium (Cr+6) in soil. It also presumes an inappropriate inhalation route to ingestion route extrapolation of carcinogenic toxicity for Cr+6. Ingested Cr+6 is efficiently reduced to the less toxic trivalent chromium (Cr+3) form in the gastrointestinal tract.

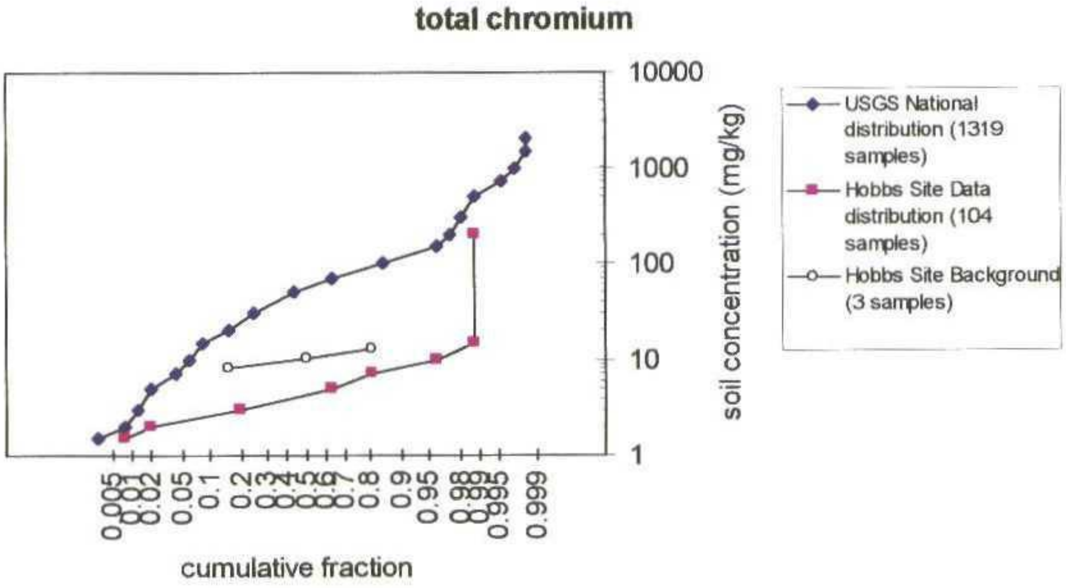
The Region 6 and 9 calculated value presumes a conservative ratio of Cr+6 to Cr+3 of 1:6 [overestimating the presence of Cr+6 in soil]. The mixed composition of Cr+3 and Cr+6 is much more appropriate for chromium in soils than presuming only Cr+6.

Measured chromium statistics for site soils follow:

7.34 mg/kg	overall average of 101 values, neglecting 6 ND values in the overall average
4.2 mg/kg	median of measured values
244 mg/kg	maximum measured value (TSB-6, 2-3')
14 mg/kg	2^nd^ highest measured value (GBS-3, 6")
10.4 mg/kg	site background, arithmetic mean (3 samples, 8.8, 9.3, 13 mg/kg)
10.2 mg/kg	site background, geometric mean (3 samples, 8.8, 9.3, 13 mg/kg)

The single point which is above either the 30 mg/kg or 210 mg/kg risk-based screening level is 244 mg/kg (TSB-6, 2-3').

The cumulative distribution, or histogram, of measured site data values on a log-normal probability plot is shown in the following figure. The "log-normal probability plot" uses axis scales which show a log-normal distribution as a straight line. For comparison purposes, the figure also shows a data distribution for surficial soils in the United States (Shacklette and Boerngen, 1984) and distribution data for three Hobbs background soils samples taken in the vicinity of the Westgate site.



A single high point of 244 mg/kg (TSB-6, 2-3') is included in the site data set. The next highest point on the site is 14 mg/kg (GBS-3, 6"). Values at samples nearest to TSB-6, 2-3' include:

TSB-6 3-5'	4.4 mg/kg	same boring
TSB-6 18-20'	2.2 mg/kg	
TMW-3 2-3'	3.2 mg/kg	25 ft away
TMW-3 3-5'	4.2 mg/kg	
TSB-7 2-3'	3.7 mg/kg	25 ft away
TSB-7 3-5'	2.8 mg/kg	
TSB-8 2-3'	2.5 mg/kg	37 ft away
TSB-8 3-5'	5.8 mg/kg	

Given the single data point of 244 mg/kg, we propose to:

- Re-sample the same soil point on the site.
- If the detected value is confirmed above the 30 mg/kg level then
    - Evaluate the volume above this level.
    - Include this soil volume in the excavation plan
    - The 244 mg/kg point (TSB-6, 2-3') is currently right on the edge of the planned excavation area.

Arsenic

Risk-based surficial soil screening levels for arsenic include:

0.43 mg/kg	direct soil exposure, ingestion, dermal contact, dust & vapor inhalation - RBCA
0.39 mg/kg	residential soil - Region 6
0.43 mg/kg	residential soil w/o dermal exposure - Region 6

All of these initial screening-level values use consistent assumptions, and the risk-based values are reasonably close to each other.

For comparison purposes only, typical values for background arsenic in soil for USEPA Region 6 states (including NM) range from 1.1 to 16.7 mg/kg (from Region 6 guidance). In the continental United States, average surficial soil arsenic is 5.2 mg/kg (geometric mean, Shacklette and Boerngen, 1984). For the site background, we have arsenic at the method detection limit (ND = 0.5 mg/kg) in soil measured for three samples. These values show that the initial RBSL screening value is below average background in many cases.

USEPA Region 9 guidance gives a specific example for arsenic:

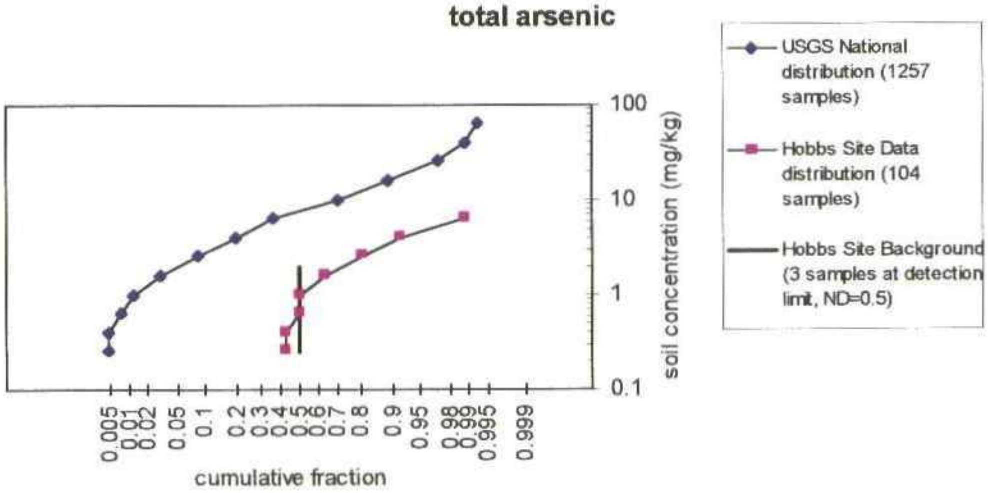
> "Generally EPA does not clean up below natural background. In some cases, the predictive risk-based models generate PRG [Preliminary Remediation Goals] levels that lie within or even below typical background. If natural background concentrations are higher than the risk-based PRGs, an adjustment of the PRG is probably needed. ... An illustrative example of this is naturally occurring arsenic in soils which frequently is higher than the risk-based concentration set at a one-in-one-million cancer risk (the PRG for residential soils is 0.39 mg/kg). After considering background concentrations in a local area, EPA Region 9 has at times used the non-cancer PRG (22 mg/kg) to evaluate sites recognizing that this value tends to be above background levels yet still falls within the range of soil concentrations (0.39-39 mg/kg) that equates to EPA's "acceptable" cancer risk range of 10E-6 to 10E-4."

A value of 30 mg/kg for arsenic in soil has been used within New Mexico in at least one site clean-up [Record of Decision (ROD) Abstract, ROD Number: EPA/ROD/R06-93/078, ROD Date: 09/22/93, Site: CLEVELAND MILL, EPA ID Number: NMD981155930, Location: SILVER CITY, NM Operable Unit: 01].

Statistics of measured values of arsenic for the site are as follows:

1.32 mg/kg	arithmetic average, including 1/2 ND (ND=0.5) for 52 samples, 106 total in average.
0.54 mg/kg	median of 106 measured sample values
7.3 mg/kg	maximum measured value
5.3 mg/kg	2nd highest value
ND	measured value for 3 background samples (ND=0.5).

A cumulative distribution, or histogram of the measured site data follows:

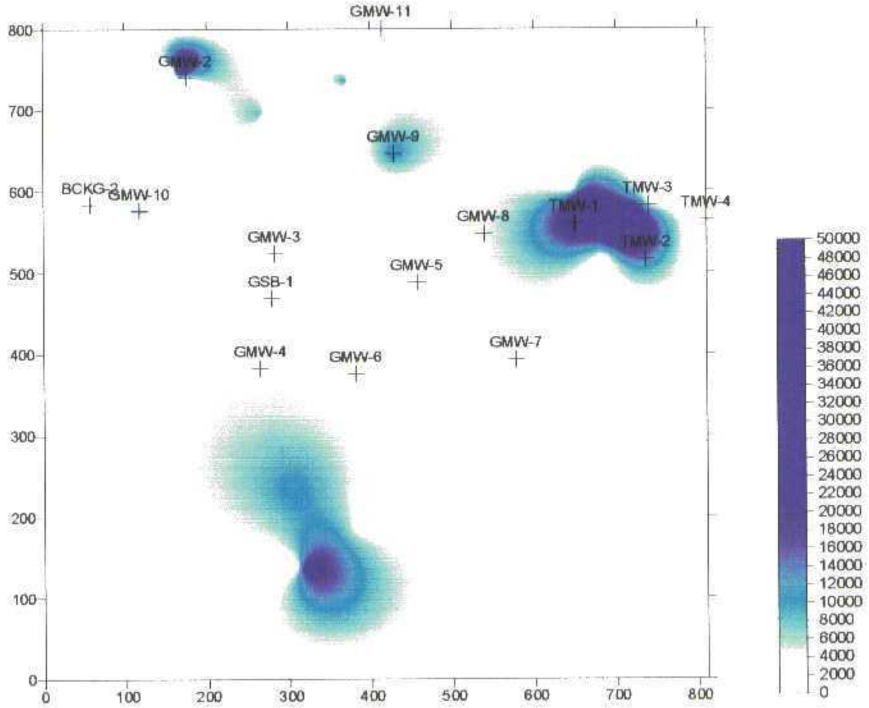


This histogram shows that:

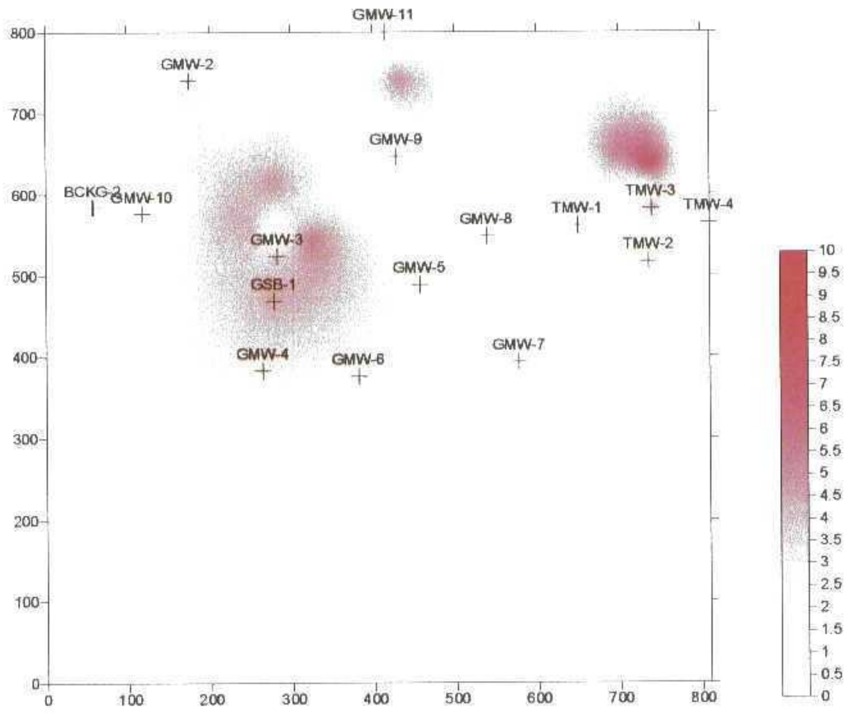
- For comparison purposes only, the site data is uniformly below the measured data distribution reported for the Continental United States.
- The median for the site measured data (0.54 mg/kg) is nearly at the method detection limit, and the likelihood of a non-detect sample on the site is 49% (52/106) or about 1 in 2.
- The measured data spans a relatively narrow range from 0.25 (0.5ND) to 7.3 mg/kg.

A plan view plot of measured arsenic in soils (0 to 10 ft), along with a plot of TPH in soils (0 to 10 ft) follows. This plot qualitatively shows that the spatial arsenic distribution in soil is not related to the principal contaminant – released crude oil – at this site.

(a) TPH



(b) Arsenic



Plot of (a) TPH and (b) arsenic for the Westgate site. The maximum value within the 0 to 10 ft below surface vertical increment is plotted. The spatial distribution shows that the highest measured soil concentration values for arsenic and TPH are not co-located. The concentration scales are in units of mg/kg, axes are in feet. The location of selected sample points and wells are shown for reference.

Given this information, we find that:

- The initial RBSL value used in the analysis is very conservative.
- The measured background in the vicinity of the site (ND) is nearly equal to the median for all the measured data on the site.
- The arsenic on-site is not correlated with the crude oil measured in soil.
- All of the measured values of arsenic are below current clean-up levels, which have been used in New Mexico and in USEPA Region 6.

Given all of this information, no further assessment or remediation of arsenic in soils at the site is planned.

References

U. S. EPA, 1998b: Human Health Medium-Specific Screening Levels, Region 6 United States Environmental Protection Agency, Multimedia Planning and Permitting Division, http://www.epa.gov/earth1r6/6pd/rcra_c/pd-n/screen.htm, last updated October 1998.

U. S. EPA, 1998c: Preliminary Remediation Goals (PRGs), Region 9 United States Environmental Protection Agency, http://www.epa.gov/region09/waste/sfund/prg/, Last Updated: June 3, 1998.

U. S. EPA, 1999: EPA Region III Risk-Based Concentration Table, Region 3 United States Environmental Protection Agency, http://www.epa.gov/reg3hwmd/risk/riskmenu.htm, last updated April 1999.

Shacklette, H. T., and J. G. Boerngen, 1984: Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States, United States Geological Survey Professional Paper 1270, (United States Government Printing Office, Washington).

For additional information see **Appendix I** (Risk-Based Corrective Action, Summary Report, Tier 1 Assessment Report) and **Appendix II** (Risk-Based Corrective Action Plan Data Worksheets).

2.5 Deficiency No. 5 – Alternate Ground Water Standards

Shell is not proposing alternate ground water standards. Notes have been added to clarify this section of the report.

2.6 Deficiency No. 6 – Potential Exceedance of Ground Water Standards-Leaching

Based on observed trends in soluble groundwater plumes resulting from petroleum hydrocarbon releases, four stages in soluble groundwater plume development are identified (API, 1998):

Expanding. Residual source present. Mass flux of contaminants exceeds assimilative capacity of aquifer and the soluble plume is expanding in length.

Stable. Insignificant changes. Active or passive remediation processes are controlling plume length and the plume length remains relatively stable.

Shrinking. Residual source nearly exhausted and active or passive remediation processes significantly reducing plume mass. Monitored well concentrations are decreasing and the plume length is shrinking.

Exhausted. Average plume concentration is very low and unchanging over time. Final stages of source zone dissolution over a relatively small area at a site.

At the tank battery, there was evidence of a small delineated zone of floating NAPL at the water table. Benzene and toluene were not detected. Low concentrations of ethylbenzene and xylenes (below NM WQCC ground water standards) were measured. This is indicative of an exhausted NAPL source zone, which is completely depleted in the more soluble benzene and toluene fractions.

Based on the operating lifetime of the tank battery, the time when it was decommissioned, and the exhausted nature of the NAPL source zone and soluble plume, the tank battery release was likely very old.

Petroleum from other potential sources on the site, including pits, is at least as old as the operating time period of the tank battery. Given the age of the site, if groundwater contamination was likely to have resulted from these other petroleum hydrocarbon source zones, it would have already occurred.

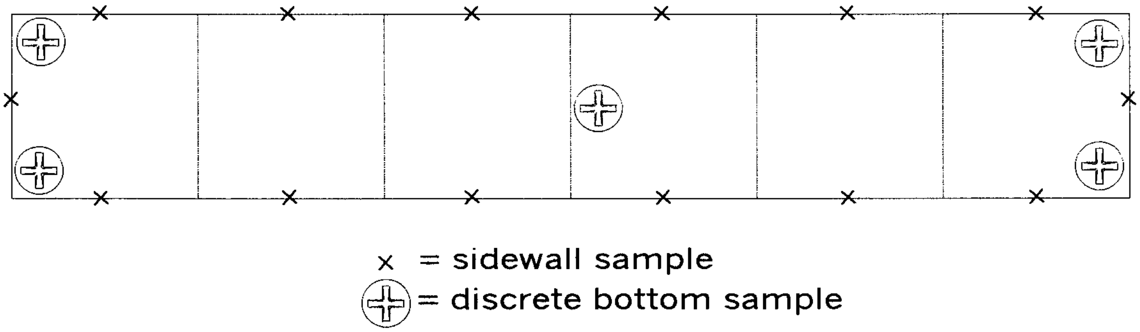
Further, for the remaining hydrocarbon left art depth at the site, it is very viscous and evidently immobile. It is very unlikely to migrate as a NAPL (if it has not done so already) or result in some future soluble groundwater plume (again, if it had not done so already).

The bulk of the crude of in soils (0 to 10 ft) at this site will be removed during the remediation.

Therefore we believe that the groundwater contamination which has resulted from operations at this site has already occurred, and remaining contamination is extremely unlikely to cause a problem in the future.

2.7 Deficiency No. 7 – Five Point Composite Sampling

The soil sampling plan for the excavated areas on both West and East Tasker and the street portion of Tasker has been modified per discussions with the NMOCD. Since the excavation will be done in stages moving across the site from west to east, five discrete samples will be taken at the bottom of the excavation at the north, south, center, east, and west areas of the entire excavated site (East, West Tasker pit areas as a whole, not each segment). The diagram below depicts the sample points. Four sample points will be compiled into one sample for both the west and east side walls. Also, for the north and south walls of each excavation segment four sample points will be compiled into one sample. The samples will be analyzed for TPH, BTEX, and New Mexico Water Quality Control Commission (WQCC) metals using USEPA Methods 418.1, 8260B, and 6010B, respectively.



2.8 Deficiency No. 8 – Practical Excavation Depth

After reviewing the data collected, the cross sections of the West Tasker and East Tasker pits previously submitted, the RBCA report, and further discussions with the NMOCD, the practical depth of excavation for these two areas is ten (10) feet. This will remove the bulk of the near surface contaminated soils. This depth will be subject to field judgement based on mutual discussions between Shell and NMOCD field representatives. Due to the addition of the Tasker Street removal the horizontal extent of the excavation will change to approximately 300 feet by 80 feet instead of approximately 73 feet by 142 feet for west Tasker and 60 feet by 100 feet for east Tasker as previously submitted in Sections 4.1.4 and 4.1.5 of the Stage 2 Abatement Plan submitted in October 1999. See Figure 1 in the October 1999 Stage 2 Abatement Plan.

2.9 Deficiency No. 9 – Air Monitoring, Safety and Health Action Plan

In order to protect the health and safety of the site workers, the public (Westgate Subdivision), and the surrounding vicinity from dusts and migration of volatilized organics in air during excavation and remediation activities; Shell will utilize a combination of control measures appropriate to each activity. Additionally, a health, safety, and monitoring plan has been created to monitor for airborne constituents during all site remediation activities. See **Appendix III** (Health and Safety Plan for the Westgate Subdivision Remediation Project, Hobbs, New Mexico). As previously stated in the October 12, 1999 submitted Stage 2 Abatement Plan, all remediation activities listed in Section 4.0, 4.1.1 Task 1A, Task 1B, Task 4.1.2, and Task 4.1.3, will be monitored for dust. Water will be used to control dust emissions.

Tasks 4.1.4 and 4.1.5 in the October 12, 1999 Stage 2 Abatement Plan, (the east and west Tasker excavations) are now modified to include the portion of Tasker Street in between. A structure consisting of an aluminum and/or composite metal framework with a durable all-weather PVC membrane fabric covering will be placed over each stage of excavation. Photographs of a structure similar to the type that will be used can be found in **Appendix IV** (Remediation Structure and Air Treatment System Photographs). The structure will provide the best control technology for dust and volatilized organic emissions. The structure will also provide for protection from the elements.

In addition to providing a cover for the excavations, the structure will be operated in a negative pressure atmosphere with a minimum of two air intake vents inside the structure attached to an air scrubbing system outside adjacent to the structure. This air scrubbing system will be comprised of electrically powered low pressure, high volume (cubic feet per minute or cfm) blowers that will draw the air from inside the structure through a fixed bed of activated carbon then to a vent pipe for release to the atmosphere. The activated carbon bed will remove dust and strip the air of any volatile organics to below regulated levels. The New Mexico Environment Department, Air Quality Bureau, in conjunction with the NMOCD, will be contacted for determination of any required discharge permits. If a permit is required, Shell will acquire one prior to using this system. In addition, water will be used to assist in suppressing any dust, if warranted. See **Appendix IV** (Remediation Structure and Air Treatment System Photographs) for photographs of a similar air scrubbing system that will be used on the Tasker Street excavations.

As previously discussed with the NMOCD at the meetings of February 8 and April 12, 2000, the Tasker excavations will be done in stages since the size of the structure will be 70' wide x 115' long x 35.5' high and the estimated size of the total excavation site will be larger than these dimensions, approximately 300 feet by 80 feet. Each excavation stage will be excavated, sampled, then backfilled prior to moving the structure. The excavations will be done starting on the west moving east. It is estimated that there will be six excavation stages, which will require moving the structure five times.

Also, as discussed in the October 1999 Stage 2 Abatement Plan and the meetings of February 8 and April 12, 2000, the proposed test excavation and associated air testing and monitoring (**Appendix V**, Characterization Of Potential Air Emissions Associated With Remediation Activities Near The Westgate Subdivision-Phase I Air Monitoring Study Design Plan) activities are necessary in order to determine the air constituents that will be present during the full scale excavations so that a proper and effective air scrubbing system can be designed. In addition, this information will further define the parameters of the final on-site Health, Safety, and Monitoring Plan.

2.10 Deficiency No. 10 – Abandoned Well on Cobb Street

Upon review of all previously submitted aerial photos and the OCD's Hobbs office well files concerning the abandoned Well #8 located at 1506 N. Cobb street, Shell is unable to provide any additional information as to the location or use of drilling and/or work-over pits associated with this abandoned well.

3.0 BASELINE AIR MONITORING-AIR QUALITY SURVEY

An air quality survey will be conducted to establish baseline air quality prior to initiating site remediation activities. This will help to establish representative baseline ambient air quality for both the Westgate Subdivision and the community at large prior to commencement of remediation activities. Baseline air quality measurements will be collected for a wide array of chemical compounds as well as surface meteorological measurements. The chemical species to be measured were selected because they are known or suspected hazardous air pollutants or are non-hazardous surrogate chemicals that are associated with industrial emissions, oilfield emissions, automotive emissions, and industrial chemicals or solvents. These chemicals are of particular interest because, if present, they may, under certain circumstances, represent a potential community exposure concern or odor nuisance. Some parameters will be collected using time integrated (averaged) sampling techniques, and others will be measured continuously. For a detailed explanation of sampling procedures, protocols, and analytes, see **Appendix V** (Characterization Of Potential Air Emissions Associated With Remediation Activities Near The Westgate Subdivision-Phase I Air Monitoring Study Design Plan, Section 2.0 – 2.1.4).

4.0 TEST EXCAVATIONS AND ISOLATION FLUX CHAMBER SAMPLING

As previously stated in Section 4.1.4 of the Stage 2 Abatement Plan of October 1999, Shell will perform a pilot excavation in portions of the West and East Tasker pits to identify the uniformity of the hydrocarbon layer and to monitor for odors and dust associated with excavation activities. Two locations will be excavated using a backhoe in the West Tasker pit area and one location excavated using a backhoe in the East Tasker pit area located at 1328 Tasker. These excavations will be no deeper than approximately six feet and three-five feet wide and long. Each excavation will be at two depths: approximately three feet and six feet below ground surface. All excavated soils will be covered in plastic to prevent emissions until placed back into the excavation. If an excavation is left open at the end of a day, it will be covered with plastic to prevent emissions.

At each excavation depth, an air sampling device (isolation flux chamber) will be placed inside the excavation to measure and identify the constituents present in the air when the soil is disturbed. The analytical results obtained from these tests will determine what type of air constituents will need to be monitored during full scale remediation activities. These results will also assist in the design of the air treatment system that will be used during site remediation and excavation activities.

It is anticipated that field activities of background ambient air sampling and test excavations will take approximately two weeks. For a detailed explanation of sampling procedures, protocols, and analytes, see **Appendix V** (Characterization Of Potential Air Emissions Associated With Remediation Activities Near The Westgate Subdivision-Phase I Air Monitoring Study Design Plan, Section 2.2 – 2.2.5).

5.0 QUARTERLY GROUNDWATER SAMPLING

After reviewing the procedures of purging and testing the groundwater monitor wells in the Westgate Subdivision, Shell requests not to sample any monitor wells that have free hydrocarbon product in them during the quarterly sampling events. In all of the previous sampling events, all monitor wells were tested. Shell is currently recovering product from the following monitor wells: GMW-1, GMW-3b, GMW-5, and GMW-9. When product removal is completed, these monitor wells will be added to the testing schedule according to the NMOCD's requirements.

6.0 FORMER GRIMES BATTERY BACKFILLING ACTIVITIES

Backfilling of the former Grimes Battery started on April 25, 2000. The backfilling was approved by the NMOCD on March 14, 2000 due to the safety hazard that the open excavation presented. The surrounding fence was removed, and then a bulldozer started scraping the caliche layer inside the fenced area into the existing excavation. In the process of scraping the caliche, a hydrocarbon layer was discovered within the fenced area on the west side of the open excavation. This layer is a few inches below the caliche surface and is about 1 foot thick. The amount of soil impacted is approximately 1,000 cubic yards. Shell proposes to include the removal and disposal of this soil during Stage 2 Abatement remediation activities. This work would fall under Task #2 in the previously submitted Stage 2 Abatement Plan of October 1999. The backfilling of the open excavation was completed on April 27, 2000.

7.0 WORK SCHEDULE

The estimated time frame to conduct the test excavation and air monitoring site activities described, analyze the samples, receive and review the results, and prepare a report will be approximately eighteen weeks from the date of approval from the NMOCD.

8.0 CONCLUSIONS

After performing the test excavations, air sampling, ambient air monitoring activities, reviewing the sampling data, and generating a report, Shell will meet with the NMOCD to discuss the results, review procedures, and discuss a time frame for remediation activities to begin.

RISK-BASED CORRECTIVE ACTION

SUMMARY REPORT

Tier 1 Assessment Report

Westgate Subdivision, Grimes
Battery & Tasker Road
Site name

Hobbs, New Mexico
Location

George Devaull & Wayne Hamilton
prepared by

October 6, 1999
March 6, 2000 (revised)
date issued

reviewed by

Date

RISK BASED CORRECTIVE ACTION

Tier 1 Summary Report

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Figure 4	Site Photos	☐	
Figure 5	Groundwater Elevation Map	☐	
Figure 6	Geological Cross-Section(s)	☐	
Figure 7	Soluble Groundwater Plume Maps	☐	
Figure 8	Time Series Groundwater Data	☐	
	Appendices specify:		
	Chemical Analysis Data Tables	☐	
	Risk-Based Screening Levels	☐	
	Risk-Based Screening Levels for Petroleum Mixtures	☐	
A 1.	Summary of Exposure Parameters	■	10/6/99 GED
A 2.	Exposure to Volatile Emissions from Subsurface Soils through Inhalation	■	8/16/99 GED
	Addendum -- *response to 2/9/2000 NoD* -- under separate section		

TIER 1 RBCA EXECUTIVE SUMMARY DISCUSSION 1.1

information key

site name:	Westgate Subdivision, Grimes Battery, and Tasker Road	site location:	Hobbs, NM

	completion / revision:		approval:		Description:
no.	by:	date:	by:	date:	
	G. E. DeVaull	10/6/99	G. E. DeVaull	10/6/99	
	G. E. DeVaull	03/15/2000	G. E. DeVaull	03/15/2000	

EXECUTIVE SUMMARY

1. Site Description and History

Briefly discuss site chronology, operations, features of potential concern, future plans for site use.

The area under investigation is located in west Hobbs, NM. The total area includes the Westgate Subdivision and undeveloped land to the west of the Westgate Subdivision. The identified areas of potential concern fall within this total area but are a small fraction of the total area.

Within the total area, the Westgate Subdivision consists of residential developed property and undeveloped property bordered by Tasker Road to the east, the Los Cuatro Land Development property to the west, Sanger Road to the south, and Princess Jeanne Drive to the north. The site also includes the undeveloped property extending approximately 400 ft west of Cobb Drive. The Grimes site is a former tank battery location that was decommissioned in 1993. The Tasker site consists of two residential properties, one currently unoccupied and one undeveloped.

The Grimes lease is an oil production property that has been in operation since the late 1920's. It consists of producing wells, tank batteries, and associated flowlines. Two oil production wells on the site were drilled in the 1940's and plugged and abandoned in 1953. According to reports on file with NMOCD, the wells were plugged according to NMOCD regulations. Oil and saltwater produced from the Grimes lease was transported by flowlines to the Grimes Battery until it was decommissioned in 1993. While in operation, produced oil was transported from the battery south in a pipeline owned by Shell Pipeline. While in operation, the pipeline terminated at the battery. The number of flowlines from production wells to the battery which were in place during operation of the battery is unknown.

The purpose of this report is to assess the extent, concentration, and exposure risk of chemicals, particularly petroleum and other oilfield-related chemicals, potentially present in the surface soils, subsurface soils, and groundwater within the bounds of the site. *Results of this assessment are intended to estimate the extent of remediation which may be needed to meet conservative* risk-based criteria. This assessment is not an epidemiological evaluation, a toxicological evaluation, or an evaluation of any actual, current or future exposure at the site, but is an estimate of criteria which would, very conservatively, meet a number of risk-based objectives.

2. Geologic and Hydrogeologic Summary

Briefly describe regional site features, climate, vadose soils, groundwater depth, quality, and use.

The site is located in an area of generally flat topography. The nearest surface water (identified from the topographic USGS quadrangle map for Hobbs West, N. Mex.) is a pond, approximately 0.5 acre in area, 0.4 miles from the site. There is no direct pathway for rainwater runoff from the site to this surface water. The site is in a semi-arid region with annual rainfall in the range of 12 to 15 inches per year.

Unsaturated zone stratigraphy at the site, from below any surface fill to groundwater at 65 ft, consists of intermixed layers of fine-grain silty sand, buff limestone (hard), fine-grain silty sand with chert, and fine-grain sand with sandstone intermixed.

The Ogallala Formation is the principal source of groundwater in the immediate area. Depth to groundwater in Lea County ranges from 12 to 300 feet below ground surface. Within the bounds of the site, depth to groundwater is approximately 65 feet. The Ogallala consists of predominately coarse fluvial conglomerate, sandstone, fine grained eolian sandstone, and clay. Where present in the area, the Ogallala unconformably overlies Triassic red-beds. The regional groundwater gradient at the site is to the east.

3. Potential Exposure Pathways

Discuss completed and potentially completed pathways for soil and groundwater.

The potential sources in the area of concern are based on previous site use. The chemicals of potential interest are those likely originating from historical oil field operations, primarily crude oil and its chemical components, and produced water, including salts. Relevant indicator compounds for crude oil potentially include benzene, ethyl benzene, toluene, xylenes (BTEX), and polycyclic aromatic hydrocarbons (PAHs). Other individual chemicals have also been included in the sample analysis, in accordance with 20 NMAC 6.2 3103 and 1101. The complete chemical analyte list is included in the site report [Westgate Subdivision, Grimes Battery and Tasker Road – Stage 1 Abatement Plan Report (Site Assessment Investigation), July 1999, Shell Exploration and Production Company, Houston, TX; prepared by BBC International, Inc., and ARCADIS Geraghty & Miller].

The site currently includes residential development, with future site use options for undeveloped areas of the site either as residential or restricted use (as a park or paved streets). The assessment conservatively presumes future unrestricted residential use throughout the site. Relevant exposure pathways for evaluating potential human exposure, as shown in Worksheet 1.3 (page 1.11), for this site include:

1) Potential exposure to surficial soils, including combined soil ingestion, dermal contact, dust inhalation, and inhalation of volatile chemicals, for residential receptors. The top 2 centimeters is usually considered surface soil by USEPA (1996, p.84, section 4.14), while surface soil is taken as the top 1 meter of soil in ASTM E 1739-95 and ASTM PS 104-98.

2) Potential exposure to volatile emissions from subsurface soils, through inhalation, for residential receptors.

3) Potential ingestion of groundwater. A water well survey has been completed, based on information on file in the State Engineer's office for the site vicinity (Sharon Hall, 20 April 1999), that is, Section 28, Township 18 South, Range 38 East, N.M.P.M., Lea County, New Mexico. This was tabulated as wells per quarter section. No downgradient water wells (east of the site) are recorded within one-half mile of the site.Residents in the immediate area are supplied by municipal water. However, use of well water for drinking water use is not known to be precluded (by ordinance or restriction) in the immediate area.

4) Potential mobility of non-aqueous phase liquids (crude oil) in unsaturated soils. As in (3) the potential concern is with groundwater, but in terms of bulk migration of crude oil to ground water.

In addition, agricultural parameters (soil total dissolved solids - TDS and soil pH) are evaluated based on ranges of agricultural parameters. This is intended to determine if potential effects on vegetation (5) may occur.

Each of the above exposure scenarios is evaluated separately; results from each individual exposure pathway scenario are not summed. That is, the resident who may be exposed in (1) to surface soils is a different individual than the receptor who might be exposed in (3) to drinking water. The long-term residential receptor for scenario (2) is a subset of scenario (1) for the case where there is no direct contact with surficial soils. These relevant exposure routes and pathways have been addressed in this assessment using risk assessment methodology consistent with USEPA Risk Assessment Guidance (USEPA, 1996; USEPA, 1991), with ASTM Standards E 1739-95 and PS104-98, and with 20 NMAC 6.2.

The risk-based assessment in this evaluation includes two parts. The first is an evaluation of detected individual indicator chemicals. These are handled with conventional risk assessment methodology, using conservative risk-based screening level (RBSL) concentrations. The second is an evaluation of the crude oil. Crude oil is a mixture of many thousands of petroleum hydrocarbon chemical constituents; evaluating each individual chemical using conventional risk assessment methods is impracticable. In this analysis we have used methodology developed by the Total Petroleum Hydrocarbon Working Group, for risk-based assessment of "Total Petroleum Hydrocarbon", or TPH (Weisman, 1998), to derive representative site-specific RBSL values for crude oil.

Individual indicator chemicals

The equations and parameters used in estimating the potential human health risk in this assessment are consistent with USEPA guidance. Generally, risk or hazard can be estimated as the product of concentration and toxicity:

$$\text{Risk} = \text{Concentration} \cdot \text{Toxicity}$$

For individual constituents, the estimate can be inverted -- a target risk (or hazard) is specified, and an acceptable concentration in the media of interest is estimated:

$$\text{Concentration} = \text{Risk} \; / \; \text{Toxicity}$$

We have followed this convention, which is consistent with ASTM Standard E 1739-95, *Risk-Based Corrective Action Applied at Petroleum Release Sites*, in defining concentration levels, or Risk-Based Screening Levels (RBSLs) which meet the desired risk or hazard targets for individual chemical constituents. Site concentrations in soil which are at or below this risk-based screening level concentration will meet the desired target risk.

A tiered assessment process is introduced in ASTM E 1739-95. This tiered approach is used in the present assessment. The first step, or tier, is in development of RBSLs applicable for all project areas using conservative, generic parameters and site assumptions. A refinement of the assessment, in calculating site-specific screening levels using site-specific information, is applied, if needed, only to that portion of the measured concentration data which exceeds the generic RBSLs. This 'tiered' assessment expedites and simplifies the risk assessment process, with no loss in conservatism nor a loss in comprehensiveness.

All screening levels for individual chemicals used in this assessment are defined at the lower limit of the 10^{-4} to 10^{-6} acceptable risk range for carcinogens, or at a generic conservative risk level of 10^{-6}. For non-carcinogens, a hazard quotient of unity (HQ = 1) is specified. The screening level concentrations shown in Worksheets 5.1 to 5.4 (pages 3.1 to 7.4, 9.1 to 10.2) for the relevant exposure pathways and each chemical are the lowest calculated values for either the relevant carcinogenic or non-carcinogenic criteria.

Descriptions and references for selected exposure factors, transport parameters, toxicity, and models, is presented in Attachment 1. This table is complete and up-to-date with respect to the current (15 March 1999) toxicological parameters available from the USEPA IRIS and HEAST databases. The assumptions used in the models are generally conservative. Conservative upper-bound exposure parameters are defined for a Reasonable Maximum Exposure (RME). Transport assumptions used for the applicable exposure pathways are as follows:

1) Potential exposure to surficial soils due to combined soil ingestion, dermal contact, dust inhalation, and inhalation of volatiles, for a residential receptor. For soil ingestion, dermal contact, and dust inhalation, soil concentrations are assumed to remain at their original levels over the entire 25 year exposure period. For volatilization, soil concentrations are assumed to start at their initial concentration level, with a reduction in emissions over time as the volatile chemicals are depleted in the surface soil layer through the volatilization process. For this exposure pathway, the potential exposures due to soil ingestion, dermal contact, dust inhalation, and vapor inhalation are summed to determine an overall acceptable concentration level. The exposure area is presumed to be 0.5 acre, or approximately the size of a residential lot. A relevant screening procedure would be to compare average concentrations over 0.5 acre area blocks to the RBSL values. We conservatively make comparisons of every measurement to the screening value and use averages in only the few instances when point samples exceed the screening level.

2) Potential exposure to volatile emissions from subsurface soils, through inhalation, for a residential receptor. The exposure duration for this scenario is assumed to be 25 years. The chemical is assumed to remain constant at its initial concentration

over the exposure duration (an infinite source), with diffusion to the breathing zone through a one-meter layer of soil. Potential exposure for both indoor and outdoor air are included. This pathway is also used in evaluation of soil gas measurement results.

3) Potential direct ingestion of ground water. Measured groundwater concentrations are directly compared to water ingestion criteria. No additional dilution or attenuation for a spatially separated source area and ground water well have been included in the initial comparison.

Conservative assumptions are used in defining the exposure pathways described above. Discussion of this conservatism is included in this summary, in Section 5, Qualitative Uncertainty Description.

As an additional step we have included comparison to exposure-pathway-specific screening values from USEPA Region 6. While these values are not always identical to the derived RBSL for the same chemical, they are often very close, and their basis for development is very similar.

Petroleum hydrocarbon mixtures
Risk-based assessment of petroleum hydrocarbon mixtures in soil at this site are included in the present evaluation, consistent with methodology discussed by Weisman (1998). In this evaluation, a number of soil samples were analyzed for TPH (total petroleum hydrocarbons) by extracting and separating the oil into an aliphatic fraction and an aromatic fraction, then analyzing each fraction using gas chromatography / flame ionization detection (GC/FID) in a simulated distillation analysis (TX1006 - TraceAnalysis Inc.; Feb 23, 1999). This analysis yields a fractional distribution of the petroleum as a function of boiling point, molecular weight, or carbon number for each of the aliphatic and aromatic fractions. The result, for each TPH analysis, is a total of 6 aliphatic and 7 aromatic petroleum fractions, and a 14th heavy residual fraction. These results are shown in Worksheets 4.4 and 4.5 (pages 2.1 to 2.18). Two additional soil samples were analyzed by detailed gas chromatography / mass spectroscopy (GC/MS) for petroleum constituents (A. D. Little; Feb 17, 1999); these analyses were also included in defining the 14 applicable petroleum fractions. Ten additional soil samples were analyzed in a simulated distillation (Triton Analytics Corp.; Feb 16, 1998); these were not separated into aliphatic and aromatic fractions and have not been used in calculating screening criteria. For each fractionated sample, we have a total TPH concentration, C_T (mg/kg-soil), which is the sum of the 14 fractional concentrations, C_i (mg/kg-soil), or mass fractions, χ_i (mg/mg-total), in the sample.

$$C_T = \sum_{n=1}^{14} C_i = C_T \cdot \sum_{n=1}^{14} \chi_i$$

The toxicity of each of the 14 petroleum fractions is conservatively assigned based on the non-carcinogenic toxicity of similar petroleum hydrocarbon chemicals within the fraction (TPHCWG, 1997, v. 4). Average properties for estimating fate and transport are also assigned to each fraction (TPHCWG, 1997, v. 3). For each of the petroleum fractions, receptor point concentrations, C_i, (in air, water, and soil at the point of exposure) are estimated for each of the sample transport and exposure pathways identified in Worksheet 1.3 (page 1.11), and which were discussed previously.

A hazard quotient (HQ) is calculated for each fraction, here for soil

$$HQ_i = \frac{C_i}{RBSL_i} = C_T \cdot \frac{\chi_i}{RBSL_i}$$

where $RBSL_i$ is an applicable risk-based screening level estimated for each petroleum fraction (in air, water, and soil at the point of exposure). A hazard index, HI, is the sum for the 14 fractions

$$HI = \sum_{n=1}^{14} HQ_i$$

The hazard index, HI, and total concentration, C_T, are directly proportional. As the total concentration in soil increases, the hazard index increases. The TPH screening level in soil is exceeded when the summed HI value is greater than one. By fixing the mixture composition specified by the mass fractions, χ_i, we can calculate a total concentration, C_T for $HI = 1$. This is the RBSL value for this petroleum sample. TPH concentrations at and below this acceptable level will meet the $HI \leq 1$ criteria.

While the hazard index, HI, and total concentration, C_T, are directly proportional for petroleum, they are not always linearly related. Partitioning between petroleum, water, air, and soil is different for each petroleum fraction, and saturation limits for air and water depend on the mixture composition (Mariner, 1997; Mott, 1995; and Johnson, 1990). This means the calculations can sometimes be complicated.

For petroleum hydrocarbons, a range of site-specific risk-based TPH criteria have been derived, based on nine detailed soil analyses of TPH composition, as shown in Worksheets 4.4 and 4.5 (pages 2.1 to 2.18). The values for TPH screening criteria for surficial soil, based on residential exposure (including child exposure factors), ranges from 2400 to 6700 mg/kg. The lower bound is:

> 2400 mg/kg total TPH residential exposure, TPH surface soil screening criteria
> (from GSB-9 (2-3') T118812 - TraceAnalysis Inc.; Feb 23, 1999, based on 50 mg/kg analyzed in sample)

We use the lower limit as a conservative generic criteria to screen a wider array of 93 detected TPH samples analyzed by method 418.1, and 10 samples analyzed by the GC/FID simulated distillation method. Each of the nine derived sample-specific TPH screening values have been used in screening results for the same respective soil sample.

A residential exposure assumption is more conservative (overpredicts potential exposure) than other possible site uses. One possible restricted land use [a park area] uses all exposure factors, including exposure duration, equal to the residential assumption (Worksheet 4.1, page 1.25), with the exception that an exposure frequency of EF = 35 days/year, rather than an EF=350 days/year. The EF = 35 days/year is based on USEPA, 1997: Exposure Factors Handbook, Volume III, USEPA, ORD, Washington, EPA/600/P-95/002Fc; Table 15-8, National averages, outdoor activity for "doer" (an active participant) of 2 hours/day. This is 350 days/year • (2 hrs/day) / (24 hrs/day) =

35 day/year. With this assumption, a restricted site use surficial soil screening criteria would be 10 times greater than the residential criteria. Nevertheless, we have used the more conservative residential exposure assumption for screening throughout the site.

These screening levels are based on conservative potential human health risk and exposure estimates. They are intended to indicate areas where either further investigation, refinement of the modeling, interim clean-up, or remediation might be needed. In all cases, the screening levels are intended to be conservative (overestimating potential risk and exposure) values. These values are not indicative of any actual, current or future exposure at the site, but are estimates of criteria which would, very conservatively, meet a number of risk-based objectives.

4. Analytical Summary

For the listed pathways (Sec. 3 - above), discuss comparisons of measured concentrations to RBSL values.

Potential exposure to surficial soils
No sorting of samples into surficial and subsurface soil data sets has been attempted in the following comparisons, but we note that the surface soil criteria is relevant only for soils which are exposed at the ground surface (and is otherwise overconservative). The top 2 centimeters is usually considered surface soil by USEPA (1996, p.84, section 4.14), while surface soil is taken as the top 1 meter of soil in ASTM E 1739-95 and ASTM PS 104-98.

For organic indicator chemicals, comparison of all samples to surficial soil criteria is shown in Worksheets 5.1 and 5.2 (pages 4.1 to 6.4). For TPH, 51 of 110 total detected TPH values exceed the residential surficial soil screening criteria (2400 mg/kg) developed in this report. All TPH values are from the Stage 1 Abatement Plan Report, July 1999; A. D. Little, Feb 17, 1999; and TraceAnalysis Inc.; Feb 23, 1999. The TPH values are shown in Worksheet 5.1 and 5.2 (Soil Data – TPH 4.1 to 4.8)

For individual indicator chemicals (organic), exceedence of either the surficial soil RBSL criteria or EPA Region 6 criteria for organic chemicals are noted as follows:

GMW-8 20-30'	1,1-dichloroethylene	0.37 mg/kg	
TSB-7 2-3 ft	indeno(1,2,3-cd)pyrene	0.95 mg/kg	57000 mg/kg TPH co-located measurement
TSB-7 2-3 ft	benzo(b)fluoranthene	1.1 mg/kg	57000 mg/kg TPH co-located measurement
TMW-3 23-25'	benzo-a-pyrene	8.81 mg/kg	3574 mg/kg TPH co-located measurement
TSB-7 2-3 ft	benzo-a-pyrene	1.1 mg/kg	57000 mg/kg TPH co-located measurement
TSB-8 2-3 ft	benzo-a-pyrene	0.35 mg/kg	32000 mg/kg TPH co-located measurement
TSB-7 2-3 ft	dibenz[1,2;5,6]anthracene	0.34 mg/kg	57000 mg/kg TPH co-located measurement
TSB-8 2-3 ft	dibenz[1,2;5,6]anthracene	0.12 mg/kg	32000 mg/kg TPH co-located measurement

For the PAHs, we note that in every case where and individual surficial soil criteria is exceeded, the 2400 mg/kg TPH residential surficial soil criteria indicates that the co-located TPH sample would also be exceeded. The TPH criteria would therefore be a conservative indicator (at this level) for other petroleum-associated indicator chemicals in surficial soils.

For inorganic chemicals, tabulated values are shown in Worksheets 5.1 and 5.2 (pages 3.1 to 3.6). Exceedences of surficial soil screening levels are noted for arsenic and chromium. These exceeded values for arsenic and chromium (and statistics) are further discussed in an addendum to this report). For total activity, the indicated screening level is also exceeded at the maximum measurement, but the arithmetic average value is within the acceptable range.

Potential exposure to volatile emissions from subsurface soils through inhalation
For exposure to vapors evolved from subsurface soils, both the measured soil concentrations, in Worksheets 5.1 and 5.2 (pages 5.4 to 5.6, 6.3 to 6.4), and soil vapor concentrations, in Worksheets 5.1a and 5.2a, have been compared with screening criteria. Exceedences of the Tier 1 screening criteria are noted for benzene volatilization to indoor air, and for a single TPH analysis, as shown in the tables. We note that the model used in these estimates is known to be very conservative, especially for readily biodegradable chemicals such as benzene (USEPA, 1996). Additional modeling has been completed for the exceeded values, using site-specific information, incorporating a finite mass limit, and including biodegradation in the modeling (see Attachment 2). With this refined modeling, the exceeded values are addressed and no potential indoor air exposure problem can be identified.

Other chemicals
One sample for bromomethane, and one sample for 1,1-dichloroethylene showed exceedences for either or both surficial soil exposure or vapor inhalation exposure. Each of these samples are at depths greater than 28 feet, no vertical migration in the same borehole is noted in sample analyses, and no detection of these chemicals in groundwater is seen. Given the low detection frequency, no observed migration, and little or no potential for exposre, we do not propose further assessment or action for these samples.

Potential ingestion of ground water
The extent and concentration of groundwater impact has been delineated in this investigation. Given the age of the site and any associated releases, we have confined the screening for groundwater to direct comparisons of groundwater measurements to water ingestion screening criteria. Values are shown in Worksheets 5.3 and 5.4 (pages 7.1 to 7.4). A single exceedence of 20 NMAC 6.2 3-103 drinking water standards criteria for organic chemicals (GMW-5, napthalene) is noted, with the well also containing NAPL at the time of sampling. MCL drinking water criteria for Nickel are exceeded at a single well; Region 6 tap water criteria are exceeded at two wells, for manganese; and 20 NMAC 6.2 drinking water standards are exceeded for fluoride in three samples. All of the inorganic chemicals detected in groundwater are believed to be naturally occurring (Westgate Subdivision, Grimes Battery and Tasker Road – Stage 1 Abatement Plan Report).

Potential mobility of non-aqueous phase liquids (NAPL)
A qualitative evaluation of NAPL mobility is shown in the groundwater investigation. Some NAPL in the vicinity of the Grimes tank battery has migrated downward over time to the water table; lateral migration of the NAPL or of any soluble plume is very limited, and is delineated. The heavily weathered oil in surface soils at this site is not mobile.

Potential effects on vegetation
Measured total dissolved solids (TDS) in soil are well-correlated with soil electrical conductivity and salt levels in soil. High salt levels in soil can disrupt plant growth (changing the osmotic pressure balance across cell walls). Measured values of TDS and pH in soil samples at the site have been compared to agricultural screening criteria [Worksheet 5.5, Soil Data (agricultural screening – pages 8.1 to 8.2)]. Measured values for 12 of 87 TDS measurements show levels of TDS which may lead to plant stress. A number of measured soil pH values are outside the optimum soil pH range for agricultural land use. The measured values of TDS and pH are consistent with the local arid climate and geology. Caliche layers are present in areas of the site and are widespread in the regional area at and just below the soil surface.

5. Qualitative Uncertainty Description

Discuss site conditions relative to the parameters used in deriving the RBSL values, and the conservatism of these parameters.

The risk-based screening levels (RBSLs) used in this evaluation are based on calculations using the upper range residential exposure parameters from USEPA. Most individuals will have exposure levels which are lower than indicated by these parameters, and many will have exposure levels which are significantly less than indicated by these parameters.

Toxicity parameters used in deriving the RBSLs are from USEPA, or for TPH are based on USEPA methodology. The USEPA methods used in deriving the threshold (noncarcinogen) toxicity parameters are based on no observed adverse effects levels, with additional added safety factors of up to 10 000. Similarly, the USEPA development of toxicity parameters for potential carcinogens is extremely conservative.

For groundwater, we have compared RBSLs based on direct ingestion of water to measured concentrations in groundwater. In an actual case (if relevant), the source-zone concentrations in this comparison will (and do) attenuate rapidly with lateral distance from the source.

Inhalation of indoor air evolved from subsurface soils is an indirect exposure route. For benzene, significant biodegradation and diffusive attenuation will occur in the soil layer between the subsurface chemical and the indoor air. The model used in estimating this transport is necessarily very conservative, and neglects this biodegradation. The conservatism of this model for application to benzene and other aromatic hydrocarbons is recognised (USEPA, 1996).

6. Initial Ecological Assessment Summary

Discuss potentially sensitive ecological receptors and habitat in the vicinity of this site.

No sensitive ecological receptors are known to be present on or in the vicinity of the site. Some soil analysis samples, screened against agricultural criteria for total dissolved solids (TDS) indicate that some plant stress is possible in areas of the site. The measured values of TDS and pH are consistent with the local arid climate and geology. Caliche layers are present in areas of the site and are widespread in the regional area at and just below the soil surface.

7. Proposed Corrective Action

Discussed proposed and completed actions at this site relative to site classification and current or proposed future land use.

There is the potential for exposure to chemicals, including TPH in surficial soil, at this site.

Risk requires exposure. Exposure requires contact with the chemical of concern. In the absence of contact with the chemical there can be no exposure. In exposure estimates, the top 2 centimeters is usually considered surface soil by USEPA (1996, p.84, section 4.14), while surface soil is taken as the top 1 meter in ASTM E 1739-95 and ASTM PS 104-98.

We propose to apply a surficial soil TPH criteria only within the upper 10 feet of soil, within residential areas of the site. This would be protective of current site use, as well as for future use and reasonable future excavation depths.

Based on the screening analysis, we propose a site-wide criteria of 2400 mg/kg TPH, for surficial soils in residential areas of the site. Based on co-located TPH and PAH analyses, this 2400 mg/kg TPH criteria would also be protective for surficial soil human-health criteria for other chemicals, including identified individual PAHs. The 2400 mg/kg TPH level for surficial soil would be protective for residential areas of the site, as well as areas of the site [a park] proposed for other uses.

Applying this surficial soil criteria means excavating some areas of the site to a depth of 10 ft. For soils below this depth, there is no potential for future direct exposure, but there is a limited potential for chemicals to migrate as a NAPL to ground water. We propose no specific concentration criteria for soils at the bottom of a remediation excavation. We do suggest a test for mobile hydrocarbon in soil, such as a paint filter test by SW-846 Method 9095. The paint filter test is used to determine the presence of free liquids in a waste sample. Waste material is placed in a paint filter. If any of the material passes through and drops from the filter within a 5-minute test period, the material is deemed to contain free liquids.

Aesthetic criteria (e.g. removing visibly stained soil) may also be included in the corrective action.

8. Reference Documents

List the document sources for the data cited in this report and its appendices.

Westgate Subdivision, Grimes Battery and Tasker Road – Stage 1 Abatement Plan Report (Site Assessment Investigation), July 1999, Shell Exploration and Production Company, Houston, TX; prepared by BBC International, Inc., and ARCADIS Geraghty & Miller.

Philip Services, Feb. 1998: Grimes Battery Soil and Water Assessment Report, prepared for Shell Exploration and Production Technology Company, Houston Texas, by Philip Services Corporation, Midland, Texas, Project 18906.

Phillip Services, Feb. 1998: Tasker Road Site Assessment Report, prepared for Shell Exploration and Production Technology Company, Houston Texas, by Philip Services Corporation, Midland, Texas, Project 18906.

USEPA, 1996: Soil Screening Guidance: Technical Background Document (United States Environmental; Protection Agency, Office of Solid Waste and Emergency Response, Washington, DC), EPA/540/R-95/128.

USEPA, 1991: Risk Assessment Guidance for Superfund, Volume I: *Human Health Evaluation Manual* (Part B, Development of Risk-Based Preliminary Remediation Goals), Interim, (United States Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, DC), NTIS PB92-963333.

ASTM E 1739-95: *Risk-Based Corrective Action Applied at Petroleum Release Sites* (American Society for Testing and Materials, West Conshohocken, PA).

ASTM PS104-98: *Standard Provisional Guide for Risk-Based Corrective Action* (American Society for Testing and Materials, West Conshohocken, PA).

TPHCWG, 1997: Development of Fraction Specific Reference Doses (RfDs) and Reference Concentrations (RfCs) for Total Petroleum Hydrocarbons (TPH), Volume 4, Prepared by Edwards, D. A., M. D. Andriot, M. A. Amoruso, A. C. Tummey, C. J. Bevan, A. Tveit, L. A. Hayes, S. A. Youngren, and D. V. Nakles for Chevron, British Petroleum, and the Total Petroleum Hydrocarbon Criteria Working Group, (Amhurst Scientific Publishers, Amhurst, Massachusetts), ISBN 1-884-940-13-7.

Johnson, P. C., M. B. Hertz, D. L. Byers, 1990: Estimates for hydrocarbon vapor emissions resulting from service station remediations and buried gasoline-contaminated soils, in Petroleum Contaminated Soils, v. 3, P. T. Kostecki and E. J. Calabrese, eds., (Lewis Publishers, Chelsea, Michigan), 295-326.

Mariner, P. E., M. Jin, and R. E. Jackson, 1997: An algorithm for the estimation of NAPL saturation and composition from typical soil chemical analyses, Ground Water Monitoring and Remediation, 17, 1:122-129.

Mott, H. V., 1995: A model for determination of the phase distribution of petroleum hydrocarbons at release sites, Ground Water Monitoring and Remediation, 15, 3:157-167.

Weisman, W. H., 1998: Total Petroleum Hydrocarbon Criteria Working Group: A Risk-Based Approach for the Management of Total Petroleum Hydrocarbons in Soil, *Journal of Soil Contamination*, 7, 1-15.

Triton Analytics Corp. (Feb 16, 1998) Letter from Dan C. Villalanti to Illeana Rhodes, High Temperature Simulated Distillation (HTSD) analysis for 10 soil samples. Phillips Environmental chain of custody record.

A. D. Little, Environmental Monitoring and Analysis Unit. (Feb 17, 1999) Note from Henry Camp to Wayne Hamilton, BTEX - GC/MS, SHC/TPH - GC/FID analysis of two samples. BBC International chain of custody record.

TraceAnalysis Inc. (Feb 23, 1999) Letter from Dr. Blair Leftwich to Cliff P. Brunson, TX1006 Analysis. of soil samples.
Westgate Subdivision, Grimes Battery and Tasker Road, July 1999, SEPC, Houston, TX, report prepared by BBC International, Inc., Hobbs, NM and ARCADIS Geraghty & Miller, Midland/Odessa, Texas.

USEPA, 1997: Exposure Factors Handbook, USEPA, ORD, Washington, EPA/600/P-95/002F.

TIER 1 RBCA EXECUTIVE SUMMARY CHECKLIST 1.2

information key

	site name:	Westgate Subdivision, Grimes Battery, and Tasker Road		site location:	Hobbs, NM
	completion / revision:		approval:		Description:
no.	by:	date:	by:	date:	
	G. E. DeVaull	10/6/99	G. E. DeVaull	10/6/99	

EXECUTIVE SUMMARY

[I would suggest that this tabular summary follow the text. It should not be the first thing that the reader encounters.]

Visual/Historical Assessment:

Site Size (acres):	☐ < 1	☐ < 10	■ > 10 *(total area)*
Current Site Land Use:	■ undeveloped	☐ industrial	■ residential
Site Access:	☐ restricted and monitored	■ fenced *(partial-temporary)*	■ open
Visual Evidence of Environmental Impact:	☐ none	■ limited	☐ extensive

types of chemicals likely to be present:

■ petroleum hydrocarbons
■ salts
☐ inorganic chemicals and metals
☐ organic chemicals (specify:________)
☐ other (specify:________)

contaminant soures:

■ tanks / spills *(former tank battery)*
☐ pits / ponds
☐ flow lines
☐ process units (specify:________)
☐ other (specify:________)

(salts may potentially originate from produced water or alternately may result from the arid climate)

Baseline Receptor Identification:

Boundary to Nearest Off-site Receptor Distance:	☐ > 500 ft	☐ *100 to 500 ft*	■ *< 100 ft*
Depth to First Encountered Groundwater:	☐ > 200 ft	■ 200 to 50 ft	☐ < 50 ft
Travel Time to Nearest Groundwater Receptor:	☐ > 10 years	☐ 2 to 10 years	☐ < 2 years
Indicated Site Classification Evaluation Urgency	☐ > 2 years	☐ 0 to 2 years	☐ immediate

receptor point exposure:

■ surface soil
☐ groundwater *(residents are on municipal water supply)*
☐ surface water *(none present on site or in vicinity)*
■ vapors or dust to air

reasonable potential receptors of concern:

■ human
☐ ecological *(vegetation only)*
■ agricultural *(vegetation only)*
☐ other (specify:________)

Notes:

List chemicals, environmental media (soil, groundwater, surface water), and exposure pathways which exceed Tier 1 criteria. Surface soil criteria include petroleum (TPH) in soils, with some polycyclic aromatic hydrocarbons (PAHs) noted. The petroleum is heavily weathered. Total dissolved solids (TDS) in some surface soil samples indicate that vegetative stress may occur.

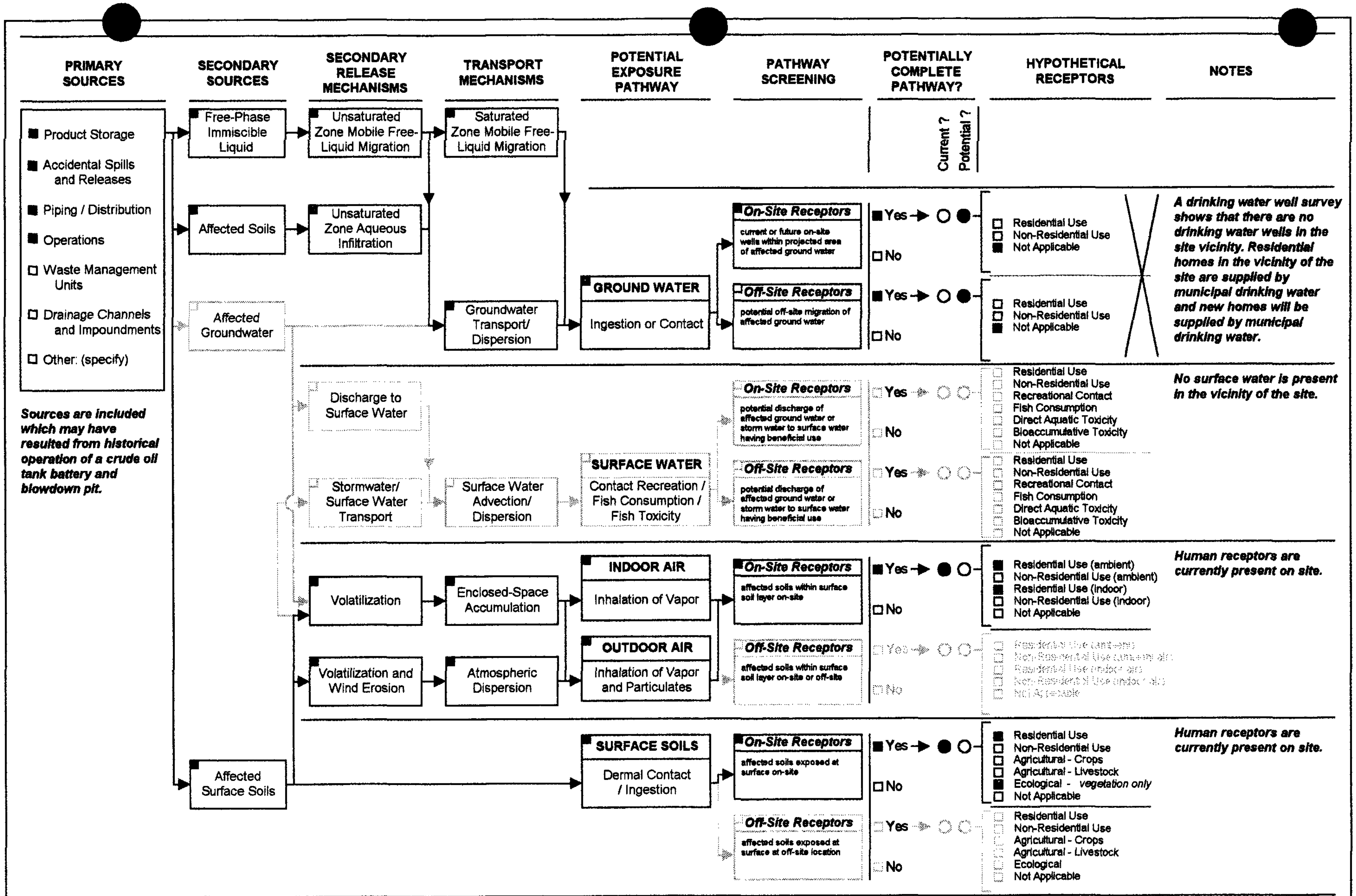
Tier 1 Tasks Completed:

	date:	by:
■ Visual / Historical Assessment	per this report	
■ Initial (screening) Assessment	per this report	
☐ Site Classification		
■ Detailed Site Characterization	per this report	
■ RBSL Comparison	per this report	
■ Initial Ecological Assessment	per this report	
☐ Corrective Action Planned / Implemented		

Suggested Tier 1 Actions:

☐ A. Site does not exceed Tier 1 criteria. -- Propose no further action.
■ B. Site exceeds some Tier 1 criteria. -- Propose corrective action to meet Tier 1 criteria.
☐ C. Site Exceeds some Tier 1 criteria. -- Propose interim actions and re-prioritize site.

Limited additional site-specific modeling for indoor air vapor exposure pathway and some data statistical averaging is applicable.



WORKSHEET 1.3 EXPOSURE SCENARIO EVALUATION FLOWCHART

Based on ASTM E 1739-95, Risk-Based Corrective Action for Petroleum Release Sites.
-- G. E. DeVaull, 12/3/97 conmodl.vsd:Page-7

Information Key

site name: HOBBS WESTGATE SUBDIVISION			site location: Hobbs, New Mexico		
	completion / revision: GED		approval: GED 26 Apl 1999		description:
no.	by:	date:	by:	date:	

SITE DESCRIPTION 2.1

information key

	site name:	Westgate Subdivision, Grimes Battery, and Tasker Road		site location:	Hobbs, NM
	completion / revision:		approval:		Description:
no.	by:	date:	by:	date:	
	W. A. Hamilton	8/1/99	W. A. Hamilton	8/1/99	

location description

Figure 1, Site Regional Topographic Map,
Figure 2, Westgate Site Map,
Figure 3, Site Aerial Photos.

Address, cross-street, city, county, state, zip code, country:
The site is located on the West side of Hobbs, New Mexico. The Westgate subdivision consist of developed and undeveloped property bordered by Tasker Road on the east, Los Cuatro property on the west, Sanger road to the South and Princess Jeanne Drive North.
Lease name, township, range, section:
W.D. Grimes Lease: Township 18 South, Range 38 East, Section 28, SW/4
Legal description of property (lot, block, district, plan):
map of site attached? ☐ no ☐ yes
notes:

Describe access to the site and the area surrounding the site. Describe current site activity.
Oil and gas operations in desert environment of the Permian Basin. Access to site is by paved and dirt roads. The surrounding area is oil and gas operations and Westgate Subdivision.

contact points

list name, address, affiliation, of the person or persons completing these worksheets.

name:	Wayne A. Hamilton	George Devaull
affiliation:	Shell E&P Company	Equilon Enterprises LLC
address:	200 N. Dairy Ashford	3333 Highway Six South
	Houston, TX 77079	Houston, TX 77082

worksheets completed for:
name: Shell E&P Company
address: 200 N. Dairy Ashford
Houston TX 77079

There are multiple surface land owners
Current legal owner or owners of site:
name: Shell Western E&P Company
address: 200 N. Dairy Ashford
telephone number: 800-
facsimile number:

Current legal owner or owners of site:
name: Los Cuatro Land Development Company
address:
telephone number:
facsimile number:

Current legal oil and gas lease operator of site:
name: Altura Energy Limited
address:
telephone number:
facsimile number:

purpose of assessment

Describe why this assessment is being performed.
This report is required by the Oil Conservation Division to assess and remediate on and off site hydrocarbons. The results of the report will provide the scientific basis for site cleanup levels.

regulatory agencies

List the agencies that have overview responsibility for this site (and for what purpose or program), other interested parties, and current status of the site. Note any previous contacts with the agency(ies) for the site.

agency:	New Mexico Oil Conservation Division	New Mexico Health Department
contact:	Bill Olson or Rodger Anderson	Dr. Evan Nelson or Randy Merker

information key

site name:	Westgate Subdivision, Grimes Battery, and Tasker Road		site location:	Hobbs, NM	
no.	completion / revision:		approval:		Description:
	by:	date:	by:	date:	
	W. A. Hamilton	8/1/99	W. A. Hamilton	8/1/99	

Identify (past and present) property owner(s), operator(s), and lease information. Describe past production and materials handling activities, waste handling and disposal practices, and chemicals used. If movement of soil has taken place at this site, note the cause (agricultural use, heavy equipment, mining, natural events, erosion, other). Tabulate in reverse chronological order.

Begin Date	End Date	Description
April 6, 1928	March 3, 1997	**Oil & Gas Lease:** Various names related to Shell Western E&P Company; T18S, R38E, Section 28, SW/4; All interest to OGL 4/445
March 3, 1997	Present	**Oil & Gas Lease:** Altura Energy Ltd.; All interest to OGL 4/445
About 1970's	Present	**Surface Ownership:** Residents along Tasker & Cobb Drives in Westgate units 1, 2 & 3 in SW/4 of Section 28.
May 28, 1976	Present	**Surface Ownership:** Los Cuatro, Inc 100%; Warranty deed dated May 28, 1976 in SW/4 of Section 28.
June 23, 1995	Present	**Surface Ownership:** Grimes Land Co, Ltd, Warranty deed dated June 23, 1995 in SW/4 of Section 28.
1930	1950	**Surface Lease:** Humble Oil/Exxon, 1 acre in the SE corner of SW/4; Surface lease for purpose for construction and maintenance of bldg., storage tanks and etc. Five year lease with right to renew. Document recites that leasee shall not be liable for damages of any nature to the surface.

*Indicate on **Figure 3, SITE PLAN VIEW**, specific areas of site activity and use, facility or unit outlines, fence lines, public roadways.*

PAST RELEASES OR SOURCE AREAS 2.3

information key

site name:	Westgate Subdivision, Grimes Battery, and Tasker Road	site location:	Hobbs, NM

	completion / revision:		approval:		Description:
no.	by:	date:	by:	date:	
	W. A. Hamilton	8/1/99	W. A. Hamilton	8/1/99	

Describe potential sources and spill events, including location, type and volume of materials stored or released, time and duration of release, and affected media (soil, groundwater, surface water, etc.). Discuss interim measures to contain or remove contaminated media and past remediation efforts as appropriate. Tabulate in reverse chronological order.

Begin Date	End Date	Description
1940's	1960's	**Pit West of Tank Battery:** Dates of operation are estimated from aerial photographs
???	???	**Emergency Pit Adjacent to Tank Battery:** Battery abandon 1993. Do not have document concerning pit usage.
		Tank Bottom Spreading: North of Tank Battery and south of Berry Drive. Do not have documentation concerning tank bottom spreading
		Flow Line Release: South of Tank Battery.
		Flow Line Release: Not a SWEPI issue. The probable release source is either Rice Engineering or Equalon.
		Abandon Well: Grimes: Abandon well site between two homes on Cobb street. Well was properly abandon and no hydrocarbons were found in soil gas investigation. (note: see Worksheet 1.2 Section 1, second paragraph)

information key

site name:		site location:	

	completion / revision:		approval:		Description:
no.	by:	Date:	by:	date:	

Typical site activities to be recorded include:
- *Preliminary Site Assessment/Site Inspection*
- *Emergency Response*
- *Review Site Classification System*
- *Risk/Exposure Assessment*
- *Remedy Selection*
- *Interim Corrective Action*
- *Remedy Implementation*

Types of sampling and testing Include:
● Soil ● groundwater ● Surface Water ● Vapors

Date Completed	Description of Task	Sampling and Testing Conducted	Goal/Result/ Product/Impact	Project Cost

REGIONAL HYDROGEOLOGIC CONDITIONS 3.1

information key

site name:			site location:		
no.	completion / revision:		approval:		description:
	by:	Date:	by:	date:	

regional hydrogeology

Also see Figure 6, Geological Cross-section(s).

Describe regional geologic framework through depth of principal regional aquifer, and any other potentially impacted lithologic units. Identify principal formations and water-bearing units. Include site vertical stratigraphy.

regional stratigraphy
Identify principal oil and gas producing formations, significant confining layers, soil or rock type, depth intervals, etc.

principal aquifers
Identify principle water-bearing zones. Indicate aquifer use designation (if any), inherent water quality (TDS, etc.), and potential yield ("low" < 1500 gpd/well, "medium" - 1500 to 15000 gpm/well, "high" - > 15000 gpd/well

indicate scale:

indicate scale:

SITE HYDROGEOLOGIC CONDITIONS – GROUNDWATER 3.2

information key

site name:	Westgate Subdivision, Grimes Battery, and Tasker Road		site location:	Hobbs, NM	
no.	completion / revision: by:	date:	approval: by:	date:	Description:
	G. E. DeVaull	8/18/99	G. E. DeVaull	8/18/99	

Is impact to ground water confirmed or highly suspected? ☒ yes / ☐ no

site hydrogeology

*Also see **Figure 5**, GROUNDWATER ELEVATION MAP, and **Figure 6**, GEOLOGICAL CROSS-SECTION(S).*

water-bearing units:	First Encountered	Primary Drinking Water	
Aquifer Type (perched, confined, unconfined):	unconfined		
Depth to groundwater (ft):	65 ft		
Aquifer Thickness (ft):	unknown		*
Seasonal/Historical water level fluctuations (± ft):			*
Gradient (ft/ft):	1 ft / 180 ft		*
flow direction:	east		
Saturated hydraulic conductivity (ft/day): *(coarse sand)*	50 ft/day (est.)		*
Maximum well yield (gpm/ft):			*
Soil or rock type:			

Discussion:

aquitard/confining layer (if known):	Below First Encountered Water	Above Primary Drinking Water Unit
Depth below grade (ft):		
Thickness (ft):		
Soil or rock type:		

Discussion:

current ground water quality data

*Also see **Figure 7**, SOLUBLE GROUNDWATER PLUME MAPS.*

	First Encountered Water	Primary Drinking Water
Total dissolved solids (mg/L):		
Observed groundwater quality impact (Y/N):		
Separate phase (free oil or condensate) present (Y/N)?:	Y	
Off-site sources (Y/N, Identify Below):		

Discussion:

Soluble hydrocarbon plume has been delineated. Weathered free product is present in some wells, but has also been delineated. Given the age of the site and current operations, no further migration of free product is anticipated, and the remaining soluble hydrocarbon plume is attenuating.

Reference Documents for Site:

Date Issued	Author	Title

Ref: See Westgate Subdivision, Grimes Battery, and Tasker Road Stage 1 Abatement Plan Report, July 1999.

* *Items not strictly required for Tier 1 analysis.*

SITE SURFACE AND VADOSE (UNSATURATED) ZONE CONDITIONS 3.3

information key

site name:	Westgate Subdivision, Grimes Battery, and Tasker Road		site location:	Hobbs, NM	
	completion / revision:		approval:		Description:
no.	by:	date:	by:	date:	
	G. E. DeVaull	8/18/99	G. E. DeVaull	8/18/99	

topography and surface features

*Site elevation, ground surface slope, and slope direction can be obtained from topographic maps and documents and from a site visit. Topographic information can also be shown on **Figure 1**, **SITE LOCATION MAP** and **Figure 3**, **SITE PLAN VIEW**.*

total site area (acres): ______
Does the site have occupied buildings on it? ■ yes / ☐ no
If yes, how many, covering what area?: multiple homes ______
Is the site paved? ■ yes / ☐ no
If yes, covering what area?: various streets and roads, see map ___
Is the site used for crops or livestock pasture?: ☐ yes / ■ no
If yes, covering what area?: ______

Terrain and surface features	■ Flat	☐ Steep	☐ Variable
site elevation interval (ft-MSL)	High Pt.______	Low Pt.______	
average ground surface slope	Direction ______	Grade (ft/ft)______	

Include building locations and size, notation of paving, and surface gradient on Figure 3, SITE PLAN VIEW, and on worksheet SITE OWNERSHIP AND ACTIVITY RECORD. Note that surface feature information on wildlife habitat is included in worksheet ECOLOGICAL ASSESSMENT SUMMARY.

other comments:

local climate

Average Annual Precipitation (in): 12 to 15 inches, (including 3.3 to 4.8 inches snowfall)
Annual Average Evapotranspiration (in): ______
Annual Pan Evaporation (in): ______
Summer Temperature Range (°F): 112°F max (1961 to 1990) ___
Winter Temperature Range (°F): -11 to 2° F (1961 to 1990) ___

other comments:
Rainfall data from National Oceanic and Atmospheric Administration data (http://www.cdc.noaa.gov), records (Wink, Winkler, TX and Midland, TX) in the vicinity of Hobbs, NM (approximately 32°42'30"N, 103°07'30"N).
Given the relatively low rainfall and dry climate, net infiltration of rainwater in the vicinity of the site, through unsaturated soils to groundwater will be minimal, and in any case, will be a small fraction of the total annual rainfall.

site vadose (unsaturated) zone hydrogeology

Also see Figure 6.

Depth to first encountered water (ft.):	65
Unsaturated zone permeability (Darcy):	*
Soil or rock type:	note below
Soil affected by hydrocarbons (Y/N)?	Y
Separate Phase Present (Y/N)?	Y

Discussion:
Unsaturated zone stratigraphy at the site, from below any surface fill to groundwater at 65 ft, is expected to consist of intermixed layers of fine-grain silty sand, buff limestone (hard), fine-grain silty sand with chert, and fine-grain sand with sandstone intermixed.

HYDROGEOLOGICAL CONDITIONS - SURFACE WATER 3.4

site name:	Westgate Subdivision, Grimes Battery, and Tasker Road	site location:	Hobbs, NM

no.	completion / revision:		approval:		Description:
	by:	date:	by:	date:	
	G. E. DeVaull	8/18/99	G. E. DeVaull	8/18/99	

surface water - non-flowing

Are there non-flowing water bodies on the site? ☐ yes / ☒ no
(ponds, lagoons, potholes, lakes, or other)
If yes, name and describe them:

Are there non-flowing water bodies adjacent to the site? ☒ yes / ☐ no
(ponds, lagoons, potholes, lakes, oceans, or other)
If yes, name and describe them:

The nearest surface water (identified from the topographic USGS quadrangle map for Hobbs West, N. Mex.) is a pond, approximately 0.5 acre in area, 0.4 miles from the site. There is no direct pathway for rain water runoff from the site to this surface water.

surface water - flowing

Are there flowing water bodies on the site? ☐ yes / ☒ no
(ditches, streams, rivers, estuaries, or other)
If yes, name and describe them:

Are there flowing water bodies adjacent to the site? ☐ yes / ☒ no
(ditches, streams, rivers, estuaries, or other)
If yes, name and describe them:

*Also see **Figure 1**, **SITE LOCATION MAP**, and **Figure 3**, **SITE PLAN VIEW**.*

If no surface waters are identified and impact is unlikely, further evaluation of surface water is unnecessary.

BENEFICIAL LAND USE SUMMARY 3.5

information key

site name:	Westgate Subdivision, Grimes Battery, and Tasker Road	site location:	Hobbs, NM

no.	completion / revision: by:	date:	approval: by:	date:	Description:
	G. E. DeVaull	8/18/99	G. E. DeVaull	8/18/99	

The purpose of this worksheet is to identify existing and reasonable beneficial uses for land, groundwater, and surface water. These uses will help establish any existing or potential receptors.

land use

Site Land Use

Figure 2, EXTENDED SITE MAP, should identify the site and the neighborhood land use. Also see ***Figure 1****, SITE LOCATION MAP, and* ***Figure 3****, SITE PLAN VIEW. Indicate percent areal use for checked boxes, if possible.*

	Current	Potential	Prior	
Residential	■	■	☐	
Commercial	☐	☐	☐	
Industrial	☐	☐	☐	*(note light / heavy)*
Agricultural - range	■	■	☐	
Agricultural - crop	☐	☐	☐	
Wildlife Habitat	☐	☐	☐	*(see ecological worksheet)*
Recreational	☐	■ *(park)*	☐	*(note if park)*
Other:	☐	☐	☐	

Describe:

Review and discuss the options for the listed items (including no anticipated future use).

Prior site use included rangeland and oil and gas operations. Residential development has begun to extend into the region of this former oilfield site. Future site use could include residential development, and restricted development for some former operation areas (tank battery vicinity to city park, for example).

Local Land Use

Also see Figure 2, EXTENDED SITE MAP. Indicate percent areal use for checked boxes, if possible.

	Current	Potential	Prior	
Residential	■	■	■	
Commercial	☐	☐	☐	
Industrial	☐	☐	☐	*(note light / heavy)*
Agricultural - range	■	■	■	
Agricultural - crop	☐	☐	☐	
Wildlife Habitat	☐	☐	☐	*(see ecological worksheet)*
Recreational	☐	☐	☐	*(note if park)*
Other:	■	■	■	***oil and gas production operations***

Discussion:

Review and discuss the options for the listed items (including no anticipated future use)

surface and ground water use

Surface Water Use

describe the potential use of these surface waters: ***(none present)***

	Current	Potential
Recreational	☐	☐
Domestic/Municipal Supply	☐	☐
Industrial Process Supply	☐	☐
Sensitive Habitat	☐	☐
Commercial/Sport Fishing	☐	☐
Aquacultural Use	☐	☐
Other:	☐	☐

First Encountered Groundwater

Also see worksheets REGIONAL HYDROGEOLOGICAL CONDITIONS and SITE HYDROGEOLOGICAL CONDITIONS - GROUNDWATER, and Figure 6, GEOLOGICAL CROSS-SECTION(S).

	Current	Potential
Domestic Supply	☐	■ *likely connection to municipal supply*
Public/Municipal Supply	☐	☐
Industrial Process Supply	☐	☐
Freshwater Replenishment	☐	☐
Aquacultural Use	☐	☐
Crop Irrigation	☐	☐
Livestock Watering	☐	■
Other:	☐	☐

Primary Drinking Water Aquifer

*Complete if this is a deeper lithologic unit than the first encountered groundwater. Also see worksheets **REGIONAL HYDROGEOLOGICAL CONDITIONS** and **SITE HYDROGEOLOGICAL CONDITIONS - GROUNDWATER**, and Figure 6, **GEOLOGICAL CROSS-SECTION(S)**.*

	Current	Potential
Domestic Supply	☐	☐
Public/Municipal Supply	☐	☐
Industrial Process Supply	☐	☐
Freshwater Replenishment	☐	☐
Other:	☐	☐

Discussion:

Review and discuss the options for the listed items (including no anticipated future use)

For the site vicinity, residences are supplied by municipal water, and any new residences could be connected to municipal water.

potential receptor survey

Comments:

*Discuss type of utility (water, storm sewer, sanitary sewer, electrical, etc.). Discuss type of building construction (slab on grade, crawl space, basement). Listing of receptor is not necessary if it is not near leak or if a deep water table is present. (indicate N/A in table where appropriate) Discuss nearest and other receptors and indicate on **Figure 3, Site Plan View**.*

	Name and Type:	Distance and Direction from Source:
Underground Utility Survey		
Also see Figures 1, 2, and 3		
Nearest Underground Utility		
Nearest Off-Site Underground Utility		
Nearest Downgradient Utility		
Building Survey		
Also see Figures 1, 2, and 3		
Nearest Building		
Nearest Inhabited Building		
Nearest Off-Site Inhabited Building		
Surface Water Hydrology		
Nearest Surface Water		
Nearest Downgradient Surface Water		

Notes:

Water table in this area is relatively deep (65 ft) and the location of residual hydrocarbon has been identified.

information key

site name:	Westgate Subdivision, Grimes Battery, and Tasker Road		site location:	Hobbs, NM	
no.	completion / revision:		approval:		Description:
	by:	date:	by:	date:	
	G. E. DeVaull	8/18/99	G. E. DeVaull	8/18/99	

summary of water wells within 0.5 mile radius of site

See Figure 1, SITE LOCATION MAP, for the well inventory survey within a 0.5 mile radius of the site

			Downgradient Direction		
	Total No.	Active No.	Total No.	Active No.	No. Screened in Potentially Impacted Aquifer
Public/Municipal					
Industrial					
Domestic					
Agricultural					

potential receptor points

for each below, identify:
(1) Closest Downgradient Supply Well
(2) Closest Downgradient Drinking Water Well
(3) Closest Actual Down-gradient Receptor

	(1)	(2)	(3)
Well No. or Designation:			
Distance from Site (ft):			
Total Well Depth (ft):			
Current Use of Water:			
Screened Interval below Ground Surface (ft):			
Seal Interval below Ground Surface (ft):			
Year Constructed:			
Water Use Classification:			

Informational References:

A water well survey has been completed, based on information on file in the State Engineer's office for the site vicinity (Sharon Hall, 20 April 1999), that is, Section 28, Township 18 South, Range 38 East, N.M.P.M., Lea County, New Mexico. This was tabulated as wells per quarter section. No downgradient water wells (east of the site) are recorded within one-half mile of the site.

Notes:

1. ***Any well (drinking water, agricultural, industrial, etc.), which has not been abandoned and is completed through any lithologic unit that could be potentially impacted.***
2. ***Municipal or residential drinking water supply completed in any lithologic unit.***
3. ***Municipal or residential drinking water supply well completed in same lithologic unit in which compounds are migrating.***

ECOLOGICAL ASSESSMENT SUMMARY 3.7

information key

site name:	Westgate Subdivision, Grimes Battery, and Tasker Road	site location:	Hobbs, NM

no.	completion / revision:		approval:		Description:
	by:	date:	by:	date:	
	G. E. DeVault	8/18/99	G. E. DeVault	8/18/99	

qualitative ecological impact assessment

Visual Site Inspection

no.	by:	affiliation:	date:	description

Observed Impacts Associated with Site

On-site vegetation	☐ none	☒ limited	☐ extensive
Off-site vegetation	☒ none	☐ limited	☐ extensive
On-site mammals, birds, fish, etc.	☒ none	☐ suspected	☐ observed
Off-site mammals, birds, fish, etc.	☒ none	☐ suspected	☐ observed
Other impacts	☐ none	☐ yes (explain below)	

Discussion:

habitat characterization

Presence of Habitat

Site located within or impacts a sensitive or protected habitat? ☒ no ☐ yes (explain below)

Description of Sensitive Habitat

*Include proximate Federal and state parks, national and state monuments, rookeries, wildlife preserves, wildlife management areas, freshwater springs, wetlands, prairie potholes. Include sources of information used to identify these areas. Indicate their location on Figure 1, **SITE LOCATION MAP** and Figure 2, **EXTENDED SITE MAP**.*

Name:
Location:
Habitat Type: ☐ Aquatic ☐ Wetland ☐ Wooded ☒ Scrub/Shrub ☒ Open Field ☐ Other
Habitat Condition: ☐ Pristine ☐ Highly Altered ☐ Early Recovery ☐ Late Recovery

Discussion:

*Provide other information relative to habitat characterization including regulatory authority, basis for protection, etc. Include photographs (Figure 4, **SITE PHOTOS**), if available.*

ecological receptors

Presence of Impacted Ecological Receptors

Site conditions have impacted sensitive ecological receptors, either on-site or off-site? ☒ no ☐ yes (explain below)

List of Potentially Affected Receptors

Note if threatened or endangered species (plant or animal) are known to inhabit the area of the site.
List economically important or sport species known to inhabit the area of the site.
Note observations, if any, regarding the presence or absence of ecological receptors including insects, fish, birds, mammals, benthic macroinvertebrates, plants, etc., on or in the vicinity of the site.

ecological assessment summary and recommended action

Observed or Potential Impacts	–	Recommended Action
☒ None observed or anticipated	–	No action required
☐ Potential for significant impact	–	Further study required (describe below)
☐ Significant impact observed	–	Further study required (describe below)

Recommended Work Program

Attach 1-2 page description of scope of work for more detailed ecological impact assessment, if needed. Address methods to be used, schedule and cost.

SALT–AFFECTED SITE SUMMARY 3.8

Information key

site name:	Westgate Subdivision, Grimes Battery, and Tasker Road	site location:	Hobbs, NM

	completion / revision:		approval:		Description:
no.	by:	date:	by:	date:	
	G. E. DeVaull	8/18/99	G. E. DeVaull	8/18/99	

Qualitative salt impact assessment

Visual Site Inspection

no.	by:	affiliation:	date:	description

Indicate the location of observed effects, reported spills and leaks, past and present operational equipment, and past and present storage locations on Figure 1, SITE LOCATION MAP and Figure 2, EXTENDED SITE MAP. Include surface and aerial photographs (Figure 4, SITE PHOTOS).

Observed Salt Effects Associated with Site
(refer to Worksheet ECOLOGICAL ASSESSMENT SUMMARY for observed effects on vegetation)

On-site erosion	☒ none	☐ localized	☐ general
Off-site erosion	☒ none	☐ localized	☐ general
On-site soil crust	☒ none	☐ white	☐ black
Off-site soil crust	☒ none	☐ white	☐ black
Other impacts	☒ no	☐ yes (explain below)	

Discussion. ***Note if halophytes (salt-tolerant plants) are present on site:***
Native vegetation in the vicinity includes grassland, short plants and bushes, and rangeland.

Operational characterization

Presence of Salt on Site (refer to SITE OWNERSHIP AND ACTIVITY RECORD)

Salt used on site (drilling mud, production chemical)	☐ no	☐ yes	
Salt produced on site (produced water, tank bottom)	☐ no	☒ yes	
Salt naturally present (salt marsh, coastal waters, playa)		☐ no	☒ yes (explain below)

Salt Leaks or Spills

Reported leaks of salt containing material on site	☒ no	☐ yes (refer to PAST RELEASES OR SOURCE AREAS)
Potential for leaks from tanks, pipelines, wells ☐ no	☒ yes (refer to SITE OWNERSHIP AND ACTIVITY RECORD)	

Water Resources

Potential Surface Water Receptors (refer to HYDROGEOLOGICAL CONDITIONS-SURFACE WATER)

Non-flowing water bodies on site (lakes, ponds, wetland, etc.)	☒ no	☐ yes (explain below)
Non-flowing water bodies off-site	☒ no	☐ yes (explain below)
Flowing water bodies on site (rivers, estuaries, etc.)	☒ no	☐ yes (explain below)
Flowing water bodies off-site	☒ no	☐ yes (explain below)

Potential Groundwater Receptors (refer to SITE HYDROGEOLOGIC CONDITIONS-GROUNDWATER)

Depth to groundwater < 6 feet	☒ no	☐ yes (explain below)
Impermeable layer < 6 feet	☐ no	☐ yes (explain below)
Off-site seeps or wells	☐ no	☐ yes (explain below).

Note: Consider the potential for deeper groundwater impacts, in the absence of surface evidence.

Salt effects assessment summary and recommended action

Observed or Potential Impacts	Recommended Action
☒ None observed or anticipated –	No action required
☐ Potential for significant impact–	Further study required (describe below)
☐ Significant impact observed –	Further study required (describe below)

Recommended Work Program
Attach 1-2 page description of scope of work for more detailed salt impact assessment, if needed. Address methods to be used, schedule and cost. See API (1997). Other useful references are Deuel and Holliday (1994), API (1991), and USDA (1954).

Measured soil total dissoved solids (TDS) levels indicate the potential for limited areas of stressed vegetation.
Caliche layers are present in areas of the site and are widespread in the regional area at and just below the soil surface.

EXPOSURE PARAMETER SUMMARY ASSESSMENT 4.1

information key

site name:	Westgate Subdivision, Grimes Battery, and Tasker Road		site location:	Hobbs, NM	
	completion / revision:		approval:		Description:
no.	by:	date:	by:	date:	
	G. E. DeVaull	8/18/99	G. E. DeVaull	8/18/99	
	G. E. DeVaull	3/6/2000	G. E. DeVaull	3/6/2000	

Indicate if the default exposure parameter value (Tier 1) is conservative for the residential or commercial/industrial scenario (y - ■, n - ☐). Indicate if a site-specific parameter has been used in deriving SSTL values (Tier 2 analysis). Note that only the selected exposure parameters which may be affected by site-specific conditions (site access, site conditions and use, presence of a receptor, climate, etc.) are checked and tabulated in this Tier 1 worksheet. The specified risk or hazard criteria are set at a level acceptable to the involved parties.

parameter		**residential**		**industrial**	**definition, units**		**site-specific values**
specified risk or hazard criteria							
THQ	☐	1		...	target hazard quotient for individual chemicals	☐	
TR_U	☐	10^{-4}		...	target excess individual lifetime cancer risk - upper range value	☐	
TR_L	☐	10^{-6}		...	target excess individual lifetime cancer risk - lower range value	☐	
exposure parameters							
AT_c		70		...	defined carcinogen averaging time (years)		
AT_n		= ED		...	defined averaging time for non-carcinogen (years)		
BW		70		...	body weight (kg) - adult		
BW		15			body weight (kg) - child, 1-6 years		
ED		30		25	exposure duration (years)		
ED		6			exposure duration (years) - child, 1-6 years		
EF	■	350	☐	250	exposure frequency (days/year)	☐	
IR_{soil}	■	100	☐	50	soil ingestion rate (mg/day) - adult	☐	
IR_{soil}	■	200			soil ingestion rate (mg/day) - child (1-6 yrs)	☐	
IR_{soil}	■	114			soil ingestion rate (mg-yr/kg-day) -- age-adjusted	☐	
$IR_{air\text{-}indoor}$	■	15	☐	20	daily inhalation rate (m^3/day) - indoor	☐	
$IR_{air\text{-}outdoor}$	■	20	☐	20	daily inhalation rate (m^3/day) - outdoor	☐	
IR_{water}	■	2	☐	1	daily water ingestion rate (L/day)	☐	
SA	☐	3160	☐	...	seasonally-averaged skin surface area (cm^2/day) - adult	☐	
SA	☐	2023			seasonally-averaged skin surface area (cm^2/day) - child (1-17yrs)	☐	
SA	☐	1567			seasonally-averaged skin surface area (cm^2-yr/day) -- age-adjusted	☐	
M		0.5		...	soil to skin adherence factor (mg/cm^2)		

discussion:

The default residential exposure parameters are always conservative (by definition) for the selected exposure scenarios. This section is to include information (if needed) on revised EF (days/year) estimates, ingestion or inhalation rate estimate changes due to exposure weighting to contaminated media (hours/day, or fractional weighting), and changes in seasonally-averaged exposed dermal area estimates due to climate or fractional exposure weighting.

For estimate of exposure for a restricted land use (proposed park), we use the residential exposure criteria with a modified exposure factor of EF = 35 days/year. All other factors are identical to the residential values. The EF = 35 days/year is based on USEPA, 1997: Exposure Factors Handbook, Volume III, USEPA, ORD, Washington, EPA/600/P-95/002Fc; Table 15-8, National averages, outdoor activity for "doer" (an active participant) of 2 hours/day. This is 350 days/year • (2 hrs/day) / (24 hrs/day) = 35 day/year. With this assumption, we find a restricted site use surficial soil screening criteria 10 times greater than the residential criteria. For conservatism, the residential level is used for screening soil concentrations throughout the site.

SITE PARAMETER SUMMARY ASSESSMENT 4.2

information key

	site name:	Westgate Subdivision, Grimes Battery, and Tasker Road		site location:	Hobbs, NM
	completion / revision:		approval:		Description:
no.	by:	date:	by:	date:	
	G. E. DeVaull	8/18/99	G. E. DeVaull	8/18/99	

This is a comparison of default site parameters (on which Tier 1 RBSL values are based) against site-specific values. The default parameters are intended to be reasonable or conservative relative to actual site conditions.

Notes:
* The conservatism of these values are to be evaluated in a Tier 1 analysis if the dependent pathway is potentially complete.
§ These values are suggested for site-specific measurement or estimation if Tier 1 RBSL values are exceeded, if the pathway may result in potential exposure, and if a Tier 2 analysis is warranted.

Indicate if the default parameter values (used in deriving Tier 1 parameters) are conservative or reasonable for the site conditions (y - ■, n - ☐). Indicate if the site-specific parameter has been used in deriving SSTL values (Tier 2 analysis only).

parameter	residential		industrial		definition, units		site-specific values
soil parameters							
	■	sandy			Soil type	☐	silty sand * §
h_{cap}	■	5			Capillary zone thickness (cm)	☐	
h_v	■	295			Vadose zone thickness (cm)	☐	
θ_{wcap}	■	0.342			Soil water content - capillary fringe region (cm^3-water/cm^3-soil)	☐	
θ_{wvad}	■	0.12			Soil water content - vadose zone (cm^3-water/cm^3-soil)	☐	§
θ_{wcrk}	■	0.12			Soil water content - soil filled foundation cracks (cm^3-w/cm^3-soil)	☐	
θ_{acap}	■	0.038			Soil air content - capillary fringe region (cm^3-air/cm^3-soil)	☐	
θ_{avad}	■	0.26			Soil air content - vadose zone (cm^3-air/cm^3-soil)	☐	
θ_{acrk}	■	0.26			Soil air content - soil filled foundation cracks (cm^3-air/cm^3-soil)	☐	
ρ_s	■	1.7			Soil bulk density - dry soil (g/cm^3)	☐	§
f_{oc}	■	0.01			Mass fraction of organic carbon in soil (g-oc/g-soil)	☐	§
θ_T	■	0.38			Soil porosity (cm^3-void/cm^3-soil)	☐	* §
L_{gw}	■	300			Depth to ground water (cm)	☐	65 ft * §
L_s	■	100			Thickness of surficial soils (cm)	☐	* §
pH	■	6.8			Soil / water pH (unitless)	☐	
groundwater parameters							
δ_{gw}	■	200			groundwater mixing zone height (cm)	☐	* §
I	■	30			water infiltration rate (cm/year)	☐	* §
U_{gw}	■	6.85			groundwater Darcy velocity (cm/day)	☐	* §
$LF_{pw,gw}$	■	4.7			leaching factor, pore water / ground water ratio (cm^3-wat/cm^3-wat)	☐	* §
surface parameters							
τ	■	30	☐	25	averaging time for surface emission vapor flux (years)	☐	
U_{air}	■	225		...	ambient air velocity in mixing zone (cm/s)	☐	
δ_{air}	■	200		...	mixing zone height (cm)	☐	
A	■	2×10^7		...	source-zone area (cm^2)	☐	§
W	■	4500		...	width of source-zone area (cm)	☐	§
L_{ss}	■	100		...	thickness of surficial soils (cm)	☐	§
P_e	■	6.9×10^{-14}		...	Areal respirable particulate emission flux from source (g/cm^2-s)	☐	
DF_{amb}	■	10		...	dispersion factor for ambient air (g-cm^2/s)/(g/cm^3)	☐	§
building parameters							
L_b	■	200	☐	300	enclosed space volume/infiltration area ratio (cm)	☐	
ER	■	12	☐	20	enclosed space air exchange rate (1/day)	☐	
L_{crack}	■	15		...	enclosed-space foundation or wall thickness (cm)	☐	
η	■	0.01		...	foundation crack fraction (cm^2-cracks/cm^2-total area)	☐	
dP	■	0		...	indoor/outdoor differential pressure (g/cm-s^2)	☐	
k_v	■	10^{-8}		...	soil permeability (cm^2)	☐	§
Z_{crack}	■	15		...	depth to bottom of slab (cm)	☐	
X_{crack}	■	3400		...	slab perimeter (cm)	☐	
A_b	■	700000		...	slab area (cm^2)	☐	
Q_s	■	0		...	convective flow through basement slab (cm^3-air/sec)	☐	
DF_{esp}	■	0.028		...	dispersion factor for enclosed-space air (g-cm^2/s)/(g/cm^3)	☐	

SUMMARY OF MEDIA INVESTIGATION & CHEMICAL ANALYSIS DATA 4.3

information key

	site name:	Westgate Subdivision, Grimes Battery, and Tasker Road		site location:	Hobbs, NM
no.	completion / revision: by:	date:	approval: by:	date:	Description:
	G. E. DeVaull	8/18/99	G. E. DeVaull	8/18/99	

			Media					
			Ground-water	Surface Soil	Subsurf. Soil	Soil Vapor	Ambient Vapor	Surface Water
relevant method?		*Not Applicable*	☐	☐	☐	☐	☐	■
		Samples Taken?	■	■	■	■	☐	☐
Chemical Analysis		Analysis Method	● anal - samples analyzed ● det - chemical detected ●					
Organic Chemicals			anal/det	anal/det	anal/det	anal/det	anal/det	anal/det
Volatile Organic Compounds	■	EPA 8260B (GC/MS)	■ ■	■ ■	■ ■	☐ ☐	☐ ☐	☐ ☐
	■	EPA 8021B (GC/PID or ELCD)	☐ ☐	■ ■	■ ■	■ ■	☐ ☐	☐ ☐
Nonhalogenated Organics	■	EPA 8015B (GC/FID)	☐ ☐	☐ ☐	☐ ☐	■ ■	☐ ☐	☐ ☐
Total Petroleum Hydrocarbons	■	EPA 8015G / 8015D (modified)	☐ ☐	☐ ☐	☐ ☐	■ ■	☐ ☐	☐ ☐
Total Petroleum Hydrocarbons	■	TX1006 (GC/FID)	☐ ☐	■ ■	☐ ☐	☐ ☐	☐ ☐	☐ ☐
Total Petroleum Hydrocarbons	■	EPA 418.1 (IR)	■ ■	■ ■	■ ■	☐ ☐	☐ ☐	☐ ☐
Total Petroleum Hydrocarbons	■	AD Little (GC/MS)	☐ ☐	■ ■	☐ ☐	☐ ☐	☐ ☐	☐ ☐
Total Petroleum Hydrocarbons	■	GC-HTSD (GC/FID)	☐ ☐	■ ■	☐ ☐	☐ ☐	☐ ☐	☐ ☐
Semivolatile Organic Compounds	■	EPA 8270C (GC/MS)	■ ■	■ ■	■ ■	☐ ☐	☐ ☐	☐ ☐
Polycyclic Aromatic Hydrocarbons	■	EPA 8270C (GC/MS)	■ ■	■ ■	■ ■	☐ ☐	☐ ☐	☐ ☐
	☐	EPA 8310 (HPLC)	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐
Halogenated Chemicals			anal/det	anal/det	anal/det	anal/det	anal/det	anal/det
Polychlorinated Biphenyls	■	EPA 8082 (GC/ECD or ELCD)	☐ ☐	■ ☐	■ ☐	☐ ☐	☐ ☐	☐ ☐
Organochlorine pesticides	■	EPA 8080	☐ ☐	■ ☐	■ ☐	☐ ☐	☐ ☐	☐ ☐
Inorganic Chemicals			anal/det	anal/det	anal/det	anal/det	anal/det	anal/det
Metals	■	EPA 6010B (ICP-AES)	■ ■	■ ■	■ ■	☐ ☐	☐ ☐	☐ ☐
	■	EPA 7*xxx* (*various*)	☐ ☐	■ ■	■ ■	☐ ☐	☐ ☐	☐ ☐
Ionizing Organic Chemicals			anal/det	anal/det	anal/det	anal/det	anal/det	anal/det
Gas Treament Amines		modified -- IC method	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐
Glycols		EPA 8015 (modified)	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐
Others			anal/det	anal/det	anal/det	anal/det	anal/det	anal/det
total activity	■	EPA 901.1M	☐ ☐	■ ■	■ ■	☐ ☐	☐ ☐	☐ ☐
inorganic anions	■	E300.0	■ ■	■ ■	■ ■	☐ ☐	☐ ☐	☐ ☐
ammonia	☐	EPA 350.*x*	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐
total dissolved solids	■	E160.1	■ ■	■ ■	■ ■	☐ ☐	☐ ☐	☐ ☐
pH	■	E150.1	■ ■	■ ■	■ ■	☐ ☐	☐ ☐	☐ ☐

Discussion of Media Investigation and Chemical Analysis (include selection of sampled media, selected analysis methods, planned additional sampling):

Analyses are tabulated from -
Triton Analytics Corp. (Feb 16, 1998).
A. D. Little, Environmental Monitoring and Analysis Unit. (Feb 17, 1999).
TraceAnalysis Inc. (Feb 23, 1999).
Westgate Subdivision, Grimes Battery and Tasker Road – Stage 1 Abatement Plan Report Site Assessment Investigation (July 1999).

SITE CLASSIFICATION SUMMARY 6.1

information key

site name:			site location:		
	completion / revision:		approval:		description:
no.	by:	date:	by:	date:	

Initial Classification			**Date:**	
	Description	Media	Urgency and Response	Addressed

Revised Classification			**Date:**	
	Description	Media	Urgency and Response	Addressed

Revised Classification			**Date:**	
	Description	Media	Urgency and Response	Addressed

CORRECTIVE ACTION EVALUATION 6.2

information key

site name:	Westgate Subdivision, Grimes Battery, and Tasker Road		site location:	Hobbs, NM	
no.	completion / revision:		approval:		Description:
	by:	date:	by:	date:	
	G. E. DeVaull	8/18/99	G. E. DeVaull	8/25/99	

This table provides a summary of chemical or mixture (petroleum) concentrations which exceed RBSL values on a pathway-specific basis. Corrective action strategies are indicated if relevant for the specific chemicals. The need for additional assessment is also indicated.

residential **(also applicable for restricted site use – proposed city park)**

EXPOSURE PATHWAY	INDICATED CHEMICALS	applicable at site?	removal / treatment	containment measures	institutional controls	additional assessment
surficial soil direct exposure	TPH, several PAHs	■	■		■	
soil to enclosed space vapor	benzene *(refined modeling implemented)*	■				
soil to outdoor vapor		■				
soil leaching to groundwater		■				
soil free-phase mobility		■				
other (specify):						

commercial / industrial **(not applicable)**

EXPOSURE PATHWAY	INDICATED CHEMICALS	applicable at site?	removal / treatment	containment measures	institutional controls	additional assessment
surficial soil direct exposure						
soil to enclosed space vapor						
soil to outdoor vapor						
soil leaching to groundwater						
soil free-phase mobility						
other (specify):						

other (indicate): **evaluation of site vegetation**

EXPOSURE PATHWAY	INDICATED CHEMICALS	applicable at site?	removal / treatment	containment measures	institutional controls	additional assessment
surficial soil direct exposure	total dissolved solids (TDS), soil conductivity	■	■			
soil to enclosed space vapor						
soil to outdoor vapor						
soil leaching to groundwater						
soil free-phase mobility						
other (specify):						

Notes:
discuss the specific corrective action options and additional assessment.

This worksheet is focused on chemicals which may need to be addressed in a remediation plan. Other chemicals are summarized in Worksheet 1.2, section 4.

Attachment 1:
Summary of Exposure Parameters

George DeVaull

October 6, 1999

The following is a summary of the applicable exposure parameters used in calculating risk-based screening levels and risk levels. These equations and parameters are consistent with those used in USEPA risk assessment guidance (USEPA, 1991b, 1989b, 1989a), in the ASTM Standard, *Risk-Based Corrective Action Applied at Petroleum Release Sites* (ASTM E 1739-95), and in the recently approved ASTM *Standard Guide for Risk Based Corrective Action* (ASTM PS 104-98). Several listed exposure parameters are not relevant in this assessment, but are included here for completeness. Where a site-specific parameter is used, it is noted. The reader is referred to either ASTM E 1739-95 or PS 104-98 for the model equations.

Parameters are defined as follows:

exposure parameters and definitions

The following parameters are consistent with the Maximally Exposed Individual (MEI) definition for upper range exposure.

AT_c	defined carcinogen averaging time		70 yrs	Lifetime (EPA, 1991b)
AT_n	defined averaging time for non-carcinogens	residential:	30 yrs	equal to ED, *corresponds to assumed exposure duration*
		commercial:	25 yrs	
BW	body weight	residential:	70 kg	used directly and in calculating age-adjusted exposure values: residential: 70 kg adult, 15 kg child (1-6 yrs), (EPA, 1991b), 35 kg (1-17 yrs) EPA, 1989b
		commercial:	70 kg	commercial/industrial, EPA (1989b)
ED	exposure duration	residential:	30 yrs	residential: 24 yr adult (ages 7 to 31 years), 6 yr child (ages 1 to 6 years) = 30 years total, Default value (EPA, 1991b)
		commercial:	25 yrs	
EF	exposure frequency	residential:	350 dys/yr	Default value (EPA, 1991b)
		commercial:	250 dys/yr	
		restricted:	35 dys/yr	EPA, 1997 (*see note following)
$IR_{s,\ adj.}$	Soil ingestion rate	residential:	114 mg-yr/ kg-day	residential: 100 mg/dy adult Default value (EPA, 1991b), 200 mg/dy child Default value (EPA, 1991b) [The calculated age-adjusted value is listed]
IR_s		commercial:	50 mg/day	commercial/industrial: Default value (EPA, 1991b)
AA_s	age adjustment on soil ingestion	residential:	yes	residential: for carcinogens, age-adjusted values, 1-6 yrs child, 7-31 yrs adult. For non-carcinogens, child and adult expsoure is evaluated separately.
		commercial:	no	adult receptor only.
IR_a	Daily inhalation rate	residential:	15 m^3/dy (indoors) 20 m^3/dy (outdoors)	residential: Default value (EPA, 1991b)
		commercial:	20 m^3/dy	commercial/industrial: assumed 8 hr per dy exposure of 60 m^3/dy total
IR_w	Daily water ingestion rate	residential:	2 L/dy	EPA (1991a)
		commercial:	1 L/dy	
$SA_{adj.}$	Skin Surface Area	residential:	1567 cm^2-yr/kg	residential: 3176 cm^2 adult - seasonally varying exposure (10-30% of average of mean adult male and female total surface area) (EPA, 1992a); 2023 cm^2 1 to 17 year olds - seasonally varying exposure (10-30% of average of mean male and female total surface area) = 1567 cm^2-yr/kg-dy age-adjusted value.
SA		commercial:	3160 cm^2	commercial/industrial: Based on mean surface area of head, hands, and forearms of adult males (EPA, 1992a)

AA_{SA}	age adjustment on skin surface area	residential:	yes	residential: for carcinogens, age-adjusted values, 1-17 yrs, 18-31 yrs adult. For non-carcinogens, child and adult fectors are evaluated separately
		commercial:	no	adult receptor only.
M	Soil to Skin Adherence Factor		0.5 $mg/cm^2/dy$	EPA dermal exposure assessment guidance (EPA, 1992a) states values should range between 0.2 to 1.0 $mg/cm^2/dy$

soil parameters and definitions

The listed parameters in this section are consistent with a sandy soil. In this analysis these parameters are applied in estimating vapor emissions from soils. These parameters are conservative (tend to overestimate vapor transport and exposure) compared to actual site soils which are less porous (e. g., silts, silty clays) and which contain a higher fraction of organic carbon. The parameters definitions and values are consistent with ASTM E 1739-95.

θ_w	soil water content - unsaturated (vadose) zone	0.12 cm^3-water/cm^3-soil	
θ_a	soil air content - unsaturated (vadose) zone	0.26 cm^3-air/cm^3-soil	$(= \theta_T - \theta_w)$
ρ_s	Soil bulk density	1.7 g/cm^3	
f_{oc}	mass fraction of organic carbon in soil	0.01g-oc / g-soil	
θ_T	Soil porosity	0.38 cm^3-void/cm^3-soil)	
L_s	Depth to contaminated soil	100 cm	assumed depth to subsurface contaminated soil is 1 m; shallower soil is considered surficial soil.

surface parameters and definitions

The listed parameters are used primarily to estimate dispersion in the atmosphere. The parameters lead to relatively conservative results for a receptor located at the center of an areal source. The parameters definitions and values are consistent with ASTM E 1739-95.

τ	Exposure duration	residential: commercial:	30 yr 25 yr	value is equal to ED for undisturbed soils.
U	Ambient air velocity in mixing zone		225 cm/s	
δ	Mixing zone height		200 cm	
A	Contaminated Area		20250000 cm^2	area in this assessment is assumed to be equal to approximately 21800 ft^2 (0.55 acre)
W	Width of Contaminated Area		4500 cm	$= [A]^{1/2}$
L_{ss}	Thickness of Surficial Soils		100 cm	this is the assumed depth of surficial soils. contamination at greater depth is classified as subsurface contamination. Because of the potential for construction activity at this site, all soil measurements are screened against both surface and subsurface soil criteria.
P_e	Particulate areal emission rate	residential & commercial:	6.86E-14 g/cm^2-s	Cowherd, 1985. Estimated dust emissions from bare, uncrusted dry soil with unlimited erosion potential

indoor air parameters and definitions

The listed parameters are used primarily to estimate indoor air infiltration from subsurface soils. The parameters definitions and values in this section are consistent with ASTM E 1739-95, and with Johnson and Ettinger (1991).

L_b	enclosed space volume/infiltration area ratio	residential: commercial:	200 cm 300 cm	For a slab foundation, this is the building height. For a basement, the subsurface walls and floor are included in this ratio.

ER	enclosed space air exchange rate	*residential:* commercial:	12 /day 20 /day	*nominal values for occupied buildings*
L_{crack}	enclosed-space foundation or wall thickness		15 cm	
η	foundation crack fraction		0.01 cm^2-cracks/cm^2-total area	
dP	indoor/outdoor differential pressure		0 g/cm-s^2	
k_v	soil permeability		10^{-8} cm^2	
Z_{crack}	depth to bottom of slab		15 cm	
X_{crack}	slab perimeter		3400 cm	
A_b	slab area		700000 cm^2	

chemical parameters

all of the following are chemical-specific.

CAS	chemical-specific		Chemical Abstracts Service Reference Number
MW		g/g-mol	molecular weight
D_{air}		cm^2/s	molecular diffusion coefficient in air
D_{water}		cm^2/s	molecular diffusion coefficient in water
K_{oc}		L-water/kg-oc	organic carbon - water partition coefficient
K_d		L-water/kg-soil	soil- water partition coefficient
H'		atm-m^3/g-mol	Henry's law coefficient
H		cm^3-water / cm^3-air	Henry's law coefficient = $H' \cdot (1000\ cm^3/L) / R\ T_a$
P_{vap}		mm Hg	saturated vapor pressure
S		mg/L	aqueous solubility limit
pK_a		(–)	acid ionization equilibrium constant
pK_b		(–)	base ionization equilibrium constant
RfD_o		mg/kg-dy	chronic oral reference dose
RfD_i		mg/kg-dy	chronic inhalation reference dose
SF_o		$(mg/kg\text{-}dy)^{-1}$	chronic oral slope factor
SF_i		$(mg/kg\text{-}dy)^{-1}$	chronic inhalation slope factor
RAF_o			relative absorption factor, oral (= 1)
RAF_d			relative absorption factor, dermal

global parameters

μ	g/cm-s	viscosity of air (= $1.81 \cdot 10^{-4}$)
ρ_a	g/cm^3	ambient air density (= 0.0012)
T_a	K	average ambient air temperature (= 293)
R	atm-L/g-mol-K	ideal gas constant (= 0.08206)

target risk or hazard quotients

HQ	specified hazard quotient (= 1.0)
Risk	specified risk level or range (10^{-4} to 10^{-6})

* The restricted site use (proposed park) EF = 35 days/year is based on USEPA, 1997: Exposure Factors Handbook, Volume III, USEPA, ORD, Washington, EPA/600/P-95/002Fc; Table 15-8, National averages, outdoor activity for "doer" (an active participant) of 2 hours/day. This is 350 days/year • (2 hrs/day) / (24 hrs/day) = 35 day/year.

References

ASTM E 1739-95: Risk-Based Corrective Action Applied at Petroleum Release Sites (American Society for Testing and Materials, West Conshohocken, PA).

ASTM PS 104-98: Standard Guide for Risk-Based Corrective Action (American Society for Testing and Materials, West Conshohocken, PA).

Cowherd, C., G. E. Muleski, P. J. Englehart, and D. A. Gillette, 1985: Rapid Assessment of Exposure to Particulate Emissions from Surface Contamination Sites, Midwest Research Institute, PB85-192219.

Johnson, P. C. and R. A. Ettinger, 1991: "Heuristic Model for Predicting the Intrusion Rate of Contaminant Vapors into Buildings", Environmental Science & Technology, 25, 1445-1452.

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Attachment 2. Refined Assessment:
exposure to volatile emissions from subsurface soils through inhalation

16 August 1999

George DeVaull

For exposure to vapors evolved from subsurface soils, both measured soil concentrations, in Worksheets 5.1 and 5.2, and soil vapor concentrations, in Worksheets 5.1a and 5.2a, have been compared with Tier 1 screening criteria. Exceedence of the Tier 1 screening criteria are noted for benzene volatilization to indoor air, and for a single TPH analysis as shown in the tables. Reports are referenced in the Worksheets for each sample.

The indoor air vapor model used in this estimate is directly from ASTM E1739-95, and is based on Johnson and Ettinger (1991). We note that the model used in these estimates known to be is <u>very</u> conservative, especially for readily biodegradable chemicals such as benzene (USEPA, 1996; Fitzpatrick and Fitzgerald, 1996).

To improve the comparison, we discuss and refine the model estimates for benzene, including factors which are initially neglected in the Tier 1 Johnson and Ettinger model.

background concentrations and target risk limits

The risk limit for benzene in air in development of screening-level concentrations is based on a target risk range of TR = 10^{-4} to 10^{-6}. For indoor air exposure factors, this yields screening level concentrations of

RBSL	TRU = 10^{-4}	TRL = 10^{-6}	
(ug/m^3)	3.92E+01	3.92E-01	screening-level concentrations for indoor air

Normal benzene concentrations measured in indoor air (USEPA, 1998) range from 2 to 39 ug/m^3, with a typical value of 5 ug/m^3. The indoor to outdoor ratio of measured values is approximately 2:1. At 5 ug/m^3 the indoor air target risk level for benzene is 1.3 x 10^{-5}. There are many potential sources for this measured benzene in indoor air. Sources of benzene (and other volatile organic chemicals) in indoor air include: building materials, consumer products, tobacco smoke, combustion sources, cooking, and attached garages.

The conservatism of the lower bound target risk level of TRL = 10^{-6} in this screening is very conservative. It is more than an order of magnitude less than normal "background" concentrations of benzene in indoor air.

mass limits

The default assumption in the Tier 1 Johnson and Ettinger model is an infinite mass of chemical in soil. One refinement of screening levels for indoor vapor exposure simply imposes a mass limit on the amount of volatile chemical in soil. This is done by specifying the depth of the impacted layer of soil (2 meters is chosen). This limits the mass of chemical available for volatilization over the exposure duration, and results in higher screening levels. For an imposed impacted layer of soil of 2 meters, screening values are shown in the following table.

subsurface soil volatilization to enclosed space -- benzene

RBSLs	TRU = 10^{-4}	TRL = 10^{-4}	
(mg/kg)	7.63E-01	7.63E-03	default assumptions
	3.03E+00	3.03E-02	mass-limit of 2 meters

RBSLs	TRU = 10^{-4}	TRL = 10^{-4}	
(mg/m^3)	2.54E+02	2.54E+00	default assumptions
	1.01E+03	1.01E+01	mass limit of 2 meters

biodegradation

Biodegradation in soil will significantly attenuate transport of petroleum vapor in soil, especially the transport of the BTEX (benzene, toluene, ethylbenzene, and xylenes) fraction. The Johnson and Ettinger (1991) soil vapor to indoor air model has been recently improved to include biodegradation effects (Johnson et al., 1998; 1999). This model requires an estimate of a biodegradation rate factor. DeVaull et al. (1997) present a summary of measured rate factors for aerobic degradation of BTEX suitable for use in this model. This summary includes data from nine authors and approximately 63 experiments, with data from soil microcosm tests, diffusive soil columns, soil columns with airflow, and field data over a broad range of concentration levels and soil types.

The biodegradation rate is a function of site-specific chemical concentration in the soil pore-water, and the rate is slowest for higher concentration levels. For this site, we have maximum near-surface soil and soil vapor concentrations which, with applicable partitioning factors, may be used in estimating a maximum soil pore-water concentration in surface soils.

0.074	(mg/kg-soil)	measured benzene concentration in soil (TMW-3, 3 ft)
0.695	(L-wat/kg-soil)	soil to soil pore-water partitioning factor (calculated from soil properties) = K_{sw}
0.107	(mg/L-water)	soil pore-water concentration using K_{sw} partition (= 0.074 mg/kg / K_{sw})
35.737	(mg/m^3-air)	measured soil gas concentration (TSVX, 3ft)
0.231	(L-wat/L-air)	air to water partition coefficient (= H, dimensionless Henry's law coefficient for benzene)
0.155	(mg/L-water)	soil pore-water concentration using H (= 35.737 / (H • 1000))

The two estimates for maximum soil pore-water concentration are relatively consistent. We use the average value of (0.107 + 0.155) / 2 = 0.131 mg/L-water for soil pore water concentration.

DeVaull (1997) specifies Monod-type kinetic rate parameters for aerobic degradation of BTEX.

0.9	(mg/L-hr)	maximum rate constant
0.2	(mg/L-water)	half-saturation constant

For an estimate of a 1st order rate constant needed in the Johnson et al. (1999) model, we conservatively simplify the Monod-type kinetics in DeVaull (1997), estimating an average rate and a underprediction of the biodegradation rate.

2.72	(1/hr)	calculated average effective 1st order rate constant (= 0.9 mg/L-hr / (0.2 mg/L + 0.131 mg/L))
9.9		95% confidence interval for data distribution in DeVaull (1997)
0.275	(1/hr)	lower limit (underpredicting degradation) rate constant

Using the average and 95% lower limit (underpredicting degradation) for benzene yields refined screening levels for this exposure pathway of:

subsurface soil volatilization to enclosed space

RBSLs	TRU = 10^{-4}	TRL = 10^{-4}	
(mg/kg)	7.63E-01	7.63E-03	default assumptions
	1.71E+01	1.71E-01	underpredicted biodegradation included
	5.38E+01	5.38E-01	average biodegradation rate included

RBSLs	TRU = 10^{-4}	TRL = 10^{-6}	
(mg/m^3)	2.54E+02	2.54E+00	default assumptions
	5.69E+03	5.69E+01	underpredicted biodegradation included
	1.79E+04	1.79E+02	average biodegradation rate included

references

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Fitzpatrick, N. A., and J. J. Fitzgerald, 1996: An Evaluation of Vapor Intrusion into Buildings through and Evaluation of Field Data, Presented at the 11th Annual Conference on Contaminated Soils University of Massachusetts at Amherst, available from Massacusetts Dept of Environmental Protection, Bureau of Waste Site Cleanup, URL: http://www.state.ma.us/dep/bwsc/miscpubs.htm.

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Johnson, P. C., and R. A. Ettinger, 1991: Heuristic model for predicting the intrusion rate of contaminant vapors into buildings. Environmental Science and Technology, 25(8):1445-1452.

Johnson, P. C., M. W. Kemblowski, and R. L. Johnson, 1998: "Assessing the Significance of Subsurface Vapor Contaminant Vapor Migration to Enclosed Spaces: Site-Specific Alternatives to Generic Estimates", American Petroleum Institute, Health and Sciences Dept., Publication Number 4674, December 1998.

Johnson, P. C., M. W. Kemblowski, and R. L. Johnson, 1999: "Assessing the Significance of Subsurface Vapor Contaminant Vapor Migration to Enclosed Spaces: Site-Specific Alternatives to Generic Estimates", Journal of Soil Contamination, 8(3):389-421.

ANALYTICAL SUMMARY - PETROLEUM HYDROCARBON ANALYSIS 4.4

Site Name:
Site Location:
Completed By:
Revision Date:

sample identifier: TSB-7A
sample description:
sample type:
☐ oil sample
■ soil sample

field sample ID: T119262
sampling unit:
sampling depth: (2-3')
sample interval:
field sampling date:

Total or Summation Analysis Results

description	analytical method number	analysis date	analysis ID code	measured chemical concen-tration (mg/kg)	detection limit (mg/kg)	QA/ QC code
TRPH	418.1	TSB-7, 2-3', SAMPLE: 106036, Table 3		20000		

Equivalent Carbon Number Range Analysis Results

	indentifier	T_{nbp} (°C)	description	formula	homolog	analytical method number	analysis date	analysis ID code	measured chemical concentration (mg/kg)	detection limit (mg/kg)	QA/QC code
1.	TPH-LT6AL1	51	EC 6< aliphatic	C5.5	aliphatic fraction						
2.	TPH-6TO8AL2	96	EC =&>6 to 8 aliphatic	C7	aliphatic fraction	TSB-7A (2-3'), T119262, Trace			89.3	<10	
3.	TPH-8TO10AL3	150	EC >8 to 10 aliphatic	C9	aliphatic fraction	TSB-7A (2-3'), T119262, Trace			168.2	<10	
4.	TPH-10TO12AL4	200	EC >10 to 12 aliphatic	C11	aliphatic fraction	TSB-7A (2-3'), T119262, Trace			166	<10	
5.	TPH-12TO16AL5	260	EC >12 to 16 aliphatic	C14	aliphatic fraction	TSB-7A (2-3'), T119262, Trace			501.7	<12.3	
6.	TPH-16TO35AL6	320	EC >16 to 35 aliphatic	C19	aliphatic fraction	TSB-7A (2-3'), T119262, Trace			1041	<10	
7.	TPH-6TO7AR1	80	Benzene (EC <6 to 7) arom.	C6.5	aromatic fraction	TSB-7A (2-3'), T119262, Trace			0	<10	
8.	TPH-7TO8AR2	110	Toluene (EC >7 to 8) arom.	C7.6	aromatic fraction	TSB-7A (2-3'), T119262, Trace			0	<10	
9.	TPH-8TO10AR3	150	EC > 8 to 10 aromatic	C9	aromatic fraction	TSB-7A (2-3'), T119262, Trace			43.3	<18.9	
10.	TPH-10TO12AR4	200	EC > 10 to 12 aromatic	C11	aromatic fraction	TSB-7A (2-3'), T119262, Trace			55.3	<10	
11.	TPH-12TO16AR5	260	EC >12 to 16 aromatic	C14	aromatic fraction	TSB-7A (2-3'), T119262, Trace			244.2	<15.5	
12.	TPH-16TO21AR6	320	EC >16 to 21 aromatic	C19	aromatic fraction	TSB-7A (2-3'), T119262, Trace			2729	<23.1	
13.	TPH-21TO35AR7	340	EC >21 to 35 aromatic	C28	aromatic fraction	TSB-7A (2-3'), T119262, Trace			1419	<10	
14.	TPH-GT35AT1	> 627.98	>C35 total		total fraction						
			aliphatic and aromatic (C35<) sum			TSB-7A (2-3'), T119262, Trace			6457.9		
			unfractionated analysis			TSB-7A (2-3'), T119262, Trace			9413	<50	

Indicator Chemical Analysis Results

CASRN	T_{nbp} (°C)	name	formula	homolog	within range:	analytical method number	analysis date	analysis ID code	measured chemical concentration (mg/kg)	detection limit (mg/kg)	QA/QC code
71-43-2	80.1	benzene	C6H6	alkyl benzenes	7.	EPA 8260	t with summary tab		0	<0.232	
108-88-3	110.7	toluene	C7H8	alkyl benzenes	8.	EPA 8260	7, 2-3', SAMPLE:		1		
100-41-4	136.2	ethylbenzene	C8H10	alkyl benzenes	9.	EPA 8260	7, 2-3', SAMPLE:		5.7		
1330-20-7	140	xylene (mixed isomers)	C8 H10	alkyl benzenes	9.	EPA 8260	7, 2-3', SAMPLE:		15.66		
91-20-3	217.9	naphthalene	C10H8	alkyl naphthalenes	11.	EPA 8270	7, 2-3', SAMPLE:		0	<25	
208-96-8	265	acenaphthalene	C12H8	naphtheno-benzenes	11.	EPA 8270					
83-32-9	278	acenaphthene	C12H10	naphtheno-benzenes	11.	EPA 8270					
86-73-7	295	fluorene	C13H10	naphtheno-benzenes	12.	EPA 8270	7, 2-3', SAMPLE:		0	<5	
85-01-8	340	phenanthrene	C14H10	polynuclear aromatics	12.	EPA 8270	7, 2-3', SAMPLE:		0	<25	
120-12-7	339.9	anthracene	C14H10	polynuclear aromatics	12.	EPA 8270	7, 2-3', SAMPLE:		0	<25	
206-44-0	384	fluoranthene	C16H10	naphtheno-benzenes	13.	EPA 8270	7, 2-3', SAMPLE:		0	<25	
129-00-0	404	pyrene	C16H10	polynuclear aromatics	13.	EPA 8270	7, 2-3', SAMPLE:		0	<25	
56-55-3	433.85	benzanthracene	C18H12	polynuclear aromatics	13.	EPA 8270					
218-01-9	447.85	chrysene	C18H12	polynuclear aromatics	13.	EPA 8270					
205-99-2	481	benzo(b)fluoranthene	C20 H12	naphtheno-benzenes	13.	EPA 8270	7, 2-3', SAMPLE:		0	<5	
207-08-9	480	benzo(k)fluoranthene	C20 H12	naphtheno-benzenes	13.	EPA 8270	7, 2-3', SAMPLE:		0	<5	
50-32-8	526.85	3,4-benzopyrene	C20 H12	polynuclear aromatics	13.	EPA 8270	7, 2-3', SAMPLE:		0	<25	
193-39-5	536	indeno(1,2,3-cd)pyrene	C21 H24	naphtheno-benzenes	13.	EPA 8270					
53-70-3	524	dibenz[1,2;5,6]anthracene	C22 H14	polynuclear aromatics	13.	EPA 8270					
191-24-2	616.85	benzo(g,h,i)perylene	C22 H12	polynuclear aromatics	13.	EPA 8270					

Notes (where applicable):
All detected petroleum hydrocarbon indicator chemicals and cuts are included in the above list.
Non-detects are omitted from the list.
In this application the indicator chemicals are screened separately from the TPH mixture.

ANALYTICAL SUMMARY - PETROLEUM HYDROCARBON ANALYSIS 4.4

Site Name:
Site Location:
Completed By:
Revision Date:

sample identifier: GBN-4
sample description:
sample type:
☐ oil sample
■ soil sample

field sample ID: T119263
sampling unit:
sampling depth:
sample interval: (6"-8")
field sampling date:

Total or Summation Analysis Results

description	analytical method number	analysis date	analysis ID code	measured chemical concen- tration (mg/kg)	detection limit (mg/kg)	QA/ QC code
TRPH	418.1	GMW-9, 8-10', SAMPLE: 106457, Table 3		11900		

Equivalent Carbon Number Range Analysis Results

	indentifier	T_{nbp} (°C)	description	formula	homolog	analytical method number	analysis date	analysis ID code	measured chemical concentration (mg/kg)	detection limit (mg/kg)	QA/QC code
1.	TPH-LT6AL1	51	EC 6< aliphatic	C5.5	aliphatic fraction						
2.	TPH-6TO8AL2	96	EC =&>6 to 8 aliphatic	C7	aliphatic fraction	GBN-4 (6"-8"), T119263, Trace			0	<10	
3.	TPH-8TO10AL3	150	EC >8 to 10 aliphatic	C9	aliphatic fraction	GBN-4 (6"-8"), T119263, Trace			0	<10	
4.	TPH-10TO12AL4	200	EC >10 to 12 aliphatic	C11	aliphatic fraction	GBN-4 (6"-8"), T119263, Trace			0	<10	
5.	TPH-12TO16AL5	260	EC >12 to 16 aliphatic	C14	aliphatic fraction	GBN-4 (6"-8"), T119263, Trace			0	<12.3	
6.	TPH-16TO35AL6	320	EC >16 to 35 aliphatic	C19	aliphatic fraction	GBN-4 (6"-8"), T119263, Trace			2623	<10	
7.	TPH-6TO7AR1	80	Benzene (EC <6 to 7) arom.	C6.5	aromatic fraction	GBN-4 (6"-8"), T119263, Trace			0	<10	
8.	TPH-7TO8AR2	110	Toluene (EC >7 to 8) arom.	C7.6	aromatic fraction	GBN-4 (6"-8"), T119263, Trace			0	<10	
9.	TPH-8TO10AR3	150	EC > 8 to 10 aromatic	C9	aromatic fraction	GBN-4 (6"-8"), T119263, Trace			0	<18.9	
10.	TPH-10TO12AR4	200	EC > 10 to 12 aromatic	C11	aromatic fraction	GBN-4 (6"-8"), T119263, Trace			0	<10	
11.	TPH-12TO16AR5	260	EC >12 to 16 aromatic	C14	aromatic fraction	GBN-4 (6"-8"), T119263, Trace			0	<15.5	
12.	TPH-16TO21AR6	320	EC >16 to 21 aromatic	C19	aromatic fraction	GBN-4 (6"-8"), T119263, Trace			4119	<23.1	
13.	TPH-21TO35AR7	340	EC >21 to 35 aromatic	C28	aromatic fraction	GBN-4 (6"-8"), T119263, Trace			5	<10	
14.	TPH-GT35AT1	> 627.98	>C35 total		total fraction						
			aliphatic and aromatic (C35<) sum						6742		
			unfractionated analysis						9901		

Indicator Chemical Analysis Results

CASRN	T_{nbp} (°C)	name	formula	homolog	within range:	analytical method number	analysis date	analysis ID code	measured chemical concentration (mg/kg)	detection limit (mg/kg)	QA/QC code
71-43-2	80.1	benzene	C6H6	alkyl benzenes	7.	EPA 8260	-9, 8-10', SAMPLE:		0	<0.025	
108-88-3	110.7	toluene	C7H8	alkyl benzenes	8.	EPA 8260	-9, 8-10', SAMPLE:		0	<0.025	
100-41-4	136.2	ethylbenzene	C8H10	alkyl benzenes	9.	EPA 8260	-9, 8-10', SAMPLE:		0	<0.025	
1330-20-7	140	xylene (mixed isomers)	C8 H10	alkyl benzenes	9.	EPA 8260	-9, 8-10', SAMPLE:		0	<0.05	
91-20-3	217.9	naphthalene	C10H8	alkyl naphthalenes	11.	EPA 8270	-9, 8-10', SAMPLE:		0	<1.25	
208-96-8	265	acenaphthalene	C12H8	naphtheno-benzenes	11.	EPA 8270					
83-32-9	278	acenaphthene	C12H10	naphtheno-benzenes	11.	EPA 8270					
86-73-7	295	fluorene	C13H10	naphtheno-benzenes	12.	EPA 8270	-9, 8-10', SAMPLE:		0	<1.25	
85-01-8	340	phenanthrene	C14H10	polynuclear aromatics	12.	EPA 8270	-9, 8-10', SAMPLE:		0	<1.25	
120-12-7	339.9	anthracene	C14H10	polynuclear aromatics	12.	EPA 8270	-9, 8-10', SAMPLE:		0	<1.25	
206-44-0	384	fluoranthene	C16H10	naphtheno-benzenes	13.	EPA 8270	-9, 8-10', SAMPLE:		0	<1.25	
129-00-0	404	pyrene	C16H10	polynuclear aromatics	13.	EPA 8270	-9, 8-10', SAMPLE:		0	<1.25	
56-55-3	433.85	benzanthracene	C18H12	polynuclear aromatics	13.	EPA 8270					
218-01-9	447.85	chrysene	C18H12	polynuclear aromatics	13.	EPA 8270					
205-99-2	481	benzo(b)fluoranthene	C20 H12	naphtheno-benzenes	13.	EPA 8270	-9, 8-10', SAMPLE:		0	<1.25	
207-08-9	480	benzo(k)fluoranthene	C20 H12	naphtheno-benzenes	13.	EPA 8270	-9, 8-10', SAMPLE:		0	<1.25	
50-32-8	526.85	3,4-benzopyrene	C20 H12	polynuclear aromatics	13.	EPA 8270	-9, 8-10', SAMPLE:		0	<1.25	
193-39-5	536	indeno(1,2,3-cd)pyrene	C21 H24	naphtheno-benzenes	13.	EPA 8270					
53-70-3	524	dibenz[1,2;5,6]anthracene	C22 H14	polynuclear aromatics	13.	EPA 8270					
191-24-2	616.85	benzo(g,h,i)perylene	C22 H12	polynuclear aromatics	13.	EPA 8270					

Notes (where applicable):
All detected petroleum hydrocarbon indicator chemicals and cuts are included in the above list.
Non-detects are omitted from the list.
In this application the indicator chemicals are screened separately from the TPH mixture.

ANALYTICAL SUMMARY - PETROLEUM HYDROCARBON ANALYSIS 4.4

Site Name:		Completed By:	
Site Location:		Revision Date:	

sample identifier:	GBN-3	field sample ID:	T117628
sample description:		sampling unit:	
sample type:		sampling depth:	(6")
	☐ oil sample	sample interval:	
	■ soil sample	field sampling date:	

Total or Summation Analysis Results

description	analytical method number	analysis date	analysis ID code	measured chemical concen-tration (mg/kg)	detection limit (mg/kg)	QA/ QC code
TRPH	418.1			0	<10	

Equivalent Carbon Number Range Analysis Results

indentifier	T_{nbp} (°C)	description	formula	homolog						
1. TPH-LT6AL1	51	EC 6< aliphatic	C5.5	aliphatic fraction						
2. TPH-6TO8AL2	96	EC =&>6 to 8 aliphatic	C7	aliphatic fraction	GBN-3 (6"), T117628, Trace A			0	<10	
3. TPH-8TO10AL3	150	EC >8 to 10 aliphatic	C9	aliphatic fraction	GBN-3 (6"), T117628, Trace A			0	<10	
4. TPH-10TO12AL4	200	EC >10 to 12 aliphatic	C11	aliphatic fraction	GBN-3 (6"), T117628, Trace A			0	<10	
5. TPH-12TO16AL5	260	EC >12 to 16 aliphatic	C14	aliphatic fraction	GBN-3 (6"), T117628, Trace A			533	<10	
6. TPH-16TO35AL6	320	EC >16 to 35 aliphatic	C19	aliphatic fraction	GBN-3 (6"), T117628, Trace A			14043	<10	
7. TPH-6TO7AR1	80	Benzene (EC <6 to 7) arom.	C6.5	aromatic fraction	GBN-3 (6"), T117628, Trace A			0	<10	
8. TPH-7TO8AR2	110	Toluene (EC >7 to 8) arom.	C7.6	aromatic fraction	GBN-3 (6"), T117628, Trace A			0	<10	
9. TPH-8TO10AR3	150	EC > 8 to 10 aromatic	C9	aromatic fraction	GBN-3 (6"), T117628, Trace A			25.1	<10	
10. TPH-10TO12AR4	200	EC > 10 to 12 aromatic	C11	aromatic fraction	GBN-3 (6"), T117628, Trace A			0	<10	
11. TPH-12TO16AR5	260	EC >12 to 16 aromatic	C14	aromatic fraction	GBN-3 (6"), T117628, Trace A			178	<10	
12. TPH-16TO21AR6	320	EC >16 to 21 aromatic	C19	aromatic fraction	GBN-3 (6"), T117628, Trace A			9406	<10	
13. TPH-21TO35AR7	340	EC >21 to 35 aromatic	C28	aromatic fraction	GBN-3 (6"), T117628, Trace A			0	<10	
14. TPH-GT35AT1	> 627.98	>C35 total		total fraction						
		aliphatic and aromatic (C35<) sum						24185.1		
		unfractionated analysis						21841		

Indicator Chemical Analysis Results

CASRN	T_{nbp} (°C)	name	formula	homolog	within range:						
71-43-2	80.1	benzene	C6H6	alkyl benzenes	7.	EPA 8260	2, 13-15', SAMPLE		0	<0.025	
108-88-3	110.7	toluene	C7H8	alkyl benzenes	8.	EPA 8260	2, 13-15', SAMPLE		0	<0.025	
100-41-4	136.2	ethylbenzene	C8H10	alkyl benzenes	9.	EPA 8260	2, 13-15', SAMPLE		0	<0.025	
1330-20-7	140	xylene (mixed isomers)	C8 H10	alkyl benzenes	9.	EPA 8260	2, 13-15', SAMPLE		0	<0.05	
91-20-3	217.9	naphthalene	C10H8	alkyl naphthalenes	11.	EPA 8270	2, 13-15', SAMPLE		0	<0.25	
208-96-8	265	acenaphthalene	C12H8	naphtheno-benzenes	11.	EPA 8270					
83-32-9	278	acenaphthene	C12H10	naphtheno-benzenes	11.	EPA 8270					
86-73-7	295	fluorene	C13H10	naphtheno-benzenes	12.	EPA 8270	2, 13-15', SAMPLE		0	<0.25	
85-01-8	340	phenanthrene	C14H10	polynuclear aromatics	12.	EPA 8270	2, 13-15', SAMPLE		0	<0.25	
120-12-7	339.9	anthracene	C14H10	polynuclear aromatics	12.	EPA 8270	2, 13-15', SAMPLE		0	<0.25	
206-44-0	384	fluoranthene	C16H10	naphtheno-benzenes	13.	EPA 8270	2, 13-15', SAMPLE		0	<0.25	
129-00-0	404	pyrene	C16H10	polynuclear aromatics	13.	EPA 8270	2, 13-15', SAMPLE		0	<0.25	
56-55-3	433.85	benzanthracene	C18H12	polynuclear aromatics	13.	EPA 8270					
218-01-9	447.85	chrysene	C18H12	polynuclear aromatics	13.	EPA 8270					
205-99-2	481	benzo(b)fluoranthene	C20 H12	naphtheno-benzenes	13.	EPA 8270	2, 13-15', SAMPLE		0	<0.25	
207-08-9	480	benzo(k)fluoranthene	C20 H12	naphtheno-benzenes	13.	EPA 8270	2, 13-15', SAMPLE		0	<0.25	
50-32-8	526.85	3,4-benzopyrene	C20 H12	polynuclear aromatics	13.	EPA 8270	2, 13-15', SAMPLE		0	<0.25	
193-39-5	536	indeno(1,2,3-cd)pyrene	C21 H24	naphtheno-benzenes	13.	EPA 8270					
53-70-3	524	dibenz[1,2;5,6]anthracene	C22 H14	polynuclear aromatics	13.	EPA 8270					
191-24-2	616.85	benzo(g,h,i)perylene	C22 H12	polynuclear aromatics	13.	EPA 8270					

Notes (where applicable):

All detected petroleum hydrocarbon indicator chemicals and cuts are included in the above list.

Non-detects are omitted from the list.

In this application the indicator chemicals are screened separately from the TPH mixture.

ANALYTICAL SUMMARY - PETROLEUM HYDROCARBON ANALYSIS 4.4

Site Name:
Site Location:
Completed By:
Revision Date:

sample identifier: GBN-1
sample description:
sample type:
☐ oil sample
■ soil sample
field sample ID: T117626
sampling unit:
sampling depth: (6")
sample interval:
field sampling date:

Total or Summation Analysis Results

description	analytical method number	analysis date	analysis ID code	measured chemical concen-tration (mg/kg)	detection limit (mg/kg)	QA/ QC code
TRPH	418.1	GSB-5, 2-3', SAMPLE: 106262, Table 3		0	<10	

Equivalent Carbon Number Range Analysis Results

	indentifier	T_{nbp} (°C)	description	formula	homolog	analytical method number	analysis date	analysis ID code	measured chemical concen-tration (mg/kg)	detection limit (mg/kg)	QA/ QC code
1.	TPH-LT6AL1	51	EC 6< aliphatic	C5.5	aliphatic fraction						
2.	TPH-6TO8AL2	96	EC =&>6 to 8 aliphatic	C7	aliphatic fraction	GBN-1 (6"), T117626, Trace			0	<10	
3.	TPH-8TO10AL3	150	EC >8 to 10 aliphatic	C9	aliphatic fraction	GBN-1 (6"), T117626, Trace			0	<10	
4.	TPH-10TO12AL4	200	EC >10 to 12 aliphatic	C11	aliphatic fraction	GBN-1 (6"), T117626, Trace			0	<10	
5.	TPH-12TO16AL5	260	EC >12 to 16 aliphatic	C14	aliphatic fraction	GBN-1 (6"), T117626, Trace			96	<10	
6.	TPH-16TO35AL6	320	EC >16 to 35 aliphatic	C19	aliphatic fraction	GBN-1 (6"), T117626, Trace			2571	<10	
7.	TPH-6TO7AR1	80	Benzene (EC <6 to 7) arom.	C6.5	aromatic fraction	GBN-1 (6"), T117626, Trace			0	<10	
8.	TPH-7TO8AR2	110	Toluene (EC >7 to 8) arom.	C7.6	aromatic fraction	GBN-1 (6"), T117626, Trace			0	<10	
9.	TPH-8TO10AR3	150	EC > 8 to 10 aromatic	C9	aromatic fraction	GBN-1 (6"), T117626, Trace			0	<10	
10.	TPH-10TO12AR4	200	EC > 10 to 12 aromatic	C11	aromatic fraction	GBN-1 (6"), T117626, Trace			0	<10	
11.	TPH-12TO16AR5	260	EC >12 to 16 aromatic	C14	aromatic fraction	GBN-1 (6"), T117626, Trace			0	<10	
12.	TPH-16TO21AR6	320	EC >16 to 21 aromatic	C19	aromatic fraction	GBN-1 (6"), T117626, Trace			911	<10	
13.	TPH-21TO35AR7	340	EC >21 to 35 aromatic	C28	aromatic fraction	GBN-1 (6"), T117626, Trace			289	<10	
14.	TPH-GT35AT1	> 627.98	>C35 total		total fraction						
			aliphatic and aromatic (C35<) sum						3780.6		
			unfractionated analysis						5322		

Indicator Chemical Analysis Results

CASRN	T_{nbp} (°C)	name	formula	homolog	within range:	analytical method number	analysis date	analysis ID code	measured chemical concen-tration (mg/kg)	detection limit (mg/kg)	QA/ QC code
71-43-2	80.1	benzene	C6H6	alkyl benzenes	7.	EPA 8260	5, 2-3', SAMPLE:		0	<0.025	
108-88-3	110.7	toluene	C7H8	alkyl benzenes	8.	EPA 8260	5, 2-3', SAMPLE:		0	<0.025	
100-41-4	136.2	ethylbenzene	C8H10	alkyl benzenes	9.	EPA 8260	5, 2-3', SAMPLE:		0	<0.025	
1330-20-7	140	xylene (mixed isomers)	C8 H10	alkyl benzenes	9.	EPA 8260	5, 2-3', SAMPLE:		0	<0.05	
91-20-3	217.9	naphthalene	C10H8	alkyl naphthalenes	11.	EPA 8270	5, 2-3', SAMPLE:		0	<2.5	
208-96-8	265	acenaphthalene	C12H8	naphtheno-benzenes	11.	EPA 8270					
83-32-9	278	acenaphthene	C12H10	naphtheno-benzenes	11.	EPA 8270					
86-73-7	295	fluorene	C13H10	naphtheno-benzenes	12.	EPA 8270	5, 2-3', SAMPLE:		0	<2.5	
85-01-8	340	phenanthrene	C14H10	polynuclear aromatics	12.	EPA 8270	5, 2-3', SAMPLE:		0	<2.5	
120-12-7	339.9	anthracene	C14H10	polynuclear aromatics	12.	EPA 8270	5, 2-3', SAMPLE:		0	<2.5	
206-44-0	384	fluoranthene	C16H10	naphtheno-benzenes	13.	EPA 8270	5, 2-3', SAMPLE:		0	<2.5	
129-00-0	404	pyrene	C16H10	polynuclear aromatics	13.	EPA 8270	5, 2-3', SAMPLE:		0	<2.5	
56-55-3	433.85	benzanthracene	C18H12	polynuclear aromatics	13.	EPA 8270					
218-01-9	447.85	chrysene	C18H12	polynuclear aromatics	13.	EPA 8270					
205-99-2	481	benzo(b)fluoranthene	C20 H12	naphtheno-benzenes	13.	EPA 8270	5, 2-3', SAMPLE:		0	<2.5	
207-08-9	480	benzo(k)fluoranthene	C20 H12	naphtheno-benzenes	13.	EPA 8270	5, 2-3', SAMPLE:		0	<2.5	
50-32-8	526.85	3,4-benzopyrene	C20 H12	polynuclear aromatics	13.	EPA 8270	5, 2-3', SAMPLE:		0	<2.5	
193-39-5	536	indeno(1,2,3-cd)pyrene	C21 H24	naphtheno-benzenes	13.	EPA 8270					
53-70-3	524	dibenz[1,2;5,6]anthracene	C22 H14	polynuclear aromatics	13.	EPA 8270					
191-24-2	616.85	benzo(g,h,i)perylene	C22 H12	polynuclear aromatics	13.	EPA 8270					

Notes (where applicable):
All detected petroleum hydrocarbon indicator chemicals and cuts are included in the above list.
Non-detects are omitted from the list.
In this application the indicator chemicals are screened separately from the TPH mixture.

ANALYTICAL SUMMARY - PETROLEUM HYDROCARBON ANALYSIS 4.4

Site Name:
Site Location:
Completed By:
Revision Date:

sample identifier: GBN-2
sample description:
sample type:
☐ oil sample
■ soil sample

field sample ID: T117627
sampling unit:
sampling depth: (6")
sample interval:
field sampling date:

Total or Summation Analysis Results

description	analytical method number	analysis date	analysis ID code	measured chemical concentration (mg/kg)	detection limit (mg/kg)	QA/QC code
TRPH	418.1					

Equivalent Carbon Number Range Analysis Results

	indentifier	T_{nbp} (°C)	description	formula	homolog	analytical method number	analysis date	analysis ID code	measured chemical concentration (mg/kg)	detection limit (mg/kg)	QA/QC code
1.	TPH-LT6AL1	51	EC 6< aliphatic	C5.5	aliphatic fraction						
2.	TPH-6TO8AL2	96	EC =&>6 to 8 aliphatic	C7	aliphatic fraction	GBN-2 (6"), T117627, Trace			0	<10	
3.	TPH-8TO10AL3	150	EC >8 to 10 aliphatic	C9	aliphatic fraction	GBN-2 (6"), T117627, Trace			0	<10	
4.	TPH-10TO12AL4	200	EC >10 to 12 aliphatic	C11	aliphatic fraction	GBN-2 (6"), T117627, Trace			0	<10	
5.	TPH-12TO16AL5	260	EC >12 to 16 aliphatic	C14	aliphatic fraction	GBN-2 (6"), T117627, Trace			0	<10	
6.	TPH-16TO35AL6	320	EC >16 to 35 aliphatic	C19	aliphatic fraction	GBN-2 (6"), T117627, Trace			585	<10	
7.	TPH-6TO7AR1	80	Benzene (EC <6 to 7) arom.	C6.5	aromatic fraction	GBN-2 (6"), T117627, Trace			0	<10	
8.	TPH-7TO8AR2	110	Toluene (EC >7 to 8) arom.	C7.6	aromatic fraction	GBN-2 (6"), T117627, Trace			0	<10	
9.	TPH-8TO10AR3	150	EC > 8 to 10 aromatic	C9	aromatic fraction	GBN-2 (6"), T117627, Trace			0	<10	
10.	TPH-10TO12AR4	200	EC > 10 to 12 aromatic	C11	aromatic fraction	GBN-2 (6"), T117627, Trace			0	<10	
11.	TPH-12TO16AR5	260	EC >12 to 16 aromatic	C14	aromatic fraction	GBN-2 (6"), T117627, Trace			0	<10	
12.	TPH-16TO21AR6	320	EC >16 to 21 aromatic	C19	aromatic fraction	GBN-2 (6"), T117627, Trace			372.4	<10	
13.	TPH-21TO35AR7	340	EC >21 to 35 aromatic	C28	aromatic fraction	GBN-2 (6"), T117627, Trace			15.7	<10	
14.	TPH-GT35AT1	> 627.98	>C35 total		total fraction						
			aliphatic and aromatic (C35<) sum						981		
			unfractionated analysis						1217		

Indicator Chemical Analysis Results

CASRN	T_{nbp} (°C)	name	formula	homolog	within range:	analytical method number	analysis date	analysis ID code	measured chemical concentration (mg/kg)	detection limit (mg/kg)	QA/QC code
71-43-2	80.1	benzene	C6H6	alkyl benzenes	7.	EPA 8260	5, 7, 8 (0-1ft) Samp		0	ND	
108-88-3	110.7	toluene	C7H8	alkyl benzenes	8.	EPA 8260	5, 7, 8 (0-1ft) Samp		0	ND	
100-41-4	136.2	ethylbenzene	C8H10	alkyl benzenes	9.	EPA 8260	5, 7, 8 (0-1ft) Samp		0	ND	
1330-20-7	140	xylene (mixed isomers)	C8 H10	alkyl benzenes	9.	EPA 8260	5, 7, 8 (0-1ft) Samp		0	ND	
91-20-3	217.9	naphthalene	C10H8	alkyl naphthalenes	11.	EPA 8270					
208-96-8	265	acenaphthalene	C12H8	naphtheno-benzenes	11.	EPA 8270					
83-32-9	278	acenaphthene	C12H10	naphtheno-benzenes	11.	EPA 8270					
86-73-7	295	fluorene	C13H10	naphtheno-benzenes	12.	EPA 8270					
85-01-8	340	phenanthrene	C14H10	polynuclear aromatics	12.	EPA 8270					
120-12-7	339.9	anthracene	C14H10	polynuclear aromatics	12.	EPA 8270					
206-44-0	384	fluoranthene	C16H10	naphtheno-benzenes	13.	EPA 8270					
129-00-0	404	pyrene	C16H10	polynuclear aromatics	13.	EPA 8270					
56-55-3	433.85	benzanthracene	C18H12	polynuclear aromatics	13.	EPA 8270					
218-01-9	447.85	chrysene	C18H12	polynuclear aromatics	13.	EPA 8270					
205-99-2	481	benzo(b)fluoranthene	C20 H12	naphtheno-benzenes	13.	EPA 8270					
207-08-9	480	benzo(k)fluoranthene	C20 H12	naphtheno-benzenes	13.	EPA 8270					
50-32-8	526.85	3,4-benzopyrene	C20 H12	polynuclear aromatics	13.	EPA 8270					
193-39-5	536	indeno(1,2,3-cd)pyrene	C21 H24	naphtheno-benzenes	13.	EPA 8270					
53-70-3	524	dibenz[1,2;5,6]anthracene	C22 H14	polynuclear aromatics	13.	EPA 8270					
191-24-2	616.85	benzo(g,h,i)perylene	C22 H12	polynuclear aromatics	13.	EPA 8270					

Notes (where applicable):
All detected petroleum hydrocarbon indicator chemicals and cuts are included in the above list.
Non-detects are omitted from the list.
In this application the indicator chemicals are screened separately from the TPH mixture.

ANALYTICAL SUMMARY - PETROLEUM HYDROCARBON ANALYSIS 4.4

Site Name:		Completed By:	
Site Location:		Revision Date:	

sample identifier:	GSB-10 (BP)	field sample ID:	T118813
sample description:		sampling unit:	
sample type:		sampling depth:	
☐	oil sample	sample interval:	(2-3')
■	soil sample	field sampling date:	

Total or Summation Analysis Results

description	analytical method number	analysis date	analysis ID code	measured chemical concen-tration (mg/kg)	detection limit (mg/kg)	QA/QC code
TRPH	418.1			1960		

Equivalent Carbon Number Range Analysis Results

	indentifier	T_{nbp} (°C)	description	formula	homolog						
1.	TPH-LT6AL1	51	EC 6< aliphatic	C5.5	aliphatic fraction						
2.	TPH-6TO8AL2	96	EC =&>6 to 8 aliphatic	C7	aliphatic fraction	GSB-10 (2-3') T118813, 2/23/9			29.6	<10	
3.	TPH-8TO10AL3	150	EC >8 to 10 aliphatic	C9	aliphatic fraction	GSB-10 (2-3') T118813, 2/23/9			271.3	<10	
4.	TPH-10TO12AL4	200	EC >10 to 12 aliphatic	C11	aliphatic fraction	GSB-10 (2-3') T118813, 2/23/9			271.2	<10	
5.	TPH-12TO16AL5	260	EC >12 to 16 aliphatic	C14	aliphatic fraction	GSB-10 (2-3') T118813, 2/23/9			812.7	<10	
6.	TPH-16TO35AL6	320	EC >16 to 35 aliphatic	C19	aliphatic fraction	GSB-10 (2-3') T118813, 2/23/9			1582.1	<10	
7.	TPH-6TO7AR1	80	Benzene (EC <6 to 7) arom.	C6.5	aromatic fraction	GSB-10 (2-3') T118813, 2/23/9			0	<10	
8.	TPH-7TO8AR2	110	Toluene (EC >7 to 8) arom.	C7.6	aromatic fraction	GSB-10 (2-3') T118813, 2/23/9			0	<10	
9.	TPH-8TO10AR3	150	EC > 8 to 10 aromatic	C9	aromatic fraction	GSB-10 (2-3') T118813, 2/23/9			40.2	<10	
10.	TPH-10TO12AR4	200	EC > 10 to 12 aromatic	C11	aromatic fraction	GSB-10 (2-3') T118813, 2/23/9			35.2	<10	
11.	TPH-12TO16AR5	260	EC >12 to 16 aromatic	C14	aromatic fraction	GSB-10 (2-3') T118813, 2/23/9			140.6	<10	
12.	TPH-16TO21AR6	320	EC >16 to 21 aromatic	C19	aromatic fraction	GSB-10 (2-3') T118813, 2/23/9			579.7	<10	
13.	TPH-21TO35AR7	340	EC >21 to 35 aromatic	C28	aromatic fraction	GSB-10 (2-3') T118813, 2/23/9			5	<10	
14.	TPH-GT35AT1	> 627.98	>C35 total		total fraction						
			aliphatic and aromatic (C35<) sum						3762		
			unfractionated analysis						6257		

Indicator Chemical Analysis Results

CASRN	T_{nbp} (°C)	name	formula	homolog	within range:						
71-43-2	80.1	benzene	C6H6	alkyl benzenes	7.	EPA 8260	,11 (2-3'), Sample:		0	<0.087	
108-88-3	110.7	toluene	C7H8	alkyl benzenes	8.	EPA 8260	,11 (2-3'), Sample:		0	<0.087	
100-41-4	136.2	ethylbenzene	C8H10	alkyl benzenes	9.	EPA 8260	,11 (2-3'), Sample:		0	<0.087	
1330-20-7	140	xylene (mixed isomers)	C8 H10	alkyl benzenes	9.	EPA 8260	,11 (2-3'), Sample:		0	<0.174	
91-20-3	217.9	naphthalene	C10H8	alkyl naphthalenes	11.	EPA 8270	,11 (2-3'), Sample:		0	<0.25	
208-96-8	265	acenaphthalene	C12H8	naphtheno-benzenes	11.	EPA 8270					
83-32-9	278	acenaphthene	C12H10	naphtheno-benzenes	11.	EPA 8270					
86-73-7	295	fluorene	C13H10	naphtheno-benzenes	12.	EPA 8270	,11 (2-3'), Sample:		0	<0.25	
85-01-8	340	phenanthrene	C14H10	polynuclear aromatics	12.	EPA 8270	,11 (2-3'), Sample:		0	<0.25	
120-12-7	339.9	anthracene	C14H10	polynuclear aromatics	12.	EPA 8270	,11 (2-3'), Sample:		0	<0.25	
206-44-0	384	fluoranthene	C16H10	naphtheno-benzenes	13.	EPA 8270	,11 (2-3'), Sample:		0	<0.25	
129-00-0	404	pyrene	C16H10	polynuclear aromatics	13.	EPA 8270	,11 (2-3'), Sample:		0	<0.25	
56-55-3	433.85	benzanthracene	C18H12	polynuclear aromatics	13.	EPA 8270					
218-01-9	447.85	chrysene	C18H12	polynuclear aromatics	13.	EPA 8270					
205-99-2	481	benzo(b)fluoranthene	C20 H12	naphtheno-benzenes	13.	EPA 8270	,11 (2-3'), Sample:		0	<0.25	
207-08-9	480	benzo(k)fluoranthene	C20 H12	naphtheno-benzenes	13.	EPA 8270	,11 (2-3'), Sample:		0	<0.25	
50-32-8	526.85	3,4-benzopyrene	C20 H12	polynuclear aromatics	13.	EPA 8270	,11 (2-3'), Sample:		0	<0.25	
193-39-5	536	indeno(1,2,3-cd)pyrene	C21 H24	naphtheno-benzenes	13.	EPA 8270					
53-70-3	524	dibenz[1,2;5,6]anthracene	C22 H14	polynuclear aromatics	13.	EPA 8270					
191-24-2	616.85	benzo(g,h,i)perylene	C22 H12	polynuclear aromatics	13.	EPA 8270					

Notes (where applicable):

All detected petroleum hydrocarbon indicator chemicals and cuts are included in the above list.

Non-detects are omitted from the list.

In this application the indicator chemicals are screened separately from the TPH mixture.

ANALYTICAL SUMMARY - PETROLEUM HYDROCARBON ANALYSIS 4.4

Site Name:		Completed By:	
Site Location:		Revision Date:	

sample identifier:	GSB-9	field sample ID:	T118812
sample description:		sampling unit:	
sample type:		sampling depth:	
	☐ oil sample	sample interval:	(2-3')
	■ soil sample	field sampling date:	

Total or Summation Analysis Results

description	analytical method number	analysis date	analysis ID code	measured chemical concen-tration (mg/kg)	detection limit (mg/kg)	QA/ QC code
TRPH	418.1			24		

Equivalent Carbon Number Range Analysis Results

	indentifier	T_{nbp} (°C)	description	formula	homolog	analytical method number	analysis date	analysis ID code	measured chemical concen-tration (mg/kg)	detection limit (mg/kg)	QA/ QC code
1.	TPH-LT6AL1	51	EC 6< aliphatic	C5.5	aliphatic fraction						
2.	TPH-6TO8AL2	96	EC =&>6 to 8 aliphatic	C7	aliphatic fraction	GSB-9 (2-3') T118812, 2/23/9			0	<10	
3.	TPH-8TO10AL3	150	EC >8 to 10 aliphatic	C9	aliphatic fraction	GSB-9 (2-3') T118812, 2/23/9			0	<10	
4.	TPH-10TO12AL4	200	EC >10 to 12 aliphatic	C11	aliphatic fraction	GSB-9 (2-3') T118812, 2/23/9			0	<10	
5.	TPH-12TO16AL5	260	EC >12 to 16 aliphatic	C14	aliphatic fraction	GSB-9 (2-3') T118812, 2/23/9			0	<10	
6.	TPH-16TO35AL6	320	EC >16 to 35 aliphatic	C19	aliphatic fraction	GSB-9 (2-3') T118812, 2/23/9			0	<10	
7.	TPH-6TO7AR1	80	Benzene (EC <6 to 7) arom.	C6.5	aromatic fraction	GSB-9 (2-3') T118812, 2/23/9			0	<10	
8.	TPH-7TO8AR2	110	Toluene (EC >7 to 8) arom.	C7.6	aromatic fraction	GSB-9 (2-3') T118812, 2/23/9			0	<10	
9.	TPH-8TO10AR3	150	EC > 8 to 10 aromatic	C9	aromatic fraction	GSB-9 (2-3') T118812, 2/23/9			0	<10	
10.	TPH-10TO12AR4	200	EC > 10 to 12 aromatic	C11	aromatic fraction	GSB-9 (2-3') T118812, 2/23/9			0	<10	
11.	TPH-12TO16AR5	260	EC >12 to 16 aromatic	C14	aromatic fraction	GSB-9 (2-3') T118812, 2/23/9			21.4	<10	
12.	TPH-16TO21AR6	320	EC >16 to 21 aromatic	C19	aromatic fraction	GSB-9 (2-3') T118812, 2/23/9			20.5	<10	
13.	TPH-21TO35AR7	340	EC >21 to 35 aromatic	C28	aromatic fraction	GSB-9 (2-3') T118812, 2/23/9			5	<10	
14.	TPH-GT35AT1	> 627.98	>C35 total		total fraction						
			aliphatic and aromatic (C35<) sum						41.9		
			unfractionated analysis						51		

Indicator Chemical Analysis Results

CASRN	T_{nbp} (°C)	name	formula	homolog	within range:	analytical method number	analysis date	analysis ID code	measured chemical concen-tration (mg/kg)	detection limit (mg/kg)	QA/ QC code
71-43-2	80.1	benzene	C6H6	alkyl benzenes	7.	EPA 8260	, 4 (2-3'), Sample: 105224, 107012, 107				ND
108-88-3	110.7	toluene	C7H8	alkyl benzenes	8.	EPA 8260	, 4 (2-3'), Sample: 105224, 107012, 107				ND
100-41-4	136.2	ethylbenzene	C8H10	alkyl benzenes	9.	EPA 8260	, 4 (2-3'), Sample: 105224, 107012, 107				ND
1330-20-7	140	xylene (mixed isomers)	C8 H10	alkyl benzenes	9.	EPA 8260	, 4 (2-3'), Sample: 105224, 107012, 107				ND
91-20-3	217.9	naphthalene	C10H8	alkyl naphthalenes	11.	EPA 8270					
208-96-8	265	acenaphthalene	C12H8	naphtheno-benzenes	11.	EPA 8270					
83-32-9	278	acenaphthene	C12H10	naphtheno-benzenes	11.	EPA 8270					
86-73-7	295	fluorene	C13H10	naphtheno-benzenes	12.	EPA 8270	, 4 (2-3'), Sample: 105224, 107012, 107				ND
85-01-8	340	phenanthrene	C14H10	polynuclear aromatics	12.	EPA 8270	, 4 (2-3'), Sample: 105224, 107012, 107				ND
120-12-7	339.9	anthracene	C14H10	polynuclear aromatics	12.	EPA 8270	, 4 (2-3'), Sample: 105224, 107012, 107				ND
206-44-0	384	fluoranthene	C16H10	naphtheno-benzenes	13.	EPA 8270	, 4 (2-3'), Sample: 105224, 107012, 107				ND
129-00-0	404	pyrene	C16H10	polynuclear aromatics	13.	EPA 8270	, 4 (2-3'), Sample: 105224, 107012, 107				ND
56-55-3	433.85	benzanthracene	C18H12	polynuclear aromatics	13.	EPA 8270					
218-01-9	447.85	chrysene	C18H12	polynuclear aromatics	13.	EPA 8270					
205-99-2	481	benzo(b)fluoranthene	C20 H12	naphtheno-benzenes	13.	EPA 8270	, 4 (2-3'), Sample: 105224, 107012, 107				ND
207-08-9	480	benzo(k)fluoranthene	C20 H12	naphtheno-benzenes	13.	EPA 8270	, 4 (2-3'), Sample: 105224, 107012, 107				ND
50-32-8	526.85	3,4-benzopyrene	C20 H12	polynuclear aromatics	13.	EPA 8270	, 4 (2-3'), Sample: 105224, 107012, 107				ND
193-39-5	536	indeno(1,2,3-cd)pyrene	C21 H24	naphtheno-benzenes	13.	EPA 8270					
53-70-3	524	dibenz[1,2;5,6]anthracene	C22 H14	polynuclear aromatics	13.	EPA 8270					
191-24-2	616.85	benzo(g,h,i)perylene	C22 H12	polynuclear aromatics	13.	EPA 8270					

Notes (where applicable):

All detected petroleum hydrocarbon indicator chemicals and cuts are included in the above list.

Non-detects are omitted from the list.

In this application the indicator chemicals are screened separately from the TPH mixture.

ANALYTICAL SUMMARY - PETROLEUM HYDROCARBON ANALYSIS 4.4

Site Name:	Shell - Hobbs, NM	Completed By:	G. DeVaull
Site Location:	Westgate	Revision Date:	

sample identifier:	TSB-7 2-3 ft	field sample ID:	
sample description:	soil sample	sampling unit:	
sample type:		sampling depth:	
	☐ oil sample	sample interval:	
	■ soil sample	field sampling date:	

Total or Summation Analysis Results

description	analytical method number	analysis date	analysis ID code	measured chemical concen-tration (mg/kg)	detection limit (mg/kg)	QA/ QC code
TPH				57000		

Equivalent Carbon Number Range Analysis Results

	indentifier	T_{nbn} (°C)	description	formula	homolog	analytical method number	analysis date	analysis ID code	measured chemical concentration (mg/kg)	detection limit (mg/kg)	QA/QC code
1.	TPH-LT6AL1	51	EC 6< aliphatic	C5.5	aliphatic fraction						
2.	TPH-6TO8AL2	96	EC =&>6 to 8 aliphatic	C7	aliphatic fraction						
3.	TPH-8TO10AL3	150	EC >8 to 10 aliphatic	C9	aliphatic fraction				51.7		
4.	TPH-10TO12AL4	200	EC >10 to 12 aliphatic	C11	aliphatic fraction				0		
5.	TPH-12TO16AL5	260	EC >12 to 16 aliphatic	C14	aliphatic fraction				0		
6.	TPH-16TO35AL6	320	EC >16 to 35 aliphatic	C19	aliphatic fraction				1535.78		
7.	TPH-6TO7AR1	80	Benzene (EC <6 to 7) arom.	C6.5	aromatic fraction				0.02		
8.	TPH-7TO8AR2	110	Toluene (EC >7 to 8) arom.	C7.6	aromatic fraction				0.012		
9.	TPH-8TO10AR3	150	EC > 8 to 10 aromatic	C9	aromatic fraction				15.3		
10.	TPH-10TO12AR4	200	EC > 10 to 12 aromatic	C11	aromatic fraction				0		
11.	TPH-12TO16AR5	260	EC >12 to 16 aromatic	C14	aromatic fraction				352.2		
12.	TPH-16TO21AR6	320	EC >16 to 21 aromatic	C19	aromatic fraction				511.1		
13.	TPH-21TO35AR7	340	EC >21 to 35 aromatic	C28	aromatic fraction				85.22		
14.	TPH-GT35AT1	> 627.98	>C35 total		total fraction				10571		
			aliphatic and aromatic (C35<) sum								
			unfractionated analysis						12749		

Indicator Chemical Analysis Results

CASRN	T_{nbn} (°C)	name	formula	homolog	within range:	analytical method number	analysis date	analysis ID code	measured chemical concentration (mg/kg)	detection limit (mg/kg)	QA/QC code
71-43-2	80.1	benzene	C_6H_6	alkyl benzenes	7.	EPA 8260			0.02		
108-88-3	110.7	toluene	C_7H_8	alkyl benzenes	8.	EPA 8260			0.012		J
100-41-4	136.2	ethylbenzene	C_8H_{10}	alkyl benzenes	9.	EPA 8260			3.2		L
1330-20-7	140	xylene (mixed isomers)	C_8H_{10}	alkyl benzenes	9.	EPA 8260			12.1		L
91-20-3	217.9	naphthalene	$C_{10}H_8$	alkyl naphthalenes	11.	EPA 8270			12		
208-96-8	265	acenaphthalene	$C_{12}H_8$	naphtheno-benzenes	11.	EPA 8270			0		
83-32-9	278	acenaphthene	$C_{12}H_{10}$	naphtheno-benzenes	11.	EPA 8270			0		
86-73-7	295	fluorene	$C_{13}H_{10}$	naphtheno-benzenes	12.	EPA 8270			6.1		
85-01-8	340	phenanthrene	$C_{14}H_{10}$	polynuclear aromatics	12.	EPA 8270			14		
120-12-7	339.9	anthracene	$C_{14}H_{10}$	polynuclear aromatics	12.	EPA 8270			0		
206-44-0	384	fluoranthene	$C_{16}H_{10}$	naphtheno-benzenes	13.	EPA 8270			0		
129-00-0	404	pyrene	$C_{16}H_{10}$	polynuclear aromatics	13.	EPA 8270			2		
56-55-3	433.85	benzanthracene	$C_{18}H_{12}$	polynuclear aromatics	13.	EPA 8270			1.2		
218-01-9	447.85	chrysene	$C_{18}H_{12}$	polynuclear aromatics	13.	EPA 8270			3.6		
205-99-2	481	benzo(b)fluoranthene	$C_{20}H_{12}$	naphtheno-benzenes	13.	EPA 8270			1.1		
207-08-9	480	benzo(k)fluoranthene	$C_{20}H_{12}$	naphtheno-benzenes	13.	EPA 8270			0.22		
50-32-8	526.85	3,4-benzopyrene	$C_{20}H_{12}$	polynuclear aromatics	13.	EPA 8270			1.1		
193-39-5	536	indeno(1,2,3-cd)pyrene	$C_{21}H_{24}$	naphtheno-benzenes	13.	EPA 8270			0.95		
53-70-3	524	dibenz[1,2;5,6]anthracene	$C_{22}H_{14}$	polynuclear aromatics	13.	EPA 8270			0.34		
191-24-2	616.85	benzo(g,h,i)perylene	$C_{22}H_{12}$	polynuclear aromatics	13.	EPA 8270			1.6		

Notes (where applicable):

All detected petroleum hydrocarbon indicator chemicals and cuts are included in the above list.

Non-detects are omitted from the list.

In this application the indicator chemicals are screened separately from the TPH mixture.

ANALYTICAL SUMMARY - PETROLEUM HYDROCARBON ANALYSIS 4.4

Site Name: Shell - Hobbs, NM
Site Location: Westgate

Completed By: G. DeVaull
Revision Date:

sample identifier: TSB-8 2-3 ft
sample description: soil sample
sample type:
☐ oil sample
■ soil sample

field sample ID:
sampling unit:
sampling depth:
sample interval:
field sampling date:

Total or Summation Analysis Results

description	analytical method number	analysis date	analysis ID code	measured chemical concentration (mg/kg)	detection limit (mg/kg)	QA/QC code
TPH				32000		

Equivalent Carbon Number Range Analysis Results

	indentifier	T_{nbp} (°C)	description	formula	homolog	analytical method number	analysis date	analysis ID code	measured chemical concentration (mg/kg)	detection limit (mg/kg)	QA/QC code
1.	TPH-LT6AL1	51	EC 6< aliphatic	C5.5	aliphatic fraction						
2.	TPH-6TO8AL2	96	EC =&>6 to 8 aliphatic	C7	aliphatic fraction						
3.	TPH-8TO10AL3	150	EC >8 to 10 aliphatic	C9	aliphatic fraction				52.76		
4.	TPH-10TO12AL4	200	EC >10 to 12 aliphatic	C11	aliphatic fraction				0		
5.	TPH-12TO16AL5	260	EC >12 to 16 aliphatic	C14	aliphatic fraction				258.6		
6.	TPH-16TO35AL6	320	EC >16 to 35 aliphatic	C19	aliphatic fraction				1059.492		
7.	TPH-6TO7AR1	80	Benzene (EC <6 to 7) arom.	C6.5	aromatic fraction				0.0098		
8.	TPH-7TO8AR2	110	Toluene (EC >7 to 8) arom.	C7.6	aromatic fraction				0.0065		
9.	TPH-8TO10AR3	150	EC > 8 to 10 aromatic	C9	aromatic fraction				59.24		
10.	TPH-10TO12AR4	200	EC > 10 to 12 aromatic	C11	aromatic fraction				0		
11.	TPH-12TO16AR5	260	EC >12 to 16 aromatic	C14	aromatic fraction				244.1		
12.	TPH-16TO21AR6	320	EC >16 to 21 aromatic	C19	aromatic fraction				268.4		
13.	TPH-21TO35AR7	340	EC >21 to 35 aromatic	C28	aromatic fraction				37.508		
14.	TPH-GT35AT1	> 627.98	>C35 total		total fraction				7151.1		
			aliphatic and aromatic (C35<) sum								
			unfractionated analysis						9013.1		

Indicator Chemical Analysis Results

CASRN	T_{nbp} (°C)	name	formula	homolog	within range:	analytical method number	analysis date	analysis ID code	measured chemical concentration (mg/kg)	detection limit (mg/kg)	QA/QC code
71-43-2	80.1	benzene	C6H6	alkyl benzenes	7.	EPA 8260			0.0098		J
108-88-3	110.7	toluene	C7H8	alkyl benzenes	8.	EPA 8260			0.0065		J
100-41-4	136.2	ethylbenzene	C8H10	alkyl benzenes	9.	EPA 8260			11		L
1330-20-7	140	xylene (mixed isomers)	C8 H10	alkyl benzenes	9.	EPA 8260			48.24		L
91-20-3	217.9	naphthalene	C10H8	alkyl naphthalenes	11.	EPA 8270			11		
208-96-8	265	acenaphthalene	C12H8	naphtheno-benzenes	11.	EPA 8270			0		
83-32-9	278	acenaphthene	C12H10	naphtheno-benzenes	11.	EPA 8270			0		
86-73-7	295	fluorene	C13H10	naphtheno-benzenes	12.	EPA 8270			3.7		
85-01-8	340	phenanthrene	C14H10	polynuclear aromatics	12.	EPA 8270			8.3		
120-12-7	339.9	anthracene	C14H10	polynuclear aromatics	12.	EPA 8270			0		
206-44-0	384	fluoranthene	C16H10	naphtheno-benzenes	13.	EPA 8270			0		
129-00-0	404	pyrene	C16H10	polynuclear aromatics	13.	EPA 8270			0.81		
56-55-3	433.85	benzanthracene	C18H12	polynuclear aromatics	13.	EPA 8270			0.45		
218-01-9	447.85	chrysene	C18H12	polynuclear aromatics	13.	EPA 8270			1.5		
205-99-2	481	benzo(b)fluoranthene	C20 H12	naphtheno-benzenes	13.	EPA 8270			0.38		
207-08-9	480	benzo(k)fluoranthene	C20 H12	naphtheno-benzenes	13.	EPA 8270			0.088		
50-32-8	526.85	3,4-benzopyrene	C20 H12	polynuclear aromatics	13.	EPA 8270			0.35		
193-39-5	536	indeno(1,2,3-cd)pyrene	C21 H24	naphtheno-benzenes	13.	EPA 8270			0.2		
53-70-3	524	dibenz[1,2;5,6]anthracene	C22 H14	polynuclear aromatics	13.	EPA 8270			0.12		
191-24-2	616.85	benzo(g,h,i)perylene	C22 H12	polynuclear aromatics	13.	EPA 8270			0.39		

Notes (where applicable):

All detected petroleum hydrocarbon indicator chemicals and cuts are included in the above list.

Non-detects are omitted from the list.

In this application the indicator chemicals are screened separately from the TPH mixture.

ANALYTICAL RESULTS - PETROLEUM MASS FRACTION DISTRIBUTION 4.5

Site Name:	Completed By:
Site Location:	Revision Date:

sample identifier:	TSB-7A	field sample ID:	T119262
sample description:		sampling unit:	TSB-7A
sample type:		sampling depth:	(2-3')
	☐ oil sample	sample interval:	
	■ soil sample	field sampling date:	

Calculated Mass Fraction Distributions

	indentifier	description	equivalent carbon number distribution only (1) mass fraction (g/g)	equivalent carbon number distribution only (1) mass conc. (mg/kg)	equivalent carbon number distribution with indicator chemicals included (2) mass fraction (g/g)	equivalent carbon number distribution with indicator chemicals included (2) mass conc. (mg/kg)	initial measured mass conc. (mg/kg)	
1.	TPH-LT6AL1	EC 6< aliphatic						
2.	TPH-6TO8AL2	EC =&>6 to 8 aliphatic	0.01382781	89.3	0.01382781	89.3	89.3	
3.	TPH-8TO10AL3	EC >8 to 10 aliphatic	0.026045215	168.2	0.026045215	168.2	168.2	
4.	TPH-10TO12AL4	EC >10 to 12 aliphatic	0.025704552	166	0.025704552	166	166	
5.	TPH-12TO16AL5	EC >12 to 16 aliphatic	0.07768659	501.7	0.07768659	501.7	501.7	
6.	TPH-16TO35AL6	EC >16 to 35 aliphatic	0.161195417	1041	0.161195417	1041	1041	
7.	TPH-6TO7AR1	Benzene (EC <6 to 7) arom.	0	0			0	(1)
8.	TPH-7TO8AR2	Toluene (EC >7 to 8) arom.	0.000154847	1			0	(1)
9.	TPH-8TO10AR3	EC > 8 to 10 aromatic	0.006704862	43.3	0.003397337	21.94	43.3	
10.	TPH-10TO12AR4	EC > 10 to 12 aromatic	0.008563023	55.3	0.008563023	55.3	55.3	
11.	TPH-12TO16AR5	EC >12 to 16 aromatic	0.037813565	244.2	0.037813565	244.2	244.2	
12.	TPH-16TO21AR6	EC >16 to 21 aromatic	0.422576649	2729	0.422576649	2729	2729	
13.	TPH-21TO35AR7	EC >21 to 35 aromatic	0.21972747	1419	0.21972747	1419	1419	
14.	TPH-GT35AT1	>C35 total						
		sum	1	6458				

CASRN	name	within range	mass conc. (mg/kg) (1)	mass fraction (g/g) (2)	mass conc. (mg/kg) (2)	initial measured mass conc. (mg/kg)
71-43-2	benzene	7.	0	0	0	0
108-88-3	toluene	8.	1	0.000154847	1	1
100-41-4	ethylbenzene	9.	5.7	0.000882626	5.7	5.7
1330-20-7	xylene (mixed isomers)	9.	15.66	0.002424899	15.66	15.66
91-20-3	naphthalene	11.	0	0	0	0
208-96-8	acenaphthalene	11.				
83-32-9	acenaphthene	11.				
86-73-7	fluorene	12.	0	0	0	0
85-01-8	phenanthrene	12.	0	0	0	0
120-12-7	anthracene	12.	0	0	0	0
206-44-0	fluoranthene	13.	0	0	0	0
129-00-0	pyrene	13.	0	0	0	0
56-55-3	benzanthracene	13.				
218-01-9	chrysene	13.				
205-99-2	benzo(b)fluoranthene	13.	0	0	0	0
207-08-9	benzo(k)fluoranthene	13.	0	0	0	0
50-32-8	3,4-benzopyrene	13.	0	0	0	0
193-39-5	indeno(1,2,3-cd)pyrene	13.				
53-70-3	dibenz[1,2;5,6]anthracene	13.				
191-24-2	benzo(g,h,i)perylene	13.				
			sum	1	6458	

Notes (where applicable):

(1) EPA 8260 (GC/MS) results, if available, are used for benzene and toluene aromatic cuts.

(2) Indicator concentrations subtracted from applicable cut range and distribution is re-normalized.

ANALYTICAL RESULTS - PETROLEUM MASS FRACTION DISTRIBUTION 4.5

Site Name:
Site Location:

Completed By:
Revision Date:

sample identifier: GBN-4
sample description:
sample type:
☐ oil sample
■ soil sample

field sample ID: T119263
sampling unit: GBN-4
sampling depth:
sample interval: (6"-8")
field sampling date:

Calculated Mass Fraction Distributions

	indentifier	description	equivalent carbon number distribution only (1) mass fraction (g/g)	equivalent carbon number distribution only (1) mass conc. (mg/kg)	equivalent carbon number distribution with indicator chemicals included (2) mass fraction (g/g)	equivalent carbon number distribution with indicator chemicals included (2) mass conc. (mg/kg)	initial measured mass conc. (mg/kg)	
1.	TPH-LT6AL1	EC 6< aliphatic						
2.	TPH-6TO8AL2	EC =&>6 to 8 aliphatic	0	0	0	0	0	
3.	TPH-8TO10AL3	EC >8 to 10 aliphatic	0	0	0	0	0	
4.	TPH-10TO12AL4	EC >10 to 12 aliphatic	0	0	0	0	0	
5.	TPH-12TO16AL5	EC >12 to 16 aliphatic	0	0	0	0	0	
6.	TPH-16TO35AL6	EC >16 to 35 aliphatic	0.388765377	2623	0.388765377	2623	2623	
7.	TPH-6TO7AR1	Benzene (EC <6 to 7) arom.	0	0			0	(1)
8.	TPH-7TO8AR2	Toluene (EC >7 to 8) arom.	0	0			0	(1)
9.	TPH-8TO10AR3	EC > 8 to 10 aromatic	0	0			0	
10.	TPH-10TO12AR4	EC > 10 to 12 aromatic	0	0	0	0	0	
11.	TPH-12TO16AR5	EC >12 to 16 aromatic	0	0			0	
12.	TPH-16TO21AR6	EC >16 to 21 aromatic	0.610493553	4119	0.610493553	4119	4119	
13.	TPH-21TO35AR7	EC >21 to 35 aromatic	0.00074107	5	0.00074107	5	5	
14.	TPH-GT35AT1	>C35 total						
		sum	1	6747				

CASRN	name	within range	mass conc. (mg/kg)	mass fraction (g/g)	mass conc. (mg/kg)	initial measured mass conc. (mg/kg)
71-43-2	benzene	7.	0	0	0	0
108-88-3	toluene	8.	0	0	0	0
100-41-4	ethylbenzene	9.	0	0	0	0
1330-20-7	xylene (mixed isomers)	9.	0	0	0	0
91-20-3	naphthalene	11.	0	0	0	0
208-96-8	acenaphthalene	11.				
83-32-9	acenaphthene	11.				
86-73-7	fluorene	12.	0	0	0	0
85-01-8	phenanthrene	12.	0	0	0	0
120-12-7	anthracene	12.	0	0	0	0
206-44-0	fluoranthene	13.	0	0	0	0
129-00-0	pyrene	13.	0	0	0	0
56-55-3	benzanthracene	13.				
218-01-9	chrysene	13.				
205-99-2	benzo(b)fluoranthene	13.	0	0	0	0
207-08-9	benzo(k)fluoranthene	13.	0	0	0	0
50-32-8	3,4-benzopyrene	13.	0	0	0	0
193-39-5	indeno(1,2,3-cd)pyrene	13.				
53-70-3	dibenz[1,2;5,6]anthracene	13.				
191-24-2	benzo(g,h,i)perylene	13.				
			sum	1	6747	

Notes (where applicable):
(1) EPA 8260 (GC/MS) results, if available, are used for benzene and toluene aromatic cuts.
(2) Indicator concentrations subtracted from applicable cut range and distribution is re-normalized.

ANALYTICAL RESULTS - PETROLEUM MASS FRACTION DISTRIBUTION 4.5

Site Name: Completed By:
Site Location: Revision Date:

sample identifier: GBN-3
sample description:
sample type:
☐ oil sample
■ soil sample

field sample ID: T117628
sampling unit:
sampling depth: (6")
sample interval:
field sampling date:

Calculated Mass Fraction Distributions

	indentifier	description	equivalent carbon number distribution only (1) mass fraction (g/g)	equivalent carbon number distribution only (1) mass conc. (mg/kg)	equivalent carbon number distribution with indicator chemicals included (2) mass fraction (g/g)	equivalent carbon number distribution with indicator chemicals included (2) mass conc. (mg/kg)	initial measured mass conc. (mg/kg)	
1.	TPH-LT6AL1	EC 6< aliphatic						
2.	TPH-6TO8AL2	EC =&>6 to 8 aliphatic	0	0	0	0	0	
3.	TPH-8TO10AL3	EC >8 to 10 aliphatic	0	0	0	0	0	
4.	TPH-10TO12AL4	EC >10 to 12 aliphatic	0	0	0	0	0	
5.	TPH-12TO16AL5	EC >12 to 16 aliphatic	0.022038362	533	0.022038362	533	533	
6.	TPH-16TO35AL6	EC >16 to 35 aliphatic	0.580646762	14043	0.580646762	14043	14043	
7.	TPH-6TO7AR1	Benzene (EC <6 to 7) arom.	0	0			0	(1)
8.	TPH-7TO8AR2	Toluene (EC >7 to 8) arom.	0	0			0	(1)
9.	TPH-8TO10AR3	EC > 8 to 10 aromatic	0.001037829	25.1	0.001037829	25.1	25.1	
10.	TPH-10TO12AR4	EC > 10 to 12 aromatic	0	0	0	0	0	
11.	TPH-12TO16AR5	EC >12 to 16 aromatic	0.007359903	178	0.007359903	178	178	
12.	TPH-16TO21AR6	EC >16 to 21 aromatic	0.388917143	9406	0.388917143	9406	9406	
13.	TPH-21TO35AR7	EC >21 to 35 aromatic	0	0			0	
14.	TPH-GT35AT1	>C35 total						
		sum	1	24185.1				

CASRN	name	within range	mass fraction (g/g)	mass conc. (mg/kg)	mass fraction (g/g)	mass conc. (mg/kg)	mass conc. (mg/kg)
71-43-2	benzene	7.		0	0	0	0
108-88-3	toluene	8.		0	0	0	0
100-41-4	ethylbenzene	9.		0	0	0	0
1330-20-7	xylene (mixed isomers)	9.		0	0	0	0
91-20-3	naphthalene	11.		0	0	0	0
208-96-8	acenaphthalene	11.					
83-32-9	acenaphthene	11.					
86-73-7	fluorene	12.		0	0	0	0
85-01-8	phenanthrene	12.		0	0	0	0
120-12-7	anthracene	12.		0	0	0	0
206-44-0	fluoranthene	13.		0	0	0	0
129-00-0	pyrene	13.		0	0	0	0
56-55-3	benzanthracene	13.					
218-01-9	chrysene	13.					
205-99-2	benzo(b)fluoranthene	13.		0	0	0	0
207-08-9	benzo(k)fluoranthene	13.		0	0	0	0
50-32-8	3,4-benzopyrene	13.		0	0	0	0
193-39-5	indeno(1,2,3-cd)pyrene	13.					
53-70-3	dibenz[1,2;5,6]anthracene	13.					
191-24-2	benzo(g,h,i)perylene	13.					
				sum	1	24185.1	

Notes (where applicable):
(1) EPA 8260 (GC/MS) results, if available, are used for benzene and toluene aromatic cuts.
(2) Indicator concentrations subtracted from applicable cut range and distribution is re-normalized.

ANALYTICAL RESULTS - PETROLEUM MASS FRACTION DISTRIBUTION 4.5

Site Name:
Site Location:
Completed By:
Revision Date:

sample identifier: GBN-1
sample description:
sample type:
☐ oil sample
☒ soil sample
field sample ID: T117626
sampling unit:
sampling depth: (6")
sample interval:
field sampling date:

Calculated Mass Fraction Distributions

	indentifier	description	equivalent carbon number distribution only (1) mass fraction (g/g)	equivalent carbon number distribution only (1) mass conc. (mg/kg)	equivalent carbon number distribution with indicator chemicals included (2) mass fraction (g/g)	equivalent carbon number distribution with indicator chemicals included (2) mass conc. (mg/kg)	initial measured mass conc. (mg/kg)	
1.	TPH-LT6AL1	EC 6< aliphatic						
2.	TPH-6TO8AL2	EC =&>6 to 8 aliphatic	0	0	0	0	0	
3.	TPH-8TO10AL3	EC >8 to 10 aliphatic	0	0	0	0	0	
4.	TPH-10TO12AL4	EC >10 to 12 aliphatic	0	0	0	0	0	
5.	TPH-12TO16AL5	EC >12 to 16 aliphatic	0.024825446	96	0.024825446	96	96	
6.	TPH-16TO35AL6	EC >16 to 35 aliphatic	0.664856478	2571	0.664856478	2571	2571	
7.	TPH-6TO7AR1	Benzene (EC <6 to 7) arom.	0	0			0	(1)
8.	TPH-7TO8AR2	Toluene (EC >7 to 8) arom.	0	0			0	(1)
9.	TPH-8TO10AR3	EC > 8 to 10 aromatic	0	0			0	
10.	TPH-10TO12AR4	EC > 10 to 12 aromatic	0	0	0	0	0	
11.	TPH-12TO16AR5	EC >12 to 16 aromatic	0	0			0	
12.	TPH-16TO21AR6	EC >16 to 21 aromatic	0.235583139	911	0.235583139	911	911	
13.	TPH-21TO35AR7	EC >21 to 35 aromatic	0.074734937	289	0.074734937	289	289	
14.	TPH-GT35AT1	>C35 total						
		sum	1	3867				

CASRN	name	within range	(1) mass fraction (g/g)	(1) mass conc. (mg/kg)	(2) mass fraction (g/g)	(2) mass conc. (mg/kg)	initial measured mass conc. (mg/kg)
71-43-2	benzene	7.		0	0	0	0
108-88-3	toluene	8.		0	0	0	0
100-41-4	ethylbenzene	9.		0	0	0	0
1330-20-7	xylene (mixed isomers)	9.		0	0	0	0
91-20-3	naphthalene	11.		0	0	0	0
208-96-8	acenaphthalene	11.					
83-32-9	acenaphthene	11.					
86-73-7	fluorene	12.		0	0	0	0
85-01-8	phenanthrene	12.		0	0	0	0
120-12-7	anthracene	12.		0	0	0	0
206-44-0	fluoranthene	13.		0	0	0	0
129-00-0	pyrene	13.		0	0	0	0
56-55-3	benzanthracene	13.					
218-01-9	chrysene	13.					
205-99-2	benzo(b)fluoranthene	13.		0	0	0	0
207-08-9	benzo(k)fluoranthene	13.		0	0	0	0
50-32-8	3,4-benzopyrene	13.		0	0	0	0
193-39-5	indeno(1,2,3-cd)pyrene	13.					
53-70-3	dibenz[1,2;5,6]anthracene	13.					
191-24-2	benzo(g,h,i)perylene	13.					
				sum	1	3867	

Notes (where applicable):
(1) EPA 8260 (GC/MS) results, if available, are used for benzene and toluene aromatic cuts.
(2) Indicator concentrations subtracted from applicable cut range and distribution is re-normalized.

ANALYTICAL RESULTS - PETROLEUM MASS FRACTION DISTRIBUTION 4.5

Site Name:	Completed By:
Site Location:	Revision Date:

sample identifier:	GBN-2	field sample ID:	T117627
sample description:		sampling unit:	
sample type:		sampling depth:	(6")
☐ oil sample		sample interval:	
■ soil sample		field sampling date:	

Calculated Mass Fraction Distributions

	indentifier	description	equivalent carbon number distribution only (1) mass fraction (g/g)	equivalent carbon number distribution only (1) mass conc. (mg/kg)	equivalent carbon number distribution with indicator chemicals included (2) mass fraction (g/g)	equivalent carbon number distribution with indicator chemicals included (2) mass conc. (mg/kg)	initial measured mass conc. (mg/kg)	
1.	TPH-LT6AL1	EC 6< aliphatic						
2.	TPH-6TO8AL2	EC =&>6 to 8 aliphatic	0	0	0	0	0	
3.	TPH-8TO10AL3	EC >8 to 10 aliphatic	0	0	0	0	0	
4.	TPH-10TO12AL4	EC >10 to 12 aliphatic	0	0	0	0	0	
5.	TPH-12TO16AL5	EC >12 to 16 aliphatic	0	0	0	0	0	
6.	TPH-16TO35AL6	EC >16 to 35 aliphatic	0.601171514	585	0.601171514	585	585	
7.	TPH-6TO7AR1	Benzene (EC <6 to 7) arom.	0	0			0	(1)
8.	TPH-7TO8AR2	Toluene (EC >7 to 8) arom.	0	0			0	(1)
9.	TPH-8TO10AR3	EC > 8 to 10 aromatic	0	0			0	
10.	TPH-10TO12AR4	EC > 10 to 12 aromatic	0	0	0	0	0	
11.	TPH-12TO16AR5	EC >12 to 16 aromatic	0	0			0	
12.	TPH-16TO21AR6	EC >16 to 21 aromatic	0.382694482	372.4	0.382694482	372.4	372.4	
13.	TPH-21TO35AR7	EC >21 to 35 aromatic	0.016134005	15.7	0.016134005	15.7	15.7	
14.	TPH-GT35AT1	>C35 total						
		sum	1	973.1				

CASRN	name	within range	equivalent carbon number distribution only (1) mass conc. (mg/kg)	equivalent carbon number distribution with indicator chemicals included (2) mass fraction (g/g)	equivalent carbon number distribution with indicator chemicals included (2) mass conc. (mg/kg)	initial measured mass conc. (mg/kg)
71-43-2	benzene	7.	0	0	0	0
108-88-3	toluene	8.	0	0	0	0
100-41-4	ethylbenzene	9.	0	0	0	0
1330-20-7	xylene (mixed isomers)	9.	0	0	0	0
91-20-3	naphthalene	11.				
208-96-8	acenaphthalene	11.				
83-32-9	acenaphthene	11.				
86-73-7	fluorene	12.				
85-01-8	phenanthrene	12.				
120-12-7	anthracene	12.				
206-44-0	fluoranthene	13.				
129-00-0	pyrene	13.				
56-55-3	benzanthracene	13.				
218-01-9	chrysene	13.				
205-99-2	benzo(b)fluoranthene	13.				
207-08-9	benzo(k)fluoranthene	13.				
50-32-8	3,4-benzopyrene	13.				
193-39-5	indeno(1,2,3-cd)pyrene	13.				
53-70-3	dibenz[1,2;5,6]anthracene	13.				
191-24-2	benzo(g,h,i)perylene	13.				
			sum	1	973.1	

Notes (where applicable):

(1) EPA 8260 (GC/MS) results, if available, are used for benzene and toluene aromatic cuts.

(2) Indicator concentrations subtracted from applicable cut range and distribution is re-normalized.

ANALYTICAL RESULTS - PETROLEUM MASS FRACTION DISTRIBUTION 4.5

Site Name:
Site Location:
Completed By:
Revision Date:

sample identifier: GSB-10 (BP)
sample description:
sample type:
☐ oil sample
■ soil sample

field sample ID: T118813
sampling unit:
sampling depth:
sample interval: (2-3')
field sampling date:

Calculated Mass Fraction Distributions

	indentifier	description	equivalent carbon number distribution only (1)		equivalent carbon number distribution with indicator chemicals included (2)		initial measured	
			mass fraction (g/g)	mass conc. (mg/kg)	mass fraction (g/g)	mass conc. (mg/kg)	mass conc. (mg/kg)	
1.	TPH-LT6AL1	EC 6< aliphatic						
2.	TPH-6TO8AL2	EC =&>6 to 8 aliphatic	0.00785646	29.6	0.00785646	29.6	29.6	
3.	TPH-8TO10AL3	EC >8 to 10 aliphatic	0.072008706	271.3	0.072008706	271.3	271.3	
4.	TPH-10TO12AL4	EC >10 to 12 aliphatic	0.071982164	271.2	0.071982164	271.2	271.2	
5.	TPH-12TO16AL5	EC >12 to 16 aliphatic	0.215707612	812.7	0.215707612	812.7	812.7	
6.	TPH-16TO35AL6	EC >16 to 35 aliphatic	0.419922497	1582.1	0.419922497	1582.1	1582.1	
7.	TPH-6TO7AR1	Benzene (EC <6 to 7) arom.	0	0			0	(1)
8.	TPH-7TO8AR2	Toluene (EC >7 to 8) arom.	0	0			0	(1)
9.	TPH-8TO10AR3	EC > 8 to 10 aromatic	0.010669922	40.2	0.010669922	40.2	40.2	
10.	TPH-10TO12AR4	EC > 10 to 12 aromatic	0.009342818	35.2	0.009342818	35.2	35.2	
11.	TPH-12TO16AR5	EC >12 to 16 aromatic	0.037318187	140.6	0.037318187	140.6	140.6	
12.	TPH-16TO21AR6	EC >16 to 21 aromatic	0.153864529	579.7	0.153864529	579.7	579.7	
13.	TPH-21TO35AR7	EC >21 to 35 aromatic	0.001327105	5	0.001327105	5	5	
14.	TPH-GT35AT1	>C35 total						
		sum	1	3767.6				

CASRN	name	within range	(1) mass conc. (mg/kg)	(2) mass fraction (g/g)	(2) mass conc. (mg/kg)	initial measured mass conc. (mg/kg)
71-43-2	benzene	7.	0	0	0	0
108-88-3	toluene	8.	0	0	0	0
100-41-4	ethylbenzene	9.	0	0	0	0
1330-20-7	xylene (mixed isomers)	9.	0	0	0	0
91-20-3	naphthalene	11.	0	0	0	0
208-96-8	acenaphthalene	11.				
83-32-9	acenaphthene	11.				
86-73-7	fluorene	12.	0	0	0	0
85-01-8	phenanthrene	12.	0	0	0	0
120-12-7	anthracene	12.	0	0	0	0
206-44-0	fluoranthene	13.	0	0	0	0
129-00-0	pyrene	13.	0	0	0	0
56-55-3	benzanthracene	13.				
218-01-9	chrysene	13.				
205-99-2	benzo(b)fluoranthene	13.	0	0	0	0
207-08-9	benzo(k)fluoranthene	13.	0	0	0	0
50-32-8	3,4-benzopyrene	13.	0	0	0	0
193-39-5	indeno(1,2,3-cd)pyrene	13.				
53-70-3	dibenz[1,2;5,6]anthracene	13.				
191-24-2	benzo(g,h,i)perylene	13.				
			sum	1	3767.6	

Notes (where applicable):
(1) EPA 8260 (GC/MS) results, if available, are used for benzene and toluene aromatic cuts.
(2) Indicator concentrations subtracted from applicable cut range and distribution is re-normalized.

ANALYTICAL RESULTS - PETROLEUM MASS FRACTION DISTRIBUTION 4.5

Site Name:
Site Location:
Completed By:
Revision Date:

sample identifier: GSB-9
sample description:
sample type:
☐ oil sample
■ soil sample

field sample ID: T118812
sampling unit:
sampling depth:
sample interval: (2-3')
field sampling date:

Calculated Mass Fraction Distributions

	indentifier	description	equivalent carbon number distribution only (1) mass fraction (g/g)	equivalent carbon number distribution only (1) mass conc. (mg/kg)	equivalent carbon number distribution with indicator chemicals included (2) mass fraction (g/g)	equivalent carbon number distribution with indicator chemicals included (2) mass conc. (mg/kg)	initial measured mass conc. (mg/kg)
1.	TPH-LT6AL1	EC 6< aliphatic					
2.	TPH-6TO8AL2	EC =&>6 to 8 aliphatic	0	0	0	0	0
3.	TPH-8TO10AL3	EC >8 to 10 aliphatic	0	0	0	0	0
4.	TPH-10TO12AL4	EC >10 to 12 aliphatic	0	0	0	0	0
5.	TPH-12TO16AL5	EC >12 to 16 aliphatic	0	0	0	0	0
6.	TPH-16TO35AL6	EC >16 to 35 aliphatic	0	0	0	0	0
7.	TPH-6TO7AR1	Benzene (EC <6 to 7) arom.	0	0			0 (1)
8.	TPH-7TO8AR2	Toluene (EC >7 to 8) arom.	0	0			0 (1)
9.	TPH-8TO10AR3	EC > 8 to 10 aromatic	0	0			0
10.	TPH-10TO12AR4	EC > 10 to 12 aromatic	0	0	0	0	0
11.	TPH-12TO16AR5	EC >12 to 16 aromatic	0.456289979	21.4	0.456289979	21.4	21.4
12.	TPH-16TO21AR6	EC >16 to 21 aromatic	0.437100213	20.5	0.437100213	20.5	20.5
13.	TPH-21TO35AR7	EC >21 to 35 aromatic	0.106609808	5	0.106609808	5	5
14.	TPH-GT35AT1	>C35 total					
		sum	1	46.9			

CASRN	name	within range
71-43-2	benzene	7.
108-88-3	toluene	8.
100-41-4	ethylbenzene	9.
1330-20-7	xylene (mixed isomers)	9.
91-20-3	naphthalene	11.
208-96-8	acenaphthalene	11.
83-32-9	acenaphthene	11.
86-73-7	fluorene	12.
85-01-8	phenanthrene	12.
120-12-7	anthracene	12.
206-44-0	fluoranthene	13.
129-00-0	pyrene	13.
56-55-3	benzanthracene	13.
218-01-9	chrysene	13.
205-99-2	benzo(b)fluoranthene	13.
207-08-9	benzo(k)fluoranthene	13.
50-32-8	3,4-benzopyrene	13.
193-39-5	indeno(1,2,3-cd)pyrene	13.
53-70-3	dibenz[1,2;5,6]anthracene	13.
191-24-2	benzo(g,h,i)perylene	13.

sum 1 46.9

Notes (where applicable):
(1) EPA 8260 (GC/MS) results, if available, are used for benzene and toluene aromatic cuts.
(2) Indicator concentrations subtracted from applicable cut range and distribution is re-normalized.

ANALYTICAL RESULTS - PETROLEUM MASS FRACTION DISTRIBUTION 4.5

Site Name:	Shell - Hobbs, NM	Completed By:	G. DeVaull
Site Location:	Westgate	Revision Date:	

sample identifier:	TSB-7 2-3 ft	field sample ID:	
sample description:	soil sample	sampling unit:	
sample type:		sampling depth:	
☐	oil sample	sample interval:	
■	soil sample	field sampling date:	

Calculated Mass Fraction Distributions

			equivalent carbon number distribution only (1)		equivalent carbon number distribution with indicator chemicals included (2)		initial measured	
	indentifier	description	mass fraction (g/g)	mass conc. (mg/kg)	mass fraction (g/g)	mass conc. (mg/kg)	mass conc. (mg/kg)	
1.	TPH-LT6AL1	EC 6< aliphatic						
2.	TPH-6TO8AL2	EC =&>6 to 8 aliphatic						
3.	TPH-8TO10AL3	EC >8 to 10 aliphatic	0.003939848	51.7	0.003939848	51.7	51.7	
4.	TPH-10TO12AL4	EC >10 to 12 aliphatic	0	0	0	0	0	
5.	TPH-12TO16AL5	EC >12 to 16 aliphatic	0	0	0	0	0	
6.	TPH-16TO35AL6	EC >16 to 35 aliphatic	0.1170356	1535.78	0.1170356	1535.78	1535.78	
7.	TPH-6TO7AR1	Benzene (EC <6 to 7) arom.	1.52412E-06	0.02			0.02	(1)
8.	TPH-7TO8AR2	Toluene (EC >7 to 8) arom.	9.14472E-07	0.012			0.012	(1)
9.	TPH-8TO10AR3	EC > 8 to 10 aromatic	0.001165951	15.3			15.3	
10.	TPH-10TO12AR4	EC > 10 to 12 aromatic	0	0	0	0	0	
11.	TPH-12TO16AR5	EC >12 to 16 aromatic	0.026839742	352.2	0.02592527	340.2	352.2	
12.	TPH-16TO21AR6	EC >16 to 21 aromatic	0.03894887	511.1	0.03741713	491	511.1	
13.	TPH-21TO35AR7	EC >21 to 35 aromatic	0.006494273	85.22	0.005571418	73.11	85.22	
14.	TPH-GT35AT1	>C35 total	0.805573278	10571	0.805573278	10571	10571	
		sum	1	13122.332				

CASRN	name	within range	mass conc. (mg/kg) (1)	mass fraction (g/g) (2)	mass conc. (mg/kg) (2)	initial measured mass conc. (mg/kg)
71-43-2	benzene	7.	0.02	1.52412E-06	0.02	0.02
108-88-3	toluene	8.	0.012	9.14472E-07	0.012	0.012
100-41-4	ethylbenzene	9.	3.2	0.000243859	3.2	3.2
1330-20-7	xylene (mixed isomers)	9.	12.1	0.000922092	12.1	12.1
91-20-3	naphthalene	11.	12	0.000914472	12	12
208-96-8	acenaphthalene	11.	0	0	0	0
83-32-9	acenaphthene	11.	0	0	0	0
86-73-7	fluorene	12.	6.1	0.000464856	6.1	6.1
85-01-8	phenanthrene	12.	14	0.001066884	14	14
120-12-7	anthracene	12.	0	0	0	0
206-44-0	fluoranthene	13.	0	0	0	0
129-00-0	pyrene	13.	2	0.000152412	2	2
56-55-3	benzanthracene	13.	1.2	9.14472E-05	1.2	1.2
218-01-9	chrysene	13.	3.6	0.000274341	3.6	3.6
205-99-2	benzo(b)fluoranthene	13.	1.1	8.38266E-05	1.1	1.1
207-08-9	benzo(k)fluoranthene	13.	0.22	1.67653E-05	0.22	0.22
50-32-8	3,4-benzopyrene	13.	1.1	8.38266E-05	1.1	1.1
193-39-5	indeno(1,2,3-cd)pyrene	13.	0.95	7.23957E-05	0.95	0.95
53-70-3	dibenz[1,2;5,6]anthracene	13.	0.34	2.591E-05	0.34	0.34
191-24-2	benzo(g,h,i)perylene	13.	1.6	0.00012193	1.6	1.6
			sum	1	13122.332	

Notes (where applicable):

(1) EPA 8260 (GC/MS) results, if available, are used for benzene and toluene aromatic cuts.

(2) Indicator concentrations subtracted from applicable cut range and distribution is re-normalized.

ANALYTICAL RESULTS - PETROLEUM MASS FRACTION DISTRIBUTION 4.5

Site Name:	Shell - Hobbs, NM	Completed By:	G. DeVaull
Site Location:	Westgate	Revision Date:	

sample identifier:	TSB-8 2-3 ft	field sample ID:	
sample description:	soil sample	sampling unit:	
sample type:		sampling depth:	
	☐ oil sample	sample interval:	
	■ soil sample	field sampling date:	

Calculated Mass Fraction Distributions

	indentifier	description	equivalent carbon number distribution only (1) mass fraction (g/g)	equivalent carbon number distribution only (1) mass conc. (mg/kg)	equivalent carbon number distribution with indicator chemicals included (2) mass fraction (g/g)	equivalent carbon number distribution with indicator chemicals included (2) mass conc. (mg/kg)	initial measured mass conc. (mg/kg)	
1.	TPH-LT6AL1	EC 6< aliphatic						
2.	TPH-6TO8AL2	EC =&>6 to 8 aliphatic						
3.	TPH-8TO10AL3	EC >8 to 10 aliphatic	0.005777982	52.76	0.005777982	52.76	52.76	
4.	TPH-10TO12AL4	EC >10 to 12 aliphatic	0	0	0	0	0	
5.	TPH-12TO16AL5	EC >12 to 16 aliphatic	0.028320433	258.6	0.028320433	258.6	258.6	
6.	TPH-16TO35AL6	EC >16 to 35 aliphatic	0.116029668	1059.492	0.116029668	1059.492	1059.492	
7.	TPH-6TO7AR1	Benzene (EC <6 to 7) arom.	1.07324E-06	0.0098			0.0098	(1)
8.	TPH-7TO8AR2	Toluene (EC >7 to 8) arom.	7.11844E-07	0.0065			0.0065	(1)
9.	TPH-8TO10AR3	EC > 8 to 10 aromatic	0.006487635	59.24			59.24	
10.	TPH-10TO12AR4	EC > 10 to 12 aromatic	0	0	0	0	0	
11.	TPH-12TO16AR5	EC >12 to 16 aromatic	0.026732474	244.1	0.025527815	233.1	244.1	
12.	TPH-16TO21AR6	EC >16 to 21 aromatic	0.029393675	268.4	0.028079501	256.4	268.4	
13.	TPH-21TO35AR7	EC >21 to 35 aromatic	0.004107667	37.508	0.00363807	33.22	37.508	
14.	TPH-GT35AT1	>C35 total	0.783148681	7151.1	0.783148681	7151.1	7151.1	
		sum	1	9131.2163				

CASRN	name	within range	mass fraction (g/g) (1)	mass conc. (mg/kg) (1)	mass fraction (g/g) (2)	mass conc. (mg/kg) (2)	initial measured mass conc. (mg/kg)
71-43-2	benzene	7.		0.0098	1.07324E-06	0.0098	0.0098
108-88-3	toluene	8.		0.0065	7.11844E-07	0.0065	0.0065
100-41-4	ethylbenzene	9.		11	0.001204659	11	11
1330-20-7	xylene (mixed isomers)	9.		48.24	0.005282976	48.24	48.24
91-20-3	naphthalene	11.		11	0.001204659	11	11
208-96-8	acenaphthalene	11.		0	0	0	0
83-32-9	acenaphthene	11.		0	0	0	0
86-73-7	fluorene	12.		3.7	0.000405203	3.7	3.7
85-01-8	phenanthrene	12.		8.3	0.00090897	8.3	8.3
120-12-7	anthracene	12.		0	0	0	0
206-44-0	fluoranthene	13.		0	0	0	0
129-00-0	pyrene	13.		0.81	8.87067E-05	0.81	0.81
56-55-3	benzanthracene	13.		0.45	4.92815E-05	0.45	0.45
218-01-9	chrysene	13.		1.5	0.000164272	1.5	1.5
205-99-2	benzo(b)fluoranthene	13.		0.38	4.16155E-05	0.38	0.38
207-08-9	benzo(k)fluoranthene	13.		0.088	9.63727E-06	0.088	0.088
50-32-8	3,4-benzopyrene	13.		0.35	3.83301E-05	0.35	0.35
193-39-5	indeno(1,2,3-cd)pyrene	13.		0.2	2.19029E-05	0.2	0.2
53-70-3	dibenz[1,2;5,6]anthracene	13.		0.12	1.31417E-05	0.12	0.12
191-24-2	benzo(g,h,i)perylene	13.		0.39	4.27106E-05	0.39	0.39
				sum	1	9131.2163	

Notes (where applicable):

(1) EPA 8260 (GC/MS) results, if available, are used for benzene and toluene aromatic cuts.

(2) Indicator concentrations subtracted from applicable cut range and distribution is re-normalized.

ANALYTICAL SUMMARY - SOIL CONCENTRATIONS 5.1

Site Name: Westgate Subdivision
Site Location: Hobbs, NM

Completed by: G. E. DeVault
Revision Date: 16 Aug 1999

All detected chemical analysis results from site soil samples are tabulated. Each line corresponds to a specific sample and chemical constituent.

Notes, if needed, are added at the end of this table and are indexed to samples using the "note index no." column.

note index no.	line index no.	location description	sample type	field sample ID	sampling unit	sampling depth (ft)	sample interval (ft)	field sampling date	analysis ID code	analysis date	analytical method number	Chemical Abstracts Service No. (CASRN)	chemical name	detection limit (mg/kg)	QA/QC code	measured chemical concentration (mg/kg)
A	1093		soil	TSB-8 8-10'		8	10		107008		E 300.0	16984-48-8	fluoride			17
A	2553	max	soil	GMW-2 13-15'		13	15		103766		Sm 4500 CN,	57-12-5	cyanide			0.08
A	695	max	soil	TSB-4 3-5'		3	5		106092		S 6010B	7429-90-5	aluminum			14000
A	832	max	soil	TSB-6 2-3'		2	3		106034		S 6010B	7439-89-6	iron			12000
A	826	max	soil	TSB-6 2-3'		2	3		106034		S 6010B	7439-92-1	lead			92
A	3302	max	soil	GBN-7 6"		0.5			120227		S 6010B	7439-96-5	manganese			257
A	3520	max	soil	BCKG-2 6"		0.5			117633		S 7471	7439-97-6	mercury			3.9
A	3391	max	soil	GBS-3 6"		0.5			117631		S 6010B	7439-98-7	molybdenum			3.8
A	2315	max	soil	GSB-15 19-21'		19	21		T118242		S 6010B	7440-02-0	nickel			38
A	3214	max	soil	GBN-3 6"		0.5			117628		S 6010B	7440-22-4	silver			30
A	2299		soil	GSB-15 19-21'		19	21		T118242		S 6010B	7440-39-3	barium			1020
A	3305		soil	GBN-7 6"		0.5			120227		S 6010B	7440-42-8	boron			60
A	3153		soil	GBN-1 6"		0.5			117626		S 6010B	7440-43-9	cadmium			1.5
A	837		soil	TSB-6 2-3'		2	3		106034		S 6010B	7440-48-4	cobalt			11
A	3216		soil	GBN-3 6"		0.5			117628		S 6010B	7440-50-8	copper			21
A	834		soil	TSB-6 2-3'		2	3		106034		S 6010B	7440-66-6	zinc			350
A	2835		soil	GMW-6 63-6		63	65		104533		E 300.0	14797-55-8	nitrate			4.2/1.3
A	744		soil	TSB-5 2-3'		2	3		106094		S 6010B	7782-49-2	selenium			3.4
		avg	soil								S 6010B	7440-38-2	arsenic (avg. value, with 1/2 ND (ND=0.5) for 52 samples, 106 total)			1.32
A	738	median	soil								S 6010B	7440-38-2	arsenic (median of 106 samples)			0.54
A	738	max	soil	TSB-5 2-3'		2	3		106094		S 6010B	7440-38-2	arsenic (maximum measured value)			7.3
A	710		soil	TSB-4 18-20'		18	20		106093		S 6010B	7440-38-2	arsenic (2nd highest value)			5.3
		avg.	soil								S 6010B	18540-29-9	chromium (overall avg., neglect 6 ND of 101 values)			7.34
		median	soil								S 6010B	18540-29-9	chromium (median of 101 samples)			4.2

note index no.	line index no.	location description	sample type	field sample ID	sampling unit	sampling depth (ft)	sample interval (ft)	field sampling date	analysis ID code	analysis date	analytical method number	Chemical Abstracts Service No. (CASRN)	chemical name	detection limit (mg/kg)	QA/ QC code	measured chemical concen-tration (mg/kg)
(continued)																
A	3531		soil	BCKG-2	6"	0.5			117633		S 6010B	7439-98-7	molybdenum			2.5
A	3503		soil	BCKG-1	6"	0.5			117632		S 6010B	7439-98-7	molybdenum			2.4
A	3560		soil	BCKG-3	6"	0.5			117634		S 6010B	7440-02-0	nickel			26
A	3532		soil	BCKG-2	6"	0.5			117633		S 6010B	7440-02-0	nickel			33
A	3504		soil	BCKG-1	6"	0.5			117632		S 6010B	7440-02-0	nickel			32
A	3550		soil	BCKG-3	6"	0.5			117634		S 6010B	7440-22-4	silver			25
A	3522		soil	BCKG-2	6"	0.5			117633		S 6010B	7440-22-4	silver			24
A	3494		soil	BCKG-1	6"	0.5			117632		S 6010B	7440-22-4	silver			24
A	3555		soil	BCKG-3	6"	0.5			117634		S 6010B	7440-66-6	zinc			27
A	3527		soil	BCKG-2	6"	0.5			117633		S 6010B	7440-66-6	zinc			47
A	3499		soil	BCKG-1	6"	0.5			117632		S 6010B	7440-66-6	zinc			23

Notes (where applicable):

All detected chemicals are included in the above table.
Non-detects are omitted from the list.
A complete analyte list is included in the site analytical data report.
maximum measured value tabulated for fluoride, aluminum, iron, manganese, molybdenum, nickel, silver, barium
boron, cadmium, cobalt, copper, zinc, nitrate, and selenium.
sulfate and chloride are not evaluated.
average and statistical values are tabulated for NORM, arsenic, and chromium.
The NORM screening value is cited from the Stage 1 Abatement Plan Report.

note index no.	line index no.	location description	sample type	field sample ID	sampling unit	sampling depth (ft)	sample interval (ft)	field sampling date	analysis ID code	analysis date	analytical method number	Chemical Abstracts Service No. (CASRN)	chemical name	detection limit (mg/kg)	QA/QC code	measured chemical concen-tration (mg/kg)
(continued)																
A	825	max	soil	TSB-6	2-3'	2	3		106034		S 6010B	18540-29-9	chromium (maximum measured value)			244
A	3378		soil	GBS-3	6"	0.5			117631		S 6010B	18540-29-9	chromium (2nd highest measured value)			14
		avg	soil								E 901.1M (pCi	pCi	total activity (overall avg., neglect 3 ND of 86 values)			6.89
		avg	soil								E 901.1M (pCi	pCi	total activity (median)			4.57
A	2590	max	soil	GMW-2	58-60'	58	60		103765		E 901.1M (pCi	pCi	total activity (maximum value)			40.61
A	541	2nd highest	soil	TSB-2	3-5'	3	5		105959		E 901.1M (pCi	pCi	total activity (2nd highest value)			30.66
A	1877	3rd highest	soil	GSB-3	2-3'	2	3		107012		E 901.1M (pCi	pCi	total activity (3rd highest value)			21.2
A	3556		soil	BCKG-3	6"	0.5			117634		S 6010B	7429-90-5	aluminum			8050
A	3528		soil	BCKG-2	6"	0.5			117633		S 6010B	7429-90-5	aluminum			6630
A	3500		soil	BCKG-1	6"	0.5			117632		S 6010B	7429-90-5	aluminum			7660
A	3544		soil	BCKG-3	6"	0.5			117634		S 6010B	7440-39-3	barium			187
A	3516		soil	BCKG-2	6"	0.5			117633		S 6010B	7440-39-3	barium			218
A	3488		soil	BCKG-1	6"	0.5			117632		S 6010B	7440-39-3	barium			106
A	3557		soil	BCKG-3	6"	0.5			117634		S 6010B	7440-42-8	boron			17
A	3529		soil	BCKG-2	6"	0.5			117633		S 6010B	7440-42-8	boron			15
A	3501		soil	BCKG-1	6"	0.5			117632		S 6010B	7440-42-8	boron			14
A	3545		soil	BCKG-3	6"	0.5			117634		S 6010B	7440-43-9	cadmium			0.88
A	3517		soil	BCKG-2	6"	0.5			117633		S 6010B	7440-43-9	cadmium			0.92
A	3489		soil	BCKG-1	6"	0.5			117632		S 6010B	7440-43-9	cadmium			0.77
A	3546		soil	BCKG-3	6"	0.5			117634		S 6010B	18540-29-9	chromium			9.3
A	3518		soil	BCKG-2	6"	0.5			117633		S 6010B	18540-29-9	chromium			13
A	3490		soil	BCKG-1	6"	0.5			117632		S 6010B	18540-29-9	chromium			8.8
A	3558		soil	BCKG-3	6"	0.5			117634		S 6010B	7440-48-4	cobalt			7.3
A	3530		soil	BCKG-2	6"	0.5			117633		S 6010B	7440-48-4	cobalt			6.9
A	3502		soil	BCKG-1	6"	0.5			117632		S 6010B	7440-48-4	cobalt			6.9
A	3552		soil	BCKG-3	6"	0.5			117634		S 6010B	7440-50-8	copper			8.4
A	3524		soil	BCKG-2	6"	0.5			117633		S 6010B	7440-50-8	copper			11
A	3496		soil	BCKG-1	6"	0.5			117632		S 6010B	7440-50-8	copper			8.3
A	3553		soil	BCKG-3	6"	0.5			117634		S 6010B	7439-89-6	iron			7000
A	3525		soil	BCKG-2	6"	0.5			117633		S 6010B	7439-89-6	iron			6140
A	3497		soil	BCKG-1	6"	0.5			117632		S 6010B	7439-89-6	iron			6460
A	3547		soil	BCKG-3	6"	0.5			117634		S 6010B	7439-92-1	lead			6.8
A	3519		soil	BCKG-2	6"	0.5			117633		S 6010B	7439-92-1	lead			14
A	3491		soil	BCKG-1	6"	0.5			117632		S 6010B	7439-92-1	lead			5.1
A	3554		soil	BCKG-3	6"	0.5			117634		S 6010B	7439-96-5	manganese			169
A	3526		soil	BCKG-2	6"	0.5			117633		S 6010B	7439-96-5	manganese			130
A	3498		soil	BCKG-1	6"	0.5			117632		S 6010B	7439-96-5	manganese			147
A	3548		soil	BCKG-3	6"	0.5			117634		S 7471	7439-97-6	mercury			0.14
A	3520		soil	BCKG-2	6"	0.5			117633		S 7471	7439-97-6	mercury			3.9
A	3492		soil	BCKG-1	6"	0.5			117632		S 7471	7439-97-6	mercury			0.12
A	3559		soil	BCKG-3	6"	0.5			117634		S 6010B	7439-98-7	molybdenum			2.6

ANALYTICAL DATA to RBSL COMPARISONS - SOIL CONCENTRATIONS 5.2

Site Name: Westgate Subdivision
Site Location: Hobbs, NM

Completed By: G. E. DeVaull
Revision Date: 16 Aug 1999; March 6, 2000

This table is a comparison of chemical analysis results to screening level concentrations.
The line index number is identical to that in the first half of this table.

Screening Level Criteria Descriptions
(residential exposure, minimum of HQ = 1 or Risk = 1E-6):
1) direct soil exposure, ingestion, dermal contact, dust & vapor inhalation - RBCA
2) residential soil - Region VI
3) residential soil w/o dermal exposure - Region VI
4) nominal soil background concentration, arithmetic average - USGS
5) NORM criteria from Stage 1 Abatement Plan Report

Screening Level comparison against site analytical data.
Exceedences are noted by a filled box (■).

line index no.	location description	field sample ID	Chemical Abstracts Service No. (CASRN)	chemical name	measured chemical concen-tration (mg/kg)	1)	surficial soil, direct exposure (mg/kg)	2)	res soil - Region VI (mg/kg)	3)	res soil w/o dermal - Region (mg/kg)	4)	nominal back-ground (mg/kg)	5)	NORM (pCi/g)		
							3		24		25		22				
1093	max	TSB-8 8-10'	16984-48-8	fluoride	17	☐		☐	3.6E+3	☐	4.7E+3	☐		☐		☐	☐
2553	max	GMW-2 13-15'	57-12-5	cyanide	0.08	☐		☐	1.2E+3	☐	1.6E+3	☐		☐		☐	☐
695	max	TSB-4 3-5'	7429-90-5	aluminum	14000	☐		☐	7.8E+4	☐	7.8E+4	☐	4.7E+4	☐		☐	☐
832	max	TSB-6 2-3'	7439-89-6	iron	12000	☐		☐	2.3E+4	☐	2.3E+4	☐	1.8E+4	☐		☐	☐
826	max	TSB-6 2-3'	7439-92-1	lead	92	☐		☐	4.0E+2	☐		☐		☐		☐	☐
3302	max	GBN-7 6"	7439-96-5	manganese	257	☐		☐	3.2E+3	☐	3.2E+3	☐		☐		☐	☐
3520	max	BCKG-2 6"	7439-97-6	mercury	3.9	☐	1.4E+1	☐		☐		☐		☐		☐	☐
3391	max	GBS-3 6"	7439-98-7	molybdenum	3.8	☐	1.4E+3	☐	3.9E+2	☐	3.9E+2	☐		☐		☐	☐
2315	max	GSB-15 19-21'	7440-02-0	nickel	38	☐	5.5E+3	☐	1.6E+3	☐	1.6E+3	■	1.8E+1	☐		☐	☐
3214	max	GBN-3 6"	7440-22-4	silver	30	☐		☐	3.9E+2	☐	3.9E+2	☐		☐		☐	☐
2299		GSB-15 19-21'	7440-39-3	barium	1020	☐	1.9E+4	☐	5.4E+3	☐	5.4E+3	■	5.8E+2	☐		☐	☐
3305		GBN-7 6"	7440-42-8	boron	60	☐	2.5E+4	☐	5.5E+3	☐	7.0E+3	☐		☐		☐	☐
3153		GBN-1 6"	7440-43-9	cadmium	1.5	☐	1.4E+2	☐	3.9E+1	☐	3.9E+1	☐		☐		☐	☐
837		TSB-6 2-3'	7440-48-4	cobalt	11	☐		☐	3.4E+3	☐	3.4E+3	☐		☐		☐	☐
3216		GBN-3 6"	7440-50-8	copper	21	☐	1.0E+4	☐	2.9E+3	☐	2.9E+3	☐		☐		☐	☐
834		TSB-6 2-3'	7440-66-6	zinc	350	☐	8.2E+4	☐	2.3E+4	☐	2.3E+4	☐		☐		☐	☐
2835		GMW-6 63-65'	14797-55-8	nitrate	4.2/1.3	☐		☐		☐		☐		☐		☐	☐
744		TSB-5 2-3'	7782-49-2	selenium	3.4	☐	1.4E+3	☐	3.9E+2	☐	3.9E+2	■	3.9E-1	☐		☐	☐
																	☐
	avg		7440-38-2	arsenic (avg. value, with 1/2 ND (ND=0.5) for 52 sam	1.32	■	4.3E-1	■	3.9E-1	■	4.3E-1	☐	7.2E+0	☐		☐	☐
738	median		7440-38-2	arsenic (median of 106 samples)	0.54	■	4.3E-1	■	3.9E-1	■	4.3E-1	☐	7.2E+0	☐		☐	☐
738	max	TSB-5 2-3'	7440-38-2	arsenic (maximum measured value)	7.3	■	4.3E-1	■	3.9E-1	■	4.3E-1	■	7.2E+0	☐		☐	☐
710		TSB-4 18-20'	7440-38-2	arsenic (2nd highest value)	5.3	■	4.3E-1	■	3.9E-1	■	4.3E-1	☐	7.2E+0	☐		☐	☐
																	☐
	avg.		18540-29-9	chromium (overall avg., neglect 6 ND of 101 values)	7.34	☐		☐	2.1E+2	☐	2.1E+2	☐	5.4E+1	☐		☐	☐
	median		18540-29-9	chromium (median of 101 samples)	4.2	☐		☐	2.1E+2	☐	2.1E+2	☐	5.4E+1	☐		☐	☐

						Screening Level comparison against site analytical data. Exceedences are noted by a filled box (■).						
line index no.	location description	field sample ID	Chemical Abstracts Service No. (CASRN)	chemical name	measured chemical concen-tration (mg/kg)	1) surficial soil, direct exposure (mg/kg)	2) res soil - Region VI (mg/kg)	3) res soil w/o dermal - Region (mg/kg)	4) nominal back-ground (mg/kg)	5) NORM (pCi/g)		
(continued)												
3531		BCKG-2 6"	7439-98-7	molybdenum	2.5	☐ 1.4E+3	☐ 3.9E+2	☐ 3.9E+2	☐	☐	☐	☐
3503		BCKG-1 6"	7439-98-7	molybdenum	2.4	☐ 1.4E+3	☐ 3.9E+2	☐ 3.9E+2	☐	☐	☐	☐
3560		BCKG-3 6"	7440-02-0	nickel	26	☐ 5.5E+3	☐ 1.6E+3	☐ 1.6E+3	■ 1.8E+1	☐	☐	☐
3532		BCKG-2 6"	7440-02-0	nickel	33	☐ 5.5E+3	☐ 1.6E+3	☐ 1.6E+3	■ 1.8E+1	☐	☐	☐
3504		BCKG-1 6"	7440-02-0	nickel	32	☐ 5.5E+3	☐ 1.6E+3	☐ 1.6E+3	■ 1.8E+1	☐	☐	☐
3550		BCKG-3 6"	7440-22-4	silver	25	☐	☐ 3.9E+2	☐ 3.9E+2	☐	☐	☐	☐
3522		BCKG-2 6"	7440-22-4	silver	24	☐	☐ 3.9E+2	☐ 3.9E+2	☐	☐	☐	☐
3494		BCKG-1 6"	7440-22-4	silver	24	☐	☐ 3.9E+2	☐ 3.9E+2	☐	☐	☐	☐
3555		BCKG-3 6"	7440-66-6	zinc	27	☐ 8.2E+4	☐ 2.3E+4	☐ 2.3E+4	☐	☐	☐	☐
3527		BCKG-2 6"	7440-66-6	zinc	47	☐ 8.2E+4	☐ 2.3E+4	☐ 2.3E+4	☐	☐	☐	☐
3499		BCKG-1 6"	7440-66-6	zinc	23	☐ 8.2E+4	☐ 2.3E+4	☐ 2.3E+4	☐	☐	☐	☐
						☐	☐	☐	☐	☐	☐	☐
						☐	☐	☐	☐	☐	☐	☐

Notes (where applicable):

Indicators in the screening level comparison table include NA (not applicable), [blank] (not calculated).

Region VI screening values: USEPA Region VI Human Health Medium-Specific□Screening Levels, USEPA, Region 6, Multimedia Planning and Permitting Division, Dallas. available at URL: http://www.epa.gov/earth1r6/6pd/rcra_c/pd-n/screen.htm

RBCA -based screening levels based on ASTM PS104-98 with default exposure parameters, USEPA toxicity parameters, and representative physical parameters.

line index no.	location description	field sample ID	Chemical Abstracts Service No. (CASRN)	chemical name	measured chemical concen-tration (mg/kg)	Screening Level comparison against site analytical data. Exceedences are noted by a filled box (■). 1) surficial soil, direct exposure (mg/kg)	2) res soil - Region VI (mg/kg)	3) res soil w/o dermal - Region (mg/kg)	4) nominal back-ground (mg/kg)	5) NORM (pCi/g)		
(continued)												
825	max	TSB-6 2-3'	18540-29-9	chromium (maximum measured value)	244	☐	■ 2.1E+2	■ 2.1E+2	■ 5.4E+1	☐	☐	☐
3378		GBS-3 6"	18540-29-9	chromium (2nd highest measured value)	14	☐	☐ 2.1E+2	☐ 2.1E+2	☐ 5.4E+1	☐	☐	☐
						☐	☐	☐	☐	☐	☐	☐
	avg		pCi	total activity (overall avg., neglect 3 ND of 86 values)	6.89	☐	☐	☐	☐	☐ 30.00	☐	☐
	avg		pCi	total activity (median)	4.57	☐	☐	☐	☐	☐ 30.00	☐	☐
2590	max	GMW-2 58-60'	pCi	total activity (maximum value)	40.61	☐	☐	☐	☐	■ 30.00	☐	☐
541	2nd highest	TSB-2 3-5'	pCi	total activity (2nd highest value)	30.66	☐	☐	☐	☐	■ 30.00	☐	☐
1877	3rd highest	GSB-3 2-3'	pCi	total activity (3rd highest value)	21.2	☐	☐	☐	☐	☐ 30.00	☐	☐
						☐	☐	☐	☐	☐	☐	☐
3556		BCKG-3 6"	7429-90-5	aluminum	8050	☐	☐ 7.8E+4	☐ 7.8E+4	☐ 4.7E+4	☐	☐	☐
3528		BCKG-2 6"	7429-90-5	aluminum	6630	☐	☐ 7.8E+4	☐ 7.8E+4	☐ 4.7E+4	☐	☐	☐
3500		BCKG-1 6"	7429-90-5	aluminum	7660	☐	☐ 7.8E+4	☐ 7.8E+4	☐ 4.7E+4	☐	☐	☐
3544		BCKG-3 6"	7440-39-3	barium	187	☐ 1.9E+4	☐ 5.4E+3	☐ 5.4E+3	☐ 5.8E+2	☐	☐	☐
3516		BCKG-2 6"	7440-39-3	barium	218	☐ 1.9E+4	☐ 5.4E+3	☐ 5.4E+3	☐ 5.8E+2	☐	☐	☐
3488		BCKG-1 6"	7440-39-3	barium	106	☐ 1.9E+4	☐ 5.4E+3	☐ 5.4E+3	☐ 5.8E+2	☐	☐	☐
3557		BCKG-3 6"	7440-42-8	boron	17	☐ 2.5E+4	☐ 5.5E+3	☐ 7.0E+3	☐	☐	☐	☐
3529		BCKG-2 6"	7440-42-8	boron	15	☐ 2.5E+4	☐ 5.5E+3	☐ 7.0E+3	☐	☐	☐	☐
3501		BCKG-1 6"	7440-42-8	boron	14	☐ 2.5E+4	☐ 5.5E+3	☐ 7.0E+3	☐	☐	☐	☐
3545		BCKG-3 6"	7440-43-9	cadmium	0.88	☐ 1.4E+2	☐ 3.9E+1	☐ 3.9E+1	☐	☐	☐	☐
3517		BCKG-2 6"	7440-43-9	cadmium	0.92	☐ 1.4E+2	☐ 3.9E+1	☐ 3.9E+1	☐	☐	☐	☐
3489		BCKG-1 6"	7440-43-9	cadmium	0.77	☐ 1.4E+2	☐ 3.9E+1	☐ 3.9E+1	☐	☐	☐	☐
3546		BCKG-3 6"	18540-29-9	chromium	9.3	☐	☐ 2.1E+2	☐ 2.1E+2	☐ 5.4E+1	☐	☐	☐
3518		BCKG-2 6"	18540-29-9	chromium	13	☐	☐ 2.1E+2	☐ 2.1E+2	☐ 5.4E+1	☐	☐	☐
3490		BCKG-1 6"	18540-29-9	chromium	8.8	☐	☐ 2.1E+2	☐ 2.1E+2	☐ 5.4E+1	☐	☐	☐
3558		BCKG-3 6"	7440-48-4	cobalt	7.3	☐	☐ 3.4E+3	☐ 3.4E+3	☐	☐	☐	☐
3530		BCKG-2 6"	7440-48-4	cobalt	6.9	☐	☐ 3.4E+3	☐ 3.4E+3	☐	☐	☐	☐
3502		BCKG-1 6"	7440-48-4	cobalt	6.9	☐	☐ 3.4E+3	☐ 3.4E+3	☐	☐	☐	☐
3552		BCKG-3 6"	7440-50-8	copper	8.4	☐ 1.0E+4	☐ 2.9E+3	☐ 2.9E+3	☐	☐	☐	☐
3524		BCKG-2 6"	7440-50-8	copper	11	☐ 1.0E+4	☐ 2.9E+3	☐ 2.9E+3	☐	☐	☐	☐
3496		BCKG-1 6"	7440-50-8	copper	8.3	☐ 1.0E+4	☐ 2.9E+3	☐ 2.9E+3	☐	☐	☐	☐
3553		BCKG-3 6"	7439-89-6	iron	7000	☐	☐ 2.3E+4	☐ 2.3E+4	☐ 1.8E+4	☐	☐	☐
3525		BCKG-2 6"	7439-89-6	iron	6140	☐	☐ 2.3E+4	☐ 2.3E+4	☐ 1.8E+4	☐	☐	☐
3497		BCKG-1 6"	7439-89-6	iron	6460	☐	☐ 2.3E+4	☐ 2.3E+4	☐ 1.8E+4	☐	☐	☐
3547		BCKG-3 6"	7439-92-1	lead	6.8	☐	☐ 4.0E+2	☐	☐	☐	☐	☐
3519		BCKG-2 6"	7439-92-1	lead	14	☐	☐ 4.0E+2	☐	☐	☐	☐	☐
3491		BCKG-1 6"	7439-92-1	lead	5.1	☐	☐ 4.0E+2	☐	☐	☐	☐	☐
3554		BCKG-3 6"	7439-96-5	manganese	169	☐	☐ 3.2E+3	☐ 3.2E+3	☐	☐	☐	☐
3526		BCKG-2 6"	7439-96-5	manganese	130	☐	☐ 3.2E+3	☐ 3.2E+3	☐	☐	☐	☐
3498		BCKG-1 6"	7439-96-5	manganese	147	☐	☐ 3.2E+3	☐ 3.2E+3	☐	☐	☐	☐
3548		BCKG-3 6"	7439-97-6	mercury	0.14	☐ 1.4E+1	☐	☐	☐	☐	☐	☐
3520		BCKG-2 6"	7439-97-6	mercury	3.9	☐ 1.4E+1	☐	☐	☐	☐	☐	☐
3492		BCKG-1 6"	7439-97-6	mercury	0.12	☐ 1.4E+1	☐	☐	☐	☐	☐	☐
3559		BCKG-3 6"	7439-98-7	molybdenum	2.6	☐ 1.4E+3	☐ 3.9E+2	☐ 3.9E+2	☐	☐	☐	☐

ANALYTICAL SUMMARY - SOIL CONCENTRATIONS 5.1

Site Name: Westgate Subdivision
Site Location: Hobbs, NM

Completed by: G. E. DeVaull
Revision Date: 16 Aug 1999

All detected chemical analysis results from site soil samples are tabulated except as specifically noted at the end of the table. Each line corresponds to a specific sample and chemical constituent.

Notes, if needed, are added at the end of this table and are indexed to samples using the "note index no." column.

note index no.	line index no.	location description	sample type	field sample ID	sampling unit	sampling depth (ft)	sample interval (ft)	field sampling date	analysis ID code	analysis date	analytical method number	Chemical Abstracts Service No. (CASRN)	chemical name	detection limit (mg/kg)	QA/QC code	measured chemical concentration (mg/kg)
A	1043		soil	TSB-8 3-5'		3	5		107006		S 418.1	TPH-ss	TRPHC			67000
A	1015		soil	TSB-8 2-3'		2	3		19350		S 418.1	TPH-ss	TRPHC			60300
A	3232		soil	GBN-3 6"		0.5			117628		S 418.1	TPH-ss	TRPHC			52000
A	455		soil	TSB-1 3-5'		3	5		105956		S 418.1	TPH-ss	TRPHC			37100
A	1455		soil	TMW-1 2-3'		2	3		105742		S 418.1	TPH-ss	TRPHC			28500
A	3372		soil	GBS-2 6"		0.5			117630		S 418.1	TPH-ss	TRPHC			25800
A	959		soil	TSB-7 3-5'		3	5		106037		S 418.1	TPH-ss	TRPHC			22900
A	1071		soil	TSB-8D 3-5'		3	5		107007		S 418.1	TPH-ss	TRPHC			21300
A	931		soil	TSB-7 2-3'		2	3		106036		S 418.1	TPH-ss	TRPHC			20000
A	1239		soil	TSB-10 2-3'		2	3		106029		S 418.1	TPH-ss	TRPHC			18500
A	1267		soil	TSB-10 3-5'		3	5		106030		S 418.1	TPH-ss	TRPHC			16000
A	2463		soil	CSS #6					103645		S 418.1	TPH-ss	TRPHC			12900
A	2980		soil	GMW-9 8-10'		8	10		106457		S 418.1	TPH-ss	TRPHC			11900
A	3344		soil	GBS-1 6"		0.5			117629		S 418.1	TPH-ss	TRPHC			11000
A	427		soil	TSB-1 2-3'		2	3		105955		S 418.1	TPH-ss	TRPHC			10200
A	3176		soil	GBN-1 6"		0.5			117626		S 418.1	TPH-ss	TRPHC			8570
A	1707		soil	TMW-4 40-42'		40	42		118283		S 418.1	TPH-ss	TRPHC			8240
A	483		soil	TSB-1 8-10'		8	10		105957		S 418.1	TPH-ss	TRPHC			7790
A	139		soil	GSB-8D 57-59'		57	59		107019		S 418.1	TPH-ss	TRPHC			6380
A	76		soil	GSB-4D 57-59'		57	59		107005		S 418.1	TPH-ss	TRPHC			5720
A	1763		soil	TMW-5 48-50'		48	50		119858		S 418.1	TPH-ss	TRPHC			5610
A	1295		soil	TSB-10 8-10'		8	10		106031		S 418.1	TPH-ss	TRPHC			5580
A	69		soil	GSB-4 57-59'		57	59		107004		S 418.1	TPH-ss	TRPHC			5340
A	875		soil	TSB-6 3-5'		3	5		106035		S 418.1	TPH-ss	TRPHC			4490
A	3400		soil	GBS-3 6"		0.5			117631		S 418.1	TPH-ss	TRPHC			4360
A	3064		soil	GMW-10 3-5'		3	5		106342		S 418.1	TPH-ss	TRPHC			4180

note index no.	line index no.	location description	sample type	field sample ID	sampling unit	sampling depth (ft)	sample interval (ft)	field sampling date	analysis ID code	analysis date	analytical method number	Chemical Abstracts Service No. (CASRN)	chemical name	detection limit (mg/kg)	QA/ QC code	measured chemical concen-tration (mg/kg)
(continued)																
A	132		soil	GSB-8 57-59'		57	59		107018		S 418.1	TPH-ss	TRPHC			4030
A	160		soil	GSB-10 3-5'		3	5		106790		S 418.1	TPH-ss	TRPHC			3960
A	2672		soil	GMW-3 63-65'		63	65		104148		S 418.1	TPH-ss	TRPHC			3820
A	1651		soil	TMW-3 23-25'		23	25		108240		S 418.1	TPH-ss	TRPHC			3574
A	2756		soil	GMW-5 58-60'		58	60		104339		S 418.1	TPH-ss	TRPHC			3170
A	1875		soil	GSB-3 2-3'		2	3		107012		S 418.1	TPH-ss	TRPHC			3130
A	2644		soil	GMW-3 53-55'		53	55		104147		S 418.1	TPH-ss	TRPHC			3000
A	1623		soil	TMW-3 3-5'		3	5		108239		S 418.1	TPH-ss	TRPHC			2986
A	167		soil	GSB-10 50-52'		50	52		106791		S 418.1	TPH-ss	TRPHC			2920
A	62		soil	GSB-4 48-50'		48	50		107003		S 418.1	TPH-ss	TRPHC			2900
A	153		soil	GSB-9 50-52'		50	52		106788		S 418.1	TPH-ss	TRPHC			2310
A	3204		soil	GBN-2 6"		0.5			117627		S 418.1	TPH-ss	TRPHC			2060
A	146		soil	GSB-9 13-15'		13	15		106787		S 418.1	TPH-ss	TRPHC			2050
A	188		soil	GSB-11 48-50'		48	50		107161			TPH-ss	TRPHC			1990
A	2099		soil	GSB-10 2-3'		2	3		106789		S 418.1	TPH-ss	TRPHC			1960
A	2784		soil	GMW-5 63-65'		63	65		104340		S 418.1	TPH-ss	TRPHC			1950
A	55		soil	GSB-3D 48-50'		48	50		107015		S 418.1	TPH-ss	TRPHC			1890
A	6		soil	GSB-1 58-60'		58	60		105072		S 418.1	TPH-ss	TRPHC			1770
A	1595		soil	TMW-3 2-3'		2	3		108238		S 418.1	TPH-ss	TRPHC			1460
A	125		soil	GSB-8 43-45'		43	45		107017		S 418.1	TPH-ss	TRPHC			1350
A	20		soil	GSB-1B 63-65'		63	65		105074		S 418.1	TPH-ss	TRPHC			1340
A	41		soil	GSB-3 38-40'		38	40		107013		S 418.1	TPH-ss	TRPHC			1310
A	181		soil	GSB-11 2-3'		2	3		107160		S 418.1	TPH-ss	TRPHC			1100
A	34		soil	GSB-2 55-57'		55	57		105226		S 418.1	TPH-ss	TRPHC			1020
A	27		soil	GSB-2 45-47'		45	47		105225		S 418.1	TPH-ss	TRPHC			870
A	48		soil	GSB-3 48-50'		48	50		107014		S 418.1	TPH-ss	TRPHC			771
A	3428		soil	GBS-4 6"		0.5			120225		S 418.1	TPH-ss	TRPHC			730
A	174		soil	GSB-11					107162		S 418.1	TPH-ss	TRPHC			704
A	111		soil	GSB-7 33-35'		33	35		106260		S 418.1	TPH-ss	TRPHC			692
A	3036		soil	GMW-9D 63-65'		63	65		106459		S 418.1	TPH-ss	TRPHC			688
A	2351		soil	GSB-16 3-5'		3	5		118543		S 418.1	TPH-ss	TRPHC			665
A	195		soil	CSS #1 0 - 1'		0	1		103639			TPH-ss	TRPHC			460
A	3456		soil	GBS-5 6"		0.5			120226		S 418.1	TPH-ss	TRPHC			419
A	13		soil	GSB-1 63-65'		63	65		105073		S 418.1	TPH-ss	TRPHC			274
A	202		soil	CSS #2 0 - 1'		0	1		103640			TPH-ss	TRPHC			222
A	1987		soil	GSB-7 2-3'		2	3		106259		S 418.1	TPH-ss	TRPHC			217
A	3008		soil	GMW-9 63-65'		63	65		106458		S 418.1	TPH-ss	TRPHC			206
A	987		soil	TSB-7 8-10'		8	10		106038		S 418.1	TPH-ss	TRPHC			139
A	1211		soil	TSB-9 18-20'		18	20		106099		S 418.1	TPH-ss	TRPHC			117
A	819		soil	TSB-5 18-20'		18	20		106096		S 418.1	TPH-ss	TRPHC			102

note index no.	line index no.	location description	sample type	field sample ID	sampling unit	sampling depth (ft)	sample interval (ft)	field sampling date	analysis ID code	analysis date	analytical method number	Chemical Abstracts Service No. (CASRN)	chemical name	detection limit (mg/kg)	QA/ QC code	measured chemical concen- tration (mg/kg)
(continued)																
A	1155		soil	TSB-9 2-3'		2	3		106097		S 418.1	TPH-ss	TRPHC			97.2
A	3288		soil	GBN-6 6"		0.5			120226		S 418.1	TPH-ss	TRPHC			87.8
A	847		soil	TSB-6 2-3'		2	3		106034		S 418.1	TPH-ss	TRPHC			86.8
A	1511		soil	TMW-1A 63-65'		63	65		105744		S 418.1	TPH-ss	TRPHC			63
A	230		soil	CSS #7					103644			TPH-ss	TRPHC			55
A	679		soil	TSB-4 2-3'		2	3		106091		S 418.1	TPH-ss	TRPHC			52.3
A	1567		soil	TMW-2 63-65'		63	65		105615		S 418.1	TPH-ss	TRPHC			50
A	209		soil	CSS #3					103641			TPH-ss	TRPHC			39.8
A	1735		soil	TMW-4 63-65'		63	65		118284		S 418.1	TPH-ss	TRPHC			29
A	2043		soil	GSB-8 2-3'		2	3		107016		S 418.1	TPH-ss	TRPHC			27.5
A	216		soil	CSS #4					103642			TPH-ss	TRPHC			24.7
A	2071		soil	GSB-9 2-3'		2	3		106786		S 418.1	TPH-ss	TRPHC			24.1
A	1539		soil	TMW-2 53-55'		53	55		105614		S 418.1	TPH-ss	TRPHC			21.5
A	223		soil	CSS #5					103643			TPH-ss	TRPHC			19.2
A	1959		soil	GSB-6 2-3'		2	3		106828		S 418.1	TPH-ss	TRPHC			18.7
A	244		soil	TSB-1 43-45'		43	45		105961			TPH-ss	TRPHC			17.4
A	1099		soil	TSB-8 8-10'		8	10		107008		S 418.1	TPH-ss	TRPHC			15.6
A	1127		soil	TSB-8 40-42'		40	42		107009		S 418.1	TPH-ss	TRPHC			15.6
A	2812		soil	GMW-6 3-5'		3	5		104532		S 418.1	TPH-ss	TRPHC			15.6
A	1903		soil	GSB-4 2-3'		2	3		107002		S 418.1	TPH-ss	TRPHC			13.5
A	511		soil	TSB-2 2-3'		2	3		105958		S 418.1	TPH-ss	TRPHC			12.3
A	2127		soil	GSB-11 2-3'		2	3		107159		S 418.1	TPH-ss	TRPHC			12
A	623		soil	TSB-3 3-5'		3	5		106197		S 418.1	TPH-ss	TRPHC			11.7
A	2616		soil	GMW-2 62-64'D		62	64		103764		S 418.1	TPH-ss	TRPHC			10.6
A	1483		soil	TMW-1 63-65'		63	65		105743		S 418.1	TPH-ss	TRPHC			0.11
E	10	SS-1	soil			2	1	35815	89559	02/13/1998	GC-HTSD	TPH-ss	SS-1 (2-3') 89559			182000
E	12	SS-2	soil			2	1	35815	89561	02/13/1998	GC-HTSD	TPH-ss	SS-2 (2-3') 89561			158000
E	14	SS-3	soil			2	1	35815	89563	02/13/1998	GC-HTSD	TPH-ss	SS-3 (2-3') 89563			71000
E	18	SS-5	soil			2		35815	89567	02/13/1998	GC-HTSD	TPH-ss	SS-5 (2') 89567			62000
C	8	TSB-7 AD	soil								ADL	TSB-7 ADL	TSB-7 2-3 ft (ADL)			57000
E	19	SS-5	soil			5		35815	89568	02/13/1998	GC-HTSD	TPH-ss	SS-5 (5') 89568			39000
C	9	TSB-8 AD	soil								ADL	TSB-8 ADL	TSB-8 2-3 ft (ADL)			32000
E	13	SS-2	soil			6		35815	89562	02/13/1998	GC-HTSD	TPH-ss	SS-2 (6') 89562			27000
D	3	GBN-3	soil								TX1006	GBN-3	GBN-3 (6") T117628			21841
E	11	SS-1	soil			5		35815	89560	02/13/1998	GC-HTSD	TPH-ss	SS-1 (5') 89560			17000
E	16	SS-4	soil			1		35815	89565	02/13/1998	GC-HTSD	TPH-ss	SS-4 (1') 89565			13000
E	15	SS-3	soil			5.5		35815	89564	02/13/1998	GC-HTSD	TPH-ss	SS-3 (5.5') 89564			11000
D	2	GBN-4	soil								TX1006	GBN-4	GBN-4 (6"-8") T119263			9901
D	1	TSB-7A	soil								TX1006	TSB-7A	TSB-7A (2-3') T119262			9413

note index no.	line index no.	location description	sample type	field sample ID	sampling unit	sampling depth (ft)	sample interval (ft)	field sampling date	analysis ID code	analysis date	analytical method number	Chemical Abstracts Service No. (CASRN)	chemical name	detection limit (mg/kg)	QA/ QC code	measured chemical concen- tration (mg/kg)
(continued)																
D	6	GSB-10 (B	soil								TX1006	GSB-10 (BP)	GSB-10 (BP) (2-3') T118813			6257
D	4	GBN-1	soil								TX1006	GBN-1	GBN-1 (6") T117626			5322
E	17	SS-4	soil			5		35815	89566	02/13/1998	GC-HTSD	TPH-ss	SS-4 (5') 89566			4000
D	5	GBN-2	soil								TX1006	GBN-2	GBN-2 (6") T117627			1217
D	7	GSB-9	soil								TX1006	GSB-9	GSB-9 (2-3') T118812			51

Notes (where applicable):

All detected chemicals are included in the above table except as noted.

Non-detects are omitted from the list.

A complete analyte list is included in the site analytical data report.

m- & p-xylenes are screened as part of mixed xylenes (m-, p-, and o- isomers) and are not listed separately above.

Analysis results for phenols using method SM 5530 A,D are not included in the above list; no phenol was detected using GC/MS analysis methods.

maximum measured values only are listed for toluene, ethylbenzene, xylenes (mixed isomers), o-xylene, pyrene, phenanthrene, fluorene, naphthalene, and 1- and 2-methylnapthalene.

A. From Stage 1 Abatement Plan Report, July 1999, Table 2. Soil Analytical Results

B. From Stage 1 Abatement Plan Report, July 1999, Table 4. Confirmation Soil Analytical Results

C. A. D. Little Analysis of Soil Samples by GC/FID, GC/MS, Feb. 17, 1999, Henry Camp.

D. Soil Analyses for TPH by Trace Analysis, Inc. using TX1006 aromatic/aliphatic seperation with boiling-point cut analysis (23 Feb 1999).

E. Soil Analyses for TPH by Triton Analytics using GC - HTSD (Gas Chromatography - High Temperature Simulated Distillation), 16 Feb 1998.

ANALYTICAL DATA to RBSL COMPARISONS - SOIL CONCENTRATIONS 5.2

Site Name: Westgate Subdivision
Site Location: Hobbs, NM

Completed By: G. E. DeVault
Revision Date: 16 Aug 1999; March 6, 2000

This table is a comparison of chemical analysis results to screening level concentrations.
The line index number is identical to that in the first half of this table.

Screening Level Criteria Descriptions
(residential exposure, minimum of HQ = 1 or Risk = 1E-6):
1) direct soil exposure, ingestion, dermal contact, dust & vapor inhalation - RBCA
2) volatilization from subsurface soil to ambient (outdoor) air - RBCA
3) volatilization from subsurface soil to indoor air - RBCA
4) Guidelines for Remediation, 8/13/93, NMOCD,, IV.2.a., Ranking Criteria (>19)
5)
6)
7) tabulation of co-located TPH measurement

3 4 5 24 25

Screening Level comparison against site analytical data.
Exceedences are noted by a filled box (■).

line index no.	location description	field sample ID	Chemical Abstracts Service No. (CASRN)	chemical name	measured chemical concen-tration (mg/kg)	1) surficial soil, direct exposure (mg/kg)	2) soil volatil-ization indoor (mg/kg)	3) soil volatil-ization outdoor (mg/kg)	4) NMOC D guide lines (mg/kg)	5) (mg/kg)	6) (mg/kg)	7) co-located TPH measure (mg/kg)
1043		TSB-8 3-5'	TPH-ss	TRPHC	67000	■ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	67000
1015		TSB-8 2-3'	TPH-ss	TRPHC	60300	■ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	60300
3232		GBN-3 6"	TPH-ss	TRPHC	52000	■ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	52000
455		TSB-1 3-5'	TPH-ss	TRPHC	37100	■ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	37100
1455		TMW-1 2-3'	TPH-ss	TRPHC	28500	■ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	28500
3372		GBS-2 6"	TPH-ss	TRPHC	25800	■ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	25800
959		TSB-7 3-5'	TPH-ss	TRPHC	22900	■ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	22900
1071		TSB-8D 3-5'	TPH-ss	TRPHC	21300	■ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	21300
931		TSB-7 2-3'	TPH-ss	TRPHC	20000	■ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	20000
1239		TSB-10 2-3'	TPH-ss	TRPHC	18500	■ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	18500
1267		TSB-10 3-5'	TPH-ss	TRPHC	16000	■ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	16000
2463		CSS #6	TPH-ss	TRPHC	12900	■ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	12900
2980		GMW-9 8-10'	TPH-ss	TRPHC	11900	■ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	11900
3344		GBS-1 6"	TPH-ss	TRPHC	11000	■ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	11000
427		TSB-1 2-3'	TPH-ss	TRPHC	10200	■ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	10200
3176		GBN-1 6"	TPH-ss	TRPHC	8570	■ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	8570
1707		TMW-4 40-42'	TPH-ss	TRPHC	8240	■ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	8240
483		TSB-1 8-10'	TPH-ss	TRPHC	7790	■ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	7790
139		GSB-8D 57-59'	TPH-ss	TRPHC	6380	■ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	6380
76		GSB-4D 57-59'	TPH-ss	TRPHC	5720	■ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	5720
1763		TMW-5 48-50'	TPH-ss	TRPHC	5610	■ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	5610
1295		TSB-10 8-10'	TPH-ss	TRPHC	5580	■ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	5580
69		GSB-4 57-59'	TPH-ss	TRPHC	5340	■ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	5340
875		TSB-6 3-5'	TPH-ss	TRPHC	4490	■ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	4490
3400		GBS-3 6"	TPH-ss	TRPHC	4360	■ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	4360
3064		GMW-10 3-5'	TPH-ss	TRPHC	4180	■ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	4180

						Screening Level comparison against site analytical data. Exceedences are noted by a filled box (■).						
line index no.	location description	field sample ID	Chemical Abstracts Service No. (CASRN)	chemical name	measured chemical concen-*tration* (mg/kg)	1) surficial soil, direct *exposure* (mg/kg)	2) soil volatil-ization *indoor* (mg/kg)	3) soil volatil-ization *outdoor* (mg/kg)	4) NMOCD guide lines (mg/kg)	5) (mg/kg)	6) (mg/kg)	7) co-located TPH *measure* (mg/kg)
(continued)												
132		GSB-8 57-59'	TPH-ss	TRPHC	4030	■ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	4030
160		GSB-10 3-5'	TPH-ss	TRPHC	3960	■ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	3960
2672		GMW-3 63-65'	TPH-ss	TRPHC	3820	■ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	3820
1651		TMW-3 23-25'	TPH-ss	TRPHC	3574	■ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	3574
2756		GMW-5 58-60'	TPH-ss	TRPHC	3170	■ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	3170
1875		GSB-3 2-3'	TPH-ss	TRPHC	3130	■ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	3130
2644		GMW-3 53-55'	TPH-ss	TRPHC	3000	■ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	3000
1623		TMW-3 3-5'	TPH-ss	TRPHC	2986	■ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	2986
167		GSB-10 50-52'	TPH-ss	TRPHC	2920	■ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	2920
62		GSB-4 48-50'	TPH-ss	TRPHC	2900	■ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	2900
153		GSB-9 50-52'	TPH-ss	TRPHC	2310	☐ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	2310
3204		GBN-2 6"	TPH-ss	TRPHC	2060	☐ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	2060
146		GSB-9 13-15'	TPH-ss	TRPHC	2050	☐ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	2050
188		GSB-11 48-50'	TPH-ss	TRPHC	1990	☐ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	1990
2099		GSB-10 2-3'	TPH-ss	TRPHC	1960	☐ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	1960
2784		GMW-5 63-65'	TPH-ss	TRPHC	1950	☐ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	1950
55		GSB-3D 48-50'	TPH-ss	TRPHC	1890	☐ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	1890
6		GSB-1 58-60'	TPH-ss	TRPHC	1770	☐ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	1770
1595		TMW-3 2-3'	TPH-ss	TRPHC	1460	☐ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	1460
125		GSB-8 43-45'	TPH-ss	TRPHC	1350	☐ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	1350
20		GSB-1B 63-65'	TPH-ss	TRPHC	1340	☐ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	1340
41		GSB-3 38-40'	TPH-ss	TRPHC	1310	☐ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	1310
181		GSB-11 2-3'	TPH-ss	TRPHC	1100	☐ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	1100
34		GSB-2 55-57'	TPH-ss	TRPHC	1020	☐ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	1020
27		GSB-2 45-47'	TPH-ss	TRPHC	870	☐ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	870
48		GSB-3 48-50'	TPH-ss	TRPHC	771	☐ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	771
3428		GBS-4 6"	TPH-ss	TRPHC	730	☐ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	730
174		GSB-11	TPH-ss	TRPHC	704	☐ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	704
111		GSB-7 33-35'	TPH-ss	TRPHC	692	☐ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	692
3036		GMW-9D 63-65'	TPH-ss	TRPHC	688	☐ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	688
2351		GSB-16 3-5'	TPH-ss	TRPHC	665	☐ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	665
195		CSS #1 0 - 1'	TPH-ss	TRPHC	460	☐ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	460
3456		GBS-5 6"	TPH-ss	TRPHC	419	☐ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	419
13		GSB-1 63-65'	TPH-ss	TRPHC	274	☐ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	274
202		CSS #2 0 - 1'	TPH-ss	TRPHC	222	☐ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	222
1987		GSB-7 2-3'	TPH-ss	TRPHC	217	☐ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	217
3008		GMW-9 63-65'	TPH-ss	TRPHC	206	☐ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	206
987		TSB-7 8-10'	TPH-ss	TRPHC	139	☐ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	139
1211		TSB-9 18-20'	TPH-ss	TRPHC	117	☐ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	117
819		TSB-5 18-20'	TPH-ss	TRPHC	102	☐ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	102

Screening Level comparison against site analytical data.
Exceedences are noted by a filled box (■).

line index no.	location description	field sample ID	Chemical Abstracts Service No. (CASRN)	chemical name	measured chemical concen-tration (mg/kg)	1) surficial soil, direct exposure (mg/kg)	2) soil volatil-ization indoor (mg/kg)	3) soil volatil-ization outdoor (mg/kg)	4) NMOC D guide lines (mg/kg)	5) (mg/kg)	6) (mg/kg)	7) co-located TPH measure (mg/kg)
(continued)												
1155		TSB-9 2-3'	TPH-ss	TRPHC	97.2	☐ 2.4E+3	☐	☐	☐ 1.0E+2	☐	☐	97.2
3288		GBN-6 6"	TPH-ss	TRPHC	87.8	☐ 2.4E+3	☐	☐	☐ 1.0E+2	☐	☐	87.8
847		TSB-6 2-3'	TPH-ss	TRPHC	86.8	☐ 2.4E+3	☐	☐	☐ 1.0E+2	☐	☐	86.8
1511		TMW-1A 63-65'	TPH-ss	TRPHC	63	☐ 2.4E+3	☐	☐	☐ 1.0E+2	☐	☐	63
230		CSS #7	TPH-ss	TRPHC	55	☐ 2.4E+3	☐	☐	☐ 1.0E+2	☐	☐	55
679		TSB-4 2-3'	TPH-ss	TRPHC	52.3	☐ 2.4E+3	☐	☐	☐ 1.0E+2	☐	☐	52.3
1567		TMW-2 63-65'	TPH-ss	TRPHC	50	☐ 2.4E+3	☐	☐	☐ 1.0E+2	☐	☐	50
209		CSS #3	TPH-ss	TRPHC	39.8	☐ 2.4E+3	☐	☐	☐ 1.0E+2	☐	☐	39.8
1735		TMW-4 63-65'	TPH-ss	TRPHC	29	☐ 2.4E+3	☐	☐	☐ 1.0E+2	☐	☐	29
2043		GSB-8 2-3'	TPH-ss	TRPHC	27.5	☐ 2.4E+3	☐	☐	☐ 1.0E+2	☐	☐	27.5
216		CSS #4	TPH-ss	TRPHC	24.7	☐ 2.4E+3	☐	☐	☐ 1.0E+2	☐	☐	24.7
2071		GSB-9 2-3'	TPH-ss	TRPHC	24.1	☐ 2.4E+3	☐	☐	☐ 1.0E+2	☐	☐	24.1
1539		TMW-2 53-55'	TPH-ss	TRPHC	21.5	☐ 2.4E+3	☐	☐	☐ 1.0E+2	☐	☐	21.5
223		CSS #5	TPH-ss	TRPHC	19.2	☐ 2.4E+3	☐	☐	☐ 1.0E+2	☐	☐	19.2
1959		GSB-6 2-3'	TPH-ss	TRPHC	18.7	☐ 2.4E+3	☐	☐	☐ 1.0E+2	☐	☐	18.7
244		TSB-1 43-45'	TPH-ss	TRPHC	17.4	☐ 2.4E+3	☐	☐	☐ 1.0E+2	☐	☐	17.4
1099		TSB-8 8-10'	TPH-ss	TRPHC	15.6	☐ 2.4E+3	☐	☐	☐ 1.0E+2	☐	☐	15.6
1127		TSB-8 40-42'	TPH-ss	TRPHC	15.6	☐ 2.4E+3	☐	☐	☐ 1.0E+2	☐	☐	15.6
2812		GMW-6 3-5'	TPH-ss	TRPHC	15.6	☐ 2.4E+3	☐	☐	☐ 1.0E+2	☐	☐	15.6
1903		GSB-4 2-3'	TPH-ss	TRPHC	13.5	☐ 2.4E+3	☐	☐	☐ 1.0E+2	☐	☐	13.5
511		TSB-2 2-3'	TPH-ss	TRPHC	12.3	☐ 2.4E+3	☐	☐	☐ 1.0E+2	☐	☐	12.3
2127		GSB-11 2-3'	TPH-ss	TRPHC	12	☐ 2.4E+3	☐	☐	☐ 1.0E+2	☐	☐	12
623		TSB-3 3-5'	TPH-ss	TRPHC	11.7	☐ 2.4E+3	☐	☐	☐ 1.0E+2	☐	☐	11.7
2616		GMW-2 62-64'D	TPH-ss	TRPHC	10.6	☐ 2.4E+3	☐	☐	☐ 1.0E+2	☐	☐	10.6
1483		TMW-1 63-65'	TPH-ss	TRPHC	0.11	☐ 2.4E+3	☐	☐	☐ 1.0E+2	☐	☐	0.11
						☐	☐	☐	☐	☐	☐	
10	SS-1		TPH-ss	SS-1 (2-3') 89559	182000	■ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	
12	SS-2		TPH-ss	SS-2 (2-3') 89561	158000	■ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	
14	SS-3		TPH-ss	SS-3 (2-3') 89563	71000	■ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	
18	SS-5		TPH-ss	SS-5 (2') 89567	62000	■ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	
8	TSB-7 AD		TSB-7 ADL	TSB-7 2-3 ft (ADL)	57000	■ 2.7E+3	☐ NA	☐ NA	■ 1.0E+2	☐	☐	
19	SS-5		TPH-ss	SS-5 (5') 89568	39000	■ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	
9	TSB-8 AD		TSB-8 ADL	TSB-8 2-3 ft (ADL)	32000	■ 2.7E+3	☐ NA	☐ NA	■ 1.0E+2	☐	☐	
13	SS-2		TPH-ss	SS-2 (6') 89562	27000	■ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	
3	GBN-3		GBN-3	GBN-3 (6") T117628	21841	■ 5.2E+3	☐ NA	☐ NA	■ 1.0E+2	☐	☐	
11	SS-1		TPH-ss	SS-1 (5') 89560	17000	■ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	
16	SS-4		TPH-ss	SS-4 (1') 89565	13000	■ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	
15	SS-3		TPH-ss	SS-3 (5.5') 89564	11000	■ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	
2	GBN-4		GBN-4	GBN-4 (6"-8") T119263	9901	■ 3.5E+3	☐ NA	☐ NA	■ 1.0E+2	☐	☐	
1	TSB-7A		TSB-7A	TSB-7A (2-3') T119262	9413	■ 3.0E+3	☐ NA	☐ NA	■ 1.0E+2	☐	☐	

						Screening Level comparison against site analytical data. Exceedences are noted by a filled box (■).						
line index no.	location description	field sample ID	Chemical Abstracts Service No. (CASRN)	chemical name	measured chemical concen-tration (mg/kg)	1) surficial soil, direct exposure (mg/kg)	2) soil volatil-ization indoor (mg/kg)	3) soil volatil-ization outdoor (mg/kg)	4) NMOC D guide lines (mg/kg)	5) (mg/kg)	6) (mg/kg)	7) co-located TPH measure (mg/kg)
(continued)												
6	GSB-10 (B		GSB-10 (BP)	GSB-10 (BP) (2-3') T118813	6257	☐ 6.7E+3	■ 1.4E+3	☐ NA	■ 1.0E+2	☐	☐	
4	GBN-1		GBN-1	GBN-1 (6") T117626	5322	☐ 6.6E+3	☐ NA	☐ NA	■ 1.0E+2	☐	☐	
17	SS-4		TPH-ss	SS-4 (5') 89566	4000	■ 2.4E+3	☐	☐	■ 1.0E+2	☐	☐	
5	GBN-2		GBN-2	GBN-2 (6") T117627	1217	☐ 5.3E+3	☐ NA	☐ NA	■ 1.0E+2	☐	☐	
7	GSB-9		GSB-9	GSB-9 (2-3') T118812	51	☐ 2.4E+3	☐ NA	☐ NA	☐ 1.0E+2	☐	☐	
						☐	☐	☐	☐	☐	☐	
						☐	☐	☐	☐	☐	☐	
						☐	☐	☐	☐	☐	☐	
						☐	☐	☐	☐	☐	☐	
						☐	☐	☐	☐	☐	☐	

Notes (where applicable):

Indicators in the screening level comparison table include NA (not applicable), [blank] (not calculated).

Region VI screening values: USEPA Region VI Human Health Medium-Specific☐Screening Levels, USEPA, Region 6, Multimedia Planning and Permitting Division, Dallas.

available at URL: http://www.epa.gov/earth1r6/6pd/rcra_c/pd-n/screen.htm

RBCA -based screening levels based on ASTM PS104-98 with default exposure parameters, USEPA toxicity parameters, and representative physical parameters.

TPH -based screening levels are based on GRI (1999): Risk-Based Corrective Action Tools for E&P Facilities, review draft.

Screening values for TPH are based on specific sample composition (notes C & D) or on an overall minimum site-specific value otherwise.

ANALYTICAL SUMMARY - SOIL CONCENTRATIONS 5.1

Site Name: Westgate Subdivision
Site Location: Hobbs, NM

Completed by: G. E. DeVaull
Revision Date: 16 Aug 1999

All detected chemical analysis results from site soil samples are tabulated except as specifically noted at the end of the table. Each line corresponds to a specific sample and chemical constituent.

Notes, if needed, are added at the end of this table and are indexed to samples using the "note index no." column.

note index no.	line index no.	location description	sample type	field sample ID	sampling unit	sampling depth (ft)	sample interval (ft)	field sampling date	analysis ID code	analysis date	analytical method number	Chemical Abstracts Service No. (CASRN)	chemical name	detection limit (mg/kg)	QA/ QC code	measured chemical concen-tration (mg/kg)
A	2497		soil	GMW-8	28-30'	28	30		104948		S-8260B	71-43-2	benzene			0.4
A	1358		soil	TMW-3 23-25'		23	25		108240		S-8260B	71-43-2	benzene			0.12
A	1334		soil	TMW-3 2-3'		2	3		108238		S-8260B	71-43-2	benzene			0.074
A	1346		soil	TMW-3 3-5'		3	5		108239		S-8260B	71-43-2	benzene			0.073
A	1370		soil	TMW-3 63-65'		63	65		108241		S-8260B	71-43-2	benzene			0.057
C	3595		soil	TSB-7 2-3 ft		2	3				EPA 8260	71-43-2	benzene			0.02
C	3611		soil	TSB-8 2-3 ft		2	3				EPA 8260	71-43-2	benzene			0.0098
A	73	max	soil	GSB-4D	57-59'	57	59		107005		S 8021B	108-88-3	toluene			10.3
A	294	max	soil	TSB-8	2-3'	2	3		19350		S-8260B	100-41-4	ethylbenzene			17
C	3614	max	soil	TSB-8 2-3 ft		2	3				EPA 8260	1330-20-7	xylene (mixed isomers)			48.24
A	297	max	soil	TSB-8	2-3'	2	3		19350		S-8260B	95-47-6	xylene, o-			5.6
B	3572		soil	TSB-5	2-3'	2	3		118970		8270C	117-81-7	di-2-ethylhexyl phthalate			0.38
A	1312		soil	TMW-1 63-65'		63	65		105743		S-8260B	74-83-9	bromomethane			0.97
A	2498		soil	GMW-8	28-30'	28	30		104948		S-8260B	75-35-4	dichloroethylene, 1,1-			0.37
A	2501		soil	GMW-8	28-30'	28	30		104948		S-8260B	79-01-6	trichloroethylene			0.42
A	334		soil	TSB-11	18-20'	18	20		106102		S-8270C	120-12-7	anthracene			2.97
C	3602	max	soil	TSB-7 2-3 ft		2	3				EPA 8270	129-00-0	pyrene			2
C	3610		soil	TSB-7 2-3 ft		2	3				EPA 8270	191-24-2	benzo(g,h,i)perylene			1.6
C	3626		soil	TSB-8 2-3 ft		2	3				EPA 8270	191-24-2	benzo(g,h,i)perylene			0.39
C	3608		soil	TSB-7 2-3 ft		2	3				EPA 8270	193-39-5	indeno(1,2,3-cd)pyrene			0.95
C	3624		soil	TSB-8 2-3 ft		2	3				EPA 8270	193-39-5	indeno(1,2,3-cd)pyrene			0.2
C	3605		soil	TSB-7 2-3 ft		2	3				EPA 8270	205-99-2	benzo(b)fluoranthene			1.1
C	3621		soil	TSB-8 2-3 ft		2	3				EPA 8270	205-99-2	benzo(b)fluoranthene			0.38
C	3606		soil	TSB-7 2-3 ft		2	3				EPA 8270	207-08-9	benzo(k)fluoranthene			0.22
C	3622		soil	TSB-8 2-3 ft		2	3				EPA 8270	207-08-9	benzo(k)fluoranthene			0.088

note index no.	line index no.	location description	sample type	field sample ID	sampling unit	sampling depth (ft)	sample interval (ft)	field sampling date	analysis ID code	analysis date	analytical method number	Chemical Abstracts Service No. (CASRN)	chemical name	detection limit (mg/kg)	QA/ QC code	measured chemical concen-tration (mg/kg)
(continued)																
C	3604		soil	TSB-7 2-3 ft		2	3				EPA 8270	218-01-9	chrysene			3.6
C	3620		soil	TSB-8 2-3 ft		2	3				EPA 8270	218-01-9	chrysene			1.5
A	1368		soil	TMW-3 23-25'		23	25		108240		S-8270C	50-32-8	benzo-a-pyrene			8.81
C	3607		soil	TSB-7 2-3 ft		2	3				EPA 8270	50-32-8	benzo-a-pyrene			1.1
C	3623		soil	TSB-8 2-3 ft		2	3				EPA 8270	50-32-8	benzo-a-pyrene			0.35
C	3609		soil	TSB-7 2-3 ft		2	3				EPA 8270	53-70-3	dibenz[1,2;5,6]anthracene			0.34
C	3625		soil	TSB-8 2-3 ft		2	3				EPA 8270	53-70-3	dibenz[1,2;5,6]anthracene			0.12
C	3603		soil	TSB-7 2-3 ft		2	3				EPA 8270	56-55-3	benzanthracene			1.2
C	3619		soil	TSB-8 2-3 ft		2	3				EPA 8270	56-55-3	benzanthracene			0.45
C	3601	max	soil	TSB-7 2-3 ft		2	3				EPA 8270	85-01-8	phenanthrene			14
C	3600	max	soil	TSB-7 2-3 ft		2	3				EPA 8270	86-73-7	fluorene			6.1
B	3578	max	soil	TSB-7 2-3'		2	3		118880		8270C	90-12-0	methylnaphthalene, 1-			43
C	3599	max	soil	TSB-7 2-3 ft		2	3				EPA 8270	91-20-3	naphthalene			12
B	3579	max	soil	TSB-7 2-3'		2	2		118880		8270C	91-57-6	methylnaphthalene, 2-			39
C			soil	TSB-8 2-3 ft		2	3				EPA 8260	BTEX	BTEX (total)			59.2563
A			soil	TMW-1 2-3'		2	3		105742		S-8260B	BTEX	BTEX (total)			54.5
A			soil	TSB-7 3-5'		3	5		106037		S-8260B	BTEX	BTEX (total)			50.9
A			soil	GSB-8D 57-59'		57	59		107019		S 8021B	BTEX	BTEX (total)			41.68
A			soil	GSB-4 48-50'		48	50		107003		S 8021B	BTEX	BTEX (total)			24.91
A			soil	GSB-3D 48-50'		48	50		107015		S 8021B	BTEX	BTEX (total)			23.27
A			soil	TSB-8 2-3'		2	3		19350		S-8260B	BTEX	BTEX (total)			22.6
A			soil	TSB-7 2-3'		2	3		106036		S-8260B	BTEX	BTEX (total)			22.36
A			soil	GSB-4D 57-59'		57	59		107005		S 8021B	BTEX	BTEX (total)			22.03
A			soil	GSB-10 3-5'		3	5		106790		S 8021B	BTEX	BTEX (total)			18.28
A			soil	GSB-10 2-3'		2	3		106789		S-8260B	BTEX	BTEX (total)			18.1
C			soil	TSB-7 2-3 ft		2	3				EPA 8260	BTEX	BTEX (total)			15.332
A			soil	GSB-8 57-59'		57	59		107018		S 8021B	BTEX	BTEX (total)			14.67
A			soil	TMW-3 23-25'		23	25		108240		S-8260B	BTEX	BTEX (total)			14.62
A			soil	TMW-4 40-42'		40	42		118283		S-8260B	BTEX	BTEX (total)			14
A			soil	GSB-4 57-59'		57	59		107004		S 8021B	BTEX	BTEX (total)			13.46
A			soil	TSB-1 3-5'		3	5		105956		S-8260B	BTEX	BTEX (total)			13
A			soil	GMW-3 53-55'		53	55		104147		S-8260B	BTEX	BTEX (total)			12.1
A			soil	GSB-3 48-50'		48	50		107014		S 8021B	BTEX	BTEX (total)			9.1
A			soil	GSB-11 48-50'		48	50		107161			BTEX	BTEX (total)			8.104
A			soil	GSB-9 13-15'		13	15		106787		S 8021B	BTEX	BTEX (total)			7.412
A			soil	GSB-10 50-52'		50	52		106791		S 8021B	BTEX	BTEX (total)			4.887
A			soil	GSB-9 50-52'		50	52		106788		S 8021B	BTEX	BTEX (total)			4.786
A			soil	GSB-8 43-45'		43	45		107017		S 8021B	BTEX	BTEX (total)			4.598
A			soil	GSB-11					107162		S 8021B	BTEX	BTEX (total)			3.559

note index no.	line index no.	location description	sample type	field sample ID	sampling unit	sampling depth (ft)	sample interval (ft)	field sampling date	analysis ID code	analysis date	analytical method number	Chemical Abstracts Service No. (CASRN)	chemical name	detection limit (mg/kg)	QA/ QC code	measured chemical concen-tration (mg/kg)
(continued)																
A			soil	GSB-11 2-3'		2	3		107160		S 8021B	BTEX	BTEX (total)			3.419
A			soil	GSB-2 55-57'		55	57		105226		S 8021B	BTEX	BTEX (total)			3.397
A			soil	GSB-7 33-35'		33	35		106260		S 8021B	BTEX	BTEX (total)			2.853
A			soil	GSB-3 38-40'		38	40		107013		S 8021B	BTEX	BTEX (total)			2.821
A			soil	GSB-2 45-47'		45	47		105225		S 8021B	BTEX	BTEX (total)			1.476
A			soil	TSB-11 18-20'		18	20		106102		S-8260B	BTEX	BTEX (total)			1.4
A			soil	GMW-5 63-65'		63	65		104340		S-8260B	BTEX	BTEX (total)			1.29
A			soil	GMW-3 63-65'		63	65		104148		S-8260B	BTEX	BTEX (total)			1.14
A			soil	GSB-1 58-60'		58	60		105072		S 8021B	BTEX	BTEX (total)			0.857
A			soil	GMW-8 28-30'		28	30		104948		S-8260B	BTEX	BTEX (total)			0.81
A			soil	GSB-16 38-40'		38	40		118544		S-8260B	BTEX	BTEX (total)			0.583
A			soil	CSS #6					103645			BTEX	BTEX (total)			0.19
A			soil	GSB-6 18-20'		38	40		106829		S 8021B	BTEX	BTEX (total)			0.162
A			soil	GSB-1 63-65'		63	65		105073		S 8021B	BTEX	BTEX (total)			0.075
A			soil	TMW-3 2-3'		2	3		108238		S-8260B	BTEX	BTEX (total)			0.074
A			soil	TMW-3 3-5'		3	5		108239		S-8260B	BTEX	BTEX (total)			0.073
A			soil	TSB-6 18-20'		18	20		106033			BTEX	BTEX (total)			0.072
A			soil	TMW-3 63-65'		63	65		108241		S-8260B	BTEX	BTEX (total)			0.057
A			soil	TSB-42 6-8"		0.5	0.66		125259			BTEX	BTEX (total)			0.027
A			soil	TSB-49 6-8"		0.5	0.66		125260			BTEX	BTEX (total)			0.026

Notes (where applicable):

All detected chemicals are included in the above table except as noted.

Non-detects are omitted from the list.

A complete analyte list is included in the site analytical data report.

m- & p-xylenes are screened as part of mixed xylenes (m-, p-, and o- isomers) and are not listed separately above.

Analysis results for phenols using method SM 5530 A,D are not included in the above list; no phenol was detected using GC/MS analysis methods.

maximum measured values only are listed for toluene, ethylbenzene, xylenes (mixed isomers), o-xylene, pyrene, phenanthrene, fluorene, naphthalene, and 1- and 2-methylnapthalene.

A. From Stage 1 Abatement Plan Report, July 1999, Table 2. Soil Analytical Results

B. From Stage 1 Abatement Plan Report, July 1999, Table 4. Confirmation Soil Analytical Results

C. A. D. Little Analysis of Soil Samples by GC/FID, GC/MS, Feb. 17, 1999, Henry Camp.

D. Soil Analyses for TPH by Trace Analysis, Inc. using TX1006 aromatic/aliphatic seperation with boiling-point cut analysis (23 Feb 1999).

E. Soil Analyses for TPH by Triton Analytics using GC - HTSD (Gas Chromatography - High Temperature Simulated Distillation), 16 Feb 1998.

ANALYTICAL DATA to RBSL COMPARISONS - SOIL CONCENTRATIONS 5.2

Site Name: Westgate Subdivision
Site Location: Hobbs, NM

Completed By: G. E. DeVaull
Revision Date: 16 Aug 1999

This table is a comparison of chemical analysis results to screening level concentrations.
The line index number is identical to that in the first half of this table.

Screening Level Criteria Descriptions
(residential exposure, minimum of HQ = 1 or Risk = 1E-6):
1) direct soil exposure, ingestion, dermal contact, dust & vapor inhalation - RBCA
2) volatilization from subsurface soil to ambient (outdoor) air - RBCA
3) volatilization from subsurface soil to indoor air - RBCA
4) residential soil - Region VI
5) residential soil w/o dermal exposure - Region VI
6) Guidelines for Remediation, 8/13/93, NMOCD,, IV.2.a., Ranking Criteria (>19)
7) tabulation of co-located TPH measurement

						3	4	5	24	25		
						Screening Level comparison against site analytical data. Exceedences are noted by a filled box (■).						
line index no.	location description	field sample ID	Chemical Abstracts Service No. (CASRN)	chemical name	measured chemical concen-tration (mg/kg)	1) surficial soil, direct exposure (mg/kg)	2) soil volatil-ization indoor (mg/kg)	3) soil volatil-ization outdoor (mg/kg)	4) res soil - Region VI (mg/kg)	5) res soil w/o dermal - Region (mg/kg)	6) NMOCD guide lines (mg/kg)	7) co-located TPH measure (mg/kg)
2497		GMW-8 28-30'	71-43-2	benzene	0.4	☐ 3.8E+0	■ 7.6E-3	■ 1.3E-1	☐ 6.7E-1	☐ 6.8E-1	☐ 1.0E+1	
1358		TMW-3 23-25'	71-43-2	benzene	0.12	☐ 3.8E+0	■ 7.6E-3	☐ 1.3E-1	☐ 6.7E-1	☐ 6.8E-1	☐ 1.0E+1	3574
1334		TMW-3 2-3'	71-43-2	benzene	0.074	☐ 3.8E+0	■ 7.6E-3	☐ 1.3E-1	☐ 6.7E-1	☐ 6.8E-1	☐ 1.0E+1	1460
1346		TMW-3 3-5'	71-43-2	benzene	0.073	☐ 3.8E+0	■ 7.6E-3	☐ 1.3E-1	☐ 6.7E-1	☐ 6.8E-1	☐ 1.0E+1	2986
1370		TMW-3 63-65'	71-43-2	benzene	0.057	☐ 3.8E+0	■ 7.6E-3	☐ 1.3E-1	☐ 6.7E-1	☐ 6.8E-1	☐ 1.0E+1	
3595		TSB-7 2-3 ft	71-43-2	benzene	0.02	☐ 3.8E+0	■ 7.6E-3	☐ 1.3E-1	☐ 6.7E-1	☐ 6.8E-1	☐ 1.0E+1	57000
3611		TSB-8 2-3 ft	71-43-2	benzene	0.0098	☐ 3.8E+0	■ 7.6E-3	☐ 1.3E-1	☐ 6.7E-1	☐ 6.8E-1	☐ 1.0E+1	32000
73	max	GSB-4D 57-59'	108-88-3	toluene	10.3	☐ 8.1E+3	☐ 2.6E+1	☐ 4.3E+2	☐ 5.2E+2	☐ 5.2E+2	☐	5720
294	max	TSB-8 2-3'	100-41-4	ethylbenzene	17	☐ 5.6E+3	☐ 1.2E+2	☐ NA	☐ 2.3E+2	☐ 2.3E+2	☐	60300
3614	max	TSB-8 2-3 ft	1330-20-7	xylene (mixed isomers)	48.24	☐ 9.5E+4	☐ NA	☐ NA	☐	☐	☐	32000
297	max	TSB-8 2-3'	95-47-6	xylene, o-	5.6	☐ 9.5E+4	☐ NA	☐ NA	☐ 2.8E+2	☐ 2.8E+2	☐	60300
3572		TSB-5 2-3'	117-81-7	di-2-ethylhexyl phthalate	0.38	☐ 3.4E+1	☐ NA	☐ NA	☐ 3.5E+1	☐ 4.6E+1	☐	
1312		TMW-1 63-65'	74-83-9	bromomethane	0.97	☐ 6.7E+1	■ 4.5E-2	■ 7.6E-1	☐ 3.9E+0	☐ 3.9E+0	☐	0.11
2498		GMW-8 28-30'	75-35-4	dichloroethylene, 1,1-	0.37	■ 1.5E-1	■ 4.6E-5	■ 7.7E-4	■ 5.3E-2	■ 5.4E-2	☐	
2501		GMW-8 28-30'	79-01-6	trichloroethylene	0.42	☐ NA	☐ NA	☐ NA	☐ 2.7E+0	☐ 2.8E+0	☐	
						☐	☐	☐	☐	☐	☐	
334		TSB-11 18-20'	120-12-7	anthracene	2.97	☐ 5.9E+4	☐ NA	☐ NA	☐ 1.6E+4	☐ 2.2E+4	☐	
3602	max	TSB-7 2-3 ft	129-00-0	pyrene	2	☐ 6.1E+3	☐ NA	☐ NA	☐ 1.7E+3	☐ 2.3E+3	☐	57000
3610		TSB-7 2-3 ft	191-24-2	benzo(g,h,i)perylene	1.6	☐ NA	☐ NA	☐ NA	☐	☐	☐	57000
3626		TSB-8 2-3 ft	191-24-2	benzo(g,h,i)perylene	0.39	☐ NA	☐ NA	☐ NA	☐	☐	☐	32000
3608		TSB-7 2-3 ft	193-39-5	indeno(1,2,3-cd)pyrene	0.95	■ 6.5E-1	☐ NA	☐ NA	■ 6.2E-1	■ 8.8E-1	☐	57000
3624		TSB-8 2-3 ft	193-39-5	indeno(1,2,3-cd)pyrene	0.2	☐ 6.5E-1	☐ NA	☐ NA	☐ 6.2E-1	☐ 8.8E-1	☐	32000
3605		TSB-7 2-3 ft	205-99-2	benzo(b)fluoranthene	1.1	■ 6.5E-1	☐ NA	☐ NA	■ 6.2E-1	■ 8.8E-1	☐	57000
3621		TSB-8 2-3 ft	205-99-2	benzo(b)fluoranthene	0.38	☐ 6.5E-1	☐ NA	☐ NA	☐ 6.2E-1	☐ 8.8E-1	☐	32000
3606		TSB-7 2-3 ft	207-08-9	benzo(k)fluoranthene	0.22	☐ 6.5E+0	☐ NA	☐ NA	☐ 6.2E+0	☐ 8.8E+0	☐	57000
3622		TSB-8 2-3 ft	207-08-9	benzo(k)fluoranthene	0.088	☐ 6.5E+0	☐ NA	☐ NA	☐ 6.2E+0	☐ 8.8E+0	☐	32000

						Screening Level comparison against site analytical data. Exceedences are noted by a filled box (■).						
line index no.	location description	field sample ID	Chemical Abstracts Service No. (CASRN)	chemical name	measured chemical concen-tration (mg/kg)	1) surficial soil, direct exposure (mg/kg)	2) soil volatil-ization indoor (mg/kg)	3) soil volatil-ization outdoor (mg/kg)	4) res soil - Region VI (mg/kg)	5) res soil w/o dermal - Region (mg/kg)	6) NMOCD guide lines (mg/kg)	7) co-located TPH measure (mg/kg)
(continued)												
		GSB-11 2-3'	BTEX	BTEX (total)	3.419	☐	☐	☐	☐	☐	☐ 5.0E+1	1100
		GSB-2 55-57'	BTEX	BTEX (total)	3.397	☐	☐	☐	☐	☐	☐ 5.0E+1	1020
		GSB-7 33-35'	BTEX	BTEX (total)	2.853	☐	☐	☐	☐	☐	☐ 5.0E+1	692
		GSB-3 38-40'	BTEX	BTEX (total)	2.821	☐	☐	☐	☐	☐	☐ 5.0E+1	1310
		GSB-2 45-47'	BTEX	BTEX (total)	1.476	☐	☐	☐	☐	☐	☐ 5.0E+1	870
		TSB-11 18-20'	BTEX	BTEX (total)	1.4	☐	☐	☐	☐	☐	☐ 5.0E+1	
		GMW-5 63-65'	BTEX	BTEX (total)	1.29	☐	☐	☐	☐	☐	☐ 5.0E+1	1950
		GMW-3 63-65'	BTEX	BTEX (total)	1.14	☐	☐	☐	☐	☐	☐ 5.0E+1	3820
		GSB-1 58-60'	BTEX	BTEX (total)	0.857	☐	☐	☐	☐	☐	☐ 5.0E+1	1770
		GMW-8 28-30'	BTEX	BTEX (total)	0.81	☐	☐	☐	☐	☐	☐ 5.0E+1	
		GSB-16 38-40'	BTEX	BTEX (total)	0.583	☐	☐	☐	☐	☐	☐ 5.0E+1	
		CSS #6	BTEX	BTEX (total)	0.19	☐	☐	☐	☐	☐	☐ 5.0E+1	12900
		GSB-6 18-20'	BTEX	BTEX (total)	0.162	☐	☐	☐	☐	☐	☐ 5.0E+1	
		GSB-1 63-65'	BTEX	BTEX (total)	0.075	☐	☐	☐	☐	☐	☐ 5.0E+1	274
		TMW-3 2-3'	BTEX	BTEX (total)	0.074	☐	☐	☐	☐	☐	☐ 5.0E+1	1460
		TMW-3 3-5'	BTEX	BTEX (total)	0.073	☐	☐	☐	☐	☐	☐ 5.0E+1	2986
		TSB-6 18-20'	BTEX	BTEX (total)	0.072	☐	☐	☐	☐	☐	☐ 5.0E+1	
		TMW-3 63-65'	BTEX	BTEX (total)	0.057	☐	☐	☐	☐	☐	☐ 5.0E+1	
		TSB-42 6-8"	BTEX	BTEX (total)	0.027	☐	☐	☐	☐	☐	☐ 5.0E+1	
		TSB-49 6-8"	BTEX	BTEX (total)	0.026	☐	☐	☐	☐	☐	☐ 5.0E+1	
						☐	☐	☐	☐	☐	☐	
						☐	☐	☐	☐	☐	☐	

Notes (where applicable):

Indicators in the screening level comparison table include NA (not applicable), [blank] (not calculated).

Region VI screening values: USEPA Region VI Human Health Medium-Specific☐Screening Levels, USEPA, Region 6, Multimedia Planning and Permitting Division, Dallas.

available at URL: http://www.epa.gov/earth1r6/6pd/rcra_c/pd-n/screen.htm

RBCA -based screening levels based on ASTM PS104-98 with default exposure parameters, USEPA *toxicity parameters*, and *representative physical parameters*.

TPH -based screening levels are based on GRI (1999): Risk-Based Corrective Action Tools for E&P Facilities, review draft.

Screening values for TPH are based on specific sample composition (notes C & D) or on an overall minimum site-specific value otherwise.

Guidelines for Remediation of Leaks, Spills, and Releases (August 13, 1993; New Mexico Oil Conservation Division), IV.2.a., Ranking Criteria, (>19) are shown for benzene and BTEX.

						Screening Level comparison against site analytical data. Exceedences are noted by a filled box (■).						
line index no.	location description	field sample ID	Chemical Abstracts Service No. (CASRN)	chemical name	measured chemical concentration (mg/kg)	1) surficial soil, direct exposure (mg/kg)	2) soil volatilization indoor (mg/kg)	3) soil volatilization outdoor (mg/kg)	4) res soil - Region VI (mg/kg)	5) res soil w/o dermal - Region (mg/kg)	6) NMOCD guide lines (mg/kg)	7) co-located TPH measure (mg/kg)
(continued)												
3604		TSB-7 2-3 ft	218-01-9	chrysene	3.6	☐ 6.5E+1	☐ NA	☐ NA	☐ 6.2E+1	☐ 8.8E+1	☐	57000
3620		TSB-8 2-3 ft	218-01-9	chrysene	1.5	☐ 6.5E+1	☐ NA	☐ NA	☐ 6.2E+1	☐ 8.8E+1	☐	32000
1368		TMW-3 23-25'	50-32-8	benzo-a-pyrene	8.81	■ 6.5E-2	☐ NA	☐ NA	■ 6.2E-2	■ 8.8E-2	☐	3574
3607		TSB-7 2-3 ft	50-32-8	benzo-a-pyrene	1.1	■ 6.5E-2	☐ NA	☐ NA	■ 6.2E-2	■ 8.8E-2	☐	57000
3623		TSB-8 2-3 ft	50-32-8	benzo-a-pyrene	0.35	■ 6.5E-2	☐ NA	☐ NA	■ 6.2E-2	■ 8.8E-2	☐	32000
3609		TSB-7 2-3 ft	53-70-3	dibenz[1,2;5,6]anthracene	0.34	■ 6.5E-2	☐ NA	☐ NA	■ 6.2E-2	■ 8.8E-2	☐	57000
3625		TSB-8 2-3 ft	53-70-3	dibenz[1,2;5,6]anthracene	0.12	■ 6.5E-2	☐ NA	☐ NA	■ 6.2E-2	■ 8.8E-2	☐	32000
3603		TSB-7 2-3 ft	56-55-3	benzanthracene	1.2	■ 6.5E-1	☐ NA	☐ NA	■ 6.2E-1	■ 8.8E-1	☐	57000
3619		TSB-8 2-3 ft	56-55-3	benzanthracene	0.45	☐ 6.5E-1	☐ NA	☐ NA	☐ 6.2E-1	☐ 8.8E-1	☐	32000
3601	max	TSB-7 2-3 ft	85-01-8	phenanthrene	14	☐ NA	☐ NA	☐ NA	☐	☐	☐	57000
3600	max	TSB-7 2-3 ft	86-73-7	fluorene	6.1	☐ 7.7E+3	☐ NA	☐ NA	☐ 2.0E+3	☐ 2.6E+3	☐	57000
3578	max	TSB-7 2-3'	90-12-0	methylnaphthalene, 1-	43	☐ 3.8E+3	☐ NA	☐ NA	☐	☐	☐	
3599	max	TSB-7 2-3 ft	91-20-3	naphthalene	12	☐ 2.8E+2	☐ 4.0E+1	☐ NA	☐ 5.5E+1	☐ 5.6E+1	☐	57000
3579	max	TSB-7 2-3'	91-57-6	methylnaphthalene, 2-	39	☐ 4.0E+3	☐ NA	☐ NA	☐	☐	☐	
		TSB-8 2-3 ft	BTEX	BTEX (total)	59.2563	☐	☐	☐	☐	☐	■ 5.0E+1	32000
		TMW-1 2-3'	BTEX	BTEX (total)	54.5	☐	☐	☐	☐	☐	■ 5.0E+1	28500
		TSB-7 3-5'	BTEX	BTEX (total)	50.9	☐	☐	☐	☐	☐	■ 5.0E+1	22900
		GSB-8D 57-59'	BTEX	BTEX (total)	41.68	☐	☐	☐	☐	☐	☐ 5.0E+1	6380
		GSB-4 48-50'	BTEX	BTEX (total)	24.91	☐	☐	☐	☐	☐	☐ 5.0E+1	2900
		GSB-3D 48-50'	BTEX	BTEX (total)	23.27	☐	☐	☐	☐	☐	☐ 5.0E+1	1890
		TSB-8 2-3'	BTEX	BTEX (total)	22.6	☐	☐	☐	☐	☐	☐ 5.0E+1	60300
		TSB-7 2-3'	BTEX	BTEX (total)	22.36	☐	☐	☐	☐	☐	☐ 5.0E+1	20000
		GSB-4D 57-59'	BTEX	BTEX (total)	22.03	☐	☐	☐	☐	☐	☐ 5.0E+1	5720
		GSB-10 3-5'	BTEX	BTEX (total)	18.28	☐	☐	☐	☐	☐	☐ 5.0E+1	3960
		GSB-10 2-3'	BTEX	BTEX (total)	18.1	☐	☐	☐	☐	☐	☐ 5.0E+1	1960
		TSB-7 2-3 ft	BTEX	BTEX (total)	15.332	☐	☐	☐	☐	☐	☐ 5.0E+1	57000
		GSB-8 57-59'	BTEX	BTEX (total)	14.67	☐	☐	☐	☐	☐	☐ 5.0E+1	4030
		TMW-3 23-25'	BTEX	BTEX (total)	14.62	☐	☐	☐	☐	☐	☐ 5.0E+1	3574
		TMW-4 40-42'	BTEX	BTEX (total)	14	☐	☐	☐	☐	☐	☐ 5.0E+1	8240
		GSB-4 57-59'	BTEX	BTEX (total)	13.46	☐	☐	☐	☐	☐	☐ 5.0E+1	5340
		TSB-1 3-5'	BTEX	BTEX (total)	13	☐	☐	☐	☐	☐	☐ 5.0E+1	37100
		GMW-3 53-55'	BTEX	BTEX (total)	12.1	☐	☐	☐	☐	☐	☐ 5.0E+1	3000
		GSB-3 48-50'	BTEX	BTEX (total)	9.1	☐	☐	☐	☐	☐	☐ 5.0E+1	771
		GSB-11 48-50'	BTEX	BTEX (total)	8.104	☐	☐	☐	☐	☐	☐ 5.0E+1	1990
		GSB-9 13-15'	BTEX	BTEX (total)	7.412	☐	☐	☐	☐	☐	☐ 5.0E+1	2050
		GSB-10 50-52'	BTEX	BTEX (total)	4.887	☐	☐	☐	☐	☐	☐ 5.0E+1	2920
		GSB-9 50-52'	BTEX	BTEX (total)	4.786	☐	☐	☐	☐	☐	☐ 5.0E+1	2310
		GSB-8 43-45'	BTEX	BTEX (total)	4.598	☐	☐	☐	☐	☐	☐ 5.0E+1	1350
		GSB-11	BTEX	BTEX (total)	3.559	☐	☐	☐	☐	☐	☐ 5.0E+1	704

ANALYTICAL SUMMARY - SOIL VAPOR CONCENTRATIONS

Site Name: Westgate Subdivision
Site Location: Hobbs, NM

Completed by: G. E. DeVaull
Revision Date: 16 Aug 1999

All detected chemical analysis results from site soil samples are tabulated. Each line corresponds to a specific sample and chemical constituent.

Notes, if needed, are added at the end of this table and are indexed to samples using the "note index no." column.

note index no.	line index no.	location description	sample type	field sample ID	sampling unit	sampling depth (ft)	sample interval (ft)	field sampling date	analysis ID code	analysis date	analytical method number	Chemical Abstracts Service No. (CASRN)	chemical name	detection limit (mg/m3)	QA/QC code	measured chemical concentration (mg/m3)
	23			TSVX		3		36027.4	60		8021	71-43-2	benzene			35.73719
	9			TSVI		7		36024.4	60		8021	71-43-2	benzene			19.49301
	25			TSVZ		5		36026.7	60		8021	71-43-2	benzene			12.99534
	311			SV-158		5		36017.4	60		8021	71-43-2	benzene			12.99534
	192			SV-39		5		36004.6	60		8021	71-43-2	benzene			3.248836
	396			SV-238		5		36004.7	60		8021	71-43-2	benzene			3.248836
	429			TSVX		3		36027.4	60		8021	108-88-3	toluene			229.9338
	598			SV-39		5		36004.6	60		8021	108-88-3	toluene			134.128
	407			TSVA		7		36024.7	60		8021	108-88-3	toluene			126.4636
	431			TSVZ		5		36026.7	60		8021	108-88-3	toluene			91.97351
	408			TSVB		5		36024.6	60		8021	108-88-3	toluene			76.64459
	415			TSVI		7		36024.4	60		8021	108-88-3	toluene			76.64459
	802			SV-238		5		36004.7	60		8021	108-88-3	toluene			22.99338
	419			TSVM		5		36024.4	60		8021	108-88-3	toluene			7.664459
	425			TSVS		5		36026.6	60		8021	108-88-3	toluene			3.83223
	430			TSVY		5		36026.7	60		8021	108-88-3	toluene			3.83223
	1219			TSVA		7		36024.7	60		8021	100-41-4	ethylbenzene			242.8593
	1220			TSVB		5		36024.6	60		8021	100-41-4	ethylbenzene			132.4687
	1227			TSVI		7		36024.4	60		8021	100-41-4	ethylbenzene			61.81873
	1241			TSVX		3		36027.4	60		8021	100-41-4	ethylbenzene			61.81873
	1243			TSVZ		5		36026.7	60		8021	100-41-4	ethylbenzene			44.15624
	1410			SV-39		5		36004.6	60		8021	100-41-4	ethylbenzene			44.15624
	1231			TSVM		5		36024.4	60		8021	100-41-4	ethylbenzene			17.66249
	1237			TSVS		5		36026.6	60		8021	100-41-4	ethylbenzene			8.831247
	1242			TSVY		5		36026.7	60		8021	100-41-4	ethylbenzene			4.415624
	1625			TSVA		7		36024.7	60		8021	1330-20-7	xylenes (mixed)			1324.687

note index no.	line index no.	location description	sample type	field sample ID	sampling unit	sampling depth (ft)	sample interval (ft)	field sampling date	analysis ID code	analysis date	analytical method number	Chemical Abstracts Service No. (CASRN)	chemical name	detection limit (mg/m3)	QA/ QC code	measured chemical concen-tration (mg/m3)
(continued)																
	1626			TSVB		5		36024.6	60		8021	1330-20-7	xylenes (mixed)			883.1247
	1816			SV-39		5		36004.6	60		8021	1330-20-7	xylenes (mixed)			287.0155
	1647			TSVX		3		36027.4	60		8021	1330-20-7	xylenes (mixed)			238.4437
	1633			TSVI		7		36024.4	60		8021	1330-20-7	xylenes (mixed)			220.7812
	1649			TSVZ		5		36026.7	60		8021	1330-20-7	xylenes (mixed)			167.7937
	1637			TSVM		5		36024.4	60		8021	1330-20-7	xylenes (mixed)			66.23435
	1719			SV-286		9.5		36297.7	50		8021	1330-20-7	xylenes (mixed)			35.32499
	2020			SV-238		5		36004.7	60		8021	1330-20-7	xylenes (mixed)			30.90937
	1643			TSVS		5		36026.6	60		8021	1330-20-7	xylenes (mixed)			26.49374
	1636			TSVL		5		36024.7	60		8021	1330-20-7	xylenes (mixed)			13.24687
	1648			TSVY		5		36026.7	60		8021	1330-20-7	xylenes (mixed)			13.24687
	1635			TSVK		5		36024.7	60		8021	1330-20-7	xylenes (mixed)			8.831247
	1646			TSVV		5		36026.6	60		8021	1330-20-7	xylenes (mixed)			8.831247
	1756			SV-323		10		36299.5	50		8021	1330-20-7	xylenes (mixed)			8.831247
	1638			TSVN		5		36024.5	60		8021	1330-20-7	xylenes (mixed)			4.415624
	1644			TSVT		5		36026.6	60		8021	1330-20-7	xylenes (mixed)			4.415624
	1645			TSVU		5		36026.6	60		8021	1330-20-7	xylenes (mixed)			4.415624
	1830			SV-53		5		36004.7	60		8021	1330-20-7	xylenes (mixed)			4.415624
	1935			SV-158		5		36017.4	60		8021	1330-20-7	xylenes (mixed)			4.415624
	907			SV-286		9.5		36297.7	50		8021	108-90-7	chlorobenzene			4.681445
	4862			SV-238		5		36004.7	60		8015	110-54-3	hexane			68.09993
	4467			TSVA		7		36024.7	60		8015	110-54-3	hexane			43.01048
	4489			TSVX		3		36027.4	60		8015	110-54-3	hexane			21.50524
	4777			SV-158		5		36017.4	60		8015	110-54-3	hexane			21.50524
	4804			SV-184		5		36013.6	60		8015	110-54-3	hexane			14.33683
	4773			SV-154		5		36012.4	60		8015	110-54-3	hexane			7.168413
	4863			SV-239		5		36026.3	60		8015	110-54-3	hexane			7.168413
	4589			SV-314		3		36299.4	50		8015	110-54-3	hexane			3.584207

Notes (where applicable):

All detected chemicals except as noted are included in the above table.
Non-detects are omitted from the list.
A complete analyte list is included in the site analytical data report.
Samples for TPH, methane, ethane, propane, butane, and pentane are omitted from the above table.

ANALYTICAL DATA to RBSL COMPARISONS - SOIL VAPOR CONCENTRATIONS 5.2a

Site Name: Westgate Subdivision
Site Location: Hobbs, NM

Completed By: G. E. DeVaull
Revision Date: 16 Aug 1999

This table is a comparison of chemical analysis results to screening level concentrations.
The line index number is identical to that in the first half of this table.

Screening Level Criteria Descriptions
(residential exposure, minimum of HQ = 1 or Risk = 1E-6):
1) migration of subsurface soil vapor to indoor air - RBCA
2) migration of subsurface soil vapor to ambient (outdoor) air - RBCA

21 20 20

Screening Level comparison against site analytical data.
Exceedences are noted by a filled box (■).

line index no.	location description	field sample ID	Chemical Abstracts Service No. (CASRN)	chemical name	measured chemical concen-tration (mg/m3)	1) soil volatil-ization outdoor (mg/m3)	2) soil volatil-ization indoor (mg/m3)				
23		TSVX	71-43-2	benzene	35.73719	☐ 4.3E+1	■ 2.5E+0				
9		TSVI	71-43-2	benzene	19.49301	☐ 4.3E+1	■ 2.5E+0				
25		TSVZ	71-43-2	benzene	12.99534	☐ 4.3E+1	■ 2.5E+0				
311		SV-158	71-43-2	benzene	12.99534	☐ 4.3E+1	■ 2.5E+0				
192		SV-39	71-43-2	benzene	3.248836	☐ 4.3E+1	■ 2.5E+0				
396		SV-238	71-43-2	benzene	3.248836	☐ 4.3E+1	■ 2.5E+0				
429		TSVX	108-88-3	toluene	229.9338	☐ 6.1E+4	☐ 3.6E+3				
598		SV-39	108-88-3	toluene	134.128	☐ 6.1E+4	☐ 3.6E+3				
407		TSVA	108-88-3	toluene	126.4636	☐ 6.1E+4	☐ 3.6E+3				
431		TSVZ	108-88-3	toluene	91.97351	☐ 6.1E+4	☐ 3.6E+3				
408		TSVB	108-88-3	toluene	76.64459	☐ 6.1E+4	☐ 3.6E+3				
415		TSVI	108-88-3	toluene	76.64459	☐ 6.1E+4	☐ 3.6E+3				
802		SV-238	108-88-3	toluene	22.99338	☐ 6.1E+4	☐ 3.6E+3				
419		TSVM	108-88-3	toluene	7.664459	☐ 6.1E+4	☐ 3.6E+3				
425		TSVS	108-88-3	toluene	3.83223	☐ 6.1E+4	☐ 3.6E+3				
430		TSVY	108-88-3	toluene	3.83223	☐ 6.1E+4	☐ 3.6E+3				
1219		TSVA	100-41-4	ethylbenzene	242.8593	☐ NA	☐ 1.1E+4				
1220		TSVB	100-41-4	ethylbenzene	132.4687	☐ NA	☐ 1.1E+4				
1227		TSVI	100-41-4	ethylbenzene	61.81873	☐ NA	☐ 1.1E+4				
1241		TSVX	100-41-4	ethylbenzene	61.81873	☐ NA	☐ 1.1E+4				
1243		TSVZ	100-41-4	ethylbenzene	44.15624	☐ NA	☐ 1.1E+4				
1410		SV-39	100-41-4	ethylbenzene	44.15624	☐ NA	☐ 1.1E+4				
1231		TSVM	100-41-4	ethylbenzene	17.66249	☐ NA	☐ 1.1E+4				
1237		TSVS	100-41-4	ethylbenzene	8.831247	☐ NA	☐ 1.1E+4				
1242		TSVY	100-41-4	ethylbenzene	4.415624	☐ NA	☐ 1.1E+4				
1625		TSVA	1330-20-7	xylenes (mixed)	1324.687	☐ NA	☐ NA				

						Screening Level comparison against site analytical data. Exceedences are noted by a filled box (■).						
line index no.	location description	field sample ID	Chemical Abstracts Service No. (CASRN)	chemical name	measured chemical concen-tration (mg/m3)	1) soil volatil-ization outdoor (mg/m3)	2) soil volatil-ization indoor (mg/m3)					
(continued)												
1626		TSVB	1330-20-7	xylenes (mixed)	883.1247	☐ NA	☐ NA					
1816		SV-39	1330-20-7	xylenes (mixed)	287.0155	☐ NA	☐ NA					
1647		TSVX	1330-20-7	xylenes (mixed)	238.4437	☐ NA	☐ NA					
1633		TSVI	1330-20-7	xylenes (mixed)	220.7812	☐ NA	☐ NA					
1649		TSVZ	1330-20-7	xylenes (mixed)	167.7937	☐ NA	☐ NA					
1637		TSVM	1330-20-7	xylenes (mixed)	66.23435	☐ NA	☐ NA					
1719		SV-286	1330-20-7	xylenes (mixed)	35.32499	☐ NA	☐ NA					
2020		SV-238	1330-20-7	xylenes (mixed)	30.90937	☐ NA	☐ NA					
1643		TSVS	1330-20-7	xylenes (mixed)	26.49374	☐ NA	☐ NA					
1636		TSVL	1330-20-7	xylenes (mixed)	13.24687	☐ NA	☐ NA					
1648		TSVY	1330-20-7	xylenes (mixed)	13.24687	☐ NA	☐ NA					
1635		TSVK	1330-20-7	xylenes (mixed)	8.831247	☐ NA	☐ NA					
1646		TSVV	1330-20-7	xylenes (mixed)	8.831247	☐ NA	☐ NA					
1756		SV-323	1330-20-7	xylenes (mixed)	8.831247	☐ NA	☐ NA					
1638		TSVN	1330-20-7	xylenes (mixed)	4.415624	☐ NA	☐ NA					
1644		TSVT	1330-20-7	xylenes (mixed)	4.415624	☐ NA	☐ NA					
1645		TSVU	1330-20-7	xylenes (mixed)	4.415624	☐ NA	☐ NA					
1830		SV-53	1330-20-7	xylenes (mixed)	4.415624	☐ NA	☐ NA					
1935		SV-158	1330-20-7	xylenes (mixed)	4.415624	☐ NA	☐ NA					
907		SV-286	108-90-7	chlorobenzene	4.681445	☐ 3.7E+3	☐ 2.2E+2					
4862		SV-238	110-54-3	hexane	68.09993	☐ 1.3E+4	☐ 7.9E+2					
4467		TSVA	110-54-3	hexane	43.01048	☐ 1.3E+4	☐ 7.9E+2					
4489		TSVX	110-54-3	hexane	21.50524	☐ 1.3E+4	☐ 7.9E+2					
4777		SV-158	110-54-3	hexane	21.50524	☐ 1.3E+4	☐ 7.9E+2					
4804		SV-184	110-54-3	hexane	14.33683	☐ 1.3E+4	☐ 7.9E+2					
4773		SV-154	110-54-3	hexane	7.168413	☐ 1.3E+4	☐ 7.9E+2					
4863		SV-239	110-54-3	hexane	7.168413	☐ 1.3E+4	☐ 7.9E+2					
4589		SV-314	110-54-3	hexane	3.584207	☐ 1.3E+4	☐ 7.9E+2					
						☐	☐					

Notes (where applicable):

Indicators in the screening level comparison table include NA (not applicable), [blank] (not calculated).

ANALYTICAL SUMMARY - GROUNDWATER CONCENTRATIONS 5.3

Site Name: Westgate Subdivision
Site Location: Hobbs, NM

Completed By: G. E. DeVaull
Revision Date: 16 Aug 1999

Tabulate all available chemical analysis results from site groundwater (and surface water) samples. Each line corresponds to a specific sample and chemical constituent. Non-detects may be omitted from this list if an analyte list is included (in an appendix) for the cited analysis methods.
Notes, if needed, are added at the end of this table and are indexed to samples using the "note index no." column.
For each detected chemical in groundwater or surface water, include a summary section in this table of the maximum detected chemical concentrations, with "max" indicated in the "note index no." column.

note index no.	line index no.	location description	sample type	field sample ID	hydro. unit, sampling unit	sampling depth (ft)	sample interval (ft)	field sampling date	analysis ID code	analysis date	analytical method number	Chemical Abstracts Service No. (CASRN)	chemical name	detection limit (mg/L)	QA/ QC code	measured chemical concen-tration (mg/L)
	1			GMW-1	LNAPL				119134		S-8260B	100-41-4	Ethylbenzene			0.11
	85			GMW-5	LNAPL				119137		S-8260B	100-41-4	Ethylbenzene			0.07
	43			GMW-3B	LNAPL				119136		S-8260B	100-41-4	Ethylbenzene			0.06
	169			GMW-9	SHEEN				118889		S-8260B	100-41-4	Ethylbenzene			0.012
	316			TMW-5					119967		S-8260B	100-41-4	Ethylbenzene			0.0025
	295			TMW-4					118892		S-8260B	100-41-4	Ethylbenzene			0.0015
	45			GMW-3B	LNAPL				119136		S-8260B	95-47-6	o-xylene			0.106
	3			GMW-1	LNAPL				119134		S-8260B	95-47-6	o-xylene			0.1
	87			GMW-5	LNAPL				119137		S-8260B	95-47-6	o-xylene			0.099
	171			GMW-9	SHEEN				118889		S-8260B	95-47-6	o-xylene			0.011
	87			GMW-5	LNAPL				119137		S-8260B	1330-20-7	xylenes (mixed)			0.599
	46			GMW-3B	LNAPL				119136		S-8260B	1330-20-7	xylenes (mixed)			0.586
	4			GMW-1	LNAPL				119134		S-8260B	1330-20-7	xylenes (mixed)			0.53
	172			GMW-9	SHEEN				118889		S-8260B	1330-20-7	xylenes (mixed)			0.04
	296			TMW-4					118892		S-8260B	1330-20-7	xylenes (mixed)			0.0046
	317			TMW-5					119967		S-8260B	1330-20-7	xylenes (mixed)			0.0023
	149			GMW-8					118939		S-8260B	1330-20-7	xylenes (mixed)			0.0019
	88			GMW-5	LNAPL				119137		8270C	86-73-7	Fluorene			0.011
	90			GMW-5	LNAPL				119137		8270C	91-20-3	Naphthalene			0.071
	6			GMW-1	LNAPL				119134		8270C	91-20-3	Naphthalene			0.024
	174			GMW-9	SHEEN				118889		8270C	91-20-3	Naphthalene			0.002
	89			GMW-5	LNAPL				119137		8270C	85-01-8	Phenanthrene			0.022
	5			GMW-1	LNAPL				119134		8270C	85-01-8	Phenanthrene			0.004
	47			GMW-3B	LNAPL				119136		8270C	85-01-8	Phenanthrene			0.003
	313			TMW-4					118892		418.1	TPH-ss	TRPHC			6.08
	334			TMW-5					119967		418.1	TPH-ss	TRPHC			0.82
	315			TMW-4					118892		901.1M (pCi/L)	pCi	Total Activity			6.57

note index no.	line index no.	location description	sample type	field sample ID	hydro. unit, sampling unit	sampling depth (ft)	sample interval (ft)	field sampling date	analysis ID code	analysis date	analytical method number	Chemical Abstracts Service No. (CASRN)	chemical name	detection limit (mg/L)	QA/ QC code	measured chemical concen-tration (mg/L)
(continued)																
	336			TMW-5					119967		901.1M (pCi/L)	pCi	Total Activity			1.95
	332			TMW-5					119967		160.1	TDS	TDS			1100
	311			TMW-4					118892		160.1	TDS	TDS			850
	227			GMW-11					118337		160.1	TDS	TDS			530
	309			TMW-4					118892		300	16887-00-6	Chloride			190
	330			TMW-5					119967		300	16887-00-6	Chloride			180
	225			GMW-11					118337		300	16887-00-6	Chloride			120
	307			TMW-4					118892		300	16984-48-8	Fluoride			2.4
	223			GMW-11					118337		300	16984-48-8	Fluoride			2.4
	328			TMW-5					119967		300	16984-48-8	Fluoride			2.1
	224			GMW-11					118337		300	7697-37-2	Nitrate			5.1
	329			TMW-5					119967		300	7697-37-2	Nitrate			4.5
	308			TMW-4					118892		300	7697-37-2	Nitrate			3.7
	331			TMW-5					119967		300	14808-79-8	Sulfate			170
	226			GMW-11					118337		300	14808-79-8	Sulfate			92
	310			TMW-4					118892		300	14808-79-8	Sulfate			85
	228			GMW-11					118337		150.1 (s.u.)	pH	pH			7.5
	312			TMW-4					118892		150.1 (s.u.)	pH	pH			7.3
	333			TMW-5					119967		150.1 (s.u.)	pH	pH			7
	7		max	GMW-1	LNAPL				119134		6010B	7440-39-3	Barium			0.3
	242		max	TMW-1					118936		6010B	7440-42-8	Boron			0.62
	9		max	GMW-1	LNAPL				119134		6010B	7439-89-6	Iron			0.29
	10			GMW-1	LNAPL				119134		6010B	7439-96-5	Manganese			0.34
	325			TMW-5					119967		6010B	7439-96-5	Manganese			0.19
	157			GMW-8					118939		6010B	7439-96-5	Manganese			0.1
	12			GMW-1	LNAPL				119134		6010B	7440-02-0	Nickel			0.25
	281			TMW-3					118888		7471A	7439-97-6	Total Mercury			0.00042

Notes (where applicable):

All detected chemicals are included in the above table.

A complete analyte list is included in the *analytical data report.*

m- an p- xylenes screened point-by-point summed as xylenes (mixed) m-, p-, and o-.

maximum value tabulated for barium, boron, iron.

ANALYTICAL DATA to RBSL COMPARISONS - GROUND WATER CONCENTRATIONS 5.4

Site Name: Westgate Subdivision
Site Location: Hobbs, NM

Completed By: G. E. DeVaull
Revision Date: 16 Aug 1999; March 6, 2000

This table is a comparison of chemical analysis results to screening level concentrations.
The line index no. is identical to that in the first half of this table.

Screening Level Criteria Descriptions:
(residential exposure, minimum of HQ = 1, Risk = 1E-6, or Federal MCL):
1) groundwater ingestion, residential exposure - RBCA
2) Federal Maximum Contaminant Level (MCL) drinking water standards
3) volatilization from groundwater to ambient (outdoor) air, residential exposure - RBCA
4) volatilization from groundwater to indoor air, residential exposure - RBCA
5) tap water - Region VI
6) 20 NMAC 6.2 3-103 drinking water standards

8 33 10 9 26 29

note: ***Values other than 20 NMAC 6.2 2-103 drinking water standards are for comparion purposes only.***
Exceedences are noted by a filled box (■).

line index no.	location description	field sample ID	Chemical Abstracts Service No. (CASRN)	chemical name	measured chemical concen-tration (mg/L)	1) water ingestion (mg/L)	2) MCL (mg/L)	3) gw volatil-ization outdoor (mg/L)	4) gw volatil-ization indoor (mg/L)	5) tap water (mg/L)	6) 20 NMAC (mg/L)	other (mg/L)
1		GMW-1	100-41-4	Ethylbenzene	0.11	☐ 7.0E-1	☐ NA	☐ NA	☐ 7.7E+1	☐ 1.1E+3	☐ 7.5E-1	☐
85		GMW-5	100-41-4	Ethylbenzene	0.07	☐ 7.0E-1	☐ NA	☐ NA	☐ 7.7E+1	☐ 1.1E+3	☐ 7.5E-1	☐
43		GMW-3B	100-41-4	Ethylbenzene	0.06	☐ 7.0E-1	☐ NA	☐ NA	☐ 7.7E+1	☐ 1.1E+3	☐ 7.5E-1	☐
169		GMW-9	100-41-4	Ethylbenzene	0.012	☐ 7.0E-1	☐ NA	☐ NA	☐ 7.7E+1	☐ 1.1E+3	☐ 7.5E-1	☐
316		TMW-5	100-41-4	Ethylbenzene	0.0025	☐ 7.0E-1	☐ NA	☐ NA	☐ 7.7E+1	☐ 1.1E+3	☐ 7.5E-1	☐
295		TMW-4	100-41-4	Ethylbenzene	0.0015	☐ 7.0E-1	☐ NA	☐ NA	☐ 7.7E+1	☐ 1.1E+3	☐ 7.5E-1	☐
45		GMW-3B	95-47-6	o-xylene	0.106	☐ 1.0E+1	☐ NA	☐ NA	☐ NA	☐ 7.3E+2	☐	☐
3		GMW-1	95-47-6	o-xylene	0.1	☐ 1.0E+1	☐ NA	☐ NA	☐ NA	☐ 7.3E+2	☐	☐
87		GMW-5	95-47-6	o-xylene	0.099	☐ 1.0E+1	☐ NA	☐ NA	☐ NA	☐ 7.3E+2	☐	☐
171		GMW-9	95-47-6	o-xylene	0.011	☐ 1.0E+1	☐ NA	☐ NA	☐ NA	☐ 7.3E+2	☐	☐
87		GMW-5	1330-20-7	xylenes (mixed)	0.599	☐ 1.0E+1	☐ NA	☐ NA	☐ NA	☐	☐ 6.2E-1	☐
46		GMW-3B	1330-20-7	xylenes (mixed)	0.586	☐ 1.0E+1	☐ NA	☐ NA	☐ NA	☐	☐ 6.2E-1	☐
4		GMW-1	1330-20-7	xylenes (mixed)	0.53	☐ 1.0E+1	☐ NA	☐ NA	☐ NA	☐	☐ 6.2E-1	☐
172		GMW-9	1330-20-7	xylenes (mixed)	0.04	☐ 1.0E+1	☐ NA	☐ NA	☐ NA	☐	☐ 6.2E-1	☐
296		TMW-4	1330-20-7	xylenes (mixed)	0.0046	☐ 1.0E+1	☐ NA	☐ NA	☐ NA	☐	☐ 6.2E-1	☐
317		TMW-5	1330-20-7	xylenes (mixed)	0.0023	☐ 1.0E+1	☐ NA	☐ NA	☐ NA	☐	☐ 6.2E-1	☐
149		GMW-8	1330-20-7	xylenes (mixed)	0.0019	☐ 1.0E+1	☐ NA	☐ NA	☐ NA	☐	☐ 6.2E-1	☐
						☐	☐	☐	☐	☐	☐	☐
88		GMW-5	86-73-7	Fluorene	0.011	☐ 1.5E+0	☐ NA	☐ NA	☐ NA	☐ 1.5E+2	☐	☐
90		GMW-5	91-20-3	Naphthalene	0.071	☐ 7.3E-1	☐ NA	☐ NA	☐ 2.6E+0	☐ 3.1E+0	■ 3.0E-2	☐
6		GMW-1	91-20-3	Naphthalene	0.024	☐ 7.3E-1	☐ NA	☐ NA	☐ 2.6E+0	☐ 3.1E+0	☐ 3.0E-2	☐
174		GMW-9	91-20-3	Naphthalene	0.002	☐ 7.3E-1	☐ NA	☐ NA	☐ 2.6E+0	☐ 3.1E+0	☐ 3.0E-2	☐
89		GMW-5	85-01-8	Phenanthrene	0.022	☐ NA	☐ NA	☐ NA	☐ NA	☐	☐	☐
5		GMW-1	85-01-8	Phenanthrene	0.004	☐ NA	☐ NA	☐ NA	☐ NA	☐	☐	☐
47		GMW-3B	85-01-8	Phenanthrene	0.003	☐ NA	☐ NA	☐ NA	☐ NA	☐	☐	☐
						☐	☐	☐	☐	☐	☐	☐
313		TMW-4	TPH-ss	TRPHC	6.08	☐	☐	☐	☐	☐	☐	☐
334		TMW-5	TPH-ss	TRPHC	0.82	☐	☐	☐	☐	☐	☐	☐
315		TMW-4	pCi	Total Activity	6.57	☐	☐	☐	☐	☐	☐ 3.0E+1	☐

note: ***Values other than 20 NMAC 6.2 2-103 drinking water standards are for comparion purposes only*.**
Exceedences are noted by a filled box (■).

line index no.	location description	field sample ID	Chemical Abstracts Service No. (CASRN)	chemical name	measured chemical concen-tration (mg/L)	1) water ingestion (mg/L)	2) MCL (mg/L)	3) gw volatil-ization outdoor (mg/L)	4) gw volatil-ization indoor (mg/L)	5) tap water (mg/L)	6) 20 NMAC (mg/L)	other (mg/L)
(continued)												
336		TMW-5	pCi	Total Activity	1.95	☐	☐	☐	☐	☐	☐ 3.0E+1	☐
332		TMW-5	TDS	TDS	1100	☐	☐	☐	☐	☐	■ 1.0E+3	☐
311		TMW-4	TDS	TDS	850	☐	☐	☐	☐	☐	☐ 1.0E+3	☐
227		GMW-11	TDS	TDS	530	☐	☐	☐	☐	☐	☐ 1.0E+3	☐
309		TMW-4	16887-00-6	Chloride	190	☐	☐	☐	☐	☐	☐ 2.5E+2	☐
330		TMW-5	16887-00-6	Chloride	180	☐	☐	☐	☐	☐	☐ 2.5E+2	☐
225		GMW-11	16887-00-6	Chloride	120	☐	☐	☐	☐	☐	☐ 2.5E+2	☐
307		TMW-4	16984-48-8	Fluoride	2.4	☐	☐	☐	☐	☐	■ 1.6E+0	☐
223		GMW-11	16984-48-8	Fluoride	2.4	☐	☐	☐	☐	☐	■ 1.6E+0	☐
328		TMW-5	16984-48-8	Fluoride	2.1	☐	☐	☐	☐	☐	■ 1.6E+0	☐
224		GMW-11	7697-37-2	Nitrate	5.1	☐	☐	☐	☐	☐	☐ 1.0E+1	☐
329		TMW-5	7697-37-2	Nitrate	4.5	☐	☐	☐	☐	☐	☐ 1.0E+1	☐
308		TMW-4	7697-37-2	Nitrate	3.7	☐	☐	☐	☐	☐	☐ 1.0E+1	☐
331		TMW-5	14808-79-8	Sulfate	170	☐	☐	☐	☐	☐	☐ 6.0E+2	☐
226		GMW-11	14808-79-8	Sulfate	92	☐	☐	☐	☐	☐	☐ 6.0E+2	☐
310		TMW-4	14808-79-8	Sulfate	85	☐	☐	☐	☐	☐	☐ 6.0E+2	☐
228		GMW-11	pH	pH	7.5	☐	☐	☐	☐	☐	☐	☐
312		TMW-4	pH	pH	7.3	☐	☐	☐	☐	☐	☐	☐
333		TMW-5	pH	pH	7	☐	☐	☐	☐	☐	☐	☐
7		GMW-1	7440-39-3	Barium	0.3	☐ 2.0E+0	☐ NA	☐ NA	☐ NA	☐ 5.2E-1	☐ 1.0E+0	☐
242		TMW-1	7440-42-8	Boron	0.62	☐ 3.3E+0	☐ NA	☐ NA	☐ NA	☐ 2.1E+1	☐ 7.5E-1	☐
9		GMW-1	7439-89-6	Iron	0.29	☐	☐	☐	☐	☐	☐ 1.0E+0	☐
10		GMW-1	7439-96-5	Manganese	0.34	☐	☐	☐	☐	■ 5.1E-2	■ 2.0E-1	☐
325		TMW-5	7439-96-5	Manganese	0.19	☐	☐	☐	☐	■ 5.1E-2	☐ 2.0E-1	☐
157		GMW-8	7439-96-5	Manganese	0.1	☐	☐	☐	☐	■ 5.1E-2	☐ 2.0E-1	☐
12		GMW-1	7440-02-0	Nickel	0.25	■ 1.0E-1	☐ NA	☐ NA	☐ NA	☐	■ 2.0E-1	☐
281		TMW-3	7439-97-6	Total Mercury	0.00042	☐ 2.0E-3	☐ NA	☐ 5.9E+0	☐ 3.7E-2	☐ 3.1E-1	☐ 2.0E-3	☐

Notes (where applicable):

Indicators in the screening level comparison table include NA (not applicable) because of: insufficient vapor pressure to be of concern for this exposure pathway;

Insufficient solubility to be of concern for this exposure pathway; or no concern with chemical present at concentrations above residual level for this exposure pathway.

CRITERIA (1) to (5) are for purpose of comparison only. 20 NMAC 6.2 3-103 values in (6) are the APPLICABLE STANDARD.

ANALYTICAL SUMMARY - SOIL CONCENTRATIONS

Site Name: Westgate Subdivision
Site Location: Hobbs, NM

Completed by: G. E. DeVault
Revision Date: 16 Aug 1999

Detected chemical analysis results from site soil samples are tabulated. Each line corresponds to a specific sample and co-located TDS and pH measurement.
Notes, if needed, are added at the end of this table and are indexed to samples using the "note index no." column.

Measured values are compared to nominal soil pH (6 < pH < 8) and electrical conductivity (EC < 4 mmhos/cm) ranges from API (1997). Electrical conductivity is based on a correllation with TDS from Deuel and Holliday (1994).

											Out of range values are noted by a filled box (■).	
note index no.	line index no.	location description	sample type	field sample ID	sampling depth (ft)	sample interval (ft)	analysis ID code	measured pH (s.u.)	measured TDS concen-tration (mg/kg)	derived electrical conductivity (mmhos/cm)	1) EC > 4	2) pH < 8 pH > 6
A	1041		soil	TSB-8 3-5'	3	5	107006	9.4	10000	16.3	■ high EC	■ high pH
A	1069		soil	TSB-8D 3-5'	3	5	107007	7.8	9600	15.7	■ high EC	☐
A	425		soil	TSB-1 2-3'	2	3	105955	8.1	6900	11.3	■ high EC	■ high pH
A	3230		soil	GBN-3 6"	0.5		117628	5.6	6200	10.1	■ high EC	■ low pH
A	1013		soil	TSB-8 2-3'	2	3	19350	9.5	4000	6.5	■ high EC	■ high pH
A	2810		soil	GMW-6 3-5'	3	5	104532	8.7	3900	6.4	■ high EC	■ high pH
A	1097		soil	TSB-8 8-10'	8	10	107008	8.6	3200	5.2	■ high EC	■ high pH
A	1265		soil	TSB-10 3-5'	3	5	106030	9.4	3000	4.9	■ high EC	■ high pH
A	1453		soil	TMW-1 2-3'	2	3	105742	10	2700	4.4	■ high EC	■ high pH
A	1901		soil	GSB-4 2-3'	2	3	107002	8	2700	4.4	■ high EC	☐
A	1293		soil	TSB-10 8-10'	8	10	106031	9	2500	4.1	■ high EC	■ high pH
A	2558		soil	GMW-2 13-15'	13	15	103766	8.3	2500	4.1	■ high EC	■ high pH
A	957		soil	TSB-7 3-5'	3	5	106037	9.1	2100	3.4	☐	■ high pH
A	1237		soil	TSB-10 2-3'	2	3	106029	8.8	2100	3.4	☐	■ high pH
A	985		soil	TSB-7 8-10'	8	10	106038	8.9	1800	2.9	☐	■ high pH
A	2097		soil	GSB-10 2-3'	2	3	106789	8.2	1600	2.6	☐	■ high pH
A	537		soil	TSB-2 3-5'	3	5	105959	8.2	1500	2.4	☐	■ high pH
A	509		soil	TSB-2 2-3'	2	3	105958	8.2	1400	2.3	☐	■ high pH
A	761		soil	TSB-5 2-3'	2	3	106094	8.1	1400	2.3	☐	■ high pH
A	3174		soil	GBN-1 6"	0.5		117626	7.6	1300	2.1	☐	☐
A	3202		soil	GBN-2 6"	0.5		117627	7.8	1300	2.1	☐	☐
A	1985		soil	GSB-7 2-3'	2	3	106259	8	1200	2.0	☐	☐
A	789		soil	TSB-5 3-5'	3	5	106095	8.2	1100	1.8	☐	■ high pH
A	1873		soil	GSB-3 2-3'	2	3	107012	8.3	1100	1.8	☐	■ high pH
A	929		soil	TSB-7 2-3'	2	3	106036	9.3	1000	1.6	☐	■ high pH
A	1125		soil	TSB-8 40-42'	40	42	107009	8.4	1000	1.6	☐	■ high pH
A	3062		soil	GMW-10 3-5'	3	5	106342	7.9	900	1.5	☐	☐
A	1845		soil	GSB-2 5-6'	5	6	105224	8.6	880	1.4	☐	■ high pH
A	2978		soil	GMW-9 8-10'	8	10	106457	8.1	880	1.4	☐	■ high pH
A	2041		soil	GSB-8 2-3'	2	3	107016	8.5	870	1.4	☐	■ high pH
A	1209		soil	TSB-9 18-20'	18	20	106099	8.4	850	1.4	☐	■ high pH
A	2461		soil	CSS #6			103645	7.9	850	1.4	☐	☐
A	481		soil	TSB-1 8-10'	8	10	105957	8.6	830	1.4	☐	■ high pH
A	2433		soil	GSB-17 38-40'	38	40	118542	8.9	760	1.2	☐	■ high pH
A	817		soil	TSB-5 18-20'	18	20	106096	8.5	710	1.2	☐	■ high pH
A	593		soil	TSB-3 2-3'	2	3	106196	7.7	630	1.0	☐	☐
A	677		soil	TSB-4 2-3'	2	3	106091	8.2	620	1.0	☐	■ high pH
A	705		soil	TSB-4 3-5'	3	5	106092	8.3	570	0.9	☐	■ high pH
A	2614		soil	GMW-2 62-64'D	62	64	103764	8.7	570	0.9	☐	■ high pH
A	3118		soil	GMW-11 19-21'	19	21	118337	8.7	560	0.9	☐	■ high pH
A	649		soil	TSB-3 18-20'	18	20	106198	8.7	540	0.9	☐	■ high pH
A	2349		soil	GSB-16 3-5'	3	5	118543	8.3	540	0.9	☐	■ high pH
A	2922		soil	GMW-8 28-30'	28	30	104948	8.7	530	0.9	☐	■ high pH
A	873		soil	TSB-6 3-5'	3	5	106035	8.4	510	0.8	☐	■ high pH
A	1509		soil	TMW-1A 63-65'	63	65	105744	8.7	510	0.8	☐	■ high pH
A	1957		soil	GSB-6 2-3'	2	3	106828	8.7	510	0.8	☐	■ high pH
A	733		soil	TSB-4 18-20'	18	20	106093	8.5	500	0.8	☐	■ high pH
A	2013		soil	GSB-7 33-35'	33	35	106344	9	480	0.8	☐	■ high pH
A	1621		soil	TMW-3 3-5'	3	5	108239	8.4	470	0.8	☐	■ high pH
A	3090		soil	GMW-10 63-65'	63	65	106343	8.7	470	0.8	☐	■ high pH

											Out of range values are noted by a filled box (■).	
note index no.	line index no.	location description	sample type	field sample ID	sampling depth (ft)	sample interval (ft)	analysis ID code	measured pH (s.u.)	measured TDS concentration (mg/kg)	derived electrical conductivity (mmhos/cm)	1) EC > 4	2) pH < 8 pH > 6
(continued)												
A	1593		soil	TMW-3 2-3'	2	3	108238	8.2	460	0.8	☐	■ high pH
A	1181		soil	TSB-9 3-5'	3	5	106098	8.5	440	0.7	☐	■ high pH
A	845		soil	TSB-6 2-3'	2	3	106034	8.4	420	0.7	☐	■ high pH
A	621		soil	TSB-3 3-5'	3	5	106197	8.3	400	0.7	☐	■ high pH
A	1153		soil	TSB-9 2-3'	2	3	106097	8.4	400	0.7	☐	■ high pH
A	2069		soil	GSB-9 2-3'	2	3	106786	8.4	400	0.7	☐	■ high pH
A	2586		soil	GMW-2 58-60'	58	60	103765	8.6	400	0.7	☐	■ high pH
A	2125		soil	GSB-11 2-3'	2	3	107159	8.2	380	0.6	☐	■ high pH
A	2405		soil	GSB-17 3-5'	3	5	118541	8.6	360	0.6	☐	■ high pH
A	901		soil	TSB-6 18-20'	18	20	106033	8.5	350	0.6	☐	■ high pH
A	2642		soil	GMW-3 53-55'	53	55	104147	9.6	330	0.5	☐	■ high pH
A	1761		soil	TMW-5 48-50'	48	50	119858	8.8	310	0.5	☐	■ high pH
A	2670		soil	GMW-3 63-65'	63	65	104148	9	310	0.5	☐	■ high pH
A	565		soil	TSB-2 18-20'	18	20	105960	8.6	300	0.5	☐	■ high pH
A	1817		soil	GSB-1 2-3'	2	3	105071	8.5	300	0.5	☐	■ high pH
A	1789		soil	TMW-5 63-65'	63	65	119859	8.8	290	0.5	☐	■ high pH
A	1929		soil	GSB-5 2-3'	2	3	106262	8.5	290	0.5	☐	■ high pH
A	453		soil	TSB-1 3-5'	3	5	105956	8.4	280	0.5	☐	■ high pH
A	2754		soil	GMW-5 58-60'	58	60	104339	10.3	280	0.5	☐	■ high pH
A	2894		soil	GMW-7 63-65'	63	65	104634	8.9	280	0.5	☐	■ high pH
A	2782		soil	GMW-5 63-65'	63	65	104340	8.9	260	0.4	☐	■ high pH
A	3034		soil	GMW-9D 63-65'	63	65	106459	8.7	252	0.4	☐	■ high pH
A	2726		soil	GMW-4 63-65'	63	65	104100	8.8	240	0.4	☐	■ high pH
A	2838		soil	GMW-6 63-6	63	65	104533	8.5	220	0.4	☐	■ high pH
A	3146		soil	GMW-11 63-65'	63	65	118338	8.9	210	0.3	☐	■ high pH
A	1649		soil	TMW-3 23-25'	23	25	108240	8.6	200	0.3	☐	■ high pH
A	2866		soil	GMW-7 48-50'	48	50	104633	8.8	200	0.3	☐	■ high pH
A	2377		soil	GSB-16 38-40'	38	40	118544	9.2	190	0.3	☐	■ high pH
A	1481		soil	TMW-1 63-65'	63	65	105743	8.7	170	0.3	☐	■ high pH
A	1677		soil	TMW-3 63-65'	63	65	108241	9.2	170	0.3	☐	■ high pH
A	2950		soil	GMW-8 63-65'	63	65	104949	9.1	170	0.3	☐	■ high pH
A	2698		soil	GMW-4 18-20'	18	20	104099	8.7	160	0.3	☐	■ high pH
A	3006		soil	GMW-9 63-65'	63	65	106458	8.9	150	0.2	☐	■ high pH
A	1537		soil	TMW-2 53-55'	53	55	105614	9	140	0.2	☐	■ high pH
A	1565		soil	TMW-2 63-65'	63	65	105615	8.4	130	0.2	☐	■ high pH
A	1705		soil	TMW-4 40-42'	40	42	118283	9	120	0.2	☐	■ high pH
A	1733		soil	TMW-4 63-65'	63	65	118284	8.6	120	0.2	☐	■ high pH
											☐	☐
											☐	☐

Notes (where applicable):

pH measured using method E 150.1 (s.u.); Total dissolved solids (TDS) with method E 160.1

API, 1997, Environmental Guidance Document: Waste Management in Exploration and Production Operations, API E5, Second Edition, American Petroleum Institute, Exploration and Production Department, February.

Deuel, L. E., and G. H. Holliday, 1994: Soil Remediation for the Petroleum Extraction Industry, PennWell Books, Tulsa, OK.

ANALYTICAL SUMMARY - SOIL CONCENTRATIONS 5.1

Site Name: Westgate Subdivision
Site Location: Hobbs, NM

Completed by: G. E. DeVaull
Revision Date: 16 Aug 1999

refined analysis

All detected chemical analysis results from site soil samples are tabulated except as specifically noted at the end of the table. Each line corresponds to a specific sample and chemical constituent.

Notes, if needed, are added at the end of this table and are indexed to samples using the "note index no." column.

note index no.	line index no.	location description	sample type	field sample ID	sampling unit	sampling depth (ft)	sample interval (ft)	field sampling date	analysis ID code	analysis date	analytical method number	Chemical Abstracts Service No. (CASRN)	chemical name	detection limit (mg/kg)	QA/QC code	measured chemical concentration (mg/kg)
A	2497		soil	GMW-8 28-30'		28	30		104948		S-8260B	71-43-2	benzene			0.4
A	1358		soil	TMW-3 23-25'		23	25		108240		S-8260B	71-43-2	benzene			0.12
A	1334		soil	TMW-3 2-3'		2	3		108238		S-8260B	71-43-2	benzene			0.074
A	1346		soil	TMW-3 3-5'		3	5		108239		S-8260B	71-43-2	benzene			0.073
A	1370		soil	TMW-3 63-65'		63	65		108241		S-8260B	71-43-2	benzene			0.057
C	3595		soil	TSB-7 2-3 ft		2	3				EPA 8260	71-43-2	benzene			0.02
C	3611		soil	TSB-8 2-3 ft		2	3				EPA 8260	71-43-2	benzene			0.0098
D	6	GSB-10 (BP)	soil								TX1006	GSB-10 (BP)	GSB-10 (BP) (2-3') T118813			6257

Notes (where applicable):

This table is limited to chemicals and samples showing exceedence of screening-level values for potential indoor air exposure.
Non-detects are omitted from the list.
A complete analyte list is included in the site analytical data report.
m- & p-xylenes are screened as part of mixed xylenes (m-, p-, and o- isomers) and are not listed separately above.
Analysis results for phenols using method SM 5530 A,D are not included in the above list; no phenol was detected using GC/MS analysis methods.
maximum measured values only are listed for toluene, ethylbenzene, xylenes (mixed isomers), o-xylene, pyrene, phenanthrene, fluorene, naphthalene, and 1- and 2-methylnapthalene.
A. From Stage 1 Abatement Plan Report, July 1999, Table 2. Soil Analytical Results
C. A. D. Little Analysis of Soil Samples by GC/FID, GC/MS, Feb. 17, 1999, Henry Camp.
D. Soil Analyses for TPH by Trace Analysis, Inc. using TX1006 aromatic/aliphatic seperation with boiling-point cut analysis (23 Feb 1999).

ANALYTICAL DATA to RBSL COMPARISONS - SOIL CONCENTRATIONS 5.2

Site Name: Westgate Subdivision
Site Location: Hobbs, NM

Completed By: G. E. DeVaull
Revision Date: 16 Aug 1999

refined analysis

This table is a comparison of chemical analysis results to screening level concentrations.
The line index number is identical to that in the first half of this table.

Screening Level Criteria Descriptions
(residential exposure, minimum of HQ = 1 or Risk = 1E-6):
1) direct soil exposure, ingestion, dermal contact, dust & vapor inhalation - RBCA
2) volatilization from subsurface soil to ambient (outdoor) air - RBCA - with mass limit
3) volatilization from subsurface soil to indoor air - RBCA - with mass limit
4) subsurface soil vapor to indoor air - with lower limit (underprediction) of biodegradation
5) subsurface soil vapor to indoor air - with average rate of biodegradation

6) tabulation of co-located TPH measurement

3 5 4

Screening Level comparison against site analytical data.
Exceedences are noted by a filled box (■).

line index *no.*	location description	field sample ID	Chemical Abstracts Service No. (CASRN)	chemical name	measured chemical concen-tration (mg/kg)	1) surficial soil, direct exposure (mg/kg)	2) soil volatil-ization outdoor (mg/kg)	3) soil volatil-ization indoor (mg/kg)	4) soil volatil-ization indoor	5) soil volatil-ization indoor		6) co-located TPH measure (mg/kg)
2497		GMW-8 28-30'	71-43-2	benzene	0.4	☐ 3.8E+0	☐ 8.2E+0	■ 3.0E-2	■ 1.7E-1	☐ 5.4E-1	☐	
1358		TMW-3 23-25'	71-43-2	benzene	0.12	☐ 3.8E+0	☐ 8.2E+0	■ 3.0E-2	☐ 1.7E-1	☐ 5.4E-1	☐	3574
1334		TMW-3 2-3'	71-43-2	benzene	0.074	☐ 3.8E+0	☐ 8.2E+0	■ 3.0E-2	☐ 1.7E-1	☐ 5.4E-1	☐	1460
1346		TMW-3 3-5'	71-43-2	benzene	0.073	☐ 3.8E+0	☐ 8.2E+0	■ 3.0E-2	☐ 1.7E-1	☐ 5.4E-1	☐	2986
1370		TMW-3 63-65'	71-43-2	benzene	0.057	☐ 3.8E+0	☐ 8.2E+0	■ 3.0E-2	☐ 1.7E-1	☐ 5.4E-1	☐	
3595		TSB-7 2-3 ft	71-43-2	benzene	0.02	☐ 3.8E+0	☐ 8.2E+0	☐ 3.0E-2	☐ 1.7E-1	☐ 5.4E-1	☐	57000
3611		TSB-8 2-3 ft	71-43-2	benzene	0.0098	☐ 3.8E+0	☐ 8.2E+0	☐ 3.0E-2	☐ 1.7E-1	☐ 5.4E-1	☐	32000
						☐	☐	☐	☐	☐	☐	
6	GSB-10 (BP		GSB-10 (BP)	GSB-10 (BP) (2-3') T118813	6257	☐ 6.7E+3	☐ NA	☐ NA	☐	☐	☐	
						☐	☐	☐	☐	☐	☐	
						☐	☐	☐	☐	☐	☐	

Notes (where applicable):
Indicators in the screening level comparison table include NA (not applicable), [blank] (not calculated).
RBCA -based screening levels based on ASTM PS104-98 with default exposure parameters, USEPA toxicity parameters, and representative physical parameters.
TPH -based screening levels are based on GRI (1999): Risk-Based Corrective Action Tools for E&P Facilities, review draft.
The refined screening level values (2 and 3) are based on a specified layer of impacted soil of 2 meters. This imposes a mass-limit on the amount of chemical in soil.
The refined screening level values (4 and 5) include aerobic biodegradation in the estimate.

ANALYTICAL SUMMARY - SOIL VAPOR CONCENTRATIONS

5.1a

Site Name: Westgate Subdivision
Site Location: Hobbs, NM

Completed by: G. E. DeVaull
Revision Date: 16 Aug 1999

refined analysis

All detected chemical analysis results from site soil samples are tabulated. Each line corresponds to a specific sample and chemical constituent.

Notes, if needed, are added at the end of this table and are indexed to samples using the "note index no." column.

note index no.	line index no.	location description	sample type	field sample ID	sampling unit	sampling depth (ft)	sample interval (ft)	field sampling date	analysis ID code	analysis date	analytical method number	Chemical Abstracts Service No. (CASRN)	chemical name	detection limit (mg/m3)	QA/ QC code	measured chemical concen- tration (mg/m3)
	23			TSVX		3		36027.4	60		8021	71-43-2	benzene			35.73719
	9			TSVI		7		36024.4	60		8021	71-43-2	benzene			19.49301
	25			TSVZ		5		36026.7	60		8021	71-43-2	benzene			12.99534
	311			SV-158		5		36017.4	60		8021	71-43-2	benzene			12.99534
	192			SV-39		5		36004.6	60		8021	71-43-2	benzene			3.248836
	396			SV-238		5		36004.7	60		8021	71-43-2	benzene			3.248836

Notes (where applicable):

This table is limited to chemicals and samples showing exceedence of screening-level values for potential indoor air exposure.

ANALYTICAL DATA to RBSL COMPARISONS - SOIL VAPOR CONCENTRATIONS 5.2a

Site Name: Westgate Subdivision
Site Location: Hobbs, NM

Completed By: G. E. DeVaull
Revision Date: 16 Aug 1999

refined analysis

This table is a comparison of chemical analysis results to screening level concentrations.
The line index number is identical to that in the first half of this table.

Screening Level Criteria Descriptions
(residential exposure, minimum of HQ = 1 or Risk = 1E-6):
1) migration of subsurface soil vapor to ambient (outdoor) air - RBCA - with mass limit
2) migration of subsurface soil vapor to indoor air - RBCA - with mass limit
3) migration of subsurface soil vapor to indoor air - RBCA - with lower limit (underprediction) of biodegradation
4) migration of subsurface soil vapor to indoor air - RBCA - with average estimate of biodegradation

21 20

line index no.	location description	field sample ID	Chemical Abstracts Service No. (CASRN)	chemical name	measured chemical concen-tration (mg/m3)	Screening Level comparison against site analytical data. Exceedences are noted by a filled box (■). 1) soil volatil-ization outdoor (mg/m3)	2) soil volatil-ization indoor (mg/m3)	3) soil volatil-ization indoor (mg/m3)	4) soil volatil-ization indoor (mg/m3)			
23		TSVX	71-43-2	benzene	35.73719	☐ 2.7E+3	■ 1.0E+1	☐ 5.7E+1	☐ 1.8E+2			
9		TSVI	71-43-2	benzene	19.49301	☐ 2.7E+3	■ 1.0E+1	☐ 5.7E+1	☐ 1.8E+2			
25		TSVZ	71-43-2	benzene	12.99534	☐ 2.7E+3	■ 1.0E+1	☐ 5.7E+1	☐ 1.8E+2			
311		SV-158	71-43-2	benzene	12.99534	☐ 2.7E+3	■ 1.0E+1	☐ 5.7E+1	☐ 1.8E+2			
192		SV-39	71-43-2	benzene	3.248836	☐ 2.7E+3	☐ 1.0E+1	☐ 5.7E+1	☐ 1.8E+2			
396		SV-238	71-43-2	benzene	3.248836	☐ 2.7E+3	☐ 1.0E+1	☐ 5.7E+1	☐ 1.8E+2			
						☐	☐	☐	☐			

Notes (where applicable):
Indicators in the screening level comparison table include NA (not applicable), [blank] (not calculated).
The refined screening level values (1 and 2) are based on a specified layer of impacted soil of 2 meters. This imposes a mass-limit on the amount of chemical in soil.
The refined screening level values (3 and 4) include aerobic biodegradation in the estimate.

Health And Safety Plan
For The
Westgate Subdivision Remediation Project
Hobbs, New Mexico

Prepared for:
Shell Exploration and Production Company
Houston, Texas

Date Issued:
May 5, 2000

ACRONYMS

ACGIH	American Conference of Governmental Industrial Hygienists
AHA	Activity Hazard Analysis
CFR	Code of Federal Regulations
CGI	Combustible Gas Indicator
CIH	Certified Industrial Hygienist
CPR	Cardiopulmonary Resuscitation
CRZ	Contamination Reduction Zone
CSP	Certified Safety Professional
dBA	Decibels
DOT	Department of Transportation
EPA	Environmental Protection Agency
EZ	Exclusion Zone
GFCI	Ground-Fault Circuit Interrupter
HASP	Health and Safety Plan
HSE	Health, Safety, and Environment
LEL	Lower Explosive Limit
MSDS	Material Safety Data Sheet
NEC	National Electrical Code
NFPA	National Fire Protection Association
NIOSH	National Institute for Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
OVM	Organic Vapor Meter
PID	Photoionization Detector
PD	Project Director
PPE	Personal Protective Equipment
ppm	Parts per Million
RCRA	Resource Conservation and Recovery Act
SLM	Sound Level Meter
SSS	Site Safety Supervisor
SVOC	Semi-volatile Organic Compound
SZ	Support Zone
TLV	Threshold Limit Value
TSCA	Toxic Substances Control Act
USCG	U.S. Coast Guard
VOC	Volatile Organic Compound

1.0 INTRODUCTION

1.1 SITE LOCATION

The Westgate Subdivision is located in Hobbs, New Mexico. The site is shown in Figure 1-1. The site includes the Grimes Tank Battery & Tasker Road. Some soils in the vicinity of the Grimes Tank Battery are contaminated with crude oil and Shell Exploration and Production Company (Shell) will be conducting a soil remediation project to address this contamination.

1.2 PROJECT DESCRIPTION

The work will be performed in two phases, a short investigation phase and a longer remediation phase. The first phase will consist of the remedial investigation. During this phase, a series of baseline ambient air quality measurements will be made. The baseline air quality measurements will be used to establish baseline ambient air quality for both the Westgate Subdivision and the community at large prior to the commencement of remediation activities. Also during this phase, a pilot excavation will be performed at two locations in the West Tasker pit area and at one location in the East Tasker pit area. The three excavations will be approximately six feet deep and three to five feet in width and length. At two depths within each excavation pit, the surface flux of organic compounds will be measured. This data will be used in the design of effective odor control and vapor and particulate matter mitigation strategies to be implemented, if necessary, once the soil remediation begins.

The second phase will consist of the soils remediation and excavation. The public health and safety will be protected by: a) enclosing the excavation with a rigid framed fabric structure, b) air treatment equipment and c) perimeter site air monitoring. The excavation is expected to involve an area of roughly 300 feet by 80 feet on both West and East Tasker including the street portion. The approximate depth of excavation will be 10 feet. The work will be performed in stages, using a rigid fabric structure enclosure to cover the excavation area to minimize emissions of dust and the migration of volatilized organic compounds into the surrounding community. The size of the structure will be 70 feet wide by 115 feet long by 35.5 feet high. The structure will be operated under negative pressure. Air from the structure will be withdrawn from at least two air intake vents, passed through an activated carbon bed, and released to the atmosphere. Water sprays will be used, as necessary, inside the structure for dust control. At each excavation area, the exposed materials will be sampled and the contamination levels compared with established action levels. Contaminated material may be transported to an off-site location for disposal. The excavation pit will be backfilled prior to moving the structure to the next stage.

1.3 CONTAMINANTS OF CONCERN

The contamination at the area is thought, based upon prior detailed investigations, to be limited to crude oil. During the first phase of work, measurements will be made for a wide variety of chemical compounds to establish which contaminants should be addressed during the second phase. The chemical species to be measured were selected because they are known or suspected hazardous air pollutants or are non-hazardous surrogate chemicals that are associated with industrial emissions, oil field emissions, automotive emissions, and industrial chemicals and solvents. These chemicals are of particular concern because they may present a potential community exposure concern or nuisance odor. The specific classes of contaminants to be measured during the first phase (remedial investigation) include volatile organic compounds (VOCs), Semi-volatile organic compounds (SVOCs), particulate matter (PM), metals, hydrogen sulfide (H_2S), and mercury (Hg).

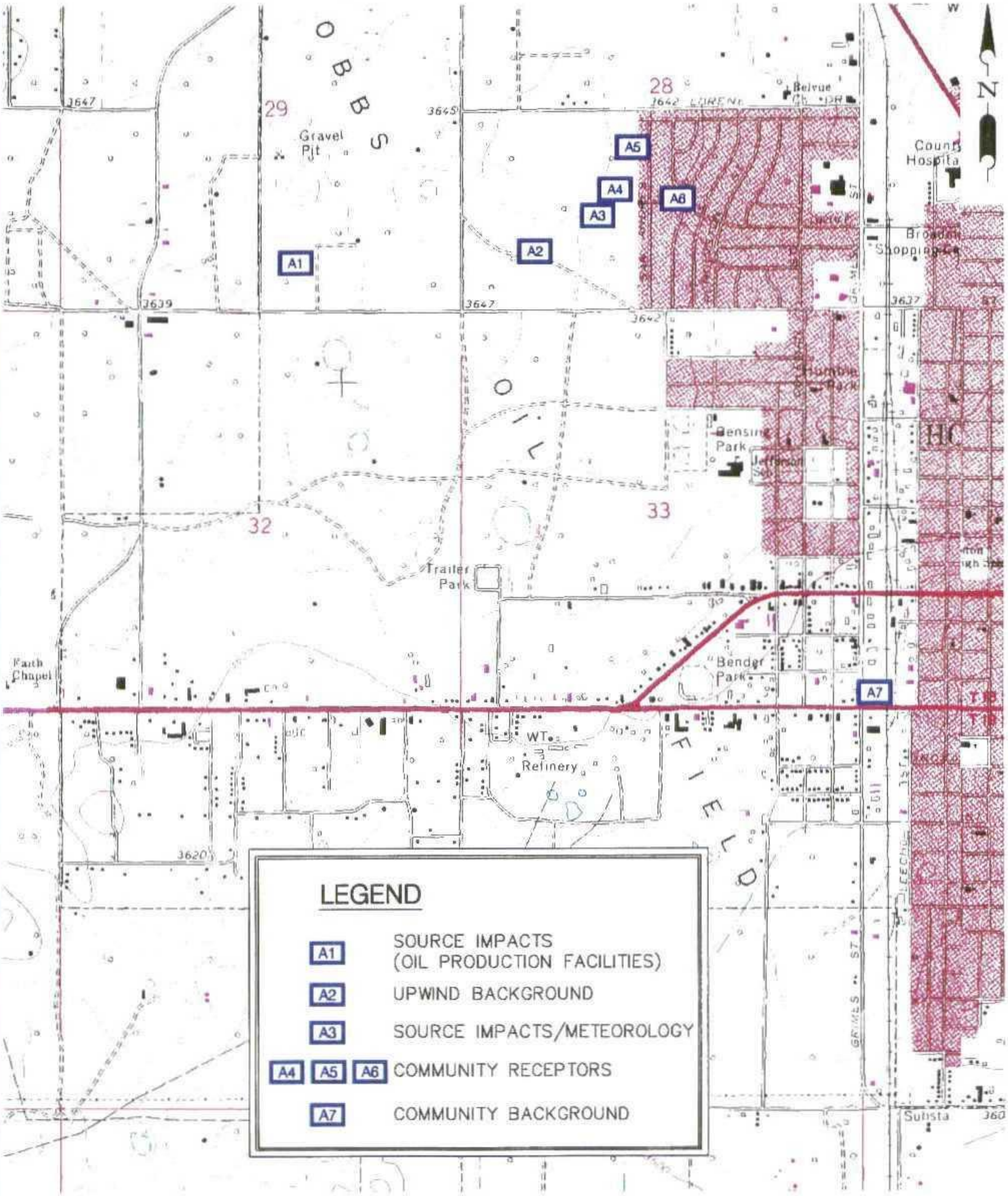


Figure 1-1

View of Westgate Subdivisior

In Hobbs, New Mexico

USGS QUAD REFERENCE:
"HOBBS, N. MEX." 1969, REV. 1979

RADIAN INTERNATIONAL
A DAMES & MOORE GROUP COMPANY

PROJ. No.: 804254.10

DWG. No.: FIGURE 1-1

FILE: K:\SHELL\HOBBS-NEW MEXICO_GLOBAL\DRAWINGS\AUTOCAD\FIGURE1BAIR 3/01/00 9:57Am DBC

The contaminants of concern for the second phase (soils remediation) of the project will be selected based on the results of the monitoring conducted during the first phase. It is expected that the contaminants of concern for the second phase will be a subset of the substances parameters monitored during the first phase. An addendum to this Health and Safety Plan (HASP) will be issued, if necessary, to address the contaminant list for the second phase.

1.4 WORK DESCRIPTION

The scope of work for this project was outlined above in Section 1.2. The major activities that will be performed to complete this project include:

Phase I

- Project mobilization;
- Baseline ambient air monitoring
- Excavation of contaminated soils;
- Restoration of excavation areas;
- Decontamination of equipment; and
- Demobilization.

Phase II

- Project mobilization;
- Installation of temporary structure;
- Excavation of contaminated soils;
- Staging of excavated soils;
- Packaging of excavated soils and off-site transport;
- Restoration of excavation areas;
- Decontamination of equipment and temporary facilities; and
- Demobilization.

2.0 SITE SAFETY AND HEALTH PLAN OBJECTIVES

2.1 SAFETY PRIORITIES

This Health and Safety Plan (HASP) was developed in accordance with the requirements set forth in:

- 29 CFR 1910.120, Occupational Safety and Health Administration (OSHA) Hazardous Waste Operations and Emergency Response Standard;
- 29 CFR 1910, OSHA Safety and Health Regulations for General Industry;
- 29 CFR 1926, OSHA Safety and Health Regulations for Construction;
- National Institute for Occupational Safety and Health (NIOSH)/OSHA/U.S. Coast Guard (USCG)/U.S. Environmental Protection Agency (EPA): Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities (October 1985); and
- Shell Contractor Health, Safety, and Environmental Handbook (HSE Handbook).

This HASP was prepared in order to provide safe procedures and practices for personnel performing project activities and community surrounding the Hobbs, New Mexico site. This HASP will refer to requirements discussed in OSHA regulations, the Shell Contractor HSE Handbook, and work plans prepared by Shell. All of these documents are incorporated into this HASP by reference. All addenda to this HASP will be developed as separate documents and transmitted to Shell for approval. The HASP and applicable addendum will also be available to all site workers and subcontractors.

2.2 ENVIRONMENT, SAFETY, AND HEALTH POLICIES AND GOALS

Shell recognizes the importance of health & safety and the environment in the workplace. An evaluation was performed of the potential hazards and the best way to mitigate these hazards, ensuring compliance with all corporate and regulatory requirements and minimizing all liabilities. For this project, Shell has adopted a philosophy of "zero accidents" and is committed to zero accidents as a goal. The zero accident goal includes the following criteria:

- The safety and health of the employee, visitor, and public and the protection of the environment is the first core value during the performance of work.
- All accidents are preventable.
- No unsafe act is tolerated or accepted.
- Site management requires total compliance with safety and health regulations and requirements and enforces such requirements.
- Managers and supervisors are proactive in safety and health.
- Line management is held responsible and accountable for safety and health and coaches employees in safety and health philosophy.

3.0 STAFF ORGANIZATION, QUALIFICATIONS, AND RESPONSIBILITIES

This section describes the health and safety responsibilities of the personnel assigned to the remediation project. All on-site personnel will be responsible for complying with the requirements of this HASP and all site-specific addenda to the HASP. The Project Director and Project Manager will be responsible for implementing the HASP and ensuring that its requirements are enforced. They will be assisted in this effort by health and safety staff.

3.1 SITE SAFETY SUPERVISOR

The Site Safety Supervisor (SSS) will serve as an advisor to the Project Director and Project Manager in matters regarding health and safety. The SSS will be certified in first aid, cardiopulmonary resuscitation (CPR), OSHA Hazardous Waste Site Operations, and OSHA Hazardous Waste Supervision. The SSS will be primarily responsible for the technical and administrative functions relative to health and safety during site activities. The SSS will have the following responsibilities:

- In conjunction with the Project Director and Project Manager, ensure all site activities are performed in a manner consistent with the HASP, and all site-specific addendums to the HASP;
- Direct health and safety activities on-site;
- Confirm that all Shell personnel and subcontractors designated to work on this project are qualified according to project-specific medical surveillance and training requirements;
- Report all incidents, accidents, and near misses to the Project Director and Project Manager;
- Maintain the onsite health and safety equipment;
- Inspect ongoing site activities and report any health and safety deficiencies to the Project Manager;
- Maintain communication with each work crew;
- Perform site monitoring to ensure that site personnel are wearing the proper level of personal protective equipment (PPE);
- Conduct initial site-specific safety training and regular safety briefings for all site personnel; and
- Serve as the Emergency Response Team Leader (ERTL).

The SSS will have the authority to take the following actions:

- Stop site activities if an "imminently dangerous" situation exists. The emergency situation will be reviewed immediately with the Project Director and the Project Manager.
- Direct personnel to change a work practice if it is determined to be hazardous to the health and safety of site personnel.
- Temporarily suspend an individual from field activities for an infraction of the HASP, pending a discussion with the Project Director and the Project Manager.

3.2 PROJECT DIRECTOR

The Project Director will be responsible for the overall direction, implementation, and enforcement of health and safety requirements. Other responsibilities will include:

- Ensure the project is performed in a manner consistent with the Shell Contractor HSE Handbook;
- Ensure that a HASP and all required site-specific addendum to the HASP are prepared and approved;
- Provide the SSS with project information for the development of the HASP;
- Monitor compliance with the HASP by Shell and subcontractor personnel;
- Ensure adequate resources are provided to the health and safety staff so that they may carry out their duties; and
- Ensure that all Shell personnel and subcontractors designated to work on this project are qualified according to project-specific medical surveillance and training requirements.

The Project Director has the authority to take the following actions.

- Determine personnel assignments on this project.
- Stop field activities if an "imminently dangerous" situation exists. The emergency situation will be immediately reviewed with the Project Manager and the SSS.

3.3 PROJECT MANAGER

The Project Manager will be responsible for the daily implementation and enforcement of the HASP and all site-specific addenda to the HASP. The Project Manager will be technically assisted on-site by the SSS. Other responsibilities will include:

- Ensure site activities are scheduled with adequate personnel and equipment resources to perform scheduled activities safely;
- Ensure adequate communication between field personnel and emergency response personnel is available, and
- Maintain communication with subcontractors.

The Project Manager will have the authority to take the following actions:

- Stop site activities if an "imminently dangerous" situation exists. The emergency situation will be reviewed immediately with the Project Director and the SSS.

3.4 WORK CREW/CONTRACT PERSONNEL

The work crew/contract personnel will have the following responsibilities:

- Immediately report any unsafe or potentially hazardous conditions to the SSS or Project Manager;
- Report *all* incidents, accidents, and near misses, no matter how minor they may seem, immediately to the SSS;
- Maintain knowledge of the information, instructions, and emergency response procedures contained in this HASP and applicable site-specific addenda to the HASP; and
- Comply with the requirements and procedures set forth in this HASP and with any addenda that are added.

4.0 TRAINING REQUIREMENTS

4.1 GENERAL HEALTH AND SAFETY TRAINING

All Shell and subcontractor personnel who will be performing remediation work within the Exclusion Zone (EZ) or Contamination Reduction Zone (CRZ) must comply with the training requirements outlined in OSHA 29 CFR 1910.120(e), OSHA 29 CFR 1926, and Shell Contractor HSE Handbook. The Project Director and SSS will verify and document that all site personnel meet the applicable OSHA training requirements before site work begins. Appendix A contains the form used for OSHA Training and Medical Documentation. Documentation regarding training certification will be kept in the on-site health and safety files.

4.2 40-HOUR INITIAL TRAINING

All employees who will be working inside the EZ or CRZ must have received, at the time of project assignment, a minimum of 40 hours of initial OSHA health and safety training for hazardous waste site operations. Personnel who have not met the requirements for initial training will not be allowed in the EZ or CRZ. A copy of each Shell and subcontractor site worker's 40-hour training certificate shall be forwarded to the SSS for review before site work begins.

4.3 ANNUAL REFRESHER TRAINING

Annual refresher training courses will be taken at a minimum of once a year. At the time of job assignment, all site workers must have received eight hours of refresher training within the past year unless forty hour course is less than one year old. This course is required of all field personnel to maintain their qualification for hazardous waste site work. A copy of each Shell and subcontractor site worker's most recent 8-hour refresher training certificate must be forwarded to the SSS for review before site work begins.

4.4 SUPERVISORY TRAINING

In accordance with OSHA 29 CFR 1910.120(e)(4), all on-site management and supervisors directly responsible for site workers, or who supervise employees engaged in hazardous waste operations, will have received at least eight additional hours of specialized training on managing hazardous waste operations at the time of the job assignment. A copy of the supervisory training certificate for each Shell and subcontractor supervisor shall be forwarded to the SSS for review before site work begins.

4.5 SITE-SPECIFIC SAFETY TRAINING

Before site activities begin at the start of each of the two phases of the project, all personnel assigned to the project will attend site-specific safety training. The SSS will conduct the training, which will specifically address the activities, procedures, and equipment applicable to the site's operation. The training will include the site layout, potential hazards, monitoring protocols, safety procedures, and emergency response services, as outlined in this HASP. Additionally, the SSS will thoroughly discuss exposure limits, employee rights and responsibilities, site contaminants and probability of exposure, required monitoring, and exposure control methods.

The training session will allow site personnel to clarify any issues they do not understand and will reinforce individual responsibilities regarding health and safety during site work. Site personnel will be thoroughly trained about the potential hazards on-site. Site workers will also fill out the HASP Compliance Agreement and a Medical Data Sheet during this training session. The Medical Data Sheet will be kept in the on-site health and safety files and will be referenced in an emergency to assist with the treatment of the victim. Appendix A contains a copy of the Medical Data Sheet.

4.6 ON-SITE SAFETY BRIEFING

The SSS and Project Manager, or their designate, will provide daily on-site safety briefings (i.e., daily "tailgate" meetings) to assist personnel in safely conducting the scheduled work activities. The briefings will include weather-related information, instructions for new operations to be conducted, and safe work practices. The briefings may also provide an opportunity to identify safety-related performance deficiencies noted during daily activities or during a safety audit.

4.7 VISITOR TRAINING

Visitors must immediately report to the SSS for site admittance. Visitors who intend to visit the EZ or CRZ must present certification of initial 40-hour training, 8-hour refresher training, Shell Contractor HSE Handbook and be actively enrolled in a medical surveillance program (refer to Sec.5). The SSS will provide all visitors with site-specific safety training, which will address the activities, hazards, and emergency procedures applicable to current site activities. Visitors entering areas of activity will be required to comply with the provisions of this HASP and applicable site-specific addendum to the HASP. PPE will be provided, as necessary.

4.8 FIRST AID AND CARDIOPULMONARY RESUSCITATION (CPR) TRAINING

The SSS will identify those individuals requiring first aid and CPR training to ensure that emergency medical treatment is available during site activities. During the 2nd phase of the project, at least two individuals (including the SSS) trained in first aid and CPR will always be available during site activities (at least one trained person will be required during the 1st phase of the project). First aid and CPR training will be consistent with the requirements of the American Red Cross Association, or equivalent and in accordance with *Occupational Exposure to Bloodborne Pathogens: Precaution for Emergency Responders* (29 CFR 1910.1030).

4.9 RESPIRATORY TRAINING AND TESTING

Before wearing a respirator, all employees must have medical documentation certifying they are capable of wearing respiratory protection. Additionally, all employees will be trained in the use of respiratory protection in accordance with Shell's and their employer's Respiratory Protection Program.

4.10 CONFINED SPACE TRAINING

Where necessary site workers will be trained as specified by 29 CFR 1910.146 for employees who are required to supervise, standby, or enter confined spaces.

4.11 ADDITIONAL TRAINING

Persons involved in any aspect of the transportation of hazardous materials will be trained in accordance with 49 CFR 172, Subpart H. The SSS will ensure those personnel performing activities such as operation of excavation equipment, and packaging and handling of excavated material are qualified and appropriately trained. Additionally, all personnel working on-site will receive fire extinguisher training.

5.0 MEDICAL SURVEILLANCE PROGRAM

5.1 GENERAL MEDICAL SURVEILLANCE REQUIREMENTS

All personnel who will be performing work in the EZ, CRZ, or any other area where potential exposure to hazardous material exists must comply with medical surveillance requirements outlined in OSHA 29 CFR 1910.120(f). All personnel who will be performing work in the EZ or CRZ will be required to have passed the Shell medical surveillance examination, or equivalent, within 1 year before reporting to the site. Table 5-1 outlines the requirements of the project-specific Medical Surveillance Program. The Project Director and SSS will verify that all site personnel meet applicable medical surveillance requirements before site work begins.

5.2 SUBCONTRACTOR MEDICAL SURVEILLANCE REQUIREMENTS

Subcontractor personnel performing work in the EZ or CRZ must participate in a medical surveillance program that meets or exceeds the requirements outlined in Table 5.1. All subcontractor medical surveillance programs will be reviewed to ensure compliance with project requirements. At the time of job assignment, all subcontractor site workers must have received a medical surveillance examination within the past year. A copy of each subcontractor site worker's most recent medical clearance form must be sent to the SSS for review before site work begins.

5.3 MEDICAL SURVEILLANCE DOCUMENTATION

Documentation regarding medical surveillance clearance will be kept in the site health and safety files. This documentation will include a signed letter stating that each employee is certified by an occupational physician as capable of wearing respiratory protection and working on a hazardous waste site [in accordance with 29 CFR 1910.120(f)].

5.4 ACCIDENT/INCIDENT MEDICAL SURVEILLANCE

As a follow-up to an injury or possible chemical exposure above established exposure limits, all employees are entitled and encouraged to seek medical attention. All accidents and potential chemical exposures must be reported immediately to the SSS, who will arrange for the appropriate medical attention.

Employees returning to work from lost-time injury due to occupational injury or illness during the contract period must be evaluated by an occupational physician prior to allowing the worker access to the work site. A copy of the written statement shall be submitted to the SSS.

All accident reports shall be prepared and submitted within 24 hours of the occurrence. The final incident investigation report shall be submitted within 72 hours.

Table 5-1. Medical Surveillance Examination Protocols

Module	History and Physical With Dipstick Urinalysis, Vision, and Vital Signs	Spirometry	Audiogram	EKG	Chest X-ray	Bio Chem
BASELINE						
Hazardous Waste	✓	✓	✓	*	✓	✓
Nonhazardous Prof.	✓					✓
Executives	✓	✓	✓	*	✓	✓
ANNUAL/PERIODIC						
Hazardous Waste	✓	✓	✓	*	5Y	✓
Nonhazardous Prof.	2Y					2Y
Executives	✓	✓	✓	*	6Y	✓
EXIT						
Hazardous Waste	✓	✓	✓		(1Y)	✓
Nonhazardous Prof.	✓					✓

Legend:

*	> 40 years of age or for medical indications
✓	Required for the indicated module
1Y - 6Y	Yearly frequency
( )	If not done within

BIOCHEM SCREEN

Complete blood count:
- White cells
- Red cells
- Hemoglobin
- Hematocrit

Chemical analysis:
- Liver functions
- Kidney functions
- Lipid metabolism
- Carbohydrate metabolism

6.0 HAZARD COMMUNICATION PROGRAM

This section identifies and assesses the potential health and safety hazards that may be encountered by site personnel during this project and prescribes required controls. Potential health and safety hazards can be classified into four distinctive categories: chemical, mechanical, physical, and biological hazards. The potential for encountering any hazard is dependent on whether it is present, the activities being performed and their location, and the season in which the activities occur. This Hazard Communication Program section is intended to communicate to personnel the general hazards and risks associated with this project site and provide guidance to manage site hazards. Wherever feasible, engineering and administrative controls will be used to reduce exposures to hazardous substances to below applicable limits and/or action levels and provide for the overall safety of employees. When engineering or administrative controls are not feasible or adequate, appropriate PPE will be used.

6.1 POTENTIAL ROUTES OF EXPOSURE

The potential routes of exposure for site personnel include:

- Inhalation of contaminants,
- Ingestion of contaminated particulate matter, and
- Dermal absorption of contaminants.

Due to the nature of the contamination, local features, and the type of site activities being performed by on-site personnel:

- There is a moderate potential for inhalation of volatile organic compounds (VOCs) for on-site workers.
- There is a moderate inhalation potential of contaminated particulate matter for on-site workers.
- There is a low ingestion potential of contaminated particulate matter for on-site workers.
- There is a low/moderate potential for skin contact with contaminated material for on-site workers.

Site personnel can reduce their exposure potential by:

- Using the proper PPE,
- Properly donning and doffing PPE,
- Practicing contamination avoidance,
- Following proper decontamination procedures, and
- Observing good personnel hygiene,

6.2 CHEMICAL HAZARDS

The chemical species identified and attributable to the project include, but may not be limited to, those listed in Table 6-1. The MSDS for chemicals to be handled on site are given in Appendix B.

Table 6-1. Potential Site Contaminants of Concern

Benzene	Methane
Toluene	Chromium
Ethylbenzene	Arsenic
Xylene	Hydrogen Sulfide
Benzo(a)anthracene	Mercury
Benzo(b)fluoranthene	
Benzo(a)pyrene	
Chrysene	
Dibenz(a,h)acridine	
Dibenz(a,h)anthracene	

6.3 PHYSICAL HAZARDS

A variety of physical hazards may be present during this project. These hazards are similar to those associated with any construction-type project. These hazards are not unique and are generally familiar to most field personnel. Task-specific hazards will be covered during daily safety briefings, as necessary.

6.3.1 Housekeeping (Slip/Trip/Fall Prevention)

As with any construction-type project, uneven work surfaces and other slipping or tripping hazards may be present. Proper site housekeeping, removal of trash, and orderly stacking and removal of materials will reduce slipping and tripping hazards. Proper site housekeeping will be the responsibility of all site personnel, and the SSS will make regular entries into the health and safety logbook at the end of each shift, indicating the work area is adequately clean before employee dismissal. The following Best Management Practices will be implemented to minimize slips, trips, and falls from occurring:

- Minimize clutter: If you do not need it, get rid of it or store it properly.
- Store materials properly: Do not stack items too high; ensure storage is secure from falling; be aware of fire and electrical hazards; report storage problems.
- Report maintenance problems: Report maintenance problems immediately—do not assume or expect someone else has/will report it.
- Keep walkways clear: Avoid blocking exits; report, mark, or clean up spills; avoid shortcuts, use only designated walkways and use handrails on stairs; close doors and file drawers.
- The SSS will complete a daily inspection of the work site. Increased inspections shall be based on the number of deficiencies identified.

General surface hazards, such as irregular surfaces, floor grating, wet surfaces, scaffolds, and ladders are common during construction activities. Employees will be made aware of such hazards and, when appropriate, areas will be flagged with caution tape (i.e., protrusions or irregular surfaces) or signs will be posted (i.e., wet and slippery surface) to warn individuals of potential walking/working surface hazards.

6.3.2 Contact with Energized Sources

During any site activities that involve work around live utilities, a potential exists for personnel, heavy equipment, or motor vehicles to come in contact with energized sources. Additionally, personnel could come in contact with energized parts of machinery or power tools. Contact with energized sources may result in fire, explosion, and/or electrocution. All work performed near electrical sources must be performed consistent with the OSHA electrical safety requirements found in 29 CFR 1926.400–1926.449.

Control efforts for this hazard include requirements that all equipment and power tools used on-site be properly maintained, positioned, guarded, and operated by competent personnel. Equipment will not be permitted within a 20-ft radius of energized sources with nominal voltage less than 300 kV. For energy systems with nominal voltage greater than 300 kV, the distance required will be regulated in accordance with 29 CFR 1926.400. The possibility of the presence of underground pipelines, electric wires, conduits, or vessels containing material under pressure will be investigated before any subsurface work (excavation, trenching, etc.) begins.

6.3.3 Electrical Work

A qualified electrician must perform site work involving electrical installation or energized equipment. All electrical work will be performed in accordance with the OSHA electrical safety requirements found in 29 CFR 1926.400–1926.449. Workers are not permitted to work near electrical power circuits unless the worker is protected against electric shock by de-energizing and grounding the circuit or by guarding or barricading the circuit and providing proper PPE. All electrical installations must comply with National Electrical Code (NEC) regulations. All electrical wiring and equipment used must be listed by a nationally recognized testing laboratory.

All electrical circuits and equipment must be grounded in accordance with the NEC regulations. The path to ground from circuits, equipment, and enclosures will be permanent and continuous. Ground-fault circuit interrupters (GFCIs) are required on all 120-V, single phase, 15- and 20-amp outlets in work areas that are not part of the permanent wiring of the building or structure. A GFCI is required when using an extension cord. GFCIs must be tested regularly with a GFCI tester.

Heavy-duty extension cords will be used; flat-type extension cords are not allowed. All extension cords must be the three-wire type and designed for hard/extra hard usage. Electrical wire or cords passing through work areas must be protected from water and damage. Worn, frayed, or damaged cords and cables will not be used. Walkways and workspaces will be kept clear of cords and cables to prevent a tripping hazard. Extension cords and cables may not be secured with staples, hung from nails, or otherwise temporarily secured. Bushings or fittings will be used to protect cords or cables passing through holes in covers, outlet boxes, etc.

In existing installations, changes in the circuit protection (in order to increase the load in excess of the load rating of the circuit wiring) are not allowed. All circuits will be protected against an overload.

All lamps used in temporary lighting will be protected from accidental contact and breakage. Metal shell and paper-lined lamp holders are not permitted. Fixtures, lamp holders, lamps, receptacles, etc. are not permitted to have live parts. Workers must not have wet hands while plugging/unplugging energized equipment. Plugs and receptacles will be kept out of water (unless they are approved for submersion).

6.3.4 Lock-Out/Tag-Out

Before a worker installs, services, or repairs a system where the unexpected release of stored energy could cause injury or electrocution, the circuits energizing the parts must be locked out and tagged. Only authorized personnel will perform lock-out/tag-out procedures. All workers affected by the lock-out/tag-out will be notified before and upon completion of the lock-out/tag-out procedures.

Lock-out/tag-out devices must be capable of withstanding the environment to which they are exposed. Locks will be attached in such a way as to prevent other personnel from operating the equipment, circuit, or control or from removing the lock unless they resort to excessive force. Tags will identify the worker who attached the device and contain information that warns against the hazardous condition that will result from the system's unauthorized startup. Tags must be legible and understood by all affected workers and incidental personnel. Table 6-2 presents the procedures for attaching and removing lock-out/tag-out devices.

Table 6-2. Lock-out/Tag-out Procedures

Step	Lock-out/tag-out procedures
1	Disconnect the circuits and/or equipment to be worked on from all electrical energy sources.
2	Ensure that the system is completely isolated so that it cannot be operated at that shut-off point or at any other location.
3	Release stored electrical energy.
4	Block or relieve stored non-electrical energy.
5	Place a lock on each shut-off or disconnect point necessary to isolate all potential energy sources. Place the lock in such a manner that it will maintain the shut-off/disconnect in the off position.
6	Place a tag on each shut-off or disconnect point. The tag must contain a statement prohibiting the unauthorized restart or reconnect of the energy source and the removal of the tag. The tag must also identify the individual performing the tag and lock-out.
7	Each worker who will be working on the system must place his or her own lock and tag on each lock-out point.
8	A qualified person must verify the system cannot be restarted or reconnected and de-energizing of the system has been accomplished.
Once the service or repairs have been made on the system:	
1	A qualified person will conduct an inspection of the work area to verify that all tools, jumpers, shorts, grounds, etc. have been removed so that the system can then be safely re-energized.
2	All workers stand clear of the system.
3	Each lock and tag will be removed by the worker who attached it. If the worker has left the site, the lock and tag may be removed by a qualified person under the following circumstances: a. The qualified person ensures the worker who placed the lock and tag has left the site; and b. The qualified person ensures the worker is aware the lock and tag has been removed before the worker resumes work on-site.

6.3.5 Hearing Conservation

Noise is a potential hazard associated with the operation of heavy equipment, power tools, pumps, or generators. Noise will be evaluated, demarcated, and controlled following OSHA Construction Industry Standards and the American Conference of Governmental Industrial Hygienists (ACGIH) threshold limit value (TLV). 85 decibels (dBA) is the OSHA action level and is considered the TLV for an 8-hour exposure. Personnel performing activities in areas where noise levels could exceed 85 dBA will be required to wear hearing protection. As a general practice, hearing protection will be worn when operating noisy equipment, power tools, and generators or as directed by the SSS. The SSS may elect to monitor the work areas for noise levels.

6.3.6 Weather-Related Hazards

Weather-related hazards include the potential for heat or cold stress, exposure to ultraviolet radiation, electrical storms, treacherous weather-related working conditions, or limited visibility. These hazards correlate with the season in which site activities occur. Climate control in the enclosure also may be an issue during summer months. Outside work will be suspended during electrical storms. In the event of other adverse weather conditions, the SSS and Project Manager will determine whether work can continue without endangering the health and safety of site personnel (refer to Sect. 12). Work in heat or cold will be performed in accordance with Sect. 6.4.11. Ultraviolet radiation caused by the sun can be a hazard during hot as well as cold clear days. Sunscreen will be used to minimize sunburn potential.

6.3.7 Hand and Power Tools

All hand and power tools will be maintained to OSHA standards or in a safe condition and in good repair. Hand and power tools will be used in accordance with 29 CFR 1926, Subpart I (1926.300–1926.307). Neither Shell nor its subcontractors will issue unsafe tools, and workers are not permitted to bring unsafe tools on-site. All tools will be used, inspected, and maintained in accordance with the manufacturer's instructions. Throwing tools or dropping tools to lower levels is prohibited. Hand and power tools will be inspected, tested, and determined to be in safe operating condition before each use. Periodic safety inspections of all tools will be conducted to ensure that the tools are in good condition, all guards are in place, and the tools are being properly maintained. Any tool that fails an inspection will be immediately removed from service and tagged with a "Do Not Use" sign until such time as the tool is repaired or removed from the site.

Workers using hand and power tools, who are exposed to falling, flying, abrasive, or splashing hazards will be required to wear appropriate PPE. Eye protection must always be worn when working on-site. Additional eye and face protection, such as safety goggles or face shields, may also be required when working with specific hand and power tools. Hearing protection may be required when working with certain power tools. Workers using tools that may subject their hands to an injury, such as cuts, abrasions, punctures, or burns, will wear protective gloves. Loose or frayed clothing, dangling jewelry, or loose long hair will not be worn when working with power tools.

Electric power-operated tools will be double insulated or grounded and equipped with an on/off switch. Guards must be provided to protect the operator and other nearby workers from hazards such as nip points, rotating parts, flying chips, and sparks. All reciprocating, rotating, and moving parts of tools will be guarded if contact is possible. Removing machine guards is prohibited.

6.3.8 Manual Lifting

Back injuries are among the leading occupational injuries reported by industrial workers. Back injuries such as pulls and disc impairments can be reduced by using proper manual lifting techniques. Leg muscles are stronger than back muscles, so workers should lift with their legs and not with their back. Proper manual lifting techniques include the following steps:

- Plan the lift before lifting the load. Take into consideration the weight, size, and shape of the load.
- Preview the intended path of travel and the destination to ensure there are no tripping hazards along the path.

- Wear heavy-duty work gloves to protect hands and fingers from rough edges, sharp corners, and metal straps. Also, keep hands away from potential pinch points between the load and other objects.

- Get the load close to your ankles, and spread your feet apart. Keep your back straight and do not bend your back too far; instead, bend at your knees.

- Feel the weight; test it.

- Lift the load smoothly, and let your legs do the lifting. If you must pivot, do not swing just the load; instead, move your feet and body with the load.

- If the load is too heavy, do not lift it alone. Lifting is always easier when performed with another person. Assistance should always be used when it is available.

6.3.9 Work at Elevations—Fall Prevention

The site activities currently scheduled for this project may include work at elevated locations (work on ladders, etc.). OSHA-approved man-lifts and ladders will be used for access to elevated locations. Workers must wear a safety harness with a lanyard attached to at least one substantial anchorages. Appropriate fall protection must be provided at unguarded locations greater than 6 feet. Fall protection will consist of (1) cables attached to a full-body safety harness and connected to a fixed, stable anchor or (2) safety nets. The selection of fall protection equipment will be based on the type of work being performed; the work environment; the weight, size, and shape of the user; the type and position of the anchorage; and the length of the lanyard. All fall protection equipment will comply with 29 CFR 1926.104, 1926.105, and 1926.556.

The manufacturer's recommendations will be followed for fitting, using, adjusting, inspecting, testing, and caring for fall protection equipment. Before workers use a fall protection device, they will receive instructions on the potential fall hazards and how to inspect, adjust, use, and care for the fall protection equipment. Fall protection equipment must be inspected each day, before use, to determine whether it is in safe working condition. If the fall protection equipment is found to be defective, it will be immediately removed from service and tagged with a "Do Not Use" sign until repaired or removed from the site. Any fall protection equipment actually used in a fall will be immediately removed from service and will not be used again.

Lifelines will be secured above the point of operation to a support capable of holding a minimum dead weight of 5400 pounds. Vertical and horizontal lifelines and lanyards will have a minimum tensile strength of 5000 pounds. Self-retracting lifelines and lanyards must automatically limit the wearer's free fall distance to less than 2 feet and have a minimum tensile strength of 3000 pounds. Only one person is allowed per lifeline. The lifeline must be protected against being cut or abraded.

Body harness systems must decelerate and bring the wearer to a complete stop within 42 inches, excluding lifeline elongation. When stopping a fall, the body harness system may not produce an arresting force on the wearer of more than ten times the worker's weight, or 1800 pounds (whichever is lower). The anchorage point for the lanyard should be located above the wearer's body harness attachment. The lanyard will be constructed of at least ½-inch nylon, or equivalent, with a maximum length to provide for a fall of no more than 6 feet.

One-third of worker deaths in construction result from falls. Many falls occur because ladders are not placed or used safely. Ladder use will comply with OSHA 1926.1053–1926.1060, including the following safety requirements:

- Choose the right ladder for the task—the proper type and size, with a sufficient rating for the task.

- Check the condition of the ladder before climbing:
  - Do not use a ladder with broken, loose, or cracked rails or rungs.
  - Do not use a ladder with oil, grease, or dirt on its rungs.
  - The ladder should have safety feet.

- Place the ladder on firm footing, with a four-to-one pitch.

- Support the ladder by:
  - Tying it off,
  - Using ladder outrigger stabilizers, or
  - Having another worker hold the ladder at the bottom.

- If another worker holds the ladder, they must:
  - Wear a hard hat,
  - Hold the ladder with both hands,
  - Brace the ladder with their feet, and
  - Not look up.

- Keep the areas around the top and bottom of the ladder clear.

- Extend the top of the ladder at least 36 inches above the landing.

- Climb the ladder carefully—facing it—and use both hands.
  - Use a tool belt or hand-line to carry material to the top or bottom of the ladder.
  - Wear shoes in good repair with clean soles.

- Inspect the ladder every day, before use, for the following problems:
  - Rail or rung damage;
  - Broken feet;
  - Rope or pulley damage;
  - Rung lock defects or damage; and
  - Excessive dirt, oil, or grease.

- If the ladder fails inspection, it must be removed from service and tagged with a "Do Not Use" sign.

Ladders with nonconductive side rails must be used when working near electrical conductors, equipment, or other sources. Ladders will not be used horizontally for platforms, runways, or scaffolds.

6.3.10 Heat Stress and Cold Stress

Heat stress is a significant potential hazard during the warmer months. Heat stress manifests itself as one of three conditions: heat cramps, heat exhaustion, or heat stroke. Heat cramps are brought about by a prolonged exposure to heat. As an individual sweats, water and salts are lost by the body, triggering painful muscle cramps. The signs and symptoms of heat cramps include:

- Severe muscle cramps, usually in the legs and abdomen;
- Exhaustion, often to the point of collapse; and
- Dizziness or periods of faintness.

First aid treatment includes shade, rest, and fluid replacement. If available, the individual should drink electrolyte-replacement fluids (e.g., Gatorade, Power Aid, 10-K). The individual should recover within half an hour.

Heat exhaustion usually occurs in a healthy individual who has been exposed to excessive heat while working or exercising. Blood collects near the skin in an effort to rid the body of excess heat. The signs and symptoms of heat exhaustion include:

- Rapid and shallow breathing;
- Weak pulse;
- Cold and clammy skin, with heavy perspiration;
- Skin appears pale;
- Fatigue, weakness, and/or dizziness; and
- Elevated body temperature.

First aid treatment includes cooling the victim, elevating the feet, and replacing fluids. If the individual has not recovered within half an hour, transport him/her to the hospital for medical attention.

Heat stroke occurs when an individual is exposed to excessive heat and their body systems become overwhelmed by heat and begin to stop functioning. This condition is a *medical emergency*, requiring the immediate cooling of the victim and transport to the hospital immediately. The signs and symptoms of heat stroke include:

- Victim has stopped sweating;
- Dry, hot, red skin;
- Body temperature approaching or above 105 °F;
- Dilated (large) pupils; and
- Loss of consciousness (victim may lapse into a coma).

Local weather conditions may produce an environment that will require restricted work schedules in order to protect employees. The SSS will be observing workers for any potential symptoms of heat stress. Adaptation of work schedules and training on recognition of heat stress conditions should help prevent heat-related illnesses from occurring. Heat stress prevention controls include:

- Allow workers to become acclimatized to the heat (3 to 6 days),
- Provide shaded or air-conditioned break areas,
- Provide sunscreen to prevent sun burn,
- Provide drinking water and electrolyte-replenishing fluids, and
- Monitor affected workers wearing PPE for heat stress with periodic heart rate and/or oral temperature checks when the ambient air temperature exceeds 70 °F in the work area. Monitor all workers without PPE when the ambient air temperature exceeds 90 °F. Monitor any worker with a history or likelihood of heat stress.

Cold stress is a danger at low temperatures and when the wind chill factor is low. Cold stress is generally described as a local cooling (frost nip, frostbite, and freezing) or a general cooling (hypothermia). Personnel working outdoors in temperatures at or below freezing may be subject to local cooling. Areas of the body that have a high surface area-to-volume ratio, such as fingers, toes, and ears, are the most susceptible.

The three categories for local cooling include:

- Frost nip: Characterized by a blanching or whitening of the skin.
- Frostbite: Skin has a waxy or white appearance and is firm to the touch, but the tissue beneath is resilient.
- Freezing: Skin tissue is cold, pale, and solid.

Frost nip and frostbite first aid includes covering the affected area with warmth and retreating to a warm area. Frozen tissue is a *medical emergency*, and the victim must be transported to the hospital immediately.

General cooling (hypothermia) occurs when exposure to cold reduces body temperature. With prolonged exposure, the body becomes unable to maintain its proper internal temperature. Without treatment, hypothermia will lead to stupor, collapse, and death. The signs and symptoms of mild hypothermia include shivering, numbness and drowsiness.

First aid for mild hypothermia includes using heat to raise the individual's body temperature. Heat may be applied to the victim in the form of heat packs, hot water bottles, and blankets. The signs and symptoms of severe hypothermia include:

- Unconsciousness,
- Slowed respiration or respiratory arrest,
- Slowed pulse or cardiac arrest,
- An irrational or stuporous state, and
- Muscular rigidity.

First aid for severe hypothermia includes handling the victim very gently; rough handling may set off an irregular heartbeat. Do not attempt to rewarm the severely hypothermic victim; rewarming may cause the development of an irregular heartbeat. Severe hypothermia is a *medical emergency*, and the victim must be transported to the hospital immediately.

Prevention of cold stress is a function of whole body protection. Adequate insulated clothing will be worn when the air temperature drops below 40 °F. Reduced work periods may be necessary in extreme conditions to allow adequate rest periods in a warm area. Other cold stress prevention controls include:

- Changing clothes when work clothes become wet with sweat,
- Avoiding caffeine (which has diuretic and circulatory effects), and
- Ensuring workers drink warm, sweet drinks or soups to increase their caloric intake and reduce the possibility of cold weather dehydration.

6.3.11 Confined Space Entry

A permit is required when working in a confined space. This includes any area that (29 CFR 1926.650 Subpart P-excavations):

- Has a limited means of entry or exit,
- Is unsuitable for continuous human occupancy,
- Contains (or may possibly contain) an accumulation of toxic or flammable contaminants,
- Contains (or may possibly contain) an oxygen-deficient atmosphere, or
- Contains a material with the potential for engulfment of a worker.
- Trenches excavated deeper than 4 feet could be considered to be confined spaces.

The site activities currently scheduled for this project may include confined space entry during both Phase I (excavation pit) and Phase II (enclosure). If a confined space entry must be performed, a confined space entry program will be implemented in accordance with 29 CFR 1910.146. Confined space entry programs include:

- An entry permit,
- Confined space training for entrants and standby rescue personnel,
- Additional PPE, and
- Air monitoring.

Workers involved in confined space entry must be familiar with all hazards, equipment, procedures, and safeguards used during their entry task.

6.3.12 Excavation and Trenching

The site activities currently scheduled for this project include excavation or trenching activities. Excavations will be performed in accordance with 29 CFR 1926 Subpart P and applicable Shell Contractor HSE Handbooks. An excavation is any man-made cavity, depression, or penetration. Depending on its depth, width, and the presence of a hazardous atmosphere, an excavation may also be considered to be a confined space.

Excavations are defined to include trenching. A trench is a narrow excavation in which the depth is greater than the width, and the width is not greater than 15 feet. Trenches excavated deeper than 4 feet could be considered to be a confined space.

Before starting any excavation, the possibility of the presence of underground pipelines, electric wires, conduits, or vessels containing material under pressure will be investigated. The Project Director and/or Project Manager will coordinate with local utility representatives to locate and shut off existing utilities. All surface encumbrances that will create a hazard to workers will be removed or supported.

Shell will designate a "competent person" for all excavation work performed during this project. One way an individual meets the requirements of a "competent person" is by having completed training in excavation safety contained in the OSHA 510 Construction Safety Training Course, or equivalent. The individual assigned to the role of competent person for this project will have extensive construction experience as well as the ability to identify soil types and the knowledge of required slopes.

The competent person will inspect excavations, adjacent areas, and protective systems on the following schedule and document findings:

- Daily, before work in or around the excavation begins;
- After every rain storm or other hazard-increasing occurrence; and
- As needed throughout the work shift as conditions change.

If a hazardous condition is noted, all endangered workers must be immediately removed from the hazard, and all work in the excavation stopped until the necessary corrections have been made.

The following safety controls will be implemented if excavation activities proceed beyond 4 feet in depth:

- An Excavation Work Plan will be required.
- The SSS will monitor excavations that may contain toxic or oxygen-deficient atmospheres before each shift begins and at periodic intervals during the shift. Continuous monitoring will be performed when practical. Results of air monitoring will be documented in the SSS's logbook. Additional safeguards may be necessary when excavating areas that may contain a hazardous atmosphere.
- The sides of all excavations in which workers may be exposed to danger from shifting soil will be guarded by a protective system. Appendices B and C of 29 CFR 1926 Subpart P provide information on proper sloping, shoring, and benching protective systems. Excavations less than 5 feet in depth which do not have a potential for a cave-in do not require a protective system.

- If the excavation endangers the stability of adjacent structures, support systems such as shoring, bracing, or underpinning will be provided.

- Personnel will not work in excavations in which there is accumulated water, or water is accumulating, unless adequate precautions have been taken to protect workers against the hazards caused by water accumulation.

- Workers will be protected from loose rock or soil that could fall from an excavation face.

- Excavated soil will be placed at least 2 feet from the edge of the excavation on poly sheets and covered.

- Workers exposed to public vehicular traffic will wear warning vests.

- When mobile equipment is operated near an excavation, or required to approach the edge of an excavation, a warning system (e.g., barricades, hand signals, mechanical signals, and/or stop logs) will be used.

- A stairway, ladder, ramp, or other safe means of exit will be located in trench excavations that are greater than 4 feet in depth. The means of exit will require no more than 25 feet of lateral travel for each person in the excavation.

- Workers are not permitted underneath loads handled by lifting or excavating equipment.

- At the end of each workday, the Project Manager and/or SSS will ensure that flagging or barriers are set up at the excavation area to prevent unauthorized personnel from falling into the excavation during non-working hours. The barriers will remain in place until the excavation has been back-filled.

6.3.13 Heavy Equipment and Motor Vehicle Operation

Only qualified personnel will operate heavy equipment and motor vehicles. Equipment will not be operated in a manner that will endanger persons or property. All heavy equipment and motor vehicles will be operated in accordance with the manufacturer's instructions, 29 CFR 1926 Subpart O.

The following inspection and repair controls will also be implemented during this project:

- The operator will inspect equipment and vehicles on a daily basis, before starting work. The inspector will maintain records of tests and inspections on-site using an Equipment Daily Inspection Checklist (located in Appendix A). All heavy equipment backup alarms and exhaust systems will be checked daily and confirmed to have no embers or sparking.

- Any unsafe equipment or vehicles will be removed from service until safety defects can be corrected. Defective equipment will be tagged with a "Do Not Operate" sign until repairs have been made or the equipment is removed from the project site.

- Equipment will be shut down and locked out before maintenance or repairs are made.

- Any cracked or broken window, windshield, or door glass will be replaced.

Operators will follow these rules:

- Seat belts will be worn when operating moving equipment.
- Motor vehicles and heavy equipment will be shut down during refueling operations.
- The on-site speed limit is no more than 10 mph for all vehicles.
- Operators will not leave their equipment unattended while it is running.
- Whenever equipment is parked, the parking brake will be set. If the equipment is parked on an incline, in addition to setting the parking brake, the wheels will also be chocked.
- Operators will be trained and experienced in the use of their equipment.
- Vehicles or equipment will not be operated in a careless or unsafe manner.
- Personnel will wear appropriate PPE when working with heavy equipment. Dermal protection must fit properly and be taped to prevent "caught on" or "caught between" hazards.
- Passengers or "riders" are not allowed on equipment.

Required equipment features:

- All bulldozers, tractors, forklifts, or similar equipment used in remediation operations will be provided with guards, canopies, or grills to protect the operator from falling or flying debris.
- All equipment and vehicles will have an audible backup alarm and an audible warning device (i.e., a horn).
- Each vehicle and piece of equipment will have a portable fire extinguisher rated not less than 10-B: C.
- Equipment will be properly guarded.

When working with moving equipment:

- One designated watch person will give signals to the operators of both equipment and vehicles in any work area. This person must be in the operator's line of sight anytime the equipment is moving.
- All personnel will stay clear of the operational area of the equipment. Workers are not permitted to stand directly underneath any load or piece of equipment (man-lift, backhoe bucket, crane load, etc.). Workers will not touch equipment while running due to pinch/crush potential of moving parts.
- Work areas will be adequately illuminated. To aid visibility, workers in traffic areas will don high visibility clothing or vests.
- Workers are prohibited from riding in equipment buckets and booms. Only workers needing access to the large equipment work area will be allowed in the area.

6.3.14 Flammable and Combustible Materials

Outdoor storage of flammable/combustible liquid containers (not more than 60 gallons each) will not exceed 1,100 gallons in any one area. All flammable and combustible liquids will be stored outdoors, in a well-ventilated area, and away from excessive heat or direct sunlight. These liquids will not be stored in areas used for exits, stairways, or aisles. Material that reacts with water will not be stored near flammable or combustible liquids. All sources of ignition are prohibited in this area, including smoking, cutting and welding, hot surfaces, open flames, sparks (static, electrical, and mechanical), and frictional heat. "Flammable Liquids" and "No Smoking or Open Flames" signs will be posted in the storage area. At least one portable fire extinguisher rated not less than 20-B:C will be located within 10 feet of the entrance to the storage area, and at least one similar fire extinguisher will be located between 25 and 75 feet outside the storage area.

Each fueling area will have at least one portable fire extinguisher rated not less than 20-B:C within 75 feet of each pump and dispenser. Smoking and open flames are prohibited in fueling areas. Motors will be turned off before equipment is refueled. At least one portable fire extinguisher rated 20-B:C will be located on all vehicles transporting or dispensing flammable or combustible liquids.

Flammable and combustible liquids should only be handled in areas that have adequate ventilation. Workers are not permitted to use liquids having a flash point greater than 100 °F as a cleaning/degreasing fluid. Workers should change as soon as possible if flammable or combustible liquid is spilled on their clothing.

Dispensing areas (for transfer of greater than 5 gallons) will be separated from other work areas by at least 25 feet. Spills in these areas will be controlled by using drainage, diking, or absorbent material. Flammable liquids will only be transferred when the two containers are electrically interconnected (i.e., bonded). When dispensing flammable and combustible liquids into smaller portable containers, only approved safety containers equipped with backflash arresters will be used.

Items with fire fueling potential will be identified and, if not in use, stored outside of flammable/combustible materials storage areas. Such items include wooden items (pallets, 2x4s, etc.), paper (boxes), plastics (bottles), and oils (lubricants).

Handling, storage, and use of flammable and combustible items will be in compliance with 29 CFR 1926.152. Material safety data sheets (MSDSs) for hazardous materials brought on-site will be kept on-site and will remain readily accessible to Shell employees and subcontractors.

6.3.15 Hot Work

The activities currently scheduled for this project may require hot work during assembly of the treatment facility or for size reduction of equipment during demobilization activities. If hot work becomes necessary, it will be performed in accordance with 29 CFR 1926.350–1926.354 and the Shell Contractor HSE Handbook. Hot work includes oxygen-acetylene welding and cutting, arc welding and cutting, gas metal welding, propane torches, and grinding. All hot work permits must be completely filled out and approved by the SSS before any hot work activities begin.

Welding, cutting, or hot work areas will be well vented to prevent fumes from becoming a nuisance or problem. Blowers should be employed to blow fumes away from workers and into areas that will not affect others. If proper ventilation cannot be applied to properly control fumes, workers that may be affected by such shall don appropriate respirators. If hot work is being performed on potentially contaminated items that could induce hazardous/toxic fumes, workers adjacent to and performing the hot work will don appropriate respirators.

6.3.16 Fire Protection and Prevention

This project falls under the classification of a temporary facility, thus having less stringent fire protection requirements than that of a permanent facility. However, the fire safety program design of the temporary treatment facility and for worker safety must comply with the Standard Building Code, OSHA Subpart F. Storage of combustibles must comply with 29 CFR 1910, 29 CFR 1926, the Standard Building Code and the National Fire Protection Association (NFPA). The fire safety design will be such that it meets relevant requirements. This section will focus on all other aspects of fire protection and prevention relevant to this project.

Management is responsible for executing and adhering to the procedures in this program. The SSS is responsible for ensuring all on-site employees are familiar with this fire protection and prevention plan and any employees responsible for maintenance/inspections are properly trained. The SSS will conduct daily inspections of all fire protection systems (fixed or portable) and storage areas with fire potential in their jurisdiction. The SSS will check and document on a weekly basis all fire protection systems and equipment storage areas to ensure they are operational and no site fire risk exists. Any fixed fire prevention system requires checks by a "qualified" individual, who may be from the local fire department rather than the SSS.

Attempts will be made to prevent the possibility of a fire (e.g., keep items at safe distance from electrical connections, store flammable materials in fireproof cabinet, etc.). However, if a fire develops, attempts should be made to extinguish the fire only if conditions are such that it can be performed safely. All emergency telephone numbers (which includes the fire department telephone number) will be posted next to the on-site telephones. Access will always be maintained to the site for emergency response vehicles (i.e., no blockage of roadways). Site personnel will be instructed to report any fire incident to the Project Manager and/or SSS, no matter how minor.

Fire extinguishers appropriate in size and classification will be present, readily accessible, and ready for use in all areas where there is potential for fires. The location and type of portable fire extinguisher will be in accordance with the requirements of NFPA 10. At least one multipurpose Class ABC portable fire extinguisher will be mounted in a clearly marked area in each office trailer and change house. The treatment facility will have at least two multipurpose Class ABC fire extinguishers located within the containment area. At least one portable multipurpose Class ABC fire extinguisher will be mounted in each site vehicle and secured to prevent physical damage to the extinguisher and injury to passengers.

Potential for an incident due to a fire is believed to be minor due to the nature of the project. However, some potential fire hazards associated with this project and methods for prevention are as follows:

- Kitchen equipment (microwaves, coffee brewers, refrigerators): Check electrical cords to ensure they are in good shape. Do not use equipment that has frayed cords or is not functioning properly. Notify the manager immediately of any equipment deficiencies.

- Electrical: Open or frayed wires pose a fire threat and will be reported immediately. Computers or other related equipment will be equipped with a surge protector. Even if no smoke is observed, burning smells will be reported immediately and the area investigated to determine whether there is fire potential.

- Storage: Ensure materials are properly stored (i.e., flammable or chemical cabinets) and marked. Ensure incompatibles in the same area are separated by minimum distances and by suitable fire-rated construction. Examples of materials that require separation between each other are flammable and combustible liquids, corrosive materials, oxidizers, and water reactives. Such items will be stored outside in accordance with OSHA standards.

- Temporary Heaters: Keep at a safe clearance and use only as recommended by the manufacturer.

- Fueling: Do not fuel equipment while equipment is operating. Allow equipment to cool before fueling. Ensure only appropriate fueling containers/equipment are used. Ensure proper bonding for portable installations.

- Smoking will be prohibited within the exclusion zone and only permitted in designated areas.

Building exits and pathways to exits will be kept clear and unobstructed. Building exit doors will not be locked while occupied and shall not require more than one action to open. Emergency lights (when required), exit signs, and other exit marking systems will be maintained in good operating condition.

No controlled open fires or hot processes are thought to be required for this project. Personnel performing any hot work and associated fire watches will don fire-resistant PPE. Fire watches for welding, cutting, grinding, or open flame activity will be performed by authorized personnel in designated cutting and welding areas. Adequate ventilation will be provided for all cutting and welding work.

Torches, regulators, pressure-reducing valves, and manifolds will be Underwriter's Laboratories, Inc.-listed or Factory Mutual approved. Oxygen-fuel gas systems (e.g., oxygen or acetylene welders) will be equipped with listed and/or approved backflow valves and pressure relief devices. All cutters, welders, helpers, and fire watch personnel will wear eye protection and protective clothing, as appropriate. Workers adjacent to arc welding areas will be protected from the rays by screens or shields.

Combustible materials, equipment, or building surfaces within 20 feet of or below the work must be covered with fire-resistant welding blankets, moved, or wetted down. Openings in ducts, tanks, or other confined spaces within 20 feet of the work shall also be covered or plugged. Fire-resistant welding blankets can be used for electric arc operations instead of wetting the work down. Mechanical ventilation shall be used continuously when cutting or welding in or on a confined space. See Sect. 6.3.15 for more details on hot work practices.

6.3.17 Compressed Gases

Only properly trained personnel will handle compressed gases. Each cylinder that is received at the work site must have the contents identified by stenciling or labels, the appropriate DOT label, a valve protection cap (if so designed), and a current hydrostatic test date, if applicable. Gas cylinders not meeting these requirements will not be accepted.

Before connecting a regulator, the cylinder valve shall be opened slightly and closed immediately to blow out dust or debris from the valve assembly. The valve will be aimed away from the operator and other personnel during this maneuver. Before opening the cylinder valve, fully close the hand control knob on the regulator. Always open a cylinder valve slowly. Never force a cylinder valve. If the valve cannot be opened by the wheel or small wrench provided, the cylinder should be returned.

Relieve all pressure from a hose that is not being used. To shut down a system, close the cylinder valve and relieve the pressure from the entire system. Never drop cylinders or permit them to strike each other. Cylinders in use and in storage will be chained, strapped, or fixed in a manner that prevents them from falling. Cylinders may be stored in the open, but will be protected against extremes of weather and from the dampness of the ground to prevent rusting. During the summer, cylinders stored in the open will be shaded against the continuous direct rays of the sun. The valve protection cap will be left on each cylinder until the cylinder has been secured against a wall or bench or placed in a cylinder stand and is ready to be used. Avoid dragging, rolling, or sliding cylinders whenever possible. The cylinder will be moved by using a suitable hand truck. Do not use white lead, oil, grease, or any other non-approved pipe-sealing compound to make a joint in an oxygen system. Never interchange regulators and hose lines among different types of gases.

Intra-site moving of large cylinders will be by cylinder carts. Cylinders moved in pickups or flatbed trucks will be secured in an upright position. All cylinders will be considered full unless properly identified as empty by the user. Empty cylinders should be returned to the storage area and not be permitted to accumulate at or near the workstation. Gas cylinder caps shall not be used to lift cylinders. Never tamper with safety devices in valves or cylinders.

Cylinders, storage areas, and manifold installations will be dry, well ventilated, and located away from ignition sources or excessive heat, including direct sunlight. Cylinders will be stored upright, and properly secured with chains, bars, brackets, or other approved devices. Oxygen cylinders and welding gases are stored a minimum of 20 feet from fuel gas cylinders or combustible materials, or separated by a barrier 5 feet high having a fire resistance rating of at least ½ hour. Empty cylinders will be stored separately from full cylinders. Both storage areas will be clearly marked. Gas cylinders will not be subjected to temperatures in excess of 125 °F.

6.3.18 Illumination

Site activities will only be conducted during daylight hours unless adequate lighting is available. The minimum lighting requirements for work areas will meet those listed in 29 CFR 1926.56, Table D-3, while any work is in progress.

6.3.19 Work On/Beside Water Bodies

Remediation of the site will not require workers to perform activities on and adjacent to bodies of water.

6.3.20 Ergonomics

The interaction of personnel with their working environment at this site may also present potential hazards, such as the incorrect lifting of heavy loads, equipment vibrations, improper body positioning, and negotiation of physical obstacles. When lifting equipment or heavy objects, personnel should always position themselves properly, maintain a straight back, and lift from the legs. They shall rely on the buddy system for assistance in lifting loads that are too heavy for one person. Back strain, the most common ergonomic hazard in the field, may be easily avoided provided that site workers ask for assistance when they need it. The SSS will visually monitor site activities to assist personnel in avoiding ergonomic hazards.

6.4 BIOLOGICAL HAZARDS

Biological agents that may cause health hazards are very diverse; consequently, their health effects are also diverse. Biological hazards include etiologic agents; bloodborne pathogens; poisonous plants, insects, and animals; and indigenous pathogens. The effects range from mild skin irritation to debilitating or life-threatening illness. Unfortunately, many biological agents are too small to be observed or arise from seemingly harmless sources.

During site activities, workers can potentially be exposed to bloodborne pathogens when rendering first aid or CPR. Poisonous plants, insects, and reptiles may also be encountered during cleanup operations. Avoiding contact with biological agents is the best way to prevent adverse health effects caused by them. Recognition of potential hazards is essential. When avoidance is impractical or impossible, PPE and personal hygiene will be used to prevent adverse effects.

Site health and safety briefings will include protective measures to be taken by workers. In addition, the SSS will evaluate the potential for exposure for each job task, advise site personnel, and adjust the site briefings accordingly.

6.4.1 Animal and Insect Bites

The site is located in a residential area in Hobbs, New Mexico. The possibility of encountering wildlife is moderate and will be communicated to all site personnel during the initial site-specific safety training. Workers will be warned to avoid wildlife and to report any encounters.

Rattlesnakes are relatively common in New Mexico. They belong to the family of pit vipers and are characterized by elliptical pupils, one to six fangs (usually two), one row of plates beneath the tail, and a head that is wider than the neck and body. The venom of these snakes affects the circulatory system. All reactions from snakebite are aggravated by fear and anxiety.

Two types of poisonous spiders may be present in this area: the black widow and the brown recluse. The black widow spider has a shiny black body about the size of a pea, with a red or yellow hourglass-shaped mark on its abdomen. It weaves shapeless webs in dark, undisturbed areas. A bite may result in illness, pain, and possibly death from complications, but usually not from the bite itself. The brown recluse spider is approximately 3/8-in. in size, with a dark, violin-shaped mark on its back. It weaves a sticky, irregular web. Within a few hours of being bitten, the victim's skin around the bite becomes red and swollen. In time, most of the tissue dies, leaving a deep sore that may take months to heal and may leave a scar. A few persons suffer an allergic reaction to its poison that could result in death. First aid measures for a spider bite and other insect bites/stings are discussed in Section 12.14.

Personnel may also encounter a number of biting or stinging insects during site activities. Insects that may be present on-site include bees, wasps, mosquitoes, scorpions, and ticks. The SSS will inform personnel about the potential insect hazards and preventative measures, such as the use of insect repellant. Site workers who have a history of allergic reactions to bee stings should inform the SSS using the Medical Data Sheet completed during the initial site-specific safety training. The SSS will provide first aid treatment in the event of an insect bite or sting.

Deer tick bites may result in the transmission of Lyme Disease. A characteristic rash may develop a few days to a few weeks after the bite of an infected tick. The rash generally looks like an expanding red ring with a clear center, but it can vary from a blotchy appearance to red throughout the rash. However, it is important to note that some victims *never* exhibit a rash. Lyme Disease symptoms include flu-like symptoms such as a headache, stiff neck, fever, muscle aches, and/or general malaise. If Lyme Disease is not treated early with antibiotics, the early symptoms may disappear, but more serious problems may follow. Long-term effects of Lyme Disease may include arthritis of the large joints, meningitis, neurological complications (such as numbness or tingling of the extremities, loss of concentration and memory retention, Bell's Palsy), withdrawal and lethargy, or cardiac symptoms. Personnel should use the following prevention tactics:

- Avoid walking through brush, woods, or grassy areas; try and avoid contact with plants if you must walk through these areas.
- Dress in light-colored clothing to make adhering ticks more visible. Wear long-sleeved shirts and tuck pants into socks.
- Use a tick repellant containing permethrin or dimethyl-m-toluamide (DEET). However, you should never use tick repellant containing more than 30% DEET, and all tick repellant should be sprayed on clothing (and allowed to dry) and not directly on your skin.
- Perform self-searches each day to check for ticks.

Initial first aid treatment for removing ticks from the skin is described in Sect. 12.14.

6.4.2 Bloodborne Pathogens

Employees are at risk of contracting infectious diseases each time they are exposed to bloodborne pathogens. Any exposure incident may result in infection and subsequent illness. Since it is possible to become infected from a single exposure incident, exposure incidents should be prevented whenever possible. To ensure employees are effectively informed concerning potential workplace health hazards, the SSS will review the requirements set forth in 29 CFR 1910.1030. If deemed necessary, the SSS will establish an exposure control plan. The purpose of this plan is to identify those tasks and procedures where occupational exposure to bloodborne pathogens may occur, to identify the positions whose duties include those tasks, and to implement controls that will significantly reduce the risk of infection by bloodborne pathogens. The plan also includes provisions for affected employees to receive Hepatitis B vaccinations, training, and, if necessary, confidential medical evaluations and follow up. CPR/First Aid responders will be trained in bloodborne pathogens.

6.4.3 Hanta Virus

The Hanta virus can be spread through mouse and rat feces. Any evidence of rodent infestation should be reported immediately to the SSS.

7.0 HAZARD/RISK ANALYSES

Appendix C presents Activity Hazard Analyses (AHAs) for each of the tasks scheduled for the project. Each AHA will be reviewed and discussed by all site workers involved with the specific task. If a task is planned for which there is no AHA, an analysis will be prepared and reviewed by site personnel. This review will be completed before starting the site-specific task, unless an emergency situation arises that requires an immediate response.

The AHAs will typically be reviewed at the site-specific safety training and will be addressed periodically during the daily on-site safety briefing. The health and safety hazards as presented in Section 6.0 (i.e., chemical/mechanical/physical/biological) will be discussed for the appropriate work. Site workers will be encouraged to discuss potential hazards and identify ways in which they suspect an accident could occur. The site workers may discuss accident scenarios and will be encouraged to suggest appropriate control measures. The meeting and topics discussed will be documented by the SSS, using a Meeting Attendance Form (Appendix A). These project tasks will include:

- Project mobilization and construction of enclosure (Table C-1);
- Excavation of contaminated soils & surrounding soils (Table C-2);
- Transporting spoils to staging area. (Table C-3);
- Transfer of spoils to trucks for off-site transport (Table C-4);
- Decontamination of equipment and temporary facilities (Table C-5);
- Area Restoration (Table C-6);
- Demobilization (Table C-7); and,
- Monitoring of air emissions (Table C-8).

8.0 SITE CONTROL MEASURES

8.1 SITE ZONES

The SSS will be responsible for establishing the site control zones, as necessary, around work areas that present hazards. Implementation of the site control zones will help minimize the number of employees who could potentially be exposed to site contamination and the potential spread of that contamination. The SSS will monitor the implementation of the required site control work rules and will report any deviations from prescribed practice to the Project Manager or stop work, as appropriate. A log will be kept of all personnel visiting, entering, or working on-site.

Site control zones will be established at each excavation area at the site. The exact locations have not yet been established, but it is expected that the EZ will be a relatively small area (e.g., 10-20m) around each excavation pit during Phase I and will be the entire area within the structure during Phase II. Monitoring will be conducted to ensure that zones are properly delineated.

8.1.1 Support Zone

The SZ is free of contamination and a relatively safe area separated from the CRZ. A portion of the SZ may be established at each individual work area. The main SZ contains the Command Post/Office, and safety support/equipment storage area. This area provides a center for team communications, emergency response, and miscellaneous support. Appropriate sanitary receptacles shall also be located in this zone. Site operations will be controlled from this location, and the Command Post may also function as an evacuation point. A log will be kept in the SZ of all personnel entering and exiting the site. Potentially contaminated personnel, equipment, or material are not allowed in the SZ, except in the form of appropriately packaged, decontaminated, and labeled samples. Meteorological conditions should be observed and noted from this zone, including those factors pertinent to heat stress.

8.1.2 Contamination Reduction Zone

A CRZ will be established between the EZ and the SZ that shall accommodate heavy and light equipment and personal decontamination. The CRZ will encompass an area immediately adjacent to the EZ and excavation pits. The CRZ area shall be partitioned into two sections. The CRZ entrance shall allow employees who have performed gross decontamination to perform additional decontamination/rinsing activities (i.e. monitoring and sampling equipment, etc.). This section shall contain water-tight basins to contain all wastewater generated. The second half of the area shall exit into the SZ and shall contain a wash sink, first aid kit and benches for heat and cold relief, fluid replenishment, and various sizes of clean PPE. All personnel entering the CRZ or EZ will wear the prescribed level of protective clothing required for that zone. All items intended to be placed on the face or in the mouth (cigarettes, chewing tobacco, food, cosmetics, etc.) are prohibited.

8.1.3 Exclusion Zone

The excavation pits, which may contain airborne or hazardous materials contamination, will be the EZ. Before each task begins, the EZ "hot line" will be clearly identified using caution flagging tape or traffic cones. The size of the EZ will depend on the phase of the project. The SSS may establish more than one restricted area within an EZ if different levels of protection are being used or if different hazards exist. All areas where invasive work activities occur will be considered to be an EZ. Personnel are not allowed in the EZ without:

- A “buddy”,
- Appropriate PPE,
- Current OSHA medical authorization, and
- Current OSHA training certification

8.2 COMMUNICATIONS

Successful communication between site personnel in the EZ/CRZ and the SZ and between site personnel and local emergency response agencies is essential. A cellular telephone will be available on-site for emergency use. Emergency numbers will be posted by the telephone (see Table 12.1). Work will not be conducted on-site without access to a telephone, and site personnel will be informed of the nearest available telephone.

8.3 SITE ACCESS AND SECURITY

Entry to and exit from the site will be controlled by the SSS. Work site entry will be limited to authorized personnel only.

For the Phase II work, signs will be printed in bold large, English letters on a contrasting background and will be posted so that they are visible from all points where entry into the enclosure might occur. The signs will indicate that the enclosure is a restricted area and that persons entering the structure must check with the SSS to see what protective steps, if any, are necessary before entering the structure.

9.0 PERSONAL PROTECTIVE EQUIPMENT

9.1 GENERAL

Personal protective equipment (PPE) will be worn to minimize personnel exposure to site contaminants. Decision-making criteria for PPE requirements include:

- Site historical information;
- Type of contaminants suspected or known to be present;
- Work location;
- Duration of site activities; and
- Type of task to be performed.

The level of protection worn by site personnel will be enforced by the SSS. Levels of protection may be upgraded or downgraded at the discretion of the SSS based on real-time air monitoring data, surface contamination criteria, and prior site experience.

9.2 SITE-SPECIFIC REQUIREMENTS

Hard hat, safety glasses, and steel-toe/steel-shank work boots must be worn at all times, except for designated areas identified by the SSS. The default level of protection will be EPA Level D when working in the community and modified EPA Level D when working in any excavation areas.

The various levels of PPE required for this project are summarized in Table 9-1. Any changes in the level of protection will be documented in the SSS's logbook. Initial levels of protection assigned for each task are outlined in the AHAs (Appendix C). Levels of protection less than those designated in these tables must first be approved by the SSS.

A site-specific respiratory protection program documenting requirements for this project is provided in Appendix D. All respiratory protection used by Shell will be selected in accordance with procedures outlined in the NIOSH Respirator Decision Logic (May 1987), 29 CFR 1926.1101, and 29 CFR 1926.62.

9.3 SITE LAUNDERING

Any reusable work coveralls used at the site will be laundered twice per week or after any day where they become contaminated. Laundering will be completed using a typical household washing machine. Coveralls will be laundered according to manufacturer's recommendations using a non-colorfast disinfectant detergent. Laundered coveralls shall be placed into a dryer and dried according to manufacturer's recommendations.

Table 9-1. PPE Selection Criteria

PPE Item	Level B	Level C	Modified Level D	Level D
Work boot (steel-toed, leather)	✓	✓	✓	✓
Work gloves			✓	✓
Hearing protection (as required)	✓	✓	✓	✓
Safety glasses			✓	✓
Hard hat	✓	✓	✓	✓
Poly-coated tyvek or equivalent		✓	✓	
Surgical inner gloves	✓	✓	✓	
Chemical resistant outer gloves	✓	✓	✓	
Chemical resistant safety boots (or boot covers)	✓	✓	✓	
Saranax coveralls	✓			
Air purifying full-face respirator with appropriate filtering cartridges		✓		
Full-face positive-pressure SCBA or full-face supplied air respirator with 5-minute escape capability	✓			

Note:

It is not anticipated that Level A protection will be required for this project. A face shield is required for employees when splash hazard exists or when decontamination is being performed using high-pressure wash.

10.0 EXPOSURE MONITORING AND AIR SAMPLING PROGRAM

10.1 GENERAL

This section describes the elements of the monitoring program to be implemented at the project site. The monitoring includes suspected or known contaminants of concern to be monitored, the type of monitoring equipment required, and action levels to be used. Due to the activities scheduled and the site historical information, it is anticipated that the following types of monitoring will be required during Phase I (the Phase II monitoring approach is to be determined after Phase I is completed):

- Volatile organic compound (VOC) levels (real-time, time-integrated, personnel);
- Semi-volatile organic compound (SVOC) levels (time-integrated);
- Combustible gas levels (real-time);
- Oxygen levels when confined space entry is required (real-time);
- Hydrogen sulfide levels (real-time);
- Particulate levels (real-time, time-integrated);
- Metals (time-integrated); and
- Thermal stresses (real-time).

10.2 REAL-TIME MONITORING

Information is given below for general work place monitoring, confined space monitoring, and site perimeter/community monitoring. More information may be found in the Phase I Monitoring Study Design Plan prepared for this project. The parameters to be monitored during Phase II, along with the number & location of monitoring sites and the frequency of monitoring will be determined once the Phase I monitoring results have been reviewed.

10.2.1 General Work Place Monitoring

There is the potential for chemical exposure of workers during the excavation activities. Therefore, during these operations the site will be monitored using the following approaches:

- Real-time monitoring with a combination flame ionization detector (FID) and photo ionization detector (PID) for organic vapors throughout the excavation and soils handling activities where exposure to volatile organic compounds (VOCs), including BTEX, is possible. Real-time monitoring of total hydrocarbon emissions will be performed as long as excavation is being performed.
- Real-time monitoring for hydrogen sulfide using a Jerome 631-X monitor. This monitor will be used during excavation operations to determine worker and community exposure to H_2S.

- Real-time monitoring for vapor phase mercury using a Jerome 431-X monitor. This monitor will be used during excavation operations to determine worker and community exposure to mercury.

Potential exposure to airborne hazards will be monitored in real-time to ensure that personal protective measures and emission controls measures are taken if the real time measurements exceed action limits. As discussed above, organic vapors, hydrogen sulfide, and mercury emissions are all of potential concern during excavation and soils handling. Therefore, real-time monitoring using direct reading instrument will be used to monitor for airborne concentrations of these constituents. The organic vapor monitor will be calibrated, using two standards, one which responds best to the FID (e.g., methane) and one that responds best to the PID (e.g., toluene), daily or as deemed necessary by the Site Safety Supervisor. Daily calibration will be performed before work begins each day and daily calibration data will be recorded and maintained as part of the project record. The hydrogen sulfide and mercury analyzers are factory calibrated and do not need daily calibrations.

At the discretion of the SSS, real-time monitoring may be performed for respirable dust levels inside each active exclusion zone during dust-producing activities. If downwind particulate levels are greater than upwind particulate by 0.15 mg/m^3 or more, dust suppression techniques will be employed. The respirable dust monitor will be calibrated before each use using a zero air filter provided by the manufacturer.

At the discretion of the SSS, a Sound Level Meter (SLM) will be used to monitor employee noise levels during heavy equipment and power tool operation and during other noise-producing site activities. Hearing protection will be required for employees exposed to 85 decibels (dBA). The SLM will be calibrated before and after each use, using an acoustical calibrator with a known decibel level output.

10.2.2 Confined Space Monitoring

The excavation pit in Phase I may be a confined space, depending on the depth and other conditions of the pit. The enclosure used in Phase II is considered to be a confined space. Initial monitoring of the spaces with a 3 in 1 meter (oxygen, combustible gas, hydrogen sulfide) will take place to sufficiently assess the conditions of the space. Other factors will also be assessed (e.g., access, egress, depth, etc.) to determine safety and applicability to confined space regulations. The following action levels are associated with the 3 in 1 meter measurements during an initial survey:

- Oxygen: The trench will not be entered if the oxygen concentration is less than 19.5%;
- Combustible gas: The trench will not be entered if the combustible gas concentration is greater than 10% of the LEL; and
- Hydrogen sulfide: The trench will not be entered if the hydrogen sulfide concentration is greater than 10 ppmv (OSHA Ceiling value is 20 ppmv), unless EPA Level B is worn.

10.2.3 Site Perimeter / Community Monitoring

A baseline air monitoring program will be conducted in the community prior to the start of excavation during Phase I. In addition, time-integrated air sampling over an 8-10 hr period at the work site perimeter (one site downwind of the trench) and in the community will be conducted during Phase I for following compounds:

- Reduced sulfur compounds (RSC) and VOCs using SilcoCan™ canisters;

- Semi-volatile organic compounds (SVOCs) in particular the polynuclear aromatic compounds (PAHs) using high volume sampling and XAD-2 resin; and

- Heavy metals using high volume sampling and a size selective inlet.

During Phase II, a perimeter monitoring program will be performed. The details of this program will be developed once the Phase I monitoring results have been reviewed. However, as a minimum, Table 10-0 depicts action levels and responses to organic vapor concentrations outside of the remediation structure and perimeter.

Table 10-0. Chemical Hazard Criteria and Response Guide for VOCs-Perimeter

Response Level	PID Total Organic Vapor Concentration	Response
1	<5 ppm above background	➢ Continue periodic PID readings.
2	≥5 ppm above background for more than two minutes	➢ If instantaneous PID readings exceed 5 ppm above background, initiate colorimetric tube screening for benzene. ➢ If colorimetric tube confirms presence of >1 ppm benzene, take a PID measurement at least once every 30 minutes. ➢ If colorimetric tube result is <1 ppm, continue monitoring with PID.
3	N/A	➢ If colorimetric tube result in response level #2 is >1 ppm for benzene, take another sample for confirmation, if confirmed, then stop work and cover excavated materials. If total PID reading exceeds 25 ppm, regardless of benzene reading, also stop work and cover excavated materials. Notify OCD and initiate corrective actions.

10.2.4 General Monitoring Considerations

All monitoring results shall be recorded on a daily basis. Copies of the data sheets shall be included in the daily safety log. Monitoring data sheets shall include:

- Date and time of monitoring;
- Monitoring location;
- Instrument type, model number, and serial number;
- Calibration/background levels;
- Monitoring results;
- Interpretation of the data; and
- The SSS's signature.

Site personnel shall inform the SSS of any changes in the odor characteristics of the site areas. For instance, if someone detects an odor that is persistent and/or intensifying in strength, they are to notify the SSS. All claims will be investigated, typically by monitoring for hydrogen sulfide and organic vapors taking note of the changes in the odor characteristics (e.g., pungent, acrid, fuel-like, etc.). The SSS will initially document the results of real-time air monitoring every 15 minutes. This frequency can be reduced or increased at the discretion of the SSS as conditions warrant.

10.3 ACTION LEVELS

Table 10-1 contains a list of the chemicals found in crude oil that will be monitored, and their OSHA permissible exposure limits (PELs). The OSHA PEL is an exposure limit for airborne contaminants and represent the average exposure concentration in air that should not be exceeded over any continuous 8-hr period (except for H_2S). If daily average exposure for workers by inhalation could exceed these values, proper respiratory protection will be required. Details regarding the health effects of these chemicals are presented in the Material Safety Data Sheets (MSDSs) in Appendix B.

Table 10-1. Chemical Hazards

Constituent	PEL (ppm)
Benzene	1.0
Toluene	200
Ethylbenzene	100
Xylenes	100
Mercury	0.012
Hydrogen Sulfide (15 minute std.)	20

Only a few compounds emitted from the crude oil are expected to be found in detectable concentrations, especially since this is a highly weathered spill. Even when detected, those substances are expected to be in low concentrations. The potential chemicals of concern (COC) are volatile organic compounds (VOCs), mercury, hydrogen sulfide, and methane. Of these chemicals, aromatic BTEX (benzene, toluene, ethyl benzene, and xylenes) are of most concern from a toxicity perspective at this site.

To be protective of worker and public health, action levels have been established for the site to ensure that the average ambient concentrations of the compounds of concern remain well below the OSHA PELs.

10.3.1 Work Place Action Levels

Tables 10-2 through 10-7 present chemical or physical hazard criteria and a response guide that will serve as the basis for abatement actions and PPE selection during the remedial activities. Monitoring at active work locations will primarily be performed at employee breathing zones and the work location perimeter. Changing levels of protection, upgrading respiratory protection, or changing work practices is based on maintaining the upper limit of the action level for approximately 1 to 5 minutes (i.e., a non-transient reading) or at the discretion of the SSS. If changes are required, the SSS will document the changes using the Field Change Form. This will include both upgrades and downgrades to the posted protection levels.

The purpose of the real-time monitoring is to alert on-site personnel to the presence of elevated (above background) levels of organic vapors at the work site with the potential for occupation exposure to workers on-site or for the release and migration of vapors that could cause an odor in the adjacent community. The objective is to control vapor emissions such that vapor concentrations at the excavation site do not exceed 5 ppmv and vapor concentrations at the work site perimeter do not exceed 1.0 ppmv. The sensitivity of the PID instrument is 0.1 ppmv and this is sufficient for this task. If persistent (30-

seconds) real-time (instantaneous) measurements of total hydrocarbon levels on the PID instrument exceeds 5 ppmv at the breathing zone of workers nearest the excavation or excavation spoils, corrective action will be taken to decrease the emissions, prevent worker exposure and prevent migration of organic vapors into the community.

If real-time instrumentation indicates the presence of VOCs at concentrations above the action levels, then a survey of the area will be performed for benzene using colorimetric tubes or their equivalent. The elevated concentrations of total hydrocarbons may indicate the presence of potentially hazardous levels of BTEX. If such levels are encountered, engineering controls to reduce benzene will be used.

In the event that the corrective action criterion for total hydrocarbon vapors or other contaminants is exceeded, the following actions will take place. The decision of corrective action will be the decision of the Site Safety Supervisor.

- Stop or slow digging of soils;
- Cover-up all piles and exposed contaminated soils with:
    - -- Polyethylene plastic,
    - -- Foam, or
    - -- Water
- Continue to monitor area for exposure with the TVA-1000; or
- Don proper respiratory protection (see Appendix D).

Table 10-2. Chemical Hazard Criteria and Response Guide for VOCs-Site Workers

Response Level	PID Total Organic Vapor Concentration	Response
1	<5 ppm above background	➢ Modified Level D PPE. Continue periodic PID readings.
2	≥5 ppm above background for more than two minutes	➢ If PID readings exceed 5 ppm above background, initiate colorimetric tube screening for benzene. ➢ If colorimetric tube confirms presence of >1 ppm benzene or PID reading exceeds 25 ppm, upgrade to modified Level C PPE[1] and take a PID measurement at least once every 30 minutes. ➢ If colorimetric tube result is <1 ppm, continue working in Modified Level D PPE. Monitor with PID.
3	N/A	➢ If colorimetric tube result is >1 ppm for benzene, stop work and cover excavated materials. Notify OCD and initiate corrective action. Don full or half-face respirators until corrective actions bring the concentration of benzene to an acceptable level. Prove this by monitoring the area until the PID measures <5 ppm and colorimetric tube result is <1 ppm.

[1] Modified Level C PPE—includes use of a half-face respirator or greater.

All measurements will be made at worker breathing zones.

Table 10-3. Action Levels for Hydrogen Sulfide (H_2S)

Action Level	Time Period	Monitoring Location	Required Action
1 ppm	(2) consecutive 1-min averages	Site Perimeter	Notify site engineer. Suspend site activities until data are reviewed and corrective measures considered.
5 ppm	2) consecutive 1-min averages	Site Perimeter	Notify site engineer. Suspend site activities until data are reviewed and corrective measures considered.
10 ppm	2) consecutive 1-min averages	Work Zone[a]	Notify health & safety officer. Upgrade to Level B - PPE for affected workers.
>50 pm	2) consecutive 1-min averages	Work Zone[a]	Notify health & safety officer. Evacuate and apply engineering controls to lower emissions.

a - Monitoring will be performed immediately downwind of the work zone, as close as is feasible (e.g., 10-20m downwind).

All worker exposure measurements will be made at worker breathing zones.

Note: For comparison:
OSHA 8-hr PEL = N/A
OSHA TWA-C (15-min) = 20 ppm
OSHA peak (10-min) = 50 ppm
IDLH = 100 ppm

Table 10-4. Action Levels for Mercury (Hg)

Action Level	**Time Period**	**Monitoring Location**	**Required Action**
5 ppb (0.042 mg/m^3)	(2) consecutive 1-min averages	Site Perimeter	Notify site engineer. Suspend site activities until data are reviewed and corrective measures considered.
10 ppb (0.083 mg/m^3)	(2) consecutive 1-min averages	Site Perimeter	Notify site engineer. Suspend site activities until data are reviewed and corrective measures considered.
12 ppb (0.1 mg/m^3)	(2) consecutive 1-min averages	Work Zone[a]	Notify health & safety officer. Upgrade to Level C - PPE for affected workers (i.e., use of ½ face respirators with appropriate cartridges).
>50 ppb (0.42 mg/m^3)	(2) consecutive 1-min averages	Work Zone[a]	Notify health & safety officer. Apply engineering controls to lower emissions.

a - Monitoring will be performed immediately downwind of the work zone, as close as is feasible (e.g., 10-20m downwind).

All worker exposure measurements will be made at worker breathing zones.

Note: For comparison:
OSHA 8-hr PEL = N/A
OSHA TWA-C (15-min) = 0.1 mg/m^3 (0.012 ppm)
IDLH = 10 mg/m^3 (1.2 ppm)

Table 10-5. CGR/ Oxygen Action Levels

Meter Response	Action
Normal Site Activities within Exclusion Zone	
CGI response 0% - 10% LEL	Continue normal operations
CGI response >10% and <20% LEL	Eliminate all sources of ignition from the work area; implement continuous monitoring
CGI response >20%	Discontinue operations; allow to vent
Confined Space Entry	
CGI response 0% - 10% LEL	Continue normal operations
CGI response >10% and <20% LEL	Eliminate all sources of ignition from the work area; implement continuous monitoring; add mechanical ventilation
CGI response >20%	Discontinue operations; retreat from work area; allow to vent
Oxygen level <19. 5%	Retreat from work area*
Oxygen level >23.5%	Retreat from work area*

* If retreat becomes necessary, the SSS will be consulted in regard to upgrading to Level B respiratory protection, adding mechanical ventilation, or possible changes in work practices.

Table 10-6. Dust Action Levels

Meter Response	Action
Respirable dust level >2.5 mg/m^3	Continue normal operations
Respirable dust levels between 2.5 and 5 mg/m^3	Implement wetting of soils within active work area
Respirable dust levels >5 mg/m^3	Upgrade to Level C (including respiratory protection); continue wetting of soils within active work area
Site perimeter dust levels downwind 0.15 mg/m^3 or more higher than upwind levels	Implement wetting of soils within site perimeter

Table 10-7. Noise Action Levels

Meter Response	**Action**
SLM response < 85 dBA	Proceed with periodic monitoring
SLM response > 85 dBA but <105 dBA	Hearing protection consisting of ear plugs is required
SLM response >105 dBA	Hearing protection consisting of ear plugs plus ear muffs is required

10.4 HEAT STRESS MONITORING

Whenever the air temperature exceeds 70 °F, the SSS will assess conditions that may cause heat stress in site workers wearing protective clothing. Other personnel will be assessed at 90 °F. Work-rest regiments for scheduled activities conducted in permeable clothing will be based on published ACGIH standards. Work-rest schedules for operations conducted in impermeable clothing, including poly-coated and Saran-coated chemical protective wear, will be needed to be more conservative.

All site workers exhibiting any symptoms of heat related illness or on request will be monitored using one or more of the following techniques:

- Heart rate method: Take radial pulse for 30 seconds and multiply by 2. If rate exceeds 110 beats/minute, shorten the work cycle by one third while the rest period remains constant.
- Oral temperature method: Measure oral temperature or use ear scans at the beginning of the rest period. If temperature exceeds 99.6 °F, shorten the work cycle by one third. Workers whose temperatures exceed 100.4°F are not permitted back into the work area
- Body weight method: Check body weight before and at the end of the work shift. If weight loss is greater than 1.5% of the total weight, the individual should be hydrated by fluid intake.

The frequency of monitoring is shown in Table 10-8.

10.5 COLD STRESS MONITORING

Whenever the air temperature falls below 40 °F, the temperature and wind speed will be measured and recorded at least every four hours to assess conditions which may cause cold stress in site workers. All workers who are exposed to temperatures at or below –10 °F with wind speeds of less than 5 miles per hour will be medically certified as suitable for such exposure. The work/warming regimen located in the ACGIH's 1999 Threshold Limit Values for Chemical Substances and Physical Agents and Biological

Table 10-8. Suggested Frequency of Physiological Monitoring for Fit and Acclimatized Workers[a]

Adjusted Temperature[b]	Normal Work Ensemble[c]	Impermeable Ensemble
90°F (32.2°C) or above	After each 45 minutes of work.	After each 15 minutes of work.
87.5°-90°F (30.8°-32.2°C)	After each 60 minutes of work.	After each 30 minutes of work.
82.5°-87.5°F (28.1°-30.8°C)	After each 90 minutes of work.	After each 60 minutes of work.
77.5°-82.5°F (25.3°-28.1°C)	After each 120 minutes of work.	After each 90 minutes of work.
72.5°-77.5°F (22.5°-25.3°C)	After each 150 minutes of work.	After each 120 minutes of work.

[a] For moderate or greater work levels (250 kilocalories/hour).

[b] Calculate the adjusted air temperature (ta adj) by using the following equation:
ta adj°F=ta°F+(13 x %sunshine). Measure air temperature (ta) with a standard mercury-in-glass thermometer, with the bulb shielded from radiant heat. Estimate percent sunshine by judging what percent of the time the sun is not covered by clouds that are thick enough to produce a shadow. (100% sunshine=no cloud cover and a sharp, distinct shadow; 0 percent sunshine=no shadows.)

[c] A normal work ensemble consists of cotton coveralls or other cotton clothing with long sleeves and pants.

Exposure indices will be used to prevent cold stress injuries. Refer to Section 12 for cold stress first aid procedures.

10.6 PERSONAL EXPOSURE MONITORING

The intent of this monitoring program is to document potential exposures to site personnel. The air monitoring results may also be used to evaluate the effectiveness of the action levels or PPE required. Personal exposure monitoring may be performed during Phase II of the project, depending on the results of the Phase I monitoring program. If implemented, the personnel who will be monitored shall be performing intrusive activities; these employees would typically have the greatest potential for air contaminant exposure. If possible, sampling will be performed when working in an area of known contamination. Personnel monitoring potentially will be conducted according to the following schedule:

- Two rounds of sampling collected during the first week of excavation activities.
- One round of sampling collected during each additional week of any additional intrusive activity.

Sampling and analytical procedures used during personnel monitoring will comply with those procedures published in NIOSH's Manual of Analytical Methods (Fourth Edition, 1994) and good industrial hygiene practices. The parameters to be measured will be selected based on the Phase I monitoring results. Any personnel monitoring will be performed using the following methods:

Compound	Sample Media	NIOSH Method
Benzene	Charcoal sorbent tube	NIOSH 1500
Toluene	Charcoal sorbent tube	NIOSH 1500
Ethylbenzene	Charcoal sorbent tube	NIOSH 1501
Xylene	Charcoal sorbent tube	NIOSH 1501
Benzo(a)anthracene	Zefluor PTFE Filter with XAD-2 tube	NIOSH 5506 or 5515
Benzo(b) fluoranthene	Zefluor PTFE Filter with XAD-2 tube	NIOSH 5506 or 5515
Benzo(a)pyrene	Zefluor PTFE Filter with XAD-2 tube	NIOSH 5506 or 5515
Chrysene	Zefluor PTFE Filter with XAD-2 tube	NIOSH 5506 or 5515
Dibenz(a,h)acridine	Zefluor PTFE Filter with XAD-2 tube	NIOSH 5506 or 5515
Dibenz(a,h)anthracene	Zefluor PTFE Filter with XAD-2 tube	NIOSH 5506 or 5515
Chromium	0.8 μm pore mixed cellulose ester filter cassette	NIOSH 7300

Personnel samples will be collected using personal air sampling pumps or passive dosimeter badges. Air sampling pumps used to collect personnel monitoring samples will be calibrated before and after use each day. Calibration will be performed using a primary calibration system, such as the bubble tube method. Results of the calibration will be included with the employee assessment report.

An analytical laboratory accredited by the American Industrial Hygiene Association (AIHA) will perform all sample analysis. Samples collected for VOCs will be analyzed using gas chromatography with a flame ionization detector (GC-FID). Samples collected for SVOCs will be analyzed by either GC-FID or high-pressure liquid chromatography with an ultraviolet detector (HPLC-UV). Samples collected for metals will be analyzed using inductively coupled plasma/atomic emission spectroscopy (ICP-AES).

Results of personnel sampling will be provided to the employee, in writing, within 15 days after the receipt of laboratory reports. Reports to employees will provide calculated time-weighted average (TWA) exposures and comparative information relative to established permissible exposure limits (PELs) and/or threshold limit values (TLVs). A copy of the employee exposure assessment report will be included in the project file and the employee's permanent records.

11.0 PERSONAL HYGIENE AND DECONTAMINATION

11.1 CONTAMINATION PREVENTION

One of the most important aspects of decontamination is the prevention of contamination. Good contamination prevention should minimize worker exposure and help ensure valid sample results by precluding cross-contamination. Procedures for contamination prevention for personnel include:

- Do not walk through areas of obvious or known contamination.
- Do not handle or touch contaminated materials directly.
- Make sure all PPE is free of cuts or tears before donning.
- Fasten all closures on suits, covering with tape if necessary.
- Particular care should be taken to protect any skin injuries. If open wounds exist on hands or forearms, handling contaminated materials or samples should be restricted.
- Stay upwind of airborne contaminants.
- Do not carry cigarettes, gum, chewing tobacco, cosmetics, etc., into potentially contaminated areas.

Procedures for contamination prevention for equipment include:

- Take care to limit the amount of contamination that comes in contact with heavy equipment.
- If contaminated tools are to be placed on non-contaminated equipment for transport, use plastic to keep non-contaminated surfaces clean.

11.2 PERSONNEL DECONTAMINATION

A personnel decontamination station will be set up at the entrance of the CRZ. All site personnel exiting the EZ will pass through the CRZ decontamination station to wash outer boots and gloves (if worn), remove any used PPE, and clean their respirators (if worn).

To reduce the volume of decontamination water generated, protective clothing (excluding reusable coveralls) may be discarded, instead of cleaned and reused. The generation of decontamination water should be minimized whenever possible. The following nine steps will be taken for personnel decontamination when site personnel exit the EZ through the CRZ. The decontamination setup is subject to modification by the SSS.

- Deposit all equipment and tools used in the EZ onto plastic sheeting or into containers.
- Scrub outer boots and any soiled PPE (i.e., outer gloves, Tyvek) thoroughly with a soapy wash solution and a scrub brush. Rinse off boots and PPE.
- Remove any tape from around boots and sleeves and dispose of in a plastic-lined drum.

- Remove disposable protective suit (inside out), if worn, and dispose of in a plastic-lined drum.
- Remove outer over-boots, if worn, and dispose of in a plastic-lined drum.
- Remove outer gloves and dispose of in a plastic-lined drum.
- Remove respirator.
- Remove inner gloves (inside out) and dispose of in a plastic-lined drum.
- Proceed to SZ to thoroughly wash face, neck, hands, and forearms (or shower) before eating, drinking, smoking, or using the rest room.

Equipment and supplies needed for the personnel decontamination station include:

- Plastic sheeting;
- Wash tubs for boot wash and rinse;
- Detergent/water solution (non-phosphate detergent);
- Respirator sanitizer/cleaner;
- Plastic tubs for respirator wash and rinse;
- Long-handle soft bristle scrub brushes for boot wash;
- Small, soft-bristle scrub brush for respirator wash;
- 55-gal drums or trash cans; and
- Plastic drum liners.

Personnel decontamination procedures to be used in the event of an emergency are outlined in Section 12 of this HASP.

11.3 EQUIPMENT DECONTAMINATION

All equipment and tools will be cleaned before site entry to remove grease, oil, dirt, or any other off-site materials. The Project Manager or SSS will inspect the equipment before approving the items for use on-site. The Project Manager or SSS will also be responsible for inspecting all items for adequacy of decontamination before removal off-site. Equipment within the EZ or CRZ will be decontaminated before maintenance is performed.

11.3.1 Decontamination Pad

During Phase II of the project, a temporary decontamination pad will be constructed to allow decontamination of equipment without release of wastewater. Equipment and vehicles will be driven onto the decontamination pad, and the proper wash and rinse steps will be followed. Features of the decontamination pad include:

- An adequate working area and surface will be used to minimize slip/trip/fall hazards.
- Water used in decontamination will drain to a collection basin.
- The upper sections of the decontamination pad will be enclosed with plastic sheeting, if necessary, to control dispersion of spray (overspray) from the pressurized power washer.
- Decontamination water will be stored in accumulation tanks.
- All equipment used in the EZ or CRZ will be decontaminated before leaving the site.

11.3.2 Small Equipment Decontamination

The following steps will be taken when decontaminating small equipment:

- Wrap small equipment such as shovels, picks, chisels, hammers, etc. in plastic sheeting.
- Transport the small equipment from the EZ or CRZ to the decontamination pad.
- Wash small equipment with pressurized water spray (i.e., "orchard sprayer").
- Scrub small equipment with soapy water using brushes and a phosphate-free soap.
- Rinse small equipment with potable water.
- Place small equipment on clean plastic sheeting and allow it to air dry.

11.3.3 Sampling Equipment Decontamination

The following steps will be taken when decontaminating sampling equipment:

- Transport the sampling equipment to the decontamination station. Sampling equipment decontamination may be performed in the CRZ.
- Wash and scrub sampling equipment with soapy water using small, soft bristle brushes and a phosphate-free soap.
- Rinse sampling equipment with potable water.
- Place sampling equipment on clean plastic sheeting and allow it to air dry.

11.3.4 Heavy Equipment Decontamination

The following steps will be taken when decontaminating large equipment:

- Before exiting the EZ, use dry decontamination methods of scraping, brushing, and wiping.
- Transport large equipment, such as dredge and forklift, from the EZ or CRZ to the decontamination pad.
- Wash heavy equipment with pressurized water spray (i.e., power washer).
- Scrub small equipment with soapy water using brushes and a phosphate-free soap.
- Rinse large equipment with water.
- Move heavy equipment onto clean plastic sheeting and allow it to air dry.

11.4 DISPOSITION OF DECONTAMINATION WASTE

Used PPE will be collected in plastic trash bags and disposed of in an appropriate container. Solid waste will be disposed of appropriately based on the sample analyses results. It is expected that wastewaters generated during this project will have negligible levels of contamination. All wastewater will be collected in accumulation tanks and eventually sent to the local wastewater treatment system. If necessary, wastewater will be tested for contamination prior to disposal. All decontamination wastewater will be disposed of at an NMOCD approved disposal facility. Shell personnel and subcontractors will take precautions to prevent contaminated water draining into local soils.

12.0 EMERGENCY RESPONSE PLAN

This section provides information regarding the actions to be taken if an emergency situation develops. In the event of an emergency, the SSS, Project Manager, or Project Director is authorized to stop work. This Emergency Response Plan will be implemented whenever conditions at the site warrant an emergency response. The Project Director has overall authority for the implementation of this Emergency Response Plan. This authority can be delegated to the SSS, who will be present on-site during all site activities.

12.1 PRE-EMERGENCY PLANNING

When an emergency occurs, decisive action is required. Decisions must often be made immediately, and personnel must be ready to immediately respond to an emergency. For this purpose, pre-emergency planning is an essential part of each project's Emergency Response Plan. Pre-emergency planning tasks will be developed and established before site work begins. Pre-emergency planning for this project includes the following tasks:

- Development and approval of this Emergency Response Plan;
- Coordination of the Emergency Response Plan with local health and emergency response agencies;
- Training of site personnel in appropriate emergency procedures;
- Maintaining emergency response equipment on-site, such as fire extinguishers, first aid supplies, and spill response equipment;
- Conducting an emergency response practice drill during site mobilization and before site activities begin; and
- Modification of the Emergency Response Plan, if necessary, as work progresses.

12.2 TYPES OF EMERGENCIES

On a day-to-day basis, all site personnel should be constantly alert for indicators of potentially hazardous or emergency situations. Rapid recognition of a dangerous situation can avert an emergency. Rapid response during an emergency may mitigate or contain the incident. Several types of emergency situations could occur during site activities. These emergency situations include:

- Fire or explosion,
- Personnel injury or illness,
- Hazardous substance spill or release, and
- Adverse weather conditions.

The remaining sections of this Emergency Response Plan provide information and procedures to be followed if any of these emergencies occur.

12.3 RESPONSE PRIORITIES AND PROCEDURES

The following outline provides guidance in prioritizing emergency response action and provides general response procedures to be followed.

First Priority: Prevent further injury or illness by:

- Protecting response personnel and community;
- Isolating the scene to authorized personnel only;
- Notifying emergency response personnel; and
- If possible, rescuing any injured parties.

Second Priority: Provide first aid to those persons with life-threatening injuries or illnesses.

Third Priority: Alleviate the immediate hazards by:

- Extinguishing incipient stage fire,
- Reducing chemical releases, and
- Containing any spill.

12.4 EVACUATION ROUTES AND PROCEDURES

In the unlikely event of a severe emergency, such as a large fire, explosion, or large chemical release, site evacuation may become necessary. The SSS will be responsible for informing site personnel of the anticipated routes of evacuation during the morning safety briefings. The evacuation route and assembly area will correlate to the wind direction, topography, and the nature of the incident. Personnel will be advised to move to an upwind location at least 100 yards from any fires and/or releases, and will be advised to continually monitor wind direction for changes. If moving upwind is not possible without encountering the incident, personnel will be advised to move cross wind or downwind to a distance necessary to be out of the path of vapor releases, smoke, odors, or spills. If site evacuation becomes necessary, the following procedure will be used:

- Site personnel are notified of an emergency evacuation via an air horn signal or verbal command. All site personnel will *immediately* stop work.
- All site personnel will evacuate the work area as quickly as possible and assemble at a location at least 100 yards upwind of the incident or as instructed during the morning safety briefing.
- The SSS will be responsible for roll call.
- The SSS will contact emergency response personnel once all site personnel have been accounted for during roll call.
- The SSS will ensure that emergency apparatus have adequate site access.

- The SSS will ensure that all combustion equipment has been shut down.
- All site personnel assembled at the designated safe evacuation area will wait for further instructions from emergency response personnel.

12.5 EMERGENCY MEDICAL TREATMENT AND FIRST AID

Local paramedics will administer all emergency medical treatment, other than first aid. Table 12-1 lists site-specific emergency telephone numbers for this project. All first aid will be administered on-site by the SSS, who is certified in CPR and first aid. Physician-approved first aid supplies will be kept in the SZ/CRZ. All vehicles used to transport injured persons to the off-site medical facility will be provided with directions and a map to the medical facility. Additionally, the SSS will accompany the victim to the medical facility.

Site personnel will complete a Medical Data Sheet during the site-specific safety training. Medical Data Sheets will be kept in the on-site health and safety file and will be referenced in an emergency to assist with the treatment of the victim. The SSS will supply the victim's Medical Data Sheet to emergency response personnel and will accompany the victim to the hospital. Before returning to work after a disabling injury/illness or loss of consciousness, the employee must present a medical release from the attending physician to the SSS.

12.6 ROUTE TO HOSPITAL

The nearest hospital is Columbia Lea Regional Medical Center, located at 5419 N. Lovington Hwy., Hobbs, New Mexico 88240. It is approximately 4 miles north of the Westgate subdivision. Figure 12-1 illustrates the route to the nearest hospital from the site.

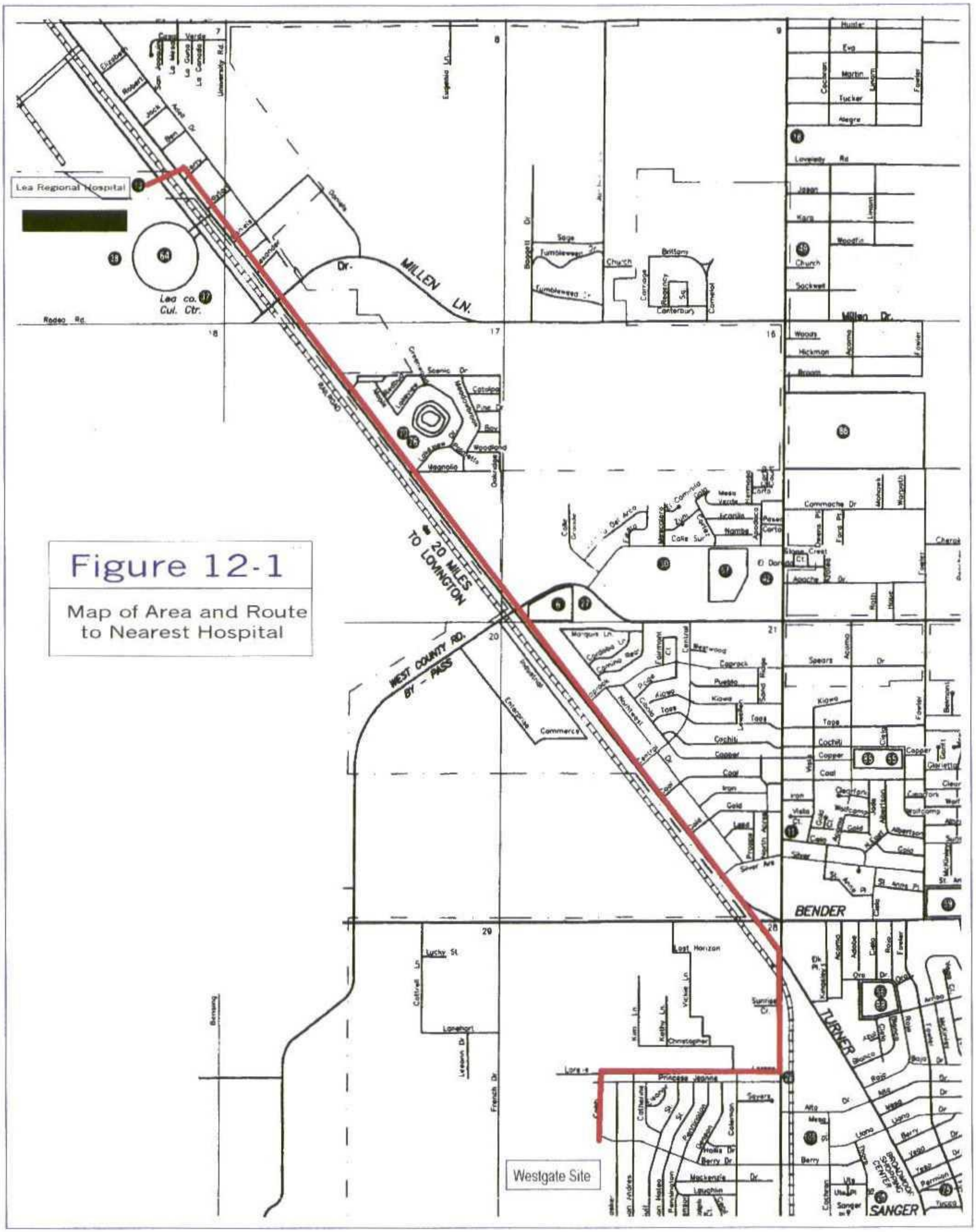
12.7 CHEMICAL EXPOSURE

In case of accidental overexposure to a hazardous material, the following guidelines will be used:

Type of overexposure	First aid guidelines
Skin contact	Skin: Wash/rinse the affected area thoroughly with copious amounts of soap and water. Eyes: Eyes should be rinsed for at least 15 min following chemical contamination. Contact emergency response personnel, if required, or transport victim to the hospital.
Inhalation	Move the victim to fresh air. Contact emergency response personnel, if required, or transport victim to the hospital.
Ingestion	Contact Poison Control Center. Contact emergency response personnel, or transport victim to the hospital.

Table 12-1. Site emergency telephone numbers

BBC International, Inc.	(505) 397-6388
Hobbs Fire Department	(505) 397-9308
Emergency Medical Service (for life-threatening emergencies)	911
Colombia Lea Regional Medical Center	(505) 492-5000
Poison Control Center	(800) 764-7661
National Response Center (*environmental emergencies only*)	(800) 424-8802
The following personnel shall be notified that an incident has occurred:	
Site Safety Supervisor: To be announced	work:
Project Director: Wayne A. Hamilton	work: (281) 544-2322
Project Manager: Cliff P. Brunson	work: (505) 397-6388
Federal OSHA Hot Line	(800) 321-6742



[redacted]

Figure 12-1. Map of Area and Route to Nearest Hospital

12.8 DECONTAMINATION DURING A MEDICAL EMERGENCY

For minor medical problems or injuries, regular decontamination procedures will be followed. If emergency, life-saving first aid and/or medical treatment is required, regular decontamination procedures may need to be abbreviated or omitted.

- Do not attempt to wash or rinse the victim, unless the victim has been contaminated with an extremely toxic or corrosive chemical that may cause injury or loss of life to emergency response personnel.
- Outer garments can be removed if it does not cause a delay, interfere with treatment, or aggravate the problem.
- PPE can be cut away, and respiratory protective equipment must always be removed.
- If contaminated clothing cannot be safely removed, the victim should be wrapped in a blanket or plastic sheeting to prevent the contamination of the inside of the ambulance and/or emergency response personnel.

The SSS will accompany the contaminated victim to the hospital to advise the medical staff of the type of contamination.

12.9 SMALL OR INCIPIENT FIRE

A small fire is defined as a fire that can be extinguished with an available 20-lb type ABC fire extinguisher. An incipient fire is a fire that is small because it has just started. In the event of a small or incipient fire, the following minimum actions will be taken:

- Evacuate nearby personnel from the area, if possible, to an upwind location or to an area not affected by smoke or hazardous decomposition products if an upwind location is not feasible.
- Attempt to extinguish fire using portable fire extinguisher or by smothering.
- Contact emergency response personnel, as needed, for any injuries or exposures to hazardous decomposition products.
- After the fire has been extinguished, or emergency response personnel have been contacted, notify the Shell Project Director.

12.10 LARGE FIRE OR EXPLOSION

An explosion, large fire, or a small fire that cannot be extinguished is beyond the first line capabilities of on-site personnel. Examples of potential fire hazards that theoretically could occur during this project include carbon bed fires and equipment refueling fires. Professional emergency response personnel would be needed to provide emergency assistance for these types of incidents. In the event of a large fire, explosion, or a small fire that cannot be extinguished, the following minimum actions will be taken:

- Evacuate *all personnel* from the site, if possible, to an upwind location or to an area not affected by smoke or hazardous decomposition products if an upwind location is not feasible.

- Perform a quick role call to account for all site personnel.

- Contact the fire department.

- Contact emergency response personnel, as needed, for any injuries or exposures to hazardous decomposition products.

- After emergency response personnel have been contacted, notify the Shell Project Director.

12.11 HAZARDOUS SUBSTANCE SPILL OR RELEASE

Hazardous substance spill or release situations may all be different due to the way the incident occurred, how hazardous the substance may be, and how much has been spilled or released. If a hazardous substance spill or release occurs (e.g., diesel fuel), the following steps will be taken:

- Evacuate site personnel, if necessary. Follow the evacuation sequence outlined in Sect. 12.4.

- Determine the source of leak or release.

- Determine the approximate volume of the leaked or released substance and identify the contaminants involved.

- Contact emergency response personnel to inform them of the possible need for assistance.

- Don appropriate PPE.

- Secure the spread of the spill, if possible, using one of the following methods of containment:
  - Patch and plug;
  - Sorbent materials such as clay, saw dust, absorbent pillows, sheets, or rolls;
  - Diking; and/or
  - Damming with soil, straw bales, or sandbags.

- After the spill/release has been contained, or emergency response personnel have been contacted, notify the Project Director.

If necessary, the local emergency response divisions will alert the National Response Center.

12.12 ADVERSE WEATHER CONDITIONS

In the event of adverse weather conditions, the SSS and Project Manager will determine whether work can continue without sacrificing the health and safety of site personnel. Some of the conditions to be considered by the SSS include:

- Potential for heat or cold stress,

- Limited visibility,

- Electrical storms, and

- Treacherous weather-related working conditions (heavy rainfall, wet conditions causing slippery footing hazards, etc.).

In the event weather conditions present an unsafe environment to workers at the site, the workers will be instructed to:

- Shut down all power equipment,

- Exit through the CRZ in accordance with the established decontamination procedures; and

- Evacuate to the field break trailer or other shelter as directed by the SSS.

12.13 FIRST AID FOR HEAT STRESS

First aid treatment for *heat cramps* includes shade, rest, and fluid replacement. If available, the individual should drink electrolyte replacement fluids (e.g., Gatorade, Power Aid, 10-K). The individual should recover within half an hour.

First aid treatment for *heat exhaustion* includes cooling the victim, elevating the feet, and fluid replacement. If the individual has not recovered within half an hour, transport the victim to the hospital for medical attention.

Heat stroke is a *medical emergency*, requiring the immediate cooling of the victim, and transport to the hospital for medical treatment immediately.

12.14 FIRST AID FOR COLD STRESS

Relocate the individual out of the cold environment. Have the individual remove any wet clothing and replace it with dry. Allow the body to rewarm itself. If areas of the skin redden (light skin) or lighten (dark skin) and look blanched, the individual may have superficial frostbite in the affected area. Have the individual apply the warmth of their own hands or blow warm air over the sight. Place fingers under the armpit and hold. The individual should begin to feel tingling or burning sensations, which are normal. For true frostbite, the shin appears white and waxy and turns mottled or blotchy, then to grayish blue. Transport to the hospital or call 911.

12.15 SNAKE, SPIDER, OR INSECT BITES/STINGS

The bite of a rattlesnake is extremely painful and swells rapidly. Weakness, sweating, faintness, nausea, tender lymph nodes, and tingling or numbness of the tongue, mouth, or scalp are common. The most important step is to get the victim to the hospital quickly. In the meantime, take the following first aid measures:

- Keep the victim from moving around.
- Keep the victim as calm as possible and preferably lying down.
- Immobilize the bitten extremity and keep it at or below the heart level.
- Treat for shock. Keep the victim lying down and comfortable. Maintain body temperature.
- If breathing stops, give mouth-to mouth resuscitation. If breathing stops and there is no pulse, perform CPR.
- Identify the snake. If the snake can be killed without risk or delay, bring it to the hospital for identification. Use extreme caution when handling the snake, even when presumed dead.
- Wash the area of the bite with soap and water. Blot dry with sterile gauze.
- Do not give alcohol, sedatives, aspirin, or any medicine containing aspirin.
- Cold therapy is not recommended.

Signs of spider bites are similar to those of other sudden illnesses. The signs include:

- Nausea or vomiting,
- Difficulty breathing or swallowing, and/or
- Sweating or salivating more than normal.

A spider bite may also be suspected when there is also severe pain in the bite area, a mark indicating a possible bite, or swelling of the area. In the event of a spider bite emergency:

- Wash the wound,
- Apply a cold pack, and
- Contact emergency response personnel immediately.

Anti-venoms are available for black widow spider bites.

If a site worker is bitten or stung by an insect:

- Remove the stinger. Scrape the stinger away from the skin with a fingernail, or credit card. Do not use tweezers. Tweezers may inject more venom from the sac.
- Wash the bite/sting area with soap and water.
- Cover the bite/sting area to keep it clean.
- Apply an ice pack to the bite/sting area to reduce any pain and swelling.
- Watch the victim for signs of an allergic reaction.

If a site worker finds a tick imbedded on the skin:

- Remove the tick immediately with fine-tipped tweezers (obtain tweezers and first aid kit from the site office trailer) by grasping the tick as close to your skin as possible and gently pulling straight out. Do not squeeze the tick's body as this may inject fluid into you.
- Wash the bit area with soap and water.
- Dry and apply antiseptic.
- Observe the skin area for rash, redness, or other signs that may require physical care.
- Destroy the tick by holding the tick in the tweezers and transferring to a plastic zip lock bag.

Emergency response personnel should be contacted in the event of an insect bite or sting:

- If the individual does not know what bit or stung him/her,
- If the individual has a history of allergic reactions to insect bites or stings,
- If the individual is bitten or stung on the face or neck, or
- If the individual begins to have difficulty breathing.

12.16 SITE SECURITY AND CONTROL

Site security will be the responsibility of the SSS and includes the control of entry or exit of personnel and equipment to the site in an emergency. The SSS will coordinate the arrival of any internal or outside emergency response personnel. Unauthorized persons will not be permitted to enter the site during an emergency incident.

12.17 EMERGENCY EQUIPMENT AND FIRST AID REQUIREMENTS

A supply of emergency PPE and equipment will be maintained on-site in sufficient quantities and locations to ensure an adequate supply for all emergency response personnel. All emergency equipment will be fully stocked and readily accessible. The following emergency supplies will be stored on-site:

- Industrial first aid kit, located in the SZ/CRZ;
- CPR mouth shield, located in the SZ/CRZ;
- Instant cold packs, located in the SZ/CRZ;
- Eye wash, located in the SZ and in the CRZ;
- Fire extinguishers, located:
  - At the entrance to the CRZ (minimum 40-B:C; maximum travel distance of 75 feet to the extinguisher),
  - In every site trailer (minimum 40-B:C),
  - In each piece of heavy equipment (minimum 10-B:C)
  - In each motor vehicle (minimum 10-B:C), and
  - Next to any flammable/combustible liquid or compressed gas storage area (minimum 40-B:C, located within 10 feet of the entrance).
- Face-shields;
- Polyvinyl chloride (PVC) coveralls;
- Regular and poly-coated Tyvek or other chemical resistant coveralls;
- Chemical resistant boot covers (latex);
- Chemical resistant outer gloves (nitrile);
- Solvent- and oil-absorbent pads and booms;
- Soap or waterless hand cleaner and towels; and
- American Red Cross First Aid and CPR Instruction Manuals.

13.0 STANDARD OPERATING SAFETY PROCEDURES, ENGINEERING CONTROLS, AND WORK PRACTICES

13.1 GENERAL SITE RULES

General site rules include the following.

- All site personnel will wear steel-toe safety shoes. A hard hat and safety glasses also will be worn when working in the vicinity of excavation or construction areas.
- The buddy system will be observed at all times in the EZ and CRZ.
- Entry into and exit from the site EZ and CRZ will only be permitted through designated access points, except during an emergency, or as authorized by the SSS.
- Personnel entering the EZ must wear the required PPE and must exit through the personnel decontamination station.
- No eating, drinking, smoking, or any other activity involving hand-to-mouth contact will be allowed in the EZ, CRZ, or before completing the personnel decontamination sequence (refer to Section 11.2).
- Facial hair that interferes with a respirator-to-face seal will not be permitted on personnel working in the EZ or CRZ.
- Never enter a confined space (including an excavation or trench) until the SSS confirms the atmosphere is safe. A confined space entry permit is required for each confined space entry.
- All site personnel who wear corrective lenses will provide their own prescription safety glasses and respirator optical inserts.
- Horseplay will not be tolerated.
- Matches and lighters are not permitted in the EZ or CRZ.

13.2 DRUM/CONTAINER HANDLING

All drums and containers used during site activities will meet the appropriate DOT, OSHA and EPA regulations for the waste that they will contain. Employees participating in activities involving drum or container use will be trained in the hazards associated with the drum activities. Activities on-site will be organized to minimize the amount of drum or container movement.

Where spills, leaks, or ruptures may occur, adequate quantities of spill containment supplies will be stationed in the immediate area. The spill containment supplies must be sufficient to contain and isolate the entire volume of hazardous substance in the drum or container. Refer to Sect. 12.11for details on emergency spill response procedures.

13.3 SANITATION

Sanitation facilities will be set up in accordance with 29 CFR 1926.51, including the following items:

- Drinking/potable water,
- Toilets,
- Washing/shower facilities and change rooms,
- Food service/eating and drinking areas,
- Waste disposal, and
- Vermin control.

14.0 ON-SITE RECORDKEEPING AND REPORTING

14.1 REQUIRED REFERENCES

The SSS will be responsible for ensuring the required reference material is available:

- Project HASP and any applicable addenda,
- OSHA 29 CFR 1910,
- OSHA 29 CFR 1926,
- A current ACGIH TLV booklet,
- A current NIOSH Pocket Guide to Chemical Hazards,
- Instruction manuals for all monitoring equipment,
- NIOSH/OSHA/USCG/EPA "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities,"
- American Red Cross First Aid and CPR Instruction Manuals, and
- Safety equipment catalogs.

14.2 REQUIRED RECORDKEEPING DOCUMENTATION

The following documentation must be kept on-site and readily accessible:

- OSHA Form 200 (Log and Summary of Occupational Injuries and Illnesses),
- MSDSs for all hazardous chemicals brought on-site by Shell and its subcontractors,
- a Site-Specific Respiratory Protection Program that meets the requirements of 29 CFR 1910.134 (Appendix D),
- Employee fit test records,
- OSHA-required training records for site workers,
- OSHA-required medical surveillance examination clearance records for site workers,
- Calibration records for all health and safety-related monitoring equipment,
- Health and safety logbook,
- Copies of any Employee Notification of Exposure forms,
- Copies of any Incident/Injury Reports,

- Copies of Daily Health and Safety Reports, and
- Signed statements of the HASP Compliance Agreement (Section 15).

14.3 TRAINING LOGS

Training log(s) will include initial site-specific safety training, daily on-site safety briefings, and visitor training. A record of the training will be documented on the Daily Health and Safety Report, which will be submitted to Shell's Authorized Representative. Appendix A contains a copy of the Meeting Attendance form. The training log will include the following information:

- Date,
- Employee's name and social security number (attendance check),
- Time allocation in training session,
- Training topic(s), and
- Trainer(s) signature.

14.4 DAILY HEALTH AND SAFETY REPORTS

The SSS will be responsible for completing a Daily Health and Safety report. Daily Health and Safety Reports will be available for review at any time. Appendix A contains the form used for the Daily Health and Safety Report. These reports will include:

- Date;
- Work areas checked;
- Employees present and their job assignment;
- PPE worn by employees;
- Accidents, incidents, near misses, or breaches of procedure;
- Equipment Inspection/Maintenance Reports;
- Record of training;
- Environmental and personnel exposure monitoring and sampling results;
- Employee and visitor register; and
- SSS signature.

The SSS has the option to incorporate completed logs/reports by reference into the Daily Health and Safety Report.

14.5 HEALTH AND SAFETY FIELD LOGBOOK

The SSS will maintain a logbook on-site in accordance with standard scientific record keeping procedures. Complete documentation of site activities will be maintained. The following information will be recorded on a daily basis:

- Site conditions (e.g., weather);
- Activities being performed;
- Personnel on-site and working in the EZ;
- Site visitors;
- Incidents, accident, and near misses;
- Violations of health and safety procedures; and
- Other significant events.

Site monitoring will also be documented in the health and safety logbook, including the following information:

- Monitoring equipment condition,
- Calibration records,
- Employees and work areas monitored, and
- Monitoring results.

The original health and safety logbooks will be kept in this project files.

14.6 OSHA 200 FORM

An OSHA 200 Form (Log and Summary of Occupational Injuries and Illnesses) will be kept in the on-site health and safety files. All recordable work-related injuries and illnesses will be recorded on this form within six days. At the end of the project, the OSHA 200 Form will be placed in the project files. Subcontractors must also meet the requirements of maintaining an OSHA 200 Form.

14.7 ACCIDENT/INCIDENT REPORTING

Upon receiving a report of an on-site incident, the SSS will investigate the circumstances surrounding the incident. The SSS will notify and provide a copy of the initial incident report to the Project Director (PD) within 24 hours of the occurrence, who will then initiate an internal accident investigation and assist in rendering corrective actions. The final incident report shall be issued to the PD within 72 hours. All employers (subcontracting companies) also must receive notification of occupational injuries/illnesses involving their employees. The accident/incident reporting procedure includes the steps shown in Table 14-1.

Table 14-1. Incident reporting process

1.	Incidents, accidents, and near misses will be reported verbally and in writing.		
2.	**If the incident or accident results in:**	**Then the SSS will verbally report:**	**And submit a written report:**
		Immediately to:	*Within 24 hours to:*
	• Fatality(s); • Hospitalization of three or more persons, or • Property damage >$50,000.	• Federal OSHA (within 8 hours), • PD, • PjM,	• PD, • PjM,
		Immediately to:	*Within 24 to:*
	• A near miss, • Hospitalization of 1 to 2 persons, or • Property damage <$50,000.	• PD; • PjM.	• PD, • PjM,
3.	The SSS will submit a written incident follow-up report within 72 Hours to the PD.		
4.	If the incident or accident results in an OSHA-recordable injury or illness or property damage, the SSS will record the injury or illness on the project OSHA 200 Form within six days of the accident or incident.		
5.	If the incident or accident results in medical attention (beyond on-site first aid) and/or includes lost time from work, the SSS will contact the appropriate Corporate office for assistance in obtaining and filing workman's compensation claim forms.		

15.0 SITE SAFETY AND HEALTH PLAN COMPLIANCE AGREEMENT

All project personnel, including visitors, must follow the requirements of this HASP and applicable addendums to the HASP. In order to document individual agreement with this requirement, all personnel must complete the following Site Safety and Health Plan Compliance Agreement. These agreements will be kept in the on-site health and safety files and will become part of the permanent project record upon completion of site activities.

I, ______________________________ (print name), have read the Site Safety and Health Plan (HASP) for the Westgate Subdivision Remediation project or I have been verbally advised of its contents. I understand and I agree to comply with all of its provisions. I understand that I could be prohibited from working on the project, and I may be subject to disciplinary actions for violating any of the health and safety requirements specified in the HASP and applicable amendments to the HASP.

____ ________________________

Signature Date

APPENDIX A

SITE FORMS

- Daily Health and Safety Report
- Meeting Attendance Form
- Medical Data Sheet
- Training and Medical Documentation
- OSHA 200 Log and Summary of Occupational Injuries and Illnesses
- Field Change Request
- Equipment Inspection Form

Page 1 of 4

HEALTH AND SAFETY DAILY REPORT
HOBBS PROJECT

Date: ______________________ QC Report No.: __________

A. Operation(s) Performed

A. Operation(s) Performed	Time Spent *(to ± hour)*
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	

B. Crew Names and Titles

B. Crew Names and Titles *Radian: ("X" indicates on site)*	Levels of Protection *(circle one)*	Work Area *(corresp. to Sect. A)*
	D / Mod D / B / NA	
	D / Mod D / B / NA	
	D / Mod D / B / NA	
	D / Mod D / B / NA	
	D / Mod D / B / NA	
	D / Mod D / B / NA	

HEALTH AND SAFETY DAILY REPORT
HOBBS PROJECT

QC Report No.: __________

B. ***(Cont.)***

Subcontractor: ("X" indicates on site)

	Levels of Protection	Work Area
____________	Non-HAZWOPER	____________
___ ____________	Non-HAZWOPER	____________
____________	Non-HAZWOPER	____________

C. Monitoring Equipment Used	Range	Average Reading
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

NOTE: Please ensure that the items listed in Section B and C correspond to the operation number listed in Section A. Use additional sheets if necessary.

D. Environmental Conditions:

Wind Speed: __________ Wind Direction: __________ Temperature: __________

Other:

____

____

HEALTH AND SAFETY DAILY REPORT

QC Report No.: ____________

PEPE FIELD SITE - PHASE II

E. Observations:

1 ______________________________

2 ______________________________

3. ______________________________

F. Verbal Instructions from Client / Regulatory Agency:

1 ______________________________

2 ______________________________

3. ______________________________

4. ______________________________

G. Corrective Actions:

1 ______________________________

2 ______________________________

3. ______________________________

4. ______________________________

NOTE: Please ensure that the items listed in Section G corresponds to the instruction number listed in Section F. Use additional sheets if necessary.

H. Health and Safety Problems:

1. Personnel ___ Yes ___ No
If yes, explain:

____

____

____

2. Monitoring Equipment ___ Yes ___ No ___ Not Used
If yes, explain:

____

____

____

3. Construction Equipment ___ Yes ___ No ___ Not Used
If yes, explain:

____

____

____

HEALTH AND SAFETY DAILY REPORT
PEPE FIELD SITE - PHASE II

QC Report No.: __________

I. Inspection(s) Performed: **Safety Deficiencies:** ___ Yes ___ No

J. Telephone/Site Meetings:

K. Site Visitors:

Name	Company	Purpose of Visit

Report Prepared By: ______________________ Date: ______________

MEETING ATTENDANCE FORM

HOBBS PROJECT **DATE:** ____________________

TOPIC:

ATTENDEES:

Print Name:	*Signature:*	*Company:*

[redacted]

MEDICAL DATA SHEET

The following Medical Data Sheet will be completed by all on-site personnel, and will be kept at the Command Post during site operations. This Medical Data Sheet will accompany personnel when medical assistance is needed and/or personnel transport to the medical facility is required.

PROJECT:____

NAME:____________________ **HOME TELEPHONE:**________________

ADDRESS:____

DATE OF BIRTH:______________ **HEIGHT:**_________ **WEIGHT:**_________

WHOM TO NOTIFY IN AN EMERGENCY:________________________

TELEPHONE OF EMERGENCY CONTACT:________________________

DRUG OR OTHER ALLERGIES:______________________________

DO YOU WEAR CONTACTS?_______________________________

LIST PREVIOUS ILLNESSES (WITHIN LAST YEAR) OR EXPOSURES TO HAZARDOUS CHEMICALS:_

____

____

MEDICATIONS YOU ARE USING:____________________________

____

ANY MEDICAL RESTRICTIONS?_____________________________

____

NAME AND TELEPHONE NUMBER OF YOUR PERSONAL PHYSICIAN:________________

____

I understand this information is confidential, and will only be used if I require medical assistance. I understand that it is my responsibility to keep the Health & Safety representative informed of any changes in this information, especially medication use (***both prescription and over-the-counter drug use***).

____________________ ____________________

Signature Date

MEDICAL CLEARANCE AND HEALTH AND SAFETY TRAINING MATRIX TRACKING

HOBBS PROJECT

Employee	Annual Physical	8-Hr Refresher	8-Hr Supervisors	40-Hr HAZWOPER Training (1)	Site Safety Kick-Off Meeting	First Aid (3-Yr)	CPR (2-Yr)	HASP Compliance Form	Confined Space Training	Respiratory Fit Test & Training

(1) Indicate if initial HAZWOPER Training is 24-hour course instead of 40-Hour course by marking box with “24-Hour” before listing the date completed.

Log and Summary of Occupational Injuries and illnesses

NOTE: This form is required by Public Law 91-596 and must be kept in the establishment for 5 years. Failure to maintain and post can result in issuance of citations and assessment of penalties. (*See posting requirements on the other side of form*)

RECORDABLE CASES: You are required to record information about every occupational death; every nonfatal occupational illness; and those nonfatal occupational injuries which involve one or more of the following: loss of conciousness, restriction of work or motion, transfer to another job, or medical treatment (other than first aid) (*See definitions on the other side of form*)

Case or File Number	Date of Injury or Onset of Illness	Employee's Name	Occupation	Department	Description of Injury or Illness
Enter a nonduplicating number which will facilitate comparisons with supplementary records.	Enter Mo/Day	Enter first name or initial, middle initial, last name	Enter regular job title, not activity employee was performing when injury occurred or at onset of illness. In the absence of a formal title, enter a brief description of the employee's duties.	Enter department in which the employee is regularly employed or a description of normal workplace to which employee is assigned, even though temporarily working in another department at the time of injury or illness.	Enter a brief description of the injury or illness and indicate the part or parts of the body affected. Typical entries for this column might be: Amputation of 1st joint right forefinger; Strain of lower back; Contact dermatitis on both hands; Electrocution - body.
(A)	(B)	(C)	(D)	(E)	(F)
					PREVIOUS PAGE TOTALS =>
					TOTALS (Instructions on other side of form) =>

OSHA No. 200

U.S. Department of Labor

For Calendar Year __________ Page: _____ of _____

Company Name

Establishment Name

Establishment Address

Form Approved
O.M.B. No. 1218-0176
See OMB Disclosure
Statement on reverse.

Extent of and Outcome of Injury						Type, Extent of, and Outcome of Illness													
Fatalities	Nonfatal Injuries					Type of Illness							Fatalities	Nonfatal Illnesses					
Injury Related	Injuries with Lost Workdays				Injuries Without Lost Workdays	CHECK Only One Column for Each Illness (See other side of form for terminations or permanent transfers)							Illness Related	Illnesses with Lost Workdays				Illnesses without Lost Workdays	
Enter Date of death. mm/dd/yy	Enter a Check if injury involves DAYS away from work or restricted work activity or both.	Enter a Check if injury involves DAYS away from work.	Enter number of DAYS away from work	Enter number of DAYS of restricted work activity	Enter a Check if no entry was made in column 1 or 2 but the injury is recordable as defined above.	Occupational Skin Disorder or Disease	Dust Disease of the lungs	Respiratory Conditions due to toxic agents	Poisoning (systemic effects of toxic materials)	Disorders due to physical agents	Disorders associated with repeated trauma	All other occupational illnesses	Enter DATE of death, mm/dd/yy	Enter a CHECK if Illness involves DAYS away from work, or DAYS of restricted work activity or both.	Enter a CHECK if Illness involves DAYS away from work.	Enter number of DAYS away from work.	Enter number of DAYS of restricted work activity	Enter a CHECK if no entry was made in columns 8 or 9	
						(7)													
(1)	(2)	(3)	(4)	(5)	(6)	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(8)	(9)	(10)	(11)	(12)	(13)	

Certification of Annual Summary Totals by: ____________________ Title: ____________________ Date: __________

OSHA 200

POST ONLY THIS PORTION OF THE LAST PAGE NO LATER THAN FEBRUARY 1

URS

Radian

FIELD CHANGE REQUEST

FCR No.______________ **PROJECT No.:**______________ **DATE:**____________________

PROJECT:____

TO:______________________________ **LOCATION:**____________________

FROM:______________________________ **LOCATION:**____________________

DESCRIPTION OF PROPOSED CHANGE:____

____

____

____

REASON FOR CHANGE:____

____

____

____

______________________________ ____________________

SITE MANAGER **DATE**

______________________________ ____________________

SITE SAFETY OFFICER **DATE**

RESPONSE:____

____

____

____

______________________________ ____________________

REGIONAL HEALTH AND SAFETY MANAGER **DATE**

Distribution:
- ☐ Project Manager
- ☐ USACE Resident Engineer
- ☐ Site Safety Files

Equipment Inspection Report

HOBBS PROJECT

Equipment Type:
Make:
Hours:

Model:
Serial Number:

Item	OK Condition	Not OK	Not Applicable	Comment
Part I: Walk-Around Inspection				
Compartment Frame				
Counter Weight				
Windshield / Windows				
Hydraulic Hoses				
Booms / Arms				
Structural				
Steering				
Linkage				
Bucket				
Shovel				
Teeth				
Bucket Pin				
Bucket Pin Bolts				
Rigging Anchorage				
Swivel Chasis				
Bolts				
Tracks				
Dirt				
Wear				
Bolts/Links				
Tires				
Tread				
Cuts/Tears				
Inflation				
Hubs/Bolts				
Outriggers				
Pads				
Hydraulic Hoses				
Condition				
Connections				
Exhaust				
Piping				
Muffler				
Supports				
Air Filter				
Grab Bars				
Door				
Non-Slip Surfaces				

[redacted]

Equipment Inspection Report
Hobbs Project

Item	OK Condition	Not OK	Not Applicable	Comment
Safety Decals/Labels				
Seat Belt				
Safety Labels				
Fire Extinguisher				
Fluid Levels				
Hydraulics				
Engine				
Transmission				
Radiator				
Battery				
Corrosion				
Connections/Wiring				
Fluids				
Fuel Fill Port and Cap				
Winch				
Motor				
Sheaves				
Drums				
Wire Rope				
Drum Wrapping (min. 3)				
Part II: Equipment Start-Up and Operation:				
Ignition				
Horn				
Lights				
Back-up Alarm				
Leaks Underneath and from Hydraulic Fittings				
Steering				
Brakes				
Swivel Chasis				
Boom Hoists and Articulations				
Outrigger Pads				
Operator Controls				
Gauges				
Comments:				

APPENDIX B

MSDS's

DYNAMATION -- AIR, COMPRESSED GAS IN CYLINDERS - ZERO GAS,COMPRESSOR MONITOR
MATERIAL SAFETY DATA SHEET
NSN: 4310013836308
Manufacturer's CAGE: 58746
Part No. Indicator: A
Part Number/Trade Name: AIR, COMPRESSED GAS IN CYLINDERS

General Information

Item Name: ZERO GAS,COMPRESSOR MONITOR
Company's Name: DYNAMATION INC
Company's Street: 3784 PLAZA DR
Company's City: ANN ARBOR
Company's State: MI
Company's Country: US
Company's Zip Code: 48108-7354
Company's Emerg Ph #: 313-769-0573/800-255-3924
Company's Info Ph #: 313-769-0573
Record No. For Safety Entry: 001
Tot Safety Entries This Stk#: 001
Status: SE
Date MSDS Prepared: 31DEC95
Safety Data Review Date: 13SEP96
Supply Item Manager: AX
MSDS Serial Number: CBTJP
Specification Number: NONE
Spec Type, Grade, Class: NONE
Hazard Characteristic Code: G3
Unit Of Issue: EA
Unit Of Issue Container Qty: UNKNOWN
Type Of Container: UNKNOWN
Net Unit Weight: UNKNOWN
NRC/State License Number: NONE
Net Propellant Weight-Ammo: NONE

Ingredients/Identity Information

Proprietary: NO
Ingredient: OXYGEN
Ingredient Sequence Number: 01
Percent: 20-22
NIOSH (RTECS) Number: RS2060000
CAS Number: 7782-44-7
OSHA PEL: NOT ESTABLISHED
ACGIH TLV: NOT ESTABLISHED

Proprietary: NO
Ingredient: NITROGEN
Ingredient Sequence Number: 02
Percent: BALENCE
NIOSH (RTECS) Number: QW9700000
CAS Number: 7727-37-9
OSHA PEL: NOT ESTABLISHED
ACGIH TLV: ASPHYXIANT; 9495

Physical/Chemical Characteristics

Appearance And Odor: COLORLESS, ODORLESS GAS
Boiling Point: -318F,-194C
Melting Point: UNKNOWN
Vapor Pressure (MM Hg/70 F): GAS
Vapor Density (Air=1): 1
Specific Gravity: N/A
Decomposition Temperature: UNKNOWN
Evaporation Rate And Ref: N/A
Solubility In Water: 18.68 CM3/L
Viscosity: UNKNOWN

Corrosion Rate (IPY): UNKNOWN
Autoignition Temperature: N/A

Fire and Explosion Hazard Data

Flash Point: N/A
Lower Explosive Limit: UNKNOWN
Upper Explosive Limit: UNKNOWN
Extinguishing Media: USE WHAT IS APPROPRIATE FOR SURROUNDING FIRE. MIXTURES CONTAINING 21% OXYGEN SUPPORT COMBUSTION.
Special Fire Fighting Proc: WEAR SELF CONTAINED BREATHING APPARATUS & FULL PROTECTIVE CLOTHING. USE WATER SPRAY TO KEEP FIRE EXPOSED CYLINDERS COOL.
Unusual Fire And Expl Hazrds: OXIDIZING ATMOSPHERE INCREASES THE LIKELIHOOD OF FIRES.

Reactivity Data

Stability: YES
Cond To Avoid (Stability): MFR GAVE NO INFORMATION OF MSDS..
Materials To Avoid: MFR GAVE NO INFORMATION OF MSDS.
Hazardous Decomp Products: N/A
Hazardous Poly Occur: NO
Conditions To Avoid (Poly): WILL NOT OCCUR.

Health Hazard Data

LD50-LC50 Mixture: PRODUCT'S LD50 (ORAL RAT) WAS NOT STATED
Route Of Entry - Inhalation: NO
Route Of Entry - Skin: NO
Route Of Entry - Ingestion: NO
Health Haz Acute And Chronic: THE ONLY ENTRY UNDER 'HEALTH HAZARDS' WAS 'N/A'.
Carcinogenicity - NTP: NO
Carcinogenicity - IARC: NO
Carcinogenicity - OSHA: NO
Explanation Carcinogenicity: MANUFACTURER GAVE NO INFORMATION ABOUT CARCINOGENICITY. HMIS FOUND NO LISTING & DOES NOT EXPECT IT TO BE CARCINOGENIC.
Signs/Symptoms Of Overexp: THE ONLY ENTRY UNDER 'HEALTH HAZARDS' WAS 'N/A'.
Med Cond Aggravated By Exp: THE ONLY ENTRY UNDER 'HEALTH HAZARDS' WAS 'N/A'.
Emergency/First Aid Proc: THE ONLY ENTRY UNDER 'HEALTH HAZARDS' WAS 'N/A'.

Precautions for Safe Handling and Use

Steps If Matl Released/Spill: N/A
Neutralizing Agent: MFR GAVE NO INFORMATION OF MSDS.
Waste Disposal Method: COMPLY W/APPLICABLE FEDERAL, STATE & LOCAL REGULATIONS. RETURN DEFECTIVE CYLINDER TO SUPPLIER.
Precautions-Handling/Storing: PROTECT AGAINST PHYSICAL DAMAGE & STORE IN TEMPERATURE <130F. KEEP VALVE PROTECTION CAP ON CYLINDERS WHEN NOT IN USE.
Other Precautions: SECURE CYLINDER WHEN USING TO PROTECT FROM FALLING. DO NOT DEFACE CYLINDERS/LABELS.

Control Measures

Respiratory Protection: MFR GAVE NO INFORMATION OF MSDS.
Ventilation: MFR GAVE NO INFORMATION OF MSDS.
Protective Gloves: MFR GAVE NO INFORMATION OF MSDS.
Eye Protection: SAFETY GLASSES WHEN HANDLING CYLINDERS
Other Protective Equipment: MFR GAVE NO INFORMATION OF MSDS.
Work Hygienic Practices: MFR GAVE NO INFORMATION OF MSDS.
Suppl. Safety & Health Data: NONE

Transportation Data

Trans Data Review Date: 96257

```
DOT PSN Code: AGJ
DOT Proper Shipping Name: AIR, COMPRESSED
DOT Class: 2.2
DOT ID Number: UN1002
DOT Label: NONFLAMMABLE GAS
IMO PSN Code: ALN
IMO Proper Shipping Name: AIR, COMPRESSED
IMO Regulations Page Number: 2103
IMO UN Number: 1002
IMO UN Class: 2(2.2)
IMO Subsidiary Risk Label: -
IATA PSN Code: AOP
IATA UN ID Number: 1002
IATA Proper Shipping Name: AIR, COMPRESSED
IATA UN Class: 2.2
IATA Label: NON-FLAMMABLE GAS
AFI PSN Code: AOP
AFI Prop. Shipping Name: AIR, COMPRESSED
AFI Class: 2.2
AFI ID Number: UN1002
AFI Pack Group: -
AFI Basic Pac Ref: A6.3,A6.7
MMAC Code: NK
N.O.S. Shipping Name: NONE
Additional Trans Data: NONE
============================================================================
                              Disposal Data
============================================================================
============================================================================
                               Label Data
============================================================================
Label Required: YES
Technical Review Date: 13SEP96
MFR Label Number: NONE
Label Status: F
Common Name: AIR, COMPRESSED GAS IN CYLINDERS
Chronic Hazard: NO
Signal Word: NONE
Acute Health Hazard-None: X
Contact Hazard-None: X
Fire Hazard-None: X
Reactivity Hazard-None: X
Special Hazard Precautions: THE ONLY ENTRY UNDER 'HEALTH HAZARDS' WAS 'N/
A'. PROTECT AGAINST PHYSICAL DAMAGE & STORE IN TEMPERATURE <130F. KEEP
VALVE PROTECTION CAP ON CYLINDERS WHEN NOT IN USE.
Protect Eye: Y
Label Name: DYNAMATION INC
Label Street: 3784 PLAZA DR
Label City: ANN ARBOR
Label State: MI
Label Zip Code: 48108-7354
Label Country: US
Label Emergency Number: 313-769-0573/800-255-3924
Year Procured: NON
```

APPENDIX C

ACTIVITY HAZARD ANALYSES

(To Be Prepared)

- Project mobilization and construction of enclosure (Table C-1);
- Excavation of contaminated soils and surrounding soils (Table C-2);
- Transporting Surge Pond spoils to staging area (Table C-3);
- Transfer of spoils to trucks for off-site transport (Table C-4);
- Decontamination of equipment and temporary facilities (Table C-5);
- Area Restoration (Table C-6);
- Demobilization (Table C-7); and,
- Monitoring of Air Emissions (Table C-8).

APPENDIX D

SITE-SPECIFIC RESPIRATORY PROTECTION PROGRAM

Respiratory Protection Plan (RPP)

This RPP complies with 29 CFR 1910.134. Respirators were selected on the basis of the anticipated respiratory hazards, work tasks, and potential workplace conditions. A sufficient number of respirator models and sizes have been made available to ensure that the respirator is acceptable to, and correctly fits the user. All respirators used by on-site staff will be NIOSH-certified and all cartridges will be labeled with the appropriate NIOSH-approval. The label shall not be removed or defaced while in use. The following table indicates the requirement for respirator use and change of cartridge-out.

Task	Respirator	Cartridge	Cartridge Change Schedule
Sampling and other associated tasks, where exposure to contaminants of concern at hazardous concentrations are a potential threat. Respirator donning action levels are discussed in Section 10.	Fitted half or full-face air purifying respirator	Organic vapor (charcoal) and P100 combination cartridges	Even though the expected concentrations of air contaminants is low, personnel required to wear a respirator will conservatively change (dispose of old and insert new) their air purifying respirator cartridges once every 48 hours of use or one week of calendar time, whichever is less.

If an employee's respirator is properly sealed and he or she notices an odor, irritation, or other symptom of potential exposure, the individual will exit (to a safe location), notify the Site Safety Supervisor, and proceed to change (insert fresh cartridges) cartridges immediately. The conditions and equipment will be evaluated for safety before employee resumes work.

D.1 Medical Evaluations

All site workers who are required to wear an APR are included in a Medical Monitoring Program and have been medically approved (see fit test record) for respirator use before donning a respirator.

D.2 Fit Testing

Fit testing is required for all respirator users. Qualitative fit tests (QLFTs) meeting the QLFT protocols listed in Appendix A of 29 CFR 1910.134 have been used to fit test individuals using APRs for atmospheres less than or equal to 10 times the PEL. All site workers respirator users on-site will have had a QLFT within one year from the start of the project.

D.3 Respirator Use

Respirators will not be used if:

- Facial hair comes between the sealing surface of the face-piece and the face, or interferes with valve function;
- There is a condition that interferes with the face-to-face-piece seal or valve function;
- Corrective glasses or other personal protective equipment are worn in a manner that would interfere with the face-to-face-piece seal;

Note: site personnel will perform an appropriate seal check (positive and negative) each time they put on a respirator.

D.4 Maintenance and Care of Respirators

Respirators will be cleaned and disinfected as necessary to keep them in a sanitary condition. They will be stored in such a manner as to prevent damage and contamination, inspected regularly, and repaired as necessary. Damaged respirators that cannot be repaired will be removed from service immediately.

D.4.1 Cleaning and Disinfecting

- Disassemble respirator and remove cartridges;
- Wash the face-piece and associated parts in a mild detergent with warm water;
- Rinse completely in clean warm water;
- Air dry in an appropriate (clean) area;
- Reassemble the respirator and replace any defective parts; and
- Place it in a clean, dry plastic bag or other airtight container.

D.4.2 Maintenance

Respirators are to be properly maintained at all times. Maintenance involves a thorough visual inspection for cleanliness and defects. Worn or deteriorated parts will be replaced prior to use. No components will be replaced or repairs made beyond those recommended by the manufacturer. The following checklist will be used when inspecting respirators:

Face-piece:

- Cracks, tears, or holes;
- Facemask distortion; and
- Cracked or loose lenses/face shield.

Head-straps:

- Breaks or tears; and
- Broken buckles.

Valves:

- Residue or dirt;
- Cracks or tears in valve material; and
- Improper seating of valve

Filters/Cartridges:

- Approval designation;
- Gaskets;
- Cracks or dents in housing; and
- Proper cartridge for hazard.

D.5 Training

All on-site workers will have received training in the use of respirators prior to the employee's use of a respirator. This training, at a minimum, included:

- Why the respirator is necessary and how improper fit, usage, or maintenance can compromise the protective effect of the respirator;
- What the limitations and capabilities of the respirator are;
- How to use the respirator in emergency situations, including situations in which the respirator malfunctions;
- How to inspect, put on, and check the seals of the respirator;
- What the procedures for maintenance and storage of the respirator are;
- How to recognize the medical signs and symptoms that may limit or prevent the effective use of the respirator; and
- The general requirements of OSHA's Respiratory Protection standard.

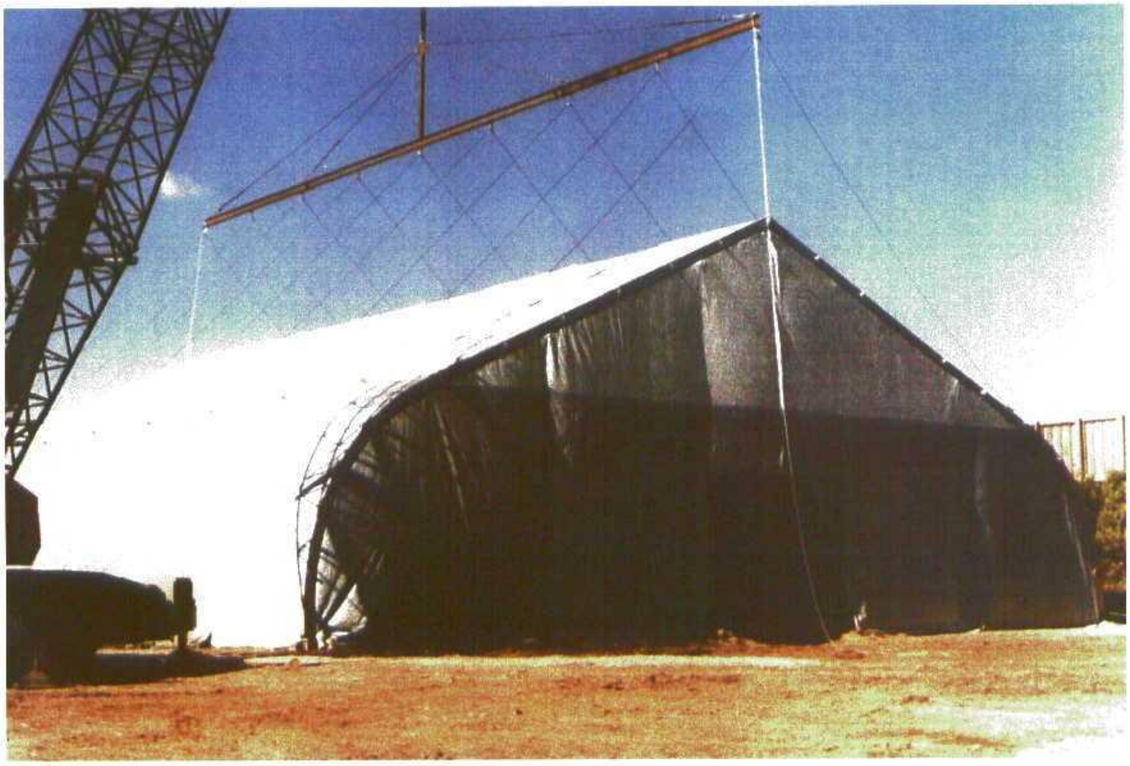
Retraining is required annually and when the following situations occur:

- Changes in the project activities or conditions;
- Employee appears to have not understood or retained during the original training; and
- Any other situation arises that affects respirator use.

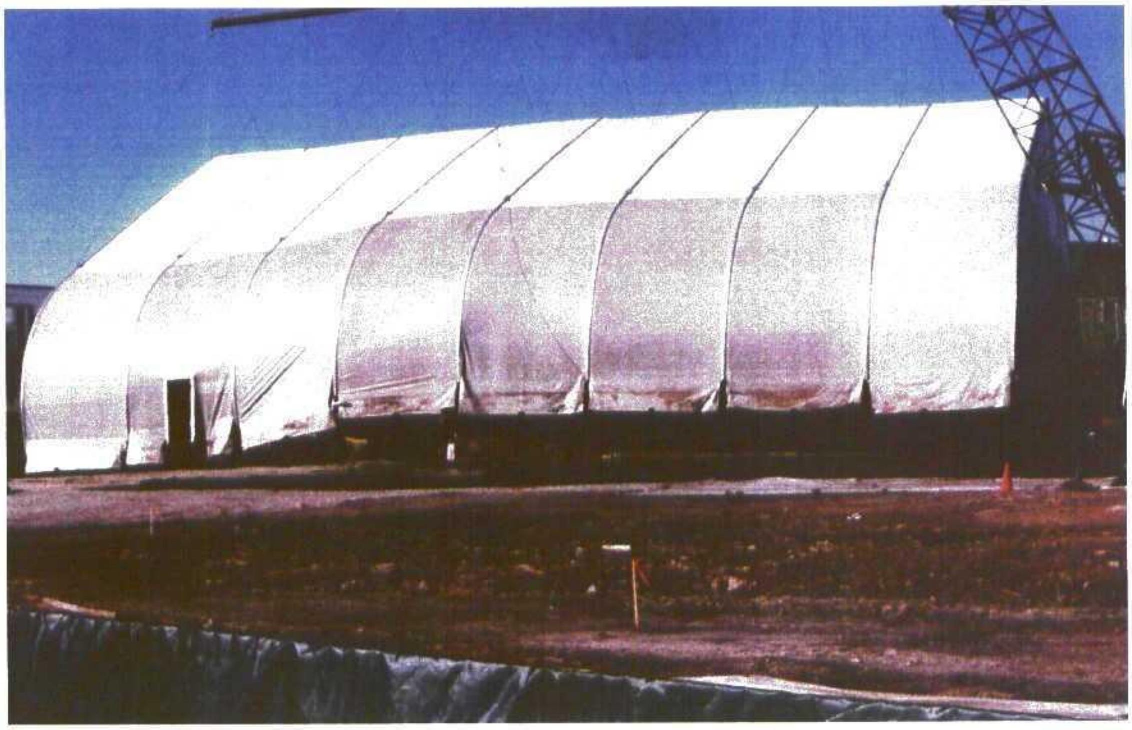
D.6 Program Evaluation

The Project Manager with the assistance of Site Safety Supervisor will monitor and evaluate project use of respirators to ensure that they are being used safely and effectively. This shall include consultation with respirator users regarding fit, respirator selection, respirator use under project conditions, and respirator maintenance.

REMEDIATION STRUCTURE – CRANE LIFTABLE AND MOVEABLE
(Similar to one to be used at Westgate)



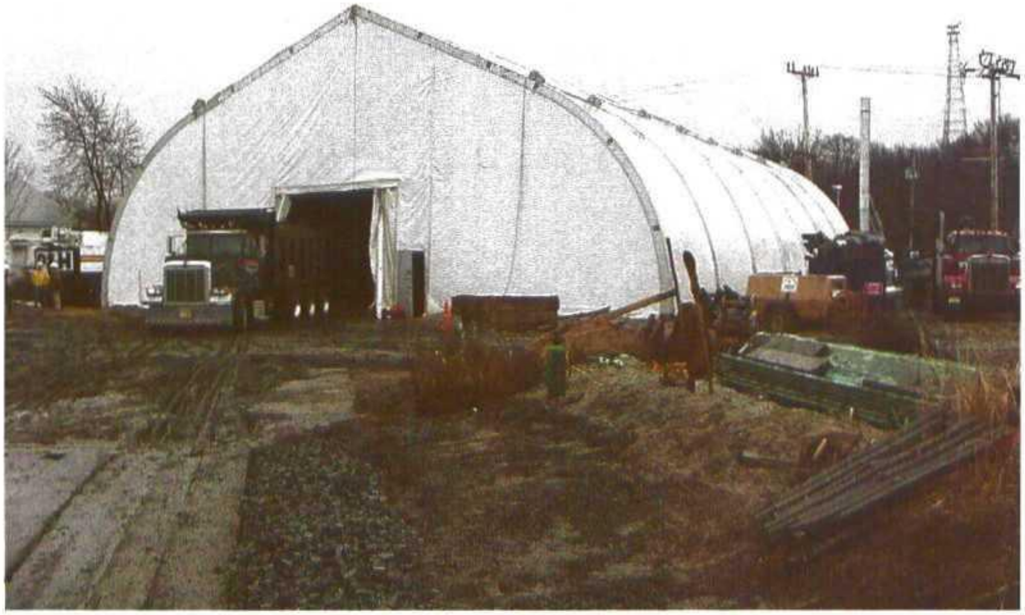
This 92' x 105' TFS Series Structure was utilized for 5 months on a coal tar remediation project. The structure maintained a negative pressure and was designed for crane lifting. It was moved over a dozen times before the project was completed.



STRUCTURE ENTRANCE – NEW JERSEY SITE – 70' X 115' X 35.5'

STRUCTURE ENTRANCE – AIR TREATMENT PLANT ON RIGHT SIDE

STRUCTURE ENTRANCE – DUMP TRUCK EXITING



STRUCTURE ENTRANCE – SIDE VIEW

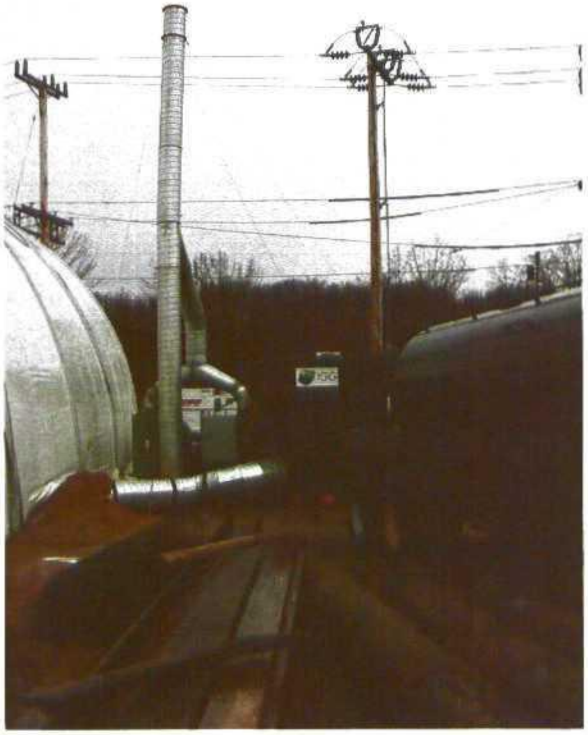
STRUCTURE ENTRANCE – EXCAVATOR AFTER EXITING

STRUCTURE ENTRANCE – FRONT END LOADER ENTERING

INSIDE STRUCTURE – AIR INTAKE VENT

STRUCTURE – AIR TREATMENT SYSTEM

STRUCTURE – AIR TREATMENT SYSTEM



CHARACTERIZATION OF POTENTIAL AIR EMISSIONS ASSOCIATED WITH REMEDIATION ACTIVITIES NEAR THE WESTGATE SUBDIVISION

Phase I Air Monitoring Study Design Plan

Submitted to:

Shell Exploration and Production Company

05 May 2000

List of Tables

List of Figures

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Appendix A: Proposed Target List of Chemical Species to be Measured

RADIAN INTERNATIONAL
A DAMES & MOORE GROUP COMPANY

CHARACTERIZATION OF POTENTIAL AIR EMISSIONS ASSOCIATED WITH REMEDIATION ACTIVITIES NEAR THE WESTGATE SUBDIVISION

Phase I Air Monitoring Study Design Plan

Prepared for:
Shell Exploration and Production Company
200 North Dairy Ashford
Houston, Texas 77079

Prepared by:

Radian International
9801 Westheimer, Suite 500
Houston, Texas 77042

05 May 2000

1.0 INTRODUCTION

The Shell Exploration and Production Company is currently engaged in efforts to remediate contaminated soils on developed and undeveloped properties adjacent to and including portions of the Westgate Subdivision in Hobbs, New Mexico. A portion of the Westgate Subdivision is built on property that is directly adjacent to the former oil and gas production facilities on the Grimes Lease. Shell intends to conduct a Phase I Baseline Air Monitoring Study to characterize potential air emissions that might result during Phase II abatement activities. The results of the Phase I Air Monitoring Study will be used to develop an effective air monitoring plan that will be implemented during full-scale site remediation.

2.0 PHASE I BASELINE INVESTIGATION APPROACH

This document outlines the approach that will be used to conduct the Phase I Baseline Air Monitoring Investigation. This investigation will be performed in two parts. The first part of the investigation will involve conducting an air quality survey to establish baseline air quality prior to initiating site remediation activities. The second part of the investigation will involve conducting a series of controlled test excavations. The purpose of the test excavations is to quantify potential air emissions that could compromise worker safety and potentially impact the community during full-scale remediation. Isolation flux measurements will be made from disturbed soil to quantify the emission flux of various air contaminants that are known or suspected to be present in the contaminated soils. Information from the surface flux measurements will be used to design effective odor, vapor, and particulate matter mitigation strategies. The ambient baseline air quality measurements will be made prior to conducting the surface flux measurements. This will help to approximate the baseline ambient air quality for both the Westgate Subdivision and the community at large prior to commencement of remediation activities. In addition, a series of ambient air quality measurements will also be made concurrent with the isolation flux measurements to assess potential community impacts during the pre-remediation testing.

The overall objectives of the Phase I Investigation are as follows:

- Conduct a survey to approximate baseline air quality prior to the start of remediation activities;
- Use surface isolation flux measurements to quantify the potential impacts, if any, of uncontrolled emissions to near-by residential areas;
- Evaluate effective strategies for controlling the emissions of odors, vapors, and particulate matter during remediation, if necessary; and
- Use the results of the Phase I Investigation to develop a plan to ensure community and worker safety during remediation.

2.1 Baseline Air Monitoring Investigation

The details of the baseline air monitoring investigation are described in this section.

2.1.1 Baseline Air Monitoring Measurement Parameters

Baseline air quality measurements will be collected for a wide array of chemical compounds as well as surface meteorological measurements. The chemical species to be measured were selected because they are known or suspected hazardous air pollutants or are non-hazardous surrogate chemicals that are associated with industrial emissions, oilfield emissions, automotive emissions, and industrial chemicals or solvents. These chemicals are of particular interest because, if present, they may, under certain circumstances, represent a potential community exposure concern or odor nuisance. Some parameters will be collected using time integrated (averaged) sampling techniques, and others will be measured continuously. Time integrated (24-hour averaged) samples will be collected for the following chemical classes:

- Volatile Organic Compounds (See Appendix A);
- Reduced Sulfur Compounds (See Appendix A);
- PM_{10} (particulate matter with an aerodynamic size of 10 micrometers or less [See Appendix A]);
- Metals and Other Elements (See Appendix A); and
- Semi-Volatile Organic Compounds (See Appendix A).

Real-time (Continuous) measurements will be made for the following parameters:

- Wind speed;
- Wind direction; and
- Temperature.

2.1.2 Ambient Air Monitoring Network Description

An array of seven air monitoring sites will be established to assess representative "baseline" air quality prior to remediation. The monitoring sites will be oriented with the prevailing wind direction for Hobbs, NM. The air monitoring sites will be selected to:

- Assess air quality upwind of the Westgate Subdivision near oil production sources;
- Assess air quality immediately upwind of Westgate Subdivision

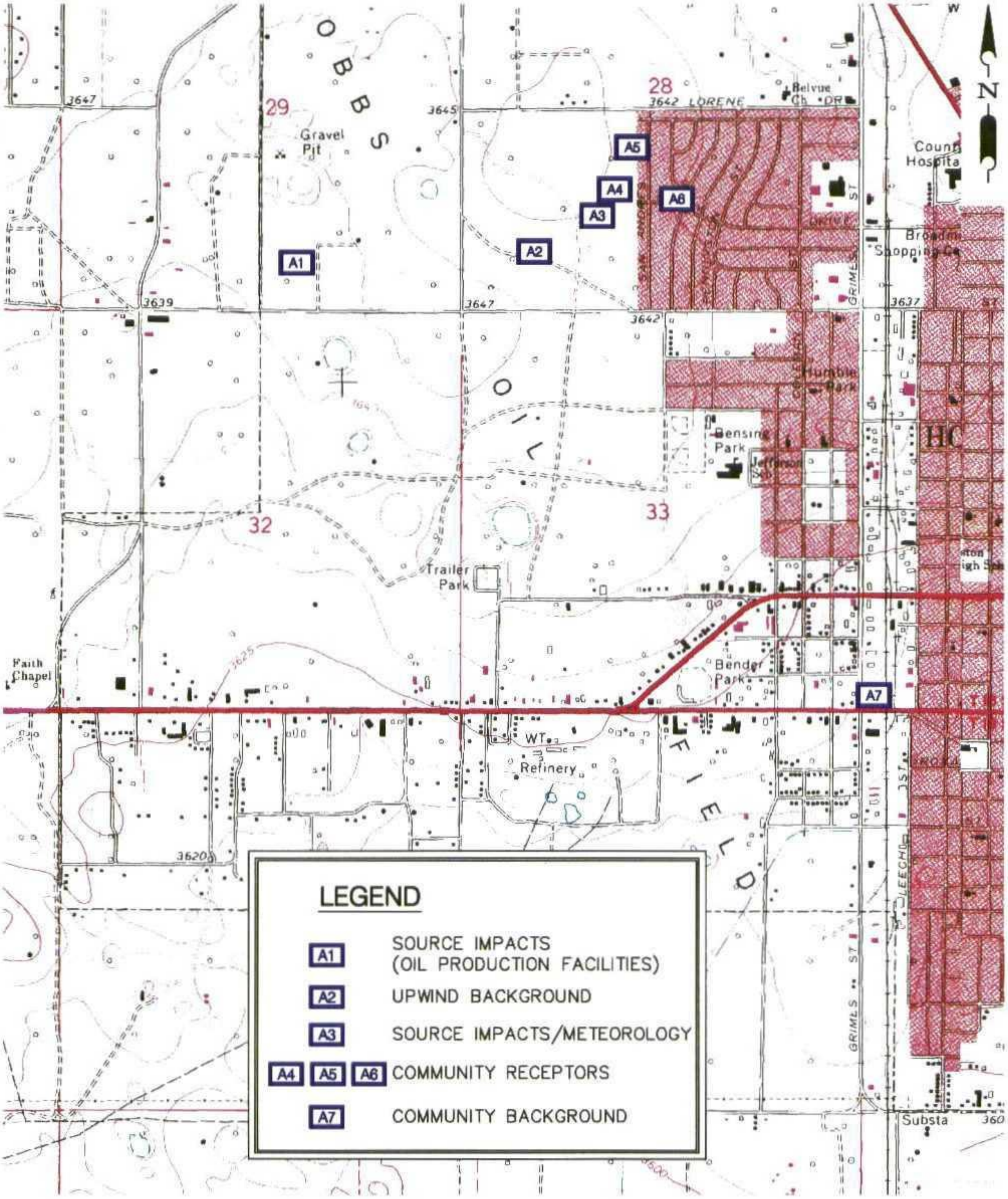
- Assess air emission impacts at the source of remedial activities;
- Assess air quality at the nearest downwind community receptor from the source of remedial activities;
- Assess air quality at other representative community receptor locations interior to the Westgate Subdivision; and
- Assess background air quality at a community receptor site distant from the Westgate Subdivision.

The proposed locations of the seven monitoring sites are shown in Figure 2.1. The locations shown in this figure are considered to be preliminary at this time. Sites will be selected in the approximate vicinity as shown. Final site selection will consider such factors as accessibility, security, adequate exposure (e.g., free air flow), and power availability. In addition, one meteorological monitoring site will be established to document meteorological conditions during the Phase I assessment. This site may be collocated at one of the seven proposed monitoring sites. The sampler array will be sufficient to gather information to address the objectives identified above.

2.1.3 Sampling and Analytical Procedures

This section describes the sampling and analytical procedures that will be used to characterize the baseline air quality prior to remediation activities. The samples collected during this study will be sent to nationally recognized and accredited labs that have demonstrated the ability to perform the analytical methods outlined in this plan.

Volatile Organic Compounds (VOCs) and Reduced Sulfur Compounds (RSCs) – Ambient air measurements of VOCs and RSCs will be sampled using six liter (volume) glass-lined, stainless steel canisters. The canister samples will be analyzed for reduced sulfur compounds using ASTM D-5504 and for hydrocarbons using EPA Method TO-15. A list of the target chemicals for these methods is provided in Appendix A. In addition, the canisters will be analyzed for aliphatic and aromatic volatile Total Petroleum Hydrocarbon (TPH) fractions in ambient air using a procedure developed by the Massachusetts Department of Environmental Protection (MADEP). This method is capable of separating complex mixtures of petroleum hydrocarbons into smaller aliphatic and aromatic fractions which range between C4 (butane) and C12 (n-dodecane). Twenty-four hour time integrated measurements will be made during each sampling event. The samples will be metered at a constant flow rate using a vacuum flow controller. Each sampling device will be activated manually between 10 AM and noon on each designated sampling day. Upon completion of the sampling period, the samples will be retrieved the following day. The samples will be sent to the laboratory and analyzed within 72-hours of collection for the reduced sulfur compounds and nominally within five days for the VOCs and TPH fractions (although the holding times for the VOCs are normally two weeks). The nominal detection limits for the individual VOCs is approximately 1-2 ppb-V or less and for RSCs is nominally is 4 ppb-V.

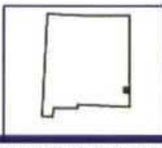


2000 0 2000

SCALE IN FEET

FIGURE 2-1
PROPOSED LOCATIONS OF
AMBIENT AIR MONITORING SITES

USGS QUAD REFERENCE:
"HOBBS, N. MEX." 1969, REV. 1979



RADIAN INTERNATIONAL
A DAMES & MOORE GROUP COMPANY

PROJ. No.: 804254.10

DWG. No.: FIGURE 2-1

FILE: K:\SHELL\HOBBS-NEW MEXICO_GLOBAL\DRAWINGS\AUTOCAD\FIGURE1BAIR 3/01/00 9:57Am DBC

Semivolatile Organic Compounds (SVOCs) - The SVOCs will be collected using PS-1 sampling devices. The SVOCs tend to partition between the particulate and vapor phases. Thus, the sampling devices employ a cartridge that consists of a pre-filter followed by a section of XAD-2 sorbent. An illustration of the PS-1 sampler is shown in Figure 2-2. The cartridge assembly that contains the filter and XAD-2 sorbent cartridge is shown in Figure 2-3. The SVOCs will be collected in tandem with the other chemical species (i.e., VOCs, RSCs and PM_{10}) and likewise will consist of 24-hour time integrated samples. The PS-1 sampler will be operated at a flow rate of approximately 200 to 250 liters per minute (l/min). These samples will be collected and analyzed using EPA Method TO-13a. The detection limit for each of these species is nominally 3 picograms/m^3. In addition, subsequent analysis of the sample extract by modified EPA Method 8015, enhanced to generate TPH fraction and specific analyte data including pristane and phytane. This method is consistent with the TPH approach suggested by the Agency for Toxic Substances and Disease Registry (Research Triangle Institute [Research Triangle Park, NC], *Toxicological Profile for Total Petroleum Hydrocarbons (TPH)*, National Technical Information Service [Springfield, VA] prepared for the U.S. Public Health Service, Agency for Toxic Substances and Disease Registry, NTIS PB99-163370. September 1999.)

Figure 2-2. PS-1 Sampler Diagram

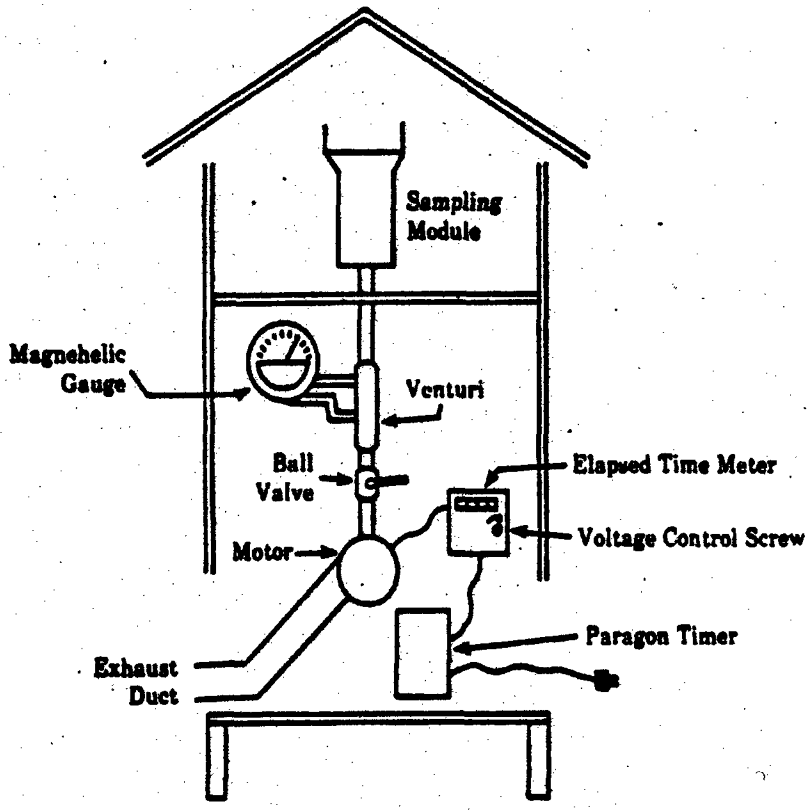
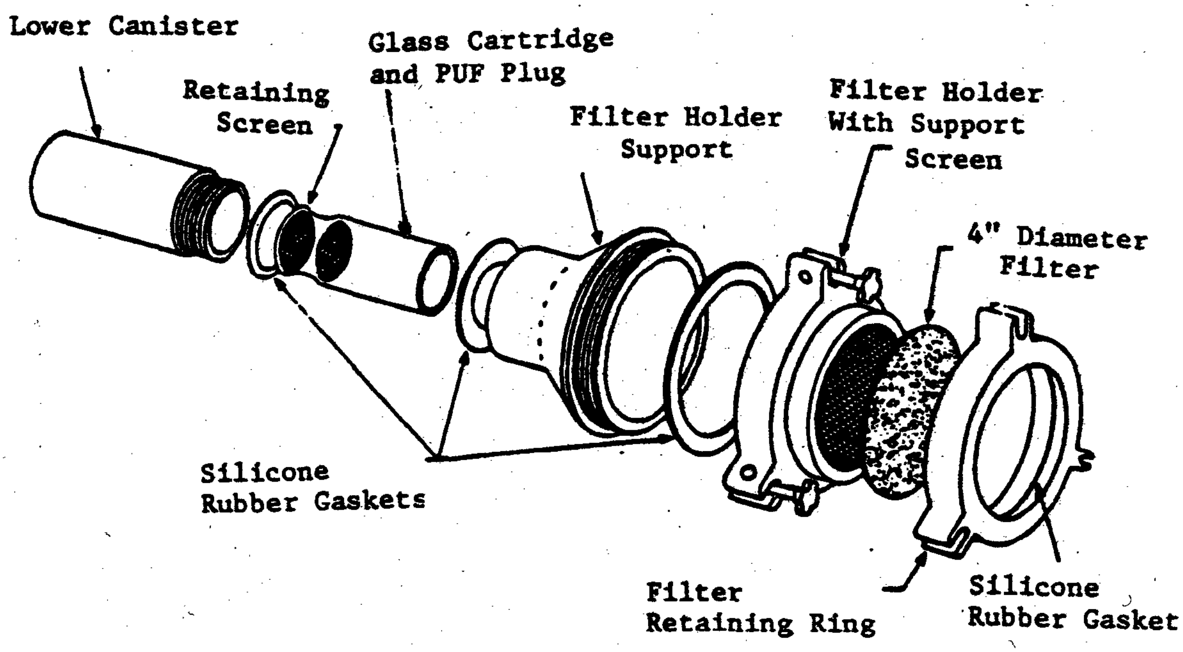


Figure 2-3. PS-1 SVOC Sampler Cartridge



PM_{10}, Metals – Particulate matter will be sampled using PM_{10} sampling devices. These devices will collect 24-hour time-integrated samples. These samplers are designed to collect particulate matter with an aerometric diameter of 10 micrometers or less. The samplers are designed to sample at a rate of approximately 40 cubic feet per minute. The PM_{10} samplers will be sampled in tandem with the VOCs, RSCs and SVOCs. A quartz fiber filter substrate will be used to collect the particulate matter samples. A portion of each filter will be extracted in nitric acid solution and the extract will be analyzed for metals and other elements using Inductively Coupled Argon Plasma spectroscopy following EPA Method SW6010. A Thermo Jarrell-Ash Model 61E instrument will be used, per EPA Reference Method EQL-1194-094. The nominal detection limits for the metals and other elements is 1 ug/m^3 with the exception of sulfur and potassium. The detection limit for sulfur is approximately 6 ug/m^3 and potassium is 3.6 ug/m^3. The specific chemical species to be analyzed are shown in Appendix A.

Continuous Analyzers – During the flux measurement survey, community sampling will also be performed to measure total hydrocarbons (this includes all volatile hydrocarbon compounds including methane), H_2S and mercury. These measurements will be made along the site perimeter in the adjacent Westgate Subdivision. The continuous analyzers to be used for this program are: 1) TVA-1000 for total hydrocarbons, 2) Jerome 431 for mercury, and 3) Jerome 631X for hydrogen sulfide. The community survey will be made by doing periodic survey testing at predetermined locations in the community as described in the site specific Health and Safety Plan.

Meteorological Measurements – Continuous meteorological measurements will be made with a portable meteorological station. The station will be operated to obtain hourly average ambient temperature, wind speed, and wind direction data during the baseline air quality monitoring survey and emission flux survey. Other meteorological parameters such as barometric pressure and humidity will be obtained from the Lea County Airport National Weather Service Site. This data will be used to correlate ambient air quality measurements at each of the ground level air monitoring sites.

2.1.4 Program Duration and Sampling Frequency

Baseline ambient air quality measurements will be collected over an approximate ten day period to establish the baseline air quality in the vicinity of the Westgate Subdivision. A total of seven (24-hour time integrated) sampling events will be conducted at each of seven monitoring sites during this period. Continuous meteorological measurements will be collected and will be correlated with the chemical measurement data.

2.2 Air Emission Flux Measurements

This section describes the monitoring activities that will be performed to characterize potential chemical emission sources that may be present during site remediation of contaminated soils. This section also cites the procedures that will be followed, presents the method sensitivity, and describes the procedures for sample collection. The methods to be used are consistent with those developed by the USEPA entitled *Procedures for Conducting Air Pathway Analyses for Superfund Activities, Interim Final Documents: Volume 1 - Overview of Air Pathway Assessments for Superfund Sites (Revised)*, EPA-450/1-89-001a (NTIS PB93-173987) published in November 1992.

2.2.1 Summary of Isolation Flux Monitoring Activities

Air emission measurements will be performed using an isolation flux chamber approach. A flux chamber is an enclosure that is used to isolate a given surface area of disturbed or undisturbed soil and measure the air emissions that diffuse to the atmosphere. Sweep air flows through the flux chamber and the concentrations of individual chemical species of interest are monitored in the flux chamber atmosphere or exhaust gas. The measurements yield an emission flux (emission rate per unit surface area). This approach is very sensitive and therefore is useful in identifying the constituents present in a contaminated area (the concentration of contaminants in the flux chamber atmosphere is more concentrated than ambient air and there are not the matrix effects encountered in soil samples). The emission fluxes can be scaled up to estimate the air emissions from the exposure of larger surface areas. The data also can be used directly as the source term in atmospheric dispersion models to calculate the (uncontrolled) downwind ambient air concentrations that might be encountered during remediation.

During the Phase I Air Monitoring Investigation, a total of six sets of flux measurements will be performed at three locations in the study area. Currently, it is anticipated that isolation flux measurements will be made at two locations in the West Tasker pit area and a third location will be sampled near the East Tasker pit area. At each sampling location, flux measurements will be performed at two depths: approximately three feet and six feet below the ground surface. These tests will be used to characterize the air emissions from the soil at each of these depths. The approximate sampling locations for the surface flux measurements are presented on Figure 2-4.

2.2.2 Flux Chamber Sampling Approach

The testing procedures will be based on the EPA User's Guide for flux chamber monitoring prepared by Radian for the U.S. EPA in the 1980's. Prior to testing, the ground will be trenched to the desired depth. Flux chamber measurements will be performed at a depth of three feet and the trench will then be dug down to a depth of six feet and another set of measurements will be performed.

Once the site is trenched to the proper depth, the flux chamber will be positioned and worked into the soil one to two inches. A diagram showing a cutaway drawing of the isolation flux chamber is shown if Figure 2-5. The soil around the edges of the flux chamber will then be compacted to ensure a good seal. The flux chamber will be operated at a sweep air flowrate of 5 liters per minute (0.005 m^3/min). The sweep air will consist of bottled "hydrocarbon free" zero air. After four chamber residence times (24 minutes), samples may be collected. The residence time, γ, is defined as the chamber volume divided by the sweep air flowrate. It typically takes three to four residence times before steady-state concentrations are reached inside the chamber and sampling can be initiated. The volume of the flux chamber is 30 liters. Assuming the sweep air flow rate is 5 liters/minute, steady state conditions will be reached after 24 minutes [(30/5) * 4 = 24].

Readings will be taken with portable gas analyzers for total hydrocarbons (FID and PID), mercury (Hg) and hydrogen sulfide (H_2S) during the first 24 minutes of operation and periodically thereafter. A one-minute (grab) VOC and RSC sample will be collected once the initial peak total hydrocarbon concentration is measured in the flux chamber. After the flux chamber reaches steady-state conditions (as described in Section 2.2.3), volatile organic compounds (VOCs) and reduced sulfur compounds (RSCs) will be collected as a grab sample over a period of roughly one-minute, using glass-lined canisters. Following the canister sampling, a sorbent sample for SVOC analysis will be collected once steady state is achieved.

2.2.3 Sampling and Analytical Procedures

The following section discusses the specific sampling procedures that will be used to collect samples for total hydrocarbons (total volatile hydrocarbons including methane), mercury, hydrogen sulfide, VOCs, RSCs, TPH (volatile fractions), individual SVOC species, and SVOC (semi-volatile TPH fractions).

Continuous Analyzers - The continuous analyzers to be used for this program are: 1) TVA-1000 for total hydrocarbons, 2) Jerome 431 for mercury, and 3) Jerome 631X for hydrogen sulfide. These analyzers will sample flux chamber air from a sampling manifold attached to the exit line of the flux chamber. All three of the analyzers will be run simultaneously and will begin collecting data immediately after the sweep air is initiated. The continuous data will be logged at one-minute intervals during the first 24 minutes of sampling. Once the reading from the continuous analyzers have stabilized (reached steady state) they will be removed and the VOC, RSC and SVOC samples will be collected.

NOTE:
THE INFORMATION AND INTERPRETATION CONTAINED ON THIS MAP ARE PRELIMINARY. THE MAP INTERPRETATION MAY CHANGE WHEN ADDITIONAL INFORMATION AND DATA IS DEVELOPED.

LEGEND

- ▨ DENOTES EXCAVATED AREA
- — DENOTES PROPOSED PARK CARVE-OUT
- – – DENOTES DIRT LEASE ROAD
- ▨ DENOTES EXCAVATION SITE

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GRIMES BATTERY & TASKER ROAD
PROPOSED LOCATIONS OF
SURFACE FLUX MEASUREMENT LOCATIONS

CLIENT SHELL–HOBBS,N.M.
JOB NUMBER 804254.10
SCALE 1"=80'
DRAWING NUMBER FIGURE 2–4
REV A

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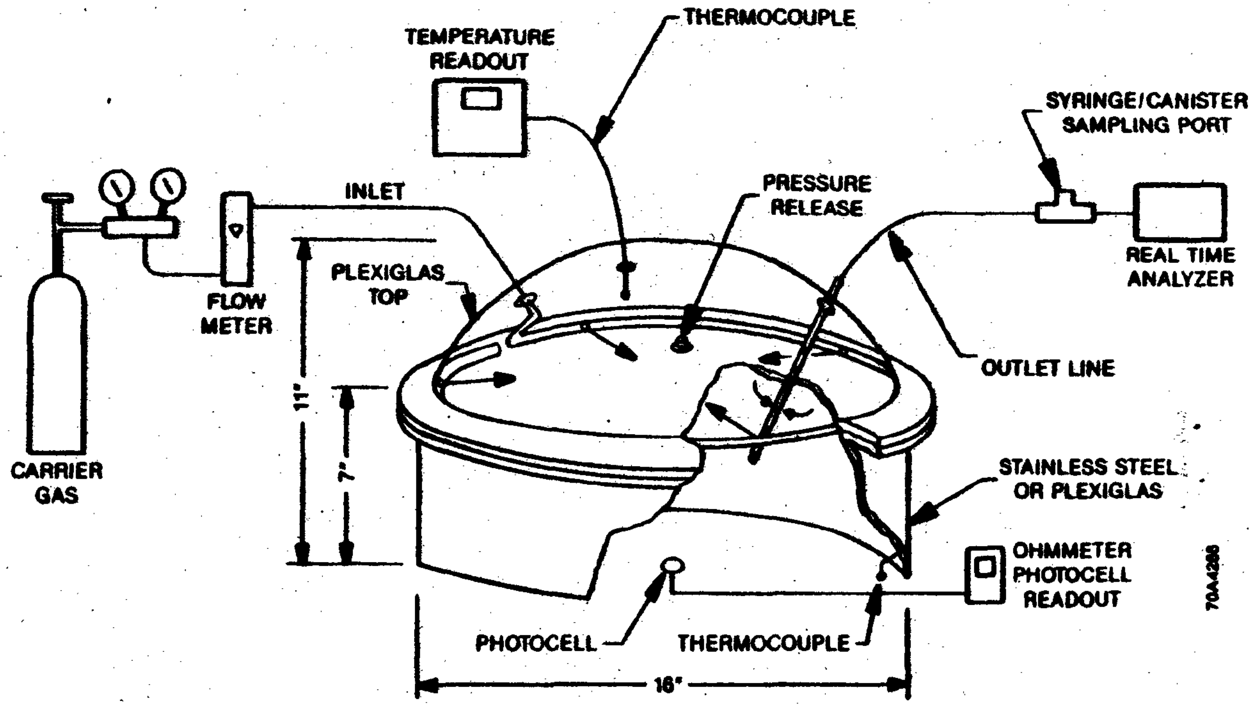
Figure 2-5 Cutaway Diagram of the Emission Isolation Flux Chamber and Support Equipment



CUT AWAY TO SHOW
SWEEP AIR INLET LINE
AND THE OUTLET LINE

Volatile Organic Compounds (VOCs) and Reduced Sulfur Compounds (RSCs) - Soil emissions of VOCs and RSCs will be sampled from the flux chamber using glass-lined stainless-steel canisters. The canister samples will be analyzed for reduced sulfur compounds using ASTM D-5504 and for hydrocarbons using EPA Method TO-15. The canister samples will be drawn from a sampling manifold attached to the exit line of the flux chamber. In addition, each canister will be analyzed for volatile aromatic and aliphatic TPH fractions using the methods previously described in Section 1.2.3.

Semivolatile Organic Compounds (SVOCs) - The SVOC compound list consists of air pollutants that tend to partition between the particulate and vapor phases. Of particular concern, from a health standpoint, are polycyclic aromatic hydrocarbons (PAHs) such as benzo(a)pyrene. SVOC samples will be collected using a sample method based on TO-13a. The sampling apparatus will include a sample pump, a rotometer, and a sorbent tube filled with XAD-2 resin. A sample pump will pull sample air through the sorbent tube, at a flowrate of 2 L/min. The flow rate will be controlled using a calibrated rotometer and checked periodically during the sampling episode. The total sample volume collected will be at least 180 to 360 L and the total sampling time will be approximately 90 to 180 minutes. These samples will be analyzed using a GC/Mass Spectroscopy using the analytical procedures described in TO-13a. In addition, subsequent analysis of the sample extract by modified EPA Method 8015, enhanced to generate TPH fraction and specific analyte data including pristane and phytane will also be performed.

Temperature - Temperature readings will be collected for soil temperature, chamber temperature and ambient temperature, using Type K thermocouples with an electronic meter. These readings will be recorded every six minutes during the initial 24-minutes and periodically thereafter.

2.2.4 Personal and Area Monitoring During Flux Chamber Tests

During the flux chamber tests, the trench area will be monitored for hydrogen sulfide and total hydrocarbons using the continuous analyzers described above. If the concentrations of these compounds move above a designated limit, work will be stopped and the trench will be immediately covered with an effective cover material. The specific procedures that will be used for personal and area monitoring, as well as necessary personal protective equipment, respiratory protection and an emergency action plan will be outlined in the Health and Safety Plan which will be approved before the initiation of field work.

Area or neighborhood monitoring will also be conducted during the flux chamber tests. This will involve collecting PM_{10}, SVOCs, RSCs, and VOCs measurements during periods when trenching operations and flux chamber sampling is underway (approximately 8-10 hours). The methodologies used to sample and analyze for these chemical classes have been previously described in Section 2.1.3. Measurements will be collected at one location adjacent to where surface flux measurements are being made, and at one location in the community. A community survey will also be made using the real-time screening instruments used to measure total hydrocarbons, mercury, and H_2S. These screening measurements will be collected periodically at specific locations along the exclusion zone perimeter, and in the community.

2.2.5 Method Sensitivity

The proximate sensitivity of the method for VOCs and RSCs is shown in Equation 1. A typical analytical detection limit of 1 $\mu g/m^3$ and a sweep air flowrate of 5 L/min (0.005 m^3/min) and an internal surface area of the flux chamber being 0.13 meters can be assumed to estimate the sensitivity of the method

$$EF = \frac{(C)(Q)}{A} \quad \text{(Equation 1)}$$

Where:
EF= Emission Flux (ug/m^2 – min.)
C = Analytical Detection Limit (ug/m^3)
Q= Sweep Air Flow-rate ($m^3/min.$)
A= Interior Surface Area of the Flux Chamber (m^2)

By inserting the values for the variables in Equation 1, one can approximate the method sensitivity.

$$EF = \frac{(1)(0.005)}{0.13} = 0.04\,\mu g/\,m^2\text{ - min}$$

This corresponds to an emission flux of 0.2 g per acre per day for a uniform, constant source. If the analytical detection limit is lower (or higher) than the assumed level of 1 $\mu g/m^3$, the method sensitivity can be adjusted linearly. For mercury and hydrogen sulfide, the analytical detection limits are approximately 1$\mu g/m^3$ resulting in similar method sensitivity as described above for the VOCs and RSCs.

The sensitivity of the method for SVOCs is as follows. Assuming a typical analytical detection limit of 1 μg and a total sample volume of 360L, the analytical detection limit will be 2.8 μg/m^3. Assuming a sweep air flowrate of 5 L/min (0.005 m^3/min), the method detection limit is:

$$EF = \frac{(2.8)(0.005)}{0.13} = 0.11\,\mu\text{g/m}^2\text{-min}$$

3.0 DEVELOPMENT OF HEALTH AND SAFETY PLAN

A project-specific health and safety (H&S) plan will be prepared prior to the start of field sampling. The H&S plan will contain the following information:

- Project description;
- Responsibilities of each field sampler;
- Emergency contact information;
- Emergency action plan;
- Incident reporting procedures;
- Environmental hazards;
- Personal and environmental monitoring;
- Protective equipment;
- Decontamination requirements;
- Disposal procedures;
- Shipping procedures; and
- H&S training requirements.

The H&S plan will be reviewed and approved prior to beginning the Phase I Air Monitoring Study.

4.0 QUALITY ASSURANCE AND QUALITY CONTROL

The purpose of the Quality Assurance (QA) and Quality Control (QC) program is to produce data of known quality that satisfy the project objectives. The QA/QC program:

- Provides a mechanism for ongoing control and evaluation of measurement data quality; and
- Provides measures of data quality in terms of precision, accuracy, completeness and background contamination. These criteria are used to assess whether the data can be used for their intended purpose.

The data quality objectives for this project are shown in Table 4-1. The values shown in Table 4-1 are not intended to represent data validation criteria. Rather, these values represent estimates of the magnitude of uncertainty that might be associated with the measurement data due to random and systematic error. The QA/QC efforts focus on controlling measurement errors within these limits and ultimately provide a database for estimating the actual uncertainty in the measurement data. Not all of the data quality objectives are equally important in terms of meeting the objectives of the program.

4.1 Calibration and Precision Assessments

All sampling devices and continuous measurement devices will be properly calibrated prior to beginning the Phase I Background Air Monitoring Investigation. Where possible and practical the continuous monitors will be challenged daily with a certified gas standard to ensure that precise measurements are being made. The flow controllers of the PM_{10}, PS-1, and canister vacuum controllers will be checked at the beginning and end of the study to ensure that they are providing accurate flow control. If at any time during the course of the investigation there is an indication of problems, the devices will be field calibrated. The Jerome analyzers used to collect H_2S and mercury samples will be calibrated by the manufacturer. The portable meteorological station will be set up and the wind direction will be aligned to "true" north using a hand held compass. The anemometer used to collect wind speed measurements will be checked with a constant speed motor wheel. The temperature sensor will be checked against a certified temperature probe traceable to NIST standards. The portable met station will be checked for calibration at the beginning and end of the Phase I Air Monitoring Assessment Study.

Precision estimates will be obtained by collecting duplicate (replicate) samples. If possible, these samples are analyzed in duplicate to provide "nested" duplicate results. These analyses can be used to develop estimates of total precision, as well as sampling and analytical

Table 4-1. Data Quality Objectives

Measurement	Method	Detection Limit[1]	Precision[2]	Accuracy[3]	Completeness[4]
Ambient Air Parameters					
VOCs	TO-15	1 ppbv	20%	±25%	90%
Volatile TPH	MADEP	1ppb	20%	±25%	90%
SVOC and SVOC TPH Fractions	TO-13A and EPA 8015	3x10^{-6} ug/m^3	25%	±35%	90%
PM$_{10}$	EPA reference High Volume	10 ug/m^3	10%	±15%	90%
Metal/Elements	ICPES/GFAA SW-6010	0.05 ug/m^3	25%	±25%	90%
Wind Speed	Cup anemometer	0.2 m/sec	N/A[5]	±1 2 m/sec	95%
Wind Direction	Wind vane	1 degree	N/A[5]	±1 degrees	95%
Ambient Temperature	Thermocouple	0.1 °C	N/A[5]	±1 °C	95%
Flux Chamber Parameters					
VOCs	TO-15	1 ppbv	20%	±25%	90%
SVOC and SVOC TPH Fractions	TO-13A and EPA 8015	100 ug/m^3	25%	±35%	90%
Sweep air flow rate	Rotometer	0.05 l/min	5%	±5%	95%
Surface temperature	Thermocouple	0.1 °C	2%	±2 °C	95%
Air temperature	Thermocouple	0.1 °C	2%	±1 °C	95%
Time	Clock	1 second	1%	±5 minutes	95%
THC	FID / PID	1 ppm	20%[6]	±50%	90%
Mercury	Gold Film Sensor	1μg/m^3	20%[6]	±50%	90%
Hydrogen Sulfide	Gold Film Sensor	1 ppb	20%[6]	±50%	90%

Footnotes:

[1] Detection limits are dependent on specific compound for VOCs, SVOCs, and metals. A typical value is given, but the actual detection limit for specific compounds may be higher or lower.

[2] Coefficient of variation for replicate measurements.

[3] Total error for a single measurement.

[4] Valid data percentage of total tests conducted.

[5] Precision for meteorological parameters is not normally assessed.

[6] Relative percent difference between duplicate samples.

Abbreviations:

CH_4	Methane
VOC	Volatile Organic Compound
ppb	parts per billion
ppm	parts per million
l/min	liters/minute
sq.m	square meters
°C	degrees centigrade
THC	Total Hydrocarbons

precision. However, if the measurement parameters are found at low concentrations or at low frequency of detection, the variability in the measurements may appear to be large on a relative basis. The number of duplicates will be a minimum of 10% for each of the VOC, RSC, PM_{10} and SVOC samples collected (i.e., for this project, one set of duplicate samples will be collected). Sample collection for duplicate pairs will be done by collecting duplicate samples from a single flux chamber system. The laboratory analytical devices will be operated in accordance with the analytical methods referenced in this document.

4.2 Accuracy Assessments

A field performance audit will be performed by Radian to assess the accuracy of the measurements for VOC, RSC, and SVOCs measurements as well as the accuracy of the meteorological measurements. The results of the field audit will be summarized in the report that summarizes the results of the Phase I Ambient Air Monitoring Study.

4.3 Background Assessments

Background levels represent the contribution to the measurement results that may be due to sampling, transportation, or analytical processes. Contributions due to the analytical system are evaluated by the analysis of analytical system blanks. Contributions due to the sampling equipment, sampling procedures, or sample handling procedures are evaluated by the analysis of field blanks. Enclosures will be checked for contamination by placing the flux chamber over a flat, clean surface (e.g., Teflon) and operating the flux chamber in a normal manner. This procedure will be performed at least once during the sampling effort. Blank canisters and sampling media blanks will also be made for ambient and isolation flux samples. Samples will be collected using the continuous analyzers and if the analyzers indicates that significant (3 times background) contamination is present during the blank checks, appropriate steps will be taken. This will include some or all of the following:

- Repeat the blank check;
- Recalibrate the analyzer; and/or
- Clean or replace the flux chamber components.

Sampling will not continue until acceptable blank values are obtained.

5.0 REPORTING

Upon completion of the Phase I Air Monitoring Investigation, the data will be reviewed and validated to ensure the data quality objectives for this study have been met. The air quality data from each monitor location will be examined to determine if measurable differences between monitors that can be attributed to emissions from the existing Grimes Tank Battery or other emission sources. The data will be summarized in a report of findings for both the baseline air quality measurements as well as the flux chamber measurements.

6.0 SCHEDULE

The schedule for conducting the Phase I Air Monitoring Investigation is shown in Figure 6-1. The schedule shows the various task elements associated with the study and the proximate time required to complete each task element. Approximately 18 weeks will be required to complete the Phase I Air Monitoring Investigation. This schedule assumes that the air monitoring sites are readily accessible, and that no significant effort will be required to prepare them to receive the air monitoring samplers and the laboratories meet scheduled turn-around times. This also assumes that the monitors can be located in accessible and secure locations with 110V power. A refined schedule will be developed once this plan is approved.

Figure 6-1. Phase I Air Monitoring Investigation Schedule

Schedule Task	Wk 1	Wk 2	Wk 3	Wk 4	Wk 5	Wk 6	Wk 7	Wk 8	Wk 9	Wk 10	Wk 11	Wk 13	Wk 14	Wk 15
Mobilization	********	********												
Develop Health and Safety Plan	********	********	D-1											
Install Air Monitoring Stations			********											
Conduct Background Air Quality Assessment			********	********										
Conduct Isolation Flux Measurements					********									
Receive Results From Laboratory						********	********	********						
Demobilize						********								
Process Data and Validate Measurement Data						********	********	********	********	*********	********			
Issue Draft Report of Findings												D-2		
Issue Final Report													*********	D-3

Note: D-X=Deliverable Item

Appendix A

Proposed Target List of Chemical Species to be Measured

A1: Metals and Other Elements

Metals and Other Elements

Aluminum
Antimony
Arsenic
Barium
Beryllium
Bismuth
Boron
Cadmium
Calcium
Chromium
Cobalt
Copper
Iron
Lead
Magnesium
Manganese
Molybdenum
Nickel
Phosphorus
Potassium
Selenium
Silicon
Silver
Sodium
Strontium
Sulfur
Tellurium
Thallium
Tin
Titanium
Tungsten
Uranium
Vanadium
Zinc

A2: Semi-Volatile Organic Compounds (SVOCs)

Semi-Volatile Organic Compounds (SVOCs)

Naphthalene
Acenaphthylene
Acenaphthene
Fluorene
Phenanthrene
Anthracene
Fluoranthene
Pyrene
Benzo(a)anthracene
Chrysene
Benzo(e)pyrene
Benzo(b)fluoranthene
Benzo(k)Fluoranthene
Benzo(a)pyrene
Dibenz(a,h)anthracene
Benzo(ghi)perylene
Indeno(1,2,3-cd)pyrene

A3: Reduced Sulfur Compounds

Reduced Sulfur Compounds

Carbonyl Sulfide
Methyl Mercaptan
Ethyl Mercaptan
Dimethyl Sulfide
Carbon Disulfide
Isopropyl Mercaptan
tert-Butyl Mercaptan
n-Propyl Mercaptan
Ethyl Methyl Sulfide
Thiophene
Isobutyl Mercaptan
Diethyl Sulfide
Butyl Mercaptan
Dimethyl Disulfide
2-Methylthophene
Tetrahydrothiophene
2-Ethylthiophene
2,6-Dimethylthiophene
Diethyl Disulfide
Hydrogen Sulfide

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A4: Volatile Organic Compounds

VOCs

1, 1 -Dichloroethene
1,1,1-Trichloroethane
1,1,2,2-Tetrachloroethane
1,1,2-Trichloroethane
1,1-Dichloroethane
1,2,3-Trimethylbenzene
1,2,4-Trichlorobenzene
1,2,4-Trimethylbenzene
1,2-Dichlorobenzene
1,2-Dichloroethane
1,2-Dichloropropane
1,3,5-Trimethylbenzene
1,3-Butadiene
1,3-Dichlorobenzene
1,4-Dichlorobenzene
1,4-Dioxane
1-Decene
1-Heptene
1-Hexene
1-Methylcyclohexene
1-Nonene
1-Octene
1-Pentene
1-Undecene
2,2,3-Trimethylpentane
2,2,4-Trimethylpentane
2,2,5-Trimethylhexane
2,3,4-Trimethylpentane
2,3-Dimethylbutane
2,3-Dimethylpentane
2,4,4-Trimethyl-1-Pentene
2,4-4-Trimethyl-2-Pentene
2,4-Dimethylpentane
2,5-Dimethylhexane
2-Butanone
2-Ethyl-1-Butene
2-Hexanone
2-Methyl-1-Butene
2-Methyl-1-Pentene
2-Methyl-2-Pentene
2-Methylheptane
2-Propanol
3-Methyl-1-Butene

VOCs (continued)

3-Methylheptane
3-Methylhexane
3-Methylpentane
4-Ethyltoluene
4-Methyl-1-Pentene
4-Methyl-2-pentanone
4-Nonene
Acetone
Acrylonitrile
a-Pinene
Benzaldehyde
Benzene
b-Pinene
Bromodichloromethane
Bromoform
Bromomethane
c-2-Butene
c-2-Hexene
c-2-Octene
c-2-Pentene
c-3-Hexene
c-3-Methyl-2-Pentene
c-4-Methyl-2-Pentene
Carbon Tetrachloride
Chlorobenzene
Chloromethane
Chlorotoluene
Chloroform
cis-1,2,Dichloroethene
cis-1,3,Dichloropropene
Cumene
Cyclohexane
Cyclohexene
Cyclopentane
Cyclopentene
Dibromochloromethane
Ethanol
Ethylbenzene
Ethylene Dibromide
Freon 113
Freon 114
Freon 12
Indan
Indene

VOCs (continued)

Isobutane
Isobutene + 1-Butene
Isobutylbenzene
Isoheptane
Isohexane
Isopentane
Isoprene
m-Diethylbenzene
Methyl t-Butyl Ether
Methylcyclohexane
Methylcyclopentane
Methylcyclopentene
Methylene Chloride
m-Ethyltoluene
Naphthalene
n-Butane
n-Butylbenzene
n-Decane
Neohexane
Neopentane
n-Heptane
n-Hexane
n-Nonane
n-Octane
n-Pentane
n-Propylbenzene
n-Undecane
o-Chlorotoluene
o-Dichlorobenzene
o-Ethyltoluene
o-Xylene
p-Chlorotoluene
p-Dichlorobenzene
p-Diethylbenzene
p-Ethyltoluene
p-Isopropyltoluene
Propane
Propylene
p-Xylene + m-Xylene
Styrene
t-1,2-Dichloroethylene
t-1,3-Dichloropropene
t-2-Butene
t-2-Hexene

VOCs (continued)

t-2-Pentene
t-Butylbenzene
Tetrachloroethene
Tetrahydrofuran
Toluene
Trichloroethene
Vinyl Chloride