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REPORTS

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Chevron USA
Schubert Site Investigation
Lea County, New Mexico

March 9, 2001

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CONSERVATION DIVISION

Wayne, Just a few sheets of the "Full" Report Bob Allen left w/ you in late March. Thanks, Rick [illegible]

Prepared for:

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I. Background

In December 2000 Safety & Environmental Solutions, Inc. (SESI) was engaged by Chevron USA, West Permian Basin Unit, to perform a site investigation at a location where oil and gas production had occurred in the past. The investigation was conducted voluntarily by Chevron at the request of the landowner, Mr. Gary Schubert, and not in response to regulatory directives. The subject area is identified as the Schubert property and is located in Unit M of Section 21, Township 18 S, Range 38 E in Lea County, New Mexico. The area is north and east of the intersection of Bender Blvd. and French Dr. The site is approximately one mile west of the Lovington Highway (NM 18) in Hobbs (Figure 1). The property is currently being cultivated and is irrigated with water from nearby wells.

Previously the subject area contained a production tank battery and an associated pit. The pit was located about 1,300 ft. north and east of the Bender-French intersection. It was relatively large (size approximately 200 x 300 ft. sq.) and was in use for an unknown period prior to 1978. Available aerial photographs clearly show the pit in 1964 but only a barely discernible outline is seen on the 1978 photograph. The pit shows two cells, but in the 1964 photograph it appears dry. The production battery is about 800 ft north and east of the intersection. Four tanks appear on the 1964 photograph; although the 1978 photo is unclear, it appears that at most only one tank remains.

The purpose of the investigation was two-fold. First, the investigation was performed to delineate the horizontal and vertical extent of any remaining hydrocarbon and/or salt materials at the pit and battery. Secondly, analytical data collected from the sampling effort was to be used as inputs to the American Petroleum Institute's (API) VADSAT model to assess the potential effects on groundwater quality from subsurface petroleum hydrocarbon releases.

VADSAT is an interactive program to simulate the movement of conservative inorganic or reactive organic species present in land-disposed waste. Program output is used to assess effects of land disposal practices on groundwater quality. Compounds considered include organic species that dissolve from oily wastes, and inorganic salts that migrate by convection and dispersion in the aqueous phase. Adsorption, biodecay and volatilization at the ground surface are considered for organic species, while salts are considered non-reactive. Release scenarios that may be modeled include both surface and subsurface releases. The latter are distinguished by the presence of overlying soil cover, which acts to impede evaporation losses of volatile compounds. The program can also model effectiveness of clay and synthetic liners.

VADSAT is based on coupled analytical solutions of the unsaturated and saturated zone flow and transport equations, which can be solved with minimal computational effort. It is well suited for conducting uncertainty analyses to assess effects of variable soil and waste characteristics on the risk of groundwater contamination at land-disposal sites. Environmental Systems and Technologies, Inc., of Blacksburg, Virginia, developed the VADSAT model in 1995 under contract from the API, and use of the model by SESI is by license from the API.

II. Work Performed

Soil Boring and Sampling

It was necessary to use the services of a land surveyor to locate the old pit and battery area because the surface has been leveled for agricultural use. Figure 2 is a copy of site survey produced by John West Engineering to locate the site of the production pit and the tank battery. Borehole locations were staked at 75 ft. north-south intervals and 50 ft. east-west intervals at Area 1 (the production pit area), and at 50 ft. intervals at Area 2 (the tank battery location).

Drilling began on February 4, 2001, using SESI personnel from Hobbs. Drilling was completed on February 16. A Giddings trailer-mounted drill, Model 25-SCT was used to bore test holes with a 4-in. hollow-stem auger. Samples from the test holes generally were collected in thin-walled sampling tubes using SOPs found in Environmental Protection Agency, 1984, Characterization of Hazardous Waste Site - A Methods Manual: Vol. II. Initially, soil samples were collected at 0-2 ft. and 2-5 ft. intervals. Due to the presence of cemented caliche at 3 ft., some sample boreholes at Area 1 did not penetrate below that depth. However, sufficient boreholes were drilled in the center of pit to provide confidence in the results. At Area 2, all holes were drilled to five feet. Locations of the boreholes at Areas 1 and 2 are shown in Figures 3 and 4, respectively. A table showing borehole lithologies is presented in Appendix A. At the completion of drilling, the boreholes were backfilled with drill cuttings.

Field-testing for Total Petroleum Hydrocarbons (TPH) was performed on most soil samples (EPA Method 418.1) using a GAC Mega Total Petroleum Hydrocarbon analyzer. The samples were preserved on ice and delivered along with Chain of Custody to Cardinal Laboratories for testing. Laboratory samples were analyzed for Total Petroleum Hydrocarbons (EPA Method SW 846 418.1), BTEX (EPA Method SW-846-8260) and Chlorides (EPA Method 600/4-79-020 325.3). Copies of the analytical results are found in Appendix B.

III. Results of Soil Testing

Soil Sampling Results – Area 1, Production Pit

Soil sampling results for TPH, BTEX and chlorides from the 17 boreholes at Area 1 are tabulated in Table 1.

Laboratory TPH concentrations ranged from less than 10 mg/Kg in six boreholes to 9,440 mg/Kg in BH 5-1 at a depth of 0-2 ft. The average TPH, calculated for all Area 1 samples, was 1,504 mg/Kg. The highest TPH concentrations are in boreholes BH 3, 4, 5, 6, and 8, which are within the center of the Area 1 investigation grid (Figure 3).

Table 1. Borehole Soil Sampling Results, Area 1 (Production Pit) Schubert Site Investigation, Lea County, New Mexico

Location, Borehole, and Sample #	Depth (ft.)	Sample Date	Concentration (mg/Kg)					
			TPH	Benzene	Toluene	E-benzene	Total Xylenes	Cl
Area 1, BH 1-1	2-5	02/04/01	<10	<0.005	0.007	<0.005	0.018	128
Area 1, BH 2-1	3-5	02/04/01	<10	<0.005	<0.005	<0.005	<0.015	192
Area 1, BH 3-1	0-2	02/05/01	3,540	<0.005	0.008	<0.005	<0.015	145
Area 1, BH 3-2	2-5	02/05/01	165	<0.005	0.010	<0.005	0.017	162
Area 1, BH 4-1	0-2	02/06/01	1,400	<0.005	0.006	<0.005	0.016	129
Area 1, BH 4-2	2-5	02/06/01	15.8	<0.005	<0.005	<0.005	<0.015	145
Area 1, BH 5-1	0-2	02/06/01	9,440	<0.005	<0.005	<0.005	<0.015	291
Area 1, BH 5-2	2-5	02/06/01	220	<0.005	<0.005	<0.005	<0.015	129
Area 1, BH 6-1	0-2	02/06/01	3,550	<0.005	<0.005	<0.005	<0.015	113
Area 1, BH 6-2	2-5	02/06/01	388	<0.005	<0.005	<0.005	<0.015	162
Area 1, BH 7	0-2	02/06/01	119	<0.005	<0.005	<0.005	<0.015	242
Area 1, BH 8	0-2	02/06/01	1,490	<0.005	<0.005	<0.005	<0.015	129
Area 1, BH 9	0-2	02/06/01	154	<0.005	<0.005	<0.005	<0.015	129
Area 1, BH 10	0-3	02/06/01	60.2	<0.005	<0.005	<0.005	<0.015	113
Area 1, BH 11	0-3	02/06/01	491	<0.005	<0.005	<0.005	<0.015	210
Area 1, BH 12	0-3	02/06/01	18.5	<0.005	<0.005	<0.005	<0.015	145
Area 1, BH 13	0-2	02/06/01	<10	<0.005	<0.005	<0.005	<0.015	81
Area 1, BH 14	0-1.5	02/06/01	<10	<0.005	<0.005	<0.005	<0.015	356
Area 1, BH 15	0-1.5	02/06/01	<10	<0.005	<0.005	<0.005	<0.015	129
Area 1, BH 16	0-2	02/06/01	<10	<0.005	<0.005	<0.005	<0.015	1,617
Area 1, BH 17	0-2	02/06/01	<10	<0.005	<0.005	<0.005	<0.015	129
		All Samples:					All Samples:	
		Area 1 TPH Mean:	1,504				Area 1 Chloride Mean:	232
		Area 1 TPH Geometric Mean:	357				Area 1 Chloride Geometric Mean:	171
		Area 1 TPH Max:	9,440				Area 1 Chloride Max:	1,617
		Area 1 TPH Min:	<10				Area 1 Chloride Min:	81
		"Shallow" Samples (≤3 ft.):					"Shallow" Samples (≤3 ft.):	
		Area 1 Shallow Samples TPH Mean:	2,026				Area 1 Shallow Samples Cl Mean:	264
		Area 1 Shallow Samples TPH Geometric Mean:	549				Area 1 Shallow Samples Cl Geom. Mean:	180
		Area 1 Shallow Samples TPH Max:	9,440				Area 1 Shallow Samples Cl Max:	1,617
		Area 1 Shallow Samples TPH Min:	<10				Area 1 Shallow Samples Cl Min:	81
		"Deep" Samples (>3 ft.):					"Deep" Samples (>3 ft.):	
		Area 1 Deep Samples TPH Mean:	197				Area 1 Deep Samples Cl Mean:	153
		Area 1 Deep Samples TPH Geometric Mean:	122				Area 1 Deep Samples Cl Geometric Mean:	151
		Area 1 Deep Samples TPH Max:	388				Area 1 Deep Samples Cl Max:	192
		Area 1 Deep Samples TPH Min:	<10				Area 1 Deep Samples Cl Min:	128

To further assist in interpretation, average TPH values were recalculated based on whether the sample was a "shallow" (0-3 ft.) or "deep" sample (>3 ft.). The mean TPH for the shallow samples was 2,026 mg/Kg, while the mean for the deep samples was only 197 mg/Kg. Lithologically, all the shallow samples except one were a brown or gray cohesive clay (BH 12 had a mixture of pink sand and brown clay). However, this type of clay is not characteristically present in the area, which may indicate that the old pit was clay-lined. Further, the soil TPH values were not excessively elevated compared to those found in other abandoned production pits in the Hobbs area.

BTEX constituent sampling showed essentially no volatile hydrocarbons present in the shallow or deep samples at very low detection limits (usually 0.005 mg/Kg). No benzene was detected in any Area 1 sample.

Chloride levels ranged from 81 mg/Kg in BH 13 to a maximum of 1,617 mg/Kg in BH 16. The latter was the only sample that exceeded 1,000 mg/Kg; the next highest sample was 356 mg/Kg in BH 14. There was only a relatively small decrease in chloride levels in the "deep" samples from levels in the upper 3 ft.; the average of the shallow samples was 264 mg/Kg while the deeper samples had a chloride mean of 153 mg/Kg. Again, the soil chloride concentrations were not excessively elevated compared to those commonly found in abandoned pits in the region. Also, except for the value of 1,617 mg/Kg in BH 16 (which is likely production related), the other chloride values may well be due to irrigation leaching of the surface since the area is currently under cultivation.

The lack of significant residual hydrocarbon or highly elevated produced water constituents in the soil samples indicates that either the pit was not in continuous use for placement of production wastes, or that it was cleaned before closure. Based on the presence of relatively clean and continuous clay at all but one borehole, and the lack of significant TPH concentrations in the underlying caliche, it is likely that the pit was not extensively used for disposal purposes. Supporting evidence for this hypothesis is the 1964 aerial photograph, which shows an apparent dry pond.

Soil Sampling Results – Area 2, Tank Battery Area

Soil sampling results for TPH, BTEX and chlorides from the 11 boreholes at Area 2 are tabulated in Table 2.

Laboratory TPH concentrations ranged from less than 10 mg/Kg in four boreholes to 1,890 mg/Kg in BH 1-1 at a depth of 0-3 ft. The average TPH, calculated for all Area 2 samples, was 445 mg/Kg. The highest TPH concentrations are in boreholes BH 1, 2, and 6, which are generally within the center of the Area 2 investigation grid (Figure 4).

As at Area 1, the TPH values were recalculated based on whether the sample was a "shallow" (0-3 ft.) or "deep" sample (>3 ft.). The mean TPH for the shallow samples was 731 mg/Kg, while the mean for the deep samples was only 112 mg/Kg. Lithologically, the shallow samples were a mixture of topsoil, clay and sandy clay. Again, the soil TPH values were not excessively elevated compared to those found in other abandoned production sites in the Hobbs area.

Table 2. Borehole Soil Sampling Results, Area 2 (Tank Battery) Schubert Site Investigation, Lea County, New Mexico

			Concentration (mg/Kg)					
Location, Borehole, and Sample #	**Depth (ft.)**	**Sample Date**	**TPH**	**Benzene**	**Toluene**	**E-benzene**	**Total Xylenes**	**Cl**
Area 2, BH 1-1	0-3	02/07/01	1,890	<0.005	0.058	0.034	0.171	81
Area 2, BH 1-2	5-5.5	02/08/01	167	<0.005	<0.005	<0.005	<0.015	113
Area 2, BH 2-1	0-2	02/08/01	911	<0.005	<0.005	<0.005	<0.015	81
Area 2, BH 2-2	3-3.5	02/08/01	18.4	<0.005	<0.005	<0.005	<0.015	65
Area 2, BH 3-1	0-3.25	02/08/01	86.6	<0.005	0.006	0.007	<0.015	178
Area 2, BH 3-2	5-5.5	02/08/01	110	<0.005	<0.005	<0.005	<0.015	162
Area 2, BH 4-1	0-2.5	02/08/01	117	<0.005	0.005	<0.005	<0.015	97
Area 2, BH 4-2	5-5.5	02/08/01	47.4	<0.005	<0.005	<0.005	<0.015	81
Area 2, BH 5-1	0-2.5	02/08/01	372	<0.005	<0.005	<0.005	<0.015	113
Area 2, BH 5-2	5-5.5	02/08/01	107	<0.005	<0.005	<0.005	<0.015	97
Area 2, BH 6-1	0-2.5	02/08/01	1,650	<0.005	<0.005	<0.005	<0.015	65
Area 2, BH 6-2	5-6	02/08/01	221	<0.005	<0.005	<0.005	<0.015	145
Area 2, BH 7-1	2-3	02/16/01	<10	<0.002	0.002	<0.002	<0.006	63
Area 2, BH 7-2	4-5	02/16/01	<10	<0.002	<0.002	<0.002	<0.006	63
Area 2, BH 8-1	0-3	02/09/01	<10	<0.005	<0.005	<0.005	<0.015	226
Area 2, BH 8-2	3-5	02/09/01	<10	<0.005	<0.005	<0.005	<0.015	178
Area 2, BH 9-1	2-3	02/16/01	92.9	<0.002	0.01	0.004	0.01	110
Area 2, BH 9-2	4-5	02/16/01	<10	<0.002	<0.002	<0.002	<0.006	94
Area 2, BH 10-1	2-3	02/16/01	<10	0.003	<0.002	<0.002	<0.006	173
Area 2, BH 10-2	4-5	02/16/01	<10	<0.002	<0.002	<0.002	<0.006	204
Area 2, BH 11-1	2-3	02/16/01	<10	<0.002	<0.002	<0.002	<0.006	141
Area 2, BH 11-2	4-5	02/16/01	<10	<0.002	<0.002	<0.002	<0.006	220
		All Samples:					All Samples:	
		Area 2 TPH Mean:	445				Area 2 Chloride Mean:	125
		Area 2 TPH Geometric Mean:	188				Area 2 Chloride Geometric Mean:	115
		Area 2 TPH Max:	1,890				Area 2 Chloride Max:	226
		Area 2 TPH Min:	<10				Area 2 Chloride Min:	63
		"Shallow" Samples (≤3 ft.):					"Shallow" Samples (≤3 ft.):	
		Area 2 Shallow Samples TPH Mean:	731				Area 2 Shallow Samples Cl Mean:	121
		Area 2 Shallow Samples TPH Geometric Mean:	372				Area 2 Shallow Samples Cl Geom. Mean:	111
		Area 2 Shallow Samples TPH Max:	1,890				Area 2 Shallow Samples Cl Max:	226
		Area 2 Shallow Samples TPH Min:	<10				Area 2 Shallow Samples Cl Min:	63
		"Deep" Samples (>3 ft.):					"Deep" Samples (>3 ft.):	
		Area 2 Deep Samples TPH Mean:	112				Area 2 Deep Samples Cl Mean:	129
		Area 2 Deep Samples TPH Geometric Mean:	85				Area 2 Deep Samples Cl Geometric Mean:	118
		Area 2 Deep Samples TPH Max:	221				Area 2 Deep Samples Cl Max:	220
		Area 2 Deep Samples TPH Min:	<10				Area 2 Deep Samples Cl Min:	63
Background								
H.P. (oily hardpan)	(Area 2)	02/09/01	48,600	<0.005	0.007	<0.005	<0.015	48
W. Bender 1 (south)	0.5-0.8	03/06/01	- -	- -	- -	- -	- -	50
W. Bender 2 (south)	2-2.4	03/06/01	- -	- -	- -	- -	- -	112

BTEX constituent sampling showed only a few volatile hydrocarbons present in the shallow at very low detection limits (usually 0.005 mg/Kg). Benzene at 0.003 mg/Kg was detected in only one Area 2 sample. At that level the value is not significant, especially for any groundwater impact. The highest BTEX values were toluene at 0.058 mg/Kg, ethylbenzene at 0.034 mg/Kg, and total xylenes at 0.171 mg/Kg. All three samples were from borehole BH 1-1 located at the center of the Area 2 grid.

Chloride levels ranged from 63 mg/Kg in BH 7 to a maximum of 226 mg/Kg in BH 8. There was essentially no difference in chloride levels in the "deep" samples from levels in the upper 3 ft.; the average of the shallow samples was 121 mg/Kg while the deeper samples had a chloride mean of 129 mg/Kg. Again, the soil chloride concentrations were not excessively elevated compared to those commonly found in abandoned pits in the region.

For those constituents sampled in soil at the production battery, the location does not pose a threat to groundwater due to the lack of significant residual hydrocarbon or highly elevated produced water contaminants.

A sample of "oily hardpan" was collected at the location of the former tank battery. Although it had a TPH of 48,600 mg/Kg, BTEX was essentially absent and chloride concentration was less than 50 mg/Kg. This material does not pose a threat to groundwater.

For comparison purposes, a background soil sample was collected for chloride analysis. The sample was collected from an uncultivated open field on the south side of Bender Blvd. east of French Drive just across from the Schubert site. The shallow sample reported 50 mg/Kg chloride while the sample at 2.4 ft. (at the top of the caliche) had a concentration of 112 mg/Kg. This value probably represents background in the vicinity of the investigation area.

IV. VADSAT Modeling of Chloride Contaminant Movement

The VADSAT model was utilized to simulate contaminate transport of chloride from the vicinity of the production pit through the vadose (unsaturated) zone to the groundwater. No organics were modeled because benzene was absent, and the low levels of other volatiles detected would be attenuated before reaching groundwater. The length of time chosen for model simulation is important because the NMOCD is looking at a minimum time period of 200 years for protection of groundwater from constituents that might be leached from the pit.

Over 40 physical and chemical variables are required to be determined prior to running the VADSAT model. Many of these are site specific (e.g. constituent concentration, waste area and thickness, depth to groundwater), while others are characteristic of the pit locale (e.g. soil type, infiltration rate, hydraulic conductivity, aquifer thickness and gradient). Some variables are essentially generic to the model and generally do not need to be changed unless there is site-specific data showing a need to modify the variables (e.g. constituent physical and chemical properties for the BTEX contaminants).

Chloride Simulations

Chloride is a very conservative contaminant (i.e. does not degrade or combine with other chemicals in the subsurface to decrease its concentration). When modeling chloride, the initial concentration and net infiltration (recharge) rate are the main drivers of contamination to the water table.

At the Schubert site, the average chloride value of 232 mg/Kg at Area 1 (the production pit) was used in the model. It was not adjusted for background concentration, nor was the geometric mean used in the simulation. Hypothetical receptors were placed at a location 10 feet downgradient from the pit at depths of 1, 5 and 10 feet below the water table. An infiltration rate of 0.5 inches per year was used in the simulation; this is the rate of recharge (under natural conditions) estimated by Nickolson and Clebsch (1961). Chloride first appears at the downgradient receptors about 180 years into the simulation, but the maximum increase in concentration at the end of 200 years is about 0.1 mg/L, which is an insignificant increase (Figure 5).

Since the area is under cultivation, a further simulation was made with a net infiltration rate of 5 inches per year, a chloride concentration of 120 mg/Kg (adjusted for background), and taking into consideration the clay beneath the site that would act as a "leaky" liner. With this scenario, chloride appears at the receptors about 110 years into the simulation. The maximum chloride concentration increase is 50 mg/L at 1 ft. depth and about 7 mg/L at 10 ft. depth (Figure 6). Although this scenario appears to pose groundwater problems, large-scale irrigated agriculture in the area is unlikely to continue past 40 years due to dropping of water levels in the Ogallala Formation below where pumping for agriculture is economical. Further, the subject property may be sold and taken out of agricultural production within the next two to three years.

Although the WQCC Regulations do not directly apply to the groundwater contamination at the site, the NMOCD is applying the methodology of the WQCC regulations in evaluating the future risk to groundwater. The regulations allow degradation of the groundwater up to the listed standard, but once reached no further degradation is allowed. At the Schubert site, the chloride concentration in the groundwater is unknown, but it is unlikely that it exceeds the New Mexico groundwater standard of 250 mg/L. Therefore it is likely that some small chloride increase would be allowed due to leaching from irrigation recharge at the production pit location. Due to the uncertainties of future use of the property for agriculture and/or the availability of irrigation water, and the lack of a current background water quality sample, further modeling efforts at the site would not be productive at this time.

V. Conclusions and Recommendations

Results of the soil sampling program show no risk to groundwater from any hydrocarbon material remaining at the site of the production pit and the tank battery. Although several samples have elevated TPH concentrations, measurable BTEX is missing from virtually all samples. Because of this, BTEX modeling was not performed at either of these sites.

Chloride modeling shows negligible increases in chloride groundwater concentrations for a modeling scenario that utilizes natural recharge as the mechanism for moving chloride to the groundwater. However, a maximum increase of 50 mg/L in chloride in the groundwater is predicted if the area were irrigated for the next 100 years or longer and net recharge increased to 5 inches per year. The latter scenario is unlikely given the constraints expected to occur as water for irrigated agriculture becomes prohibitively expensive as water levels drop and it is diverted to beneficial uses that are more economically valuable.

Based on evaluation of the soil sampling results and simulation of contaminant movement in the subsurface, SESI believes that no further investigation or remedial action is necessary or needed at either of the two sites (production pit and tank battery) investigated at the Schubert property.

VI. References

Nicholson, A. N., Jr., and Clebsch, A., Jr., 1961. *Geology and Ground-water Conditions in Southern Lea County, New Mexico.* Ground-Water Report 6, New Mexico Bureau of Mines and Mineral Resources, Socorro, New Mexico, 120 p.