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FIGURES F-8, F-14, F-48 to F-63
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FINAL REPORT

ENVIRONMENTAL RESOURCES MANAGEMENT GROUP

Lenz Oil Participating Respondents

Lenz Oil Feasibility Study Report
Lenz Oil Site
Lemont, Illinois

Volume II
(Appendices)

February 1997

Project No. 94017-22

Revision No. 3

Environmental Resources Management-North Central, Inc.
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APPENDIX A
RISK CALCULATION PROCEDURES FOR INDIVIDUAL SOIL SAMPLES

APPENDIX A - RISK CALCULATION PROCEDURES FOR INDIVIDUAL SOIL SAMPLES

This appendix presents a summary of the procedures used to calculate the soil risks for the Lenz Oil Site, located in Lemont, Illinois, as well as the corresponding results. In general, the procedures presented in the Baseline Risk Assessment report prepared by PRC Environmental, Inc. (PRC), and dated March 25, 1993, were used to calculate soil risks for the Lenz Oil Site. However, as indicated in Section 2.3, the concentrations of chemicals in air used to calculate inhalation risks were determined using the procedures contained within the American Society for Testing and Materials' (ASTM's) Standard E1739-95: *Standard Guide for Risk-based Corrective Action Applied at Petroleum Release Sites* (the "ASTM standard"). These values were used instead of the concentrations of chemicals in air calculated by PRC and reported in the Baseline Risk Assessment. All of the risks were determined for the: (1) future on-site resident scenario, and (2) the current adjacent resident scenario.

The following sections of this appendix describe:

- The procedure to determine the background inorganic soil concentrations (Section 1.0),
- The calculation of volatilized emissions using the procedures outlines in the ASTM standard (Section 2.0),
- The calculation of particulate emissions using the procedures outlined in the ASTM standard (Section 3.0), and
- The calculation of risks associated with ingestion, dermal contact, and volatilized and particulate emissions inhalation (Section 4.0).

1.0 *BACKGROUND INORGANIC SOIL CONCENTRATIONS*

As indicated in Appendix B of the Baseline Risk Assessment document, inorganic analytes present at concentrations lower than background were not used in the risk calculations, and the soil borings used to define background concentrations are SB213, SB214, and SB215 (Table A-1). Because the evaluation presented in this appendix requires the comparison of individual soil locations with background concentrations, each inorganic parameter was compared to the maximum concentration of the parameter detected in the background samples. As presented in Section 1.5.1.2 of the text, the maximum concentrations detected in the background soil samples were lower than the maximum state-wide background concentrations for "metropolitan statistical areas" included in the Illinois Environmental Protection Agency's document *A Summary of Selected Background Conditions for Inorganics in Soil*, dated August 1994.

2.0 *ESTIMATION OF VOLATILIZED EMISSIONS*

Emissions of organic compounds of concern in both surface soil (i.e., the 0- to 5-foot depth interval) and subsurface soil as a result of volatilization were calculated using the ASTM standard procedures. Inorganic compounds do not volatilize under typical conditions; therefore, no inorganic analytes were evaluated for volatile emissions.

2.1 *SURFACE SOIL EQUATIONS*

The concentrations in air for the organic compounds of concern in the shallow soils were determined by calculating a volatilization factor for each compound and multiplying this factor by the respective compound's soil concentration. The ASTM standard provides two equations for the determination of a volatilization factor. These are:

$$VF_{ss} = \left(\frac{2(W)(\rho_s)\left(10^3 \frac{cm^3 - kg}{m^3 - g}\right)}{(\upsilon_{air})(\delta_{air})} \right) \left(\frac{(D_s^{eff})(H^1)}{\pi\left[\theta_{ws} + (k_s)(\rho_s) + (H^1)(\theta_{as})\right] \bullet \tau} \right)^{\frac{1}{2}}$$

or

$$VF_{ss} = \frac{W \bullet \rho_s \bullet d \bullet 10^3 \frac{cm^3 - kg}{m^3 - g}}{U_{air} \bullet \delta_{air} \bullet \tau}$$

Where:

VF_{ss}	=	Volatilization factor for surficial soils, kg/m^3
W	=	Width of source area parallel to the wind direction, 304.8 cm (assumed value, reflects a 10-foot diameter around individual soil borings based on the normal heterogeneity of soils and the fact that each sampling location had different number, type, and concentration of organics)
ρ_s	=	Soil bulk density, 1.5 g/cm^3 (default value)
U_{air}	=	Average wind speed above ground surface in ambient mixing zone, 225 cm/s (default value)
δ_{air}	=	Ambient air mixing zone height, 200 cm (default value)
D_s^{eff}	=	Effective diffusion coefficient, cm^2/s (calculated value)
H'	=	Henry's Law constant, dimensionless (parameter-specific)
π	=	Pi, 3.1416
θ_{ws}	=	Volumetric water content in vadose zone soils, dimensionless, 0.17 for clayey silts

k_s	=	Soil-water sorption coefficient, dimensionless (calculated value)
θ_{as}	=	Volumetric air content in vadose zone soils, dimensionless, 0.22 for clayey silts
τ	=	Averaging time for vapor flux, 9.46×10^8 s (equivalent to 30 years)
d	=	Lower depth of surficial soil zone, 100 cm (default value)

The effective diffusion coefficient is calculated for each parameter as follows:

$$D_s^{eff} = \frac{D^{air} \bullet \theta_{as}^{3.33}}{\theta_t^{2}} + \frac{D^{water} \bullet \theta_{ws}^{3.33}}{H' \bullet \theta_t^{2}}$$

Where:

D^{air}	=	Diffusion coefficient in air, in cm^2/s (parameter-specific)
D^{water}	=	Diffusion coefficient in water, in cm^2/s (parameter-specific)
θ_t	=	Total soil porosity, dimensionless, 0.39 for clayey silts

D_s^{eff}, θ_{as}, θ_{ws}, and H' are as previously defined.

The soil-water sorption coefficient is calculated by using the following formula:

$$k_s = (k_{oc})(f_{oc})$$

Where:

k_{oc}	=	Organic carbon partition coefficient, in cm^3/g or L/kg
f_{oc}	=	Organic carbon content of soil, dimensionless, 0.006 for surface soil (conservative value used in the proposed Illinois Part 742 regulations, the site-specific average is 0.0133)

As indicated in the ASTM standard, the lower result of the two surface soil volatilization factors is used as the volatilization factor for the emission calculations. Once the volatilization factor has been obtained, the ambient air concentration is calculated by multiplying this factor by the parameter's soil concentration. Table A-2 summarizes the parameter-specific properties used in the volatilization factors determination for the analytes of concern. The volatilization factors are the same for both the future on-site and the current adjacent resident scenarios.

2.2 *SURFACE SOIL EMISSIONS SAMPLE CALCULATIONS*

The following calculations determine the volatilization factor for trichloroethene in surface soils:

$$H' = 0.422$$
$$D^{air} = 0.079\ cm^2/s$$
$$k_{oc} = 166\ cm^3/g$$
$$D^{water} = 9.1 \times 10^{-6}\ cm^2/s$$
$$k_s = (166)(0.006) = 0.996\ cm^3/g$$

$$D_s^{eff} = \frac{(0.079\ cm^2/s)(0.22)^{3.33}}{(0.39)^2} + \frac{(9.1 \times 10^{-6}\ cm^2/s)(0.17)^{3.33}}{(0.422)(0.39)^2}$$
$$D_s^{eff} = 3.36 \times 10^{-3}\ cm^2/s$$

$$VF_{ss} = \left(\frac{2(304.8)(1.5)(10^3)}{(225)(200)}\right)\left(\frac{(3.36 \times 10^{-3})(0.422)}{3.1416(0.17 + (0.996)(1.5) + (0.422)(0.22))(9.46 \times 10^8)}\right)^{\frac{1}{2}}$$
$$VF_{ss} = 4.60 \times 10^{-5}\ kg/m^3$$

$$VF_{ss} = \frac{(304.8\ cm)(1.5\ g/cm^3)(100\ cm)\left(10^3\ \frac{cm^3 \cdot kg}{m^3 \cdot g}\right)}{(225\ cm/s)(200\ cm)(9.46x10^8\ s)}$$
$$VF_{ss} = 1.07 \times 10^{-6}\ kg/m^3$$

Since the lower of the two calculated values must be used, the surface soil volatilization factor used in the emissions calculation for trichloroethene is $1.07 \times 10^{-6}\ kg/m^3$.

The ambient air concentration of trichloroethene resulting from volatilization reaction from soil boring SB-01 (0 to 5 feet) is:

$$(0.220\ mg/kg)(1.07 \times 10^{-6}\ kg/m^3) = 2.35 \times 10^{-7} mg/m^3$$

2.3 *SUBSURFACE SOIL EQUATIONS*

The volatilization factor from subsurface soil to ambient air is given by the following equation:

$$VF_{samb} = \frac{H' \bullet \rho_s \bullet 10^3 \frac{cm^3 - kg}{m^3 - g}}{\left[\theta_{ws} + (k_s \bullet \rho_s) + (H' \bullet \theta_{as})\right]\left[1 + \frac{(U_{air} \bullet \delta_{air} \bullet L_s)}{(D_s^{eff} \bullet W)}\right]}$$

Where:

VF_{samb} = Subsurface soil to ambient air volatilization factor, in kg/m^3
L_s = Depth to subsurface soil, 100 cm (default value)

The terms H', ρ_s, θ_{ws}, k_s, θ_{as}, U_{air}, δ_{air}, D_s^{eff}, and W are as defined in Section 2.1 The effective diffusion coefficient and the soil-water sorption coefficient are calculated as defined in Section 2.1, with the exception that the default value for the organic carbon content (f_{oc}) for subsurface soil in the proposed Illinois Part 742 regulations was used. This value is 0.002, which is lower than the site-specific average of 0.0133.

The ambient air concentrations due to volatilization from subsurface soils are then calculated by multiplying the parameter's concentration in the subsurface soil by its volatilization factor.

2.4 *SUBSURFACE SOIL EMISSIONS SAMPLE CALCULATIONS*

The following is a sample calculation for trichloroethene in subsurface soil:

$k_s = (166)(0.002) = 0.332\ cm^3/g$

$$VF_{samb} = \frac{0.422 \bullet 1.5\ g/cm^3 \bullet 10^3 \frac{cm^3 - kg}{m^3 - g}}{\left[0.17 + \left((0.332\ cm^3/g)(1.5\ g/cm^3)\right) + ((0.422)(0.22))\right]\left[1 + \frac{225\ cm/s \bullet 200\ cm \bullet 100\ cm}{(3.36 \times 10^{-3}\ cm^2/s)(304.8\ cm)}\right]}$$

$VF_{samb} = 1.89 \times 10^{-4}\ kg/m^3$

The ambient air concentration of trichloroethene from volatile emissions from soil boring SB15R (4.5 to 9.5 feet) is:

$$(0.780\ mg/kg)(1.89 \times 10^{-4}\ kg/m^3) = 1.5 \times 10^{-4}\ mg/m^3$$

3.0 *ESTIMATION OF PARTICULATE EMISSIONS*

As previously indicated, organic and inorganic particulate emissions were calculated by using the procedures in the ASTM standard. In accordance with the Baseline Risk Assessment, emissions were only calculated for surface soil, because no particulate emissions are generated from subsurface soil. The following sections detail the procedure employed and provide a sample calculation.

3.1 *EQUATIONS*

The particulate emission factor for surficial soil is given by the following equation:

$$VF_p = \frac{P_e \bullet W \bullet 10^3 \ \frac{cm^3 - kg}{m^3 - g}}{U_{air} \bullet \delta_{air}}$$

Where:

VF_p = Particulate volatilization factor, in kg/m^3
P_e = Particulate emission rate, 6.9×10^{-14} $g/cm^2 \bullet s$ (default value)

The terms W, U_{air}, and δ_{air} are as defined in Section 2.1. Once a particulate emission factor has been determined, the ambient air concentration of detected analytes can be determined by multiplying each analyte's soil concentration by the particulate emission factor.

3.2 *SAMPLE CALCULATION*

The following is a sample calculation of the particulate emission factor:

$$VF_p = \frac{6.9 \times 10^{-14} \ g/cm^2/s \bullet 304.8 \ cm \bullet 10^3 \ \frac{cm^3 - kg}{m^3 - g}}{225 \ cm/s \bullet 200 \ cm}$$

$$= 4.67 \times 10^{-13} \ kg/m^3$$

The ambient air concentration of trichloroethene from particulate emissions from soil boring SB-01 (0 to 5 feet) is:

$$(0.220 \ mg/kg)(4.67 \times 10^{-13} \ kg/m^3) = 1.03 \times 10^{-13} \ mg/m^3$$

4.0 *CALCULATION OF RISKS*

As presented in the Baseline Risk Assessment document, the soil samples collected from a depth of 0 to 5 feet were used to calculate the risks from ingestion, dermal contact, and inhalation of particulate and VOC emissions, while the samples collected from a depth of 5 to 10 feet were used to calculate the risks from inhalation of VOC emissions. The chronic intake calculations were conducted in accordance with the procedures outlined in Section 3 of the Baseline Risk Assessment document as follows:

- Soil ingestion - Equation 3-5, Page 47;
- Soil dermal contact - Equation 3-7, Page 50; and
- Soil volatile and particulate emissions inhalation - Equation 3-9, Page 52.

The exposure and toxicity factors used to calculate the risks are outlined in the Baseline Risk Assessment document in Section 3.4 (i.e., the exposure factors) and in Tables 4-1 through 4-4 (i.e., the toxicity factors). Consistent with the Baseline Risk Assessment document, the future on-site resident scenario evaluates risks to 0- to 6-year-old children, while the current adjacent resident scenario evaluates risks to 7- to 15-year-old children. Table A-3 of this appendix summarizes the exposure scenarios and factors used in the calculation of intake rates. As indicated in the Baseline Risk Assessment document, the carcinogenic risks for adults and children were added to obtain the total carcinogenic risk, but the total noncarcinogenic risk was calculated as the risks to children only. In addition, only carcinogenic and noncarcinogenic risks for adults were calculated for the inhalation exposure route.

The carcinogenic risks and hazard indices for the various pathways were obtained by using the following equations from Section 5 of the Baseline Risk Assessment document:

- Carcinogenic risk - Equation 5-1, Page 96;
- Total carcinogenic risks - Equation 5-2, Page 97;
- Total exposure point carcinogenic risks - Equation 5-3, Page 98;
- Hazard indices - Equation 5-4, Page 98;
- Total hazard indices - Equation 5-5, Page 100; and
- Total exposure point hazard indices - Equation 5-6, Page 100.

The risks obtained for each sample for the future on-site resident scenario are shown in Tables A-4, A-5, A-6, A-7, and A-8 for the Phase I shallow, Phase II shallow, Phase I deep, Phase II deep, and LNAPL investigation

soil samples, respectively. Table A-9 evaluates the health effects of noncarcinogenic risks under the future on-site resident scenario posed by the only sample location that had a total hazard index equal or greater than 1.

Tables A-10 and A-11 present the risks for the shallow soil samples under the current adjacent resident scenario. In accordance with the Baseline Risk Assessment, the risks to the current adjacent resident and the future on-site resident for the inhalation pathway are the same, and are presented in Tables A-6 through A-8. Under the current adjacent resident scenario, all total hazard indices are less than 1.

TABLES

TABLE A-1
BACKGROUND SOIL CONCENTRATIONS
LENZ OIL SITE
LEMONT, ILLINOIS

Location Units	Background Samples Concentrations SB213 (mg/kg)	 SB214 (mg/kg)	 SB215 (mg/kg)	Background Concentration (mg/kg)
Analyte				
Aluminum	6,980	10,400	9,260	10,400
Arsenic	6.30	8.70	11.1	11.1
Barium	56.4	51.5	46.3	56.4
Beryllium	0.36	0.57	0.41	0.57
Calcium	6,160	42,200	58,700	58,700
Chromium	10.4	14.2	11.5	14.2
Cobalt	6.8	7.5	7.4	7.5
Copper	12.0	17.9	17.2	17.9
Iron	16,900	21,700	21,000	21,700
Lead	13.1	26.8	13.1	26.8
Magnesium	3,810	26,600	36,300	36,300
Manganese	677	602	619	677
Nickel	10.9	16.7	16.9	16.9
Potassium	1,090	1,710	1,160	1,710
Vanadium	17.4	25.0	21.1	25.0
Zinc	48.3	83.1	57.1	83.1

TABLE A-2

SUMMARY OF PHYSICAL PROPERTIES USED
IN AMBIENT AIR EMISSIONS CALCULATIONS (1)

Parameter	Diffusivity in Air (cm^2/s)	Diffusivity in Water (cm^2/s)	Henry's Law Constant (dimensionless)	Organic Carbon Partition Coefficient (mL/g)
Carbon Disulfide	0.104	1.00E-05	1.24	45.7
Methylene chloride	0.101	1.17E-05	0.0898	11.7
Chlorobenzene	0.073	0.0000087	0.152	219
Acetone	0.124	1.14E-05	0.00159	0.575
1,1-Dichloroethane	0.0742	1.05E-05	0.23	31.6
1,2-Dichloroethene (Total)	0.0736	0.0000113	0.167	35.5
trans-1,2-Dichloroethene	0.0707	0.0000119	0.385	52.5
2-Butanone	0.09485	NA	0.0019	4.5
1,1,1-Trichloroethane	0.078	8.80E-06	0.705	110
trans-1,3-dichloropropene	0.0626	1.00E-05	0.726	45.7
Trichloroethene	0.079	9.10E-06	0.422	166
Benzene	0.088	9.80E-06	0.228	58.9
Tetrachloroethene	0.072	8.20E-06	0.754	155
1,2-Dichlorobenzene	0.069	7.90E-06	0.0779	617
Phenol	0.082	9.10E-06	0.0000163	28.8
Toluene	0.087	8.60E-06	0.272	182
Ethyl benzene	0.075	7.80E-06	0.323	363
Xylenes (Total)	0.072	1.00E-05	0.25	260
Methoxyclor	0.0156	4.46E-06	0.000648	97,700
4-Methylphenol	0.060198	NA	0.000032	3,020
2,6-Dinitrotoluene	0.0327	0.00000726	0.0000306	69.2
Naphthalene	0.059	7.50E-06	0.0198	2,000
2-Methylnaphthalene	0.0639	NA	NA	4,571
Acenaphthene	0.0421	7.69E-06	0.00636	7,080
Dibenzofuran	0.058748	NA	NA	8,128
Fluorene	0.0363	7.88E-06	0.00261	13,800
Phenanthrene	0.057074	NA	0.001	14,000
Anthracene	0.0324	7.74E-06	0.00267	29,500
di-n-Butylphthalate	0.0438	7.86E-06	3.85E-08	33,900
Fluoranthene	0.0302	6.35E-06	0.00066	107,000
N-Nitrosodiphenylamine	0.0312	0.00000635	0.000205	1,290
Pyrene	0.0272	7.24E-06	0.000451	105,000
Butylbenzylphthalate	0.0174	4.83E-06	0.0000517	57,500
Benzo(a)anthracene	0.051	9.00E-06	0.000137	398,000
bis-(2-ethylhexyl)phthalate	0.0351	3.66E-06	0.00000418	15,100,000
Chrysene	0.0248	6.21E-06	0.00388	398,000
Benzo(b)fluoranthene	0.0226	5.56E-06	0.00455	1,230,000
Benzo(k)fluoranthene	0.0226	5.56E-06	0.000034	1,230,000
Benzo(a)pyrene	0.043	9.00E-06	0.0000463	1,020,000
Indeno(1,2,3,cd)pyrene	0.019	5.66E-06	0.0000566	3,470,000
Benzo(g,h,i)perylene	0.050951	NA	0.0000057	1,600,000
gamma-BHC	0.0142	7.34E-06	0.000574	1,070
Dieldrin	0.0125	4.74E-06	0.000619	21,400
Aldrin	0.0132	4.86E-06	0.00697	2,450,000
Endosulfan I	0.0115	4.55E-06	0.000459	2,140
4,4'-DDE	0.0144	5.87E-06	0.000861	4,470,000
4,4'-DDD	0.0169	4.76E-06	0.000164	1,000,000
4,4'-DDT	0.0137	4.95E-06	0.000332	2,630,000
alpha-Chlordane	0.0118	4.37E-06	0.00199	120,000
gamma-Chlordane	0.0118	4.37E-06	0.00199	120,000
Aroclor 1242	0.0519	NA	0.023	530,000
Aroclor1248	0.0519	NA	0.023	530,000
Aroclor 1254	0.047025	NA	0.11	530,000
Aroclor 1260	0.043653	NA	0.29	530,000

Note:

(1) Obtained from Appendix C of Title 35 fo the Illinois Administrative Code, Part 742, *Tiered Approach to Corrective Action Objectives.*

Key:

NA = Not available

TABLE A-3

SUMMARY OF EXPOSURE SCENARIOS AND FACTORS USED FOR THE EVALUATION OF RISKS
LENZ OIL SITE
LEMONT, ILLINOIS

	Exposure	Subpopulation	Exposure	
Future On-site Resident Scenario				
Carcinogenic	Ingestion of Soil	Sum of adults and children ages 0 to 6 years	Ingestion Rate:	
			Children:	200 mg/day
			Adults:	100 mg/day
			Exposure Frequency:	350 days/year
			Exposure Duration:	
			Children:	6 years
			Adults:	24 years
			Body Weight:	
			Children:	15 Kg
			Adults:	70 Kg
			Averaging Time:	25,550 days
	Dermal Contact with Soil	Sum of adults and children ages 0 to 6 years	Surface Area Exposed:	
			Children:	1,048 cm^2
			Adults:	2,666 cm^2
			Adherence Factor:	1 mg/cm^2
			Absorption Factor:	
			Volatiles:	0.25
			Semivolatiles/Pesticides:	0.10
			Inorganics:	0.01
			Exposure Frequency:	350 days/year
			Exposure Duration:	
			Children:	6 years
			Adults:	24 years
			Body Weight:	
			Children:	15 Kg
			Adults:	70 Kg
			Averaging Time:	25,550 days
	Inhalation of Vapors and Particulates	Adults only	Inhalation Rate:	0.8333 m^3/hour
			Exposure Frequency:	24 hours/day
				350 days/year
			Exposure Duration:	24 years
			Body Weight:	70 Kg
			Averaging Time:	25,550 days

TABLE A-3

SUMMARY OF EXPOSURE SCENARIOS AND FACTORS USED FOR THE EVALUATION OF RISKS
LENZ OIL SITE
LEMONT, ILLINOIS

	Exposure	Subpopulation	Exposure	
Future On-site Resident Scenario				
Noncarcinogenic	Ingestion of Soil	Children ages 0 to 6 years only	Ingestion Rate:	200 mg/day
			Exposure Frequency:	350 days/year
			Exposure Duration:	6 years
			Body Weight:	15 Kg
			Averaging Time:	2,190 days
	Dermal Contact with Soil	Children ages 0 to 6 years only	Surface Area Exposed:	1,048 cm^2
			Adherence Factor:	1 mg/cm^2
			Absorption Factor:	
			Volatiles:	0.25
			Semivolatiles/Pesticides:	0.10
			Inorganics:	0.01
			Exposure Frequency:	350 days/year
			Exposure Duration:	6 years
			Body Weight:	15 Kg
			Averaging Time:	2,190 days
	Inhalation of Vapors and Particulates	Adults only	Inhalation Rate:	0.8333 m^3/hour
			Exposure Frequency:	24 hours/day 350 days/year
			Exposure Duration:	24 years
			Body Weight:	70 Kg
			Averaging Time:	8,760 days

TABLE A-3

SUMMARY OF EXPOSURE SCENARIOS AND FACTORS USED FOR THE EVALUATION OF RISKS
LENZ OIL SITE
LEMONT, ILLINOIS

	Exposure	Subpopulation	Exposure	
Current Adjacent Resident Scenario				
Carcinogenic	Ingestion of Soil	Sum of adults and children ages 7 to 15 years	Ingestion Rate:	
			Children:	100 mg/day
			Adults:	100 mg/day
			Exposure Frequency:	10 days/year
			Exposure Duration:	
			Children:	9 years
			Adults:	21 years
			Body Weight:	
			Children:	37 Kg
			Adults:	70 Kg
			Averaging Time:	25,550 days
	Dermal Contact with Soil	Sum of adults and children ages 7 to 15 years	Surface Area Exposed:	
			Children:	2,975 cm^2
			Adults:	5,000 cm^2
			Adherence Factor:	1 mg/cm^2
			Absorption Factor:	
			Volatiles:	0.25
			Semivolatiles/Pesticides:	0.10
			Inorganics:	0.01
			Exposure Frequency:	10 days/year
			Exposure Duration:	
			Children:	9 years
			Adults:	21 years
			Body Weight:	
			Children:	37 Kg
			Adults:	70 Kg
			Averaging Time:	25,550 days
	Inhalation of Vapors and Particulates	Adults only	Inhalation Rate:	0.8333 m^3/hour
			Exposure Frequency:	24 hours/day 350 days/year
			Exposure Duration:	24 years
			Body Weight:	70 Kg
			Averaging Time:	25,550 days

TABLE A-3

SUMMARY OF EXPOSURE SCENARIOS AND FACTORS USED FOR THE EVALUATION OF RISKS
LENZ OIL SITE
LEMONT, ILLINOIS

	Exposure	Subpopulation	Exposure	
Current Adjacent Resident Scenario				
Noncarcinogenic	Ingestion of Soil	Children ages 7 to 15 years only	Ingestion Rate:	100 mg/day
			Exposure Frequency:	10 days/year
			Exposure Duration:	6 years
			Body Weight:	15 Kg
			Averaging Time:	3,285 days
	Dermal Contact with Soil	Children ages 7 to 15 years only	Surface Area Exposed:	2,975 cm^2
			Adherence Factor:	1 mg/cm^2
			Absorption Factor:	
			Volatiles:	0.25
			Semivolatiles/Pesticides:	0.10
			Inorganics:	0.01
			Exposure Frequency:	10 days/year
			Exposure Duration:	9 years
			Body Weight:	37 Kg
			Averaging Time:	3,285 days
	Inhalation of Vapors and Particulates	Adults only	Inhalation Rate:	0.8333 m^3/hour
			Exposure Frequency:	24 hours/day 350 days/year
			Exposure Duration:	24 years
			Body Weight:	70 Kg
			Averaging Time:	8,760 days

TABLE A-4
FUTURE ON-SITE RESIDENT SCENARIO SOIL RISKS
SHALLOW SOIL BORINGS - PHASE I
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk (3)				Hazard Index (3,4)			
		Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
SB01 (0-5 feet deep)									
Acetone	0.270	--	--	--	--	0.000	0.000	--	0.000
Trichloroethene	0.220	3.8E-09	1.1E-08	4.7E-10	1.5E-08	--	--	--	--
trans-1,3-Dichloropropene	0.007	2.0E-09	5.8E-09	1.1E-10	7.8E-09	0.000	0.000	0.000	0.001
Tetrachloroethene	0.110	8.8E-09	2.6E-08	2.5E-11	3.4E-08	0.000	0.000	--	0.000
Naphthalene	0.082	--	--	--	--	0.000	0.000	--	0.000
2-Methylnaphthalene	0.067	--	--	--	--	--	--	--	--
Acenaphthene	0.140	--	--	--	--	0.000	0.000	--	0.000
Dibenzofuran	0.120	--	--	--	--	--	--	--	--
Fluorene	0.300	--	--	--	--	0.000	0.000	--	0.000
Phenanthrene	2.0	--	--	--	--	--	--	--	--
Anthracene	0.660	--	--	--	--	0.000	0.000	--	0.000
Fluoranthene	3.1	--	--	--	--	0.001	0.001	--	0.002
Pyrene	2.5	--	--	--	--	0.001	0.001	--	0.002
Benzo(a)anthracene	1.6	2.1E-06	2.5E-06	1.8E-07	4.7E-06	--	--	--	--
Chrysene	1.5	6.1E-08	7.1E-08	5.1E-09	1.4E-07	--	--	--	--
Benzo(b)fluoranthene	1.5	1.9E-06	2.2E-06	1.6E-07	4.3E-06	--	--	--	--
Benzo(k)fluoranthene	1.4	8.3E-07	9.7E-07	7.1E-08	1.9E-06	--	--	--	--
Benzo(a)pyrene	1.5	1.4E-05	1.6E-05	1.2E-06	3.1E-05	--	--	--	--
Indeno(1,2,3-cd)pyrene	0.610	1.2E-06	1.4E-06	1.1E-07	2.8E-06	--	--	--	--
Benzo(g,h,i)perylene	0.650	1.3E-07	1.5E-07	1.1E-08	3.0E-07	--	--	--	--
Aroclor-1260	0.900	1.1E-05	1.3E-05	--	2.4E-05	--	--	--	--
Aluminum	16,200	--	--	--	--	--	--	--	--
Barium	214	--	--	--	--	0.039	0.002	--	0.041
Calcium	98,200	--	--	--	--	--	--	--	--
Chromium (5)	38.5	--	--	--	--	0.000	0.000	--	0.001
Cobalt	20.6	--	--	--	--	--	--	--	--
Copper	259	--	--	--	--	--	--	--	--
Iron	27,500	--	--	--	--	--	--	--	--
Lead	339	--	--	--	--	--	--	--	--
Magnesium	39,900	--	--	--	--	--	--	--	--
Mercury	0.18	--	--	--	--	0.008	0.000	0.000	0.008
Potassium	2,530	--	--	--	--	--	--	--	--
Selenium	0.55	--	--	--	--	0.001	0.000	--	0.001
Sodium	1,460	--	--	--	--	--	--	--	--
Vanadium	30.6	--	--	--	--	--	--	--	--
Zinc	553	--	--	--	--	0.035	0.002	--	0.037
Totals:		3E-05	4E-05	2E-06	7E-05	0.087	0.006	0.000	0.093
Inorganics Totals:					0E+00				0.088
SB02 (0-5 feet deep)									
Acetone	0.150	--	--	--	--	0.000	0.000	--	0.000
Methylene chloride	0.030	3.5E-10	1.0E-09	--	1.4E-09	0.000	0.000	0.000	0.000
Phenanthrene	0.140	--	--	--	--	--	--	--	--
Fluoranthene	0.150	--	--	--	--	0.000	0.000	--	0.000
Pyrene	0.150	--	--	--	--	0.000	0.000	--	0.000
Chrysene	0.090	3.7E-09	4.3E-09	3.1E-10	8.2E-09	--	--	--	--
bis(2-Ethylhexyl)phthalate	0.160	3.5E-09	4.1E-09	--	7.6E-09	0.000	0.000	--	0.000
Arsenic	12.1	--	--	3.3E-11	3.3E-11	0.516	0.027	--	0.543
Barium	128	--	--	--	--	0.023	0.001	--	0.025
Calcium	76,200	--	--	--	--	--	--	--	--
Chromium (5)	34.7	--	--	--	--	0.000	0.000	--	0.000
Cobalt	12.4	--	--	--	--	--	--	--	--
Copper	50.9	--	--	--	--	--	--	--	--
Iron	22,500	--	--	--	--	--	--	--	--
Lead	182	--	--	--	--	--	--	--	--
Magnesium	43,400	--	--	--	--	--	--	--	--
Manganese	1,590	--	--	--	--	--	--	0.000	0.000
Potassium	2,680	--	--	--	--	--	--	--	--
Sodium	2,430	--	--	--	--	--	--	--	--
Vanadium	32.9	--	--	--	--	--	--	--	--
Zinc	216	--	--	--	--	0.014	0.001	--	0.015
Totals:		8E-09	9E-09	3E-10	2E-08	0.554	0.029	0.000	0.583
Inorganics Totals:					3E-11				0.583

TABLE A-4
FUTURE ON-SITE RESIDENT SCENARIO SOIL RISKS
SHALLOW SOIL BORINGS - PHASE I
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk (3)				Hazard Index (3,4)			
		Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
SB03 (0-5 feet deep)									
trans-1,3-Dichloropropene	0.007	2.0E-09	5.8E-09	1.1E-10	7.8E-09	0.000	0.000	0.000	0.001
2-Methylnaphthalene	0.077	--	--	--	--	--	--	--	--
Phenanthrene	0.081	--	--	--	--	--	--	--	--
Fluoranthene	0.110	--	--	--	--	0.000	0.000	--	0.000
Pyrene	0.160	--	--	--	--	0.000	0.000	--	0.000
Butylbenzylphthalate	0.330	--	--	--	--	0.000	0.000	--	0.000
Chrysene	0.084	3.4E-09	4.0E-09	2.9E-10	7.7E-09	--	--	--	--
bis(2-Ethylhexyl)phthalate	0.088	1.9E-09	2.3E-09	--	4.2E-09	0.000	0.000	--	0.000
Aluminum	13,300	--	--	--	--	--	--	--	--
Barium	287	--	--	--	--	0.052	0.003	--	0.055
Calcium	92,900	--	--	--	--	--	--	--	--
Chromium (5)	35.0	--	--	--	--	0.000	0.000	--	0.000
Cobalt	20.6	--	--	--	--	--	--	--	--
Copper	87.2	--	--	--	--	--	--	--	--
Lead	309	--	--	--	--	--	--	--	--
Magnesium	53,000	--	--	--	--	--	--	--	--
Mercury	0.50	--	--	--	--	0.021	0.001	0.000	0.022
Potassium	2,150	--	--	--	--	--	--	--	--
Sodium	1,180	--	--	--	--	--	--	--	--
Zinc	221	--	--	--	--	0.014	0.001	--	0.015
Totals:		7E-09	1E-08	4E-10	2E-08	0.089	0.005	0.000	0.094
Inorganics Totals:					0E+00				0.093
SB04 (0-2.5 feet deep)									
Aluminum	12,400	--	--	--	--	--	--	--	--
Barium	379	--	--	--	--	0.069	0.004	--	0.073
Cadmium	1.3	--	--	4.4E-13	4.4E-13	0.017	0.001	--	0.017
Calcium	133,000	--	--	--	--	--	--	--	--
Chromium (5)	49.9	--	--	--	--	0.001	0.000	--	0.001
Cobalt	14.1	--	--	--	--	--	--	--	--
Copper	156	--	--	--	--	--	--	--	--
Lead	619	--	--	--	--	--	--	--	--
Magnesium	62,900	--	--	--	--	--	--	--	--
Mercury	0.11	--	--	--	--	0.005	0.000	0.000	0.005
Nickel	28.5000	--	--	--	--	0.018	0.001	--	0.019
Potassium	3,190	--	--	--	--	--	--	--	--
Sodium	1,260	--	--	--	--	--	--	--	--
Zinc	327	--	--	--	--	0.021	0.001	--	0.022
Cyanide	4.3	--	--	--	--	0.003	0.000	--	0.003
Totals:		0E+00	0E+00	4E-13	4E-13	0.133	0.007	0.000	0.140
Inorganics Totals:					4E-13				0.140
SB04 (2.5-5 feet deep)									
Aluminum	12,700	--	--	--	--	--	--	--	--
Barium	314	--	--	--	--	0.057	0.003	--	0.060
Cadmium	1.3	--	--	4.4E-13	4.4E-13	0.017	0.001	--	0.017
Chromium (5)	54.3	--	--	--	--	0.001	0.000	--	0.001
Cobalt	14.3	--	--	--	--	--	--	--	--
Copper	144	--	--	--	--	--	--	--	--
Lead	642	--	--	--	--	--	--	--	--
Nickel	25.2	--	--	--	--	0.016	0.001	--	0.017
Zinc	336	--	--	--	--	0.021	0.001	--	0.023
Cyanide	4.0	--	--	--	--	0.003	0.000	--	0.003
Totals:		0E+00	0E+00	4E-13	4E-13	0.115	0.006	0.000	0.121
Inorganics Totals:					4E-13				0.121

TABLE A-4
FUTURE ON-SITE RESIDENT SCENARIO SOIL RISKS
SHALLOW SOIL BORINGS - PHASE I
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk (3)				Hazard Index (3,4)			
		Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
SB05 (2.5-5 feet deep)									
Aluminum	11,500	--	--	--	--	--	--	--	--
Barium	363	--	--	--	--	0.066	0.003	--	0.070
Cadmium	1.1	--	--	3.7E-13	3.7E-13	0.014	0.001	--	0.015
Calcium	116,000	--	--	--	--	--	--	--	--
Chromium (5)	46.3	--	--	--	--	0.001	0.000	--	0.001
Cobalt	13.6	--	--	--	--	--	--	--	--
Copper	128	--	--	--	--	--	--	--	--
Lead	427	--	--	--	--	--	--	--	--
Magnesium	64,500	--	--	--	--	--	--	--	--
Mercury	0.099	--	--	--	--	0.004	0.000	0.000	0.004
Nickel	22.3	--	--	--	--	0.014	0.001	--	0.015
Potassium	3,070	--	--	--	--	--	--	--	--
Sodium	993	--	--	--	--	--	--	--	--
Zinc	210	--	--	--	--	0.013	0.001	--	0.014
Totals:		0E+00	0E+00	4E-13	4E-13	0.113	0.006	0.000	0.119
Inorganics Totals:					4E-13				0.119
SB06 (2.5-5 feet deep)									
Aroclor-1242	12	1.4E-04	1.7E-04	--	3.1E-04	--	--	--	--
Aroclor-1254	9.3	1.1E-04	1.3E-04	--	2.4E-04	--	--	--	--
Aroclor-1260	0.680	8.2E-06	9.6E-06	--	1.8E-05	--	--	--	--
beta-BHC	0.087	--	--	--	--	--	--	--	--
Aluminum	24,700	--	--	--	--	--	--	--	--
Barium	1,280	--	--	--	--	0.234	0.012	--	0.246
Cadmium	1.7	--	--	5.7E-13	5.7E-13	0.022	0.001	--	0.023
Calcium	78,700	--	--	--	--	--	--	--	--
Chromium (5)	92.8	--	--	--	--	0.001	0.000	--	0.001
Cobalt	16.6	--	--	--	--	--	--	--	--
Copper	670	--	--	--	--	--	--	--	--
Iron	38,400	--	--	--	--	--	--	--	--
Lead	683	--	--	--	--	--	--	--	--
Magnesium	37,300	--	--	--	--	--	--	--	--
Mercury	0.090	--	--	--	--	0.004	0.000	0.000	0.004
Nickel	46.7	--	--	--	--	0.030	0.002	--	0.031
Potassium	3,860	--	--	--	--	--	--	--	--
Sodium	3,370	--	--	--	--	--	--	--	--
Vanadium	43.4	--	--	--	--	--	--	--	--
Zinc	639	--	--	--	--	0.041	0.002	--	0.043
Cyanide	6.3	--	--	--	--	0.004	0.000	--	0.004
Totals:		3E-04	3E-04	6E-13	6E-04	0.335	0.018	0.000	0.353
Inorganics Totals:					6E-13				0.353
SB07 (2.5-5 feet deep)									
Aluminum	14,400	--	--	--	--	--	--	--	--
Barium	498	--	--	--	--	0.091	0.005	--	0.096
Cadmium	1.6	--	--	5.4E-13	5.4E-13	0.020	0.001	--	0.022
Calcium	99,000	--	--	--	--	--	--	--	--
Chromium (5)	55.1	--	--	--	--	0.001	0.000	--	0.001
Cobalt	14.2	--	--	--	--	--	--	--	--
Copper	277	--	--	--	--	--	--	--	--
Lead	687	--	--	--	--	--	--	--	--
Magnesium	49,300	--	--	--	--	--	--	--	--
Nickel	33.1	--	--	--	--	0.021	0.001	--	0.022
Potassium	2,910	--	--	--	--	--	--	--	--
Sodium	1,490	--	--	--	--	--	--	--	--
Vanadium	26.9	--	--	--	--	--	--	--	--
Zinc	382	--	--	--	--	0.024	0.001	--	0.026
Cyanide	5.3	--	--	--	--	0.003	0.000	--	0.004
Totals:		0E+00	0E+00	5E-13	5E-13	0.161	0.008	0.000	0.170
Inorganics Totals:					5E-13				0.170

TABLE A-4
FUTURE ON-SITE RESIDENT SCENARIO SOIL RISKS
SHALLOW SOIL BORINGS - PHASE I
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk (3)				Hazard Index (3,4)			
		Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
SB08 (0-2.5 feet deep)									
Aluminum	15,400	--	--	--	--	--	--	--	--
Barium	511	--	--	--	--	0.093	0.005	--	0.098
Cadmium	1.3	--	--	4.4E-13	4.4E-13	0.017	0.001	--	0.017
Calcium	99,400,	--	--	--	--	--	--	--	--
Chromium (5)	51.5	--	--	--	--	0.001	0.000	--	0.001
Cobalt	19.0	--	--	--	--	--	--	--	--
Copper	193	--	--	--	--	--	--	--	--
Lead	663	--	--	--	--	--	--	--	--
Magnesium	48,300	--	--	--	--	--	--	--	--
Nickel	47.5	--	--	--	--	0.030	0.002	--	0.032
Potassium	3,410	--	--	--	--	--	--	--	--
Selenium	0.73	--	--	--	--	0.002	0.000	--	0.002
Sodium	1,680	--	--	--	--	--	--	--	--
Vanadium	27.5	--	--	--	--	--	--	--	--
Zinc	406	--	--	--	--	0.026	0.001	--	0.027
Cyanide	4.8	--	--	--	--	0.003	0.000	--	0.003
Totals:		0E+00	0E+00	4E-13	4E-13	0.172	0.009	0.000	0.181
Inorganics Totals:					4E-13				0.181
SB08 (2.5-5 feet deep)									
Aluminum	19,500	--	--	--	--	--	--	--	--
Arsenic	11.6	--	--	3.2E-11	3.2E-11	0.495	0.026	--	0.520
Barium	462	--	--	--	--	0.084	0.004	--	0.089
Cadmium	2.6	--	--	8.7E-13	8.7E-13	0.033	0.002	--	0.035
Calcium	126,000	--	--	--	--	--	--	--	--
Chromium (5)	96.9	--	--	--	--	0.001	0.000	--	0.001
Cobalt	22.8	--	--	--	--	--	--	--	--
Copper	190	--	--	--	--	--	--	--	--
Lead	909	--	--	--	--	--	--	--	--
Magnesium	57,900	--	--	--	--	--	--	--	--
Mercury	0.11	--	--	--	--	0.005	0.000	0.000	0.005
Nickel	31.0	--	--	--	--	0.020	0.001	--	0.021
Potassium	5,460	--	--	--	--	--	--	--	--
Sodium	1,250	--	--	--	--	--	--	--	--
Vanadium	32.8	--	--	--	--	--	--	--	--
Zinc	514	--	--	--	--	0.033	0.002	--	0.035
Cyanide	7.7	--	--	--	--	0.005	0.000	--	0.005
Totals:		0E+00	0E+00	3E-11	3E-11	0.676	0.035	0.000	0.711
Inorganics Totals:					3E-11				0.711
SB09 (2.5-5 feet deep)									
Aluminum	17,500	--	--	--	--	--	--	--	--
Barium	98.8	--	--	--	--	0.018	0.001	--	0.019
Chromium (5)	42.9	--	--	--	--	0.001	0.000	--	0.001
Cobalt	18.7	--	--	--	--	--	--	--	--
Copper	79.4	--	--	--	--	--	--	--	--
Iron	26,200	--	--	--	--	--	--	--	--
Lead	87.3	--	--	--	--	--	--	--	--
Nickel	28.4	--	--	--	--	0.018	0.001	--	0.019
Potassium	2,240	--	--	--	--	--	--	--	--
Sodium	183	--	--	--	--	--	--	--	--
Vanadium	35.9	--	--	--	--	--	--	--	--
Totals:		0E+00	0E+00	0E+00	0E+00	0.037	0.002	0.000	0.039
Inorganics Totals:					0E+00				0.039

TABLE A-4
FUTURE ON-SITE RESIDENT SCENARIO SOIL RISKS
SHALLOW SOIL BORINGS - PHASE I
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk (3)				Hazard Index (3,4)			
		Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
SB10 (0-2.5 feet deep)									
Aluminum	19,900	--	--	--	--	--	--	--	--
Barium	701	--	--	--	--	0.128	0.007	--	0.135
Cadmium	1.5	--	--	5.0E-13	5.0E-13	0.019	0.001	--	0.020
Calcium	76,500	--	--	--	--	--	--	--	--
Chromium (5)	50.3	--	--	--	--	0.001	0.000	--	0.001
Cobalt	21.1	--	--	--	--	--	--	--	--
Copper	564	--	--	--	--	--	--	--	--
Iron	25,400	--	--	--	--	--	--	--	--
Lead	476	--	--	--	--	--	--	--	--
Nickel	32.0	--	--	--	--	0.020	0.001	--	0.022
Potassium	3,390	--	--	--	--	--	--	--	--
Sodium	1,890	--	--	--	--	--	--	--	--
Vanadium	32.2	--	--	--	--	--	--	--	--
Zinc	243	--	--	--	--	0.016	0.001	--	0.016
Cyanide	2.0	--	--	--	--	0.001	0.000	--	0.001
Totals:		0E+00	0E+00	5E-13	5E-13	0.185	0.010	0.000	0.195
Inorganics Totals:					5E-13				0.195
SB10 (2.5-5 feet deep)									
Aluminum	20,400	--	--	--	--	--	--	--	--
Barium	1,100	--	--	--	--	0.201	0.011	--	0.212
Cadmium	1.0	--	--	3.3E-13	3.3E-13	0.013	0.001	--	0.013
Calcium	70,800	--	--	--	--	--	--	--	--
Chromium (5)	46.7	--	--	--	--	0.001	0.000	--	0.001
Cobalt	17.7	--	--	--	--	--	--	--	--
Copper	175	--	--	--	--	--	--	--	--
Iron	27,400	--	--	--	--	--	--	--	--
Lead	386	--	--	--	--	--	--	--	--
Nickel	31.4	--	--	--	--	0.020	0.001	--	0.021
Potassium	2,740	--	--	--	--	--	--	--	--
Sodium	3,820	--	--	--	--	--	--	--	--
Vanadium	36.6	--	--	--	--	--	--	--	--
Zinc	252	--	--	--	--	0.016	0.001	--	0.017
Cyanide	6.0	--	--	--	--	0.004	0.000	--	0.004
Totals:		0E+00	0E+00	3E-13	3E-13	0.254	0.013	0.000	0.268
Inorganics Totals:					3E-13				0.268
SB11 (0-2.5 feet deep)									
Aluminum	16,400	--	--	--	--	--	--	--	--
Barium	573	--	--	--	--	0.105	0.005	--	0.110
Cadmium	1.4	--	--	4.7E-13	4.7E-13	0.018	0.001	--	0.019
Calcium	111,000	--	--	--	--	--	--	--	--
Chromium (5)	50.6	--	--	--	--	0.001	0.000	--	0.001
Cobalt	16.1	--	--	--	--	--	--	--	--
Copper	174	--	--	--	--	--	--	--	--
Lead	606	--	--	--	--	--	--	--	--
Magnesium	52,000	--	--	--	--	--	--	--	--
Nickel	26.2	--	--	--	--	0.017	0.001	--	0.018
Potassium	3,400	--	--	--	--	--	--	--	--
Sodium	1,630	--	--	--	--	--	--	--	--
Vanadium	29.2	--	--	--	--	--	--	--	--
Zinc	425	--	--	--	--	0.027	0.001	--	0.029
Cyanide	3.7	--	--	--	--	0.002	0.000	--	0.002
Totals:		0E+00	0E+00	5E-13	5E-13	0.170	0.009	0.000	0.178
Inorganics Totals:					5E-13				0.178

TABLE A-4
FUTURE ON-SITE RESIDENT SCENARIO SOIL RISKS
SHALLOW SOIL BORINGS - PHASE I
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk (3)				Hazard Index (3,4)			
		Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
SB11 (2.5-5 feet deep)									
Aluminum	14,500	--	--	--	--	--	--	--	--
Barium	343	--	--	--	--	0.063	0.003	--	0.066
Cadmium	1.4	--	--	4.7E-13	4.7E-13	0.018	0.001	--	0.019
Calcium	136,000	--	--	--	--	--	--	--	--
Chromium (5)	52.9	--	--	--	--	0.001	0.000	--	0.001
Cobalt	18.8	--	--	--	--	--	--	--	--
Copper	167	--	--	--	--	--	--	--	--
Lead	685	--	--	--	--	--	--	--	--
Magnesium	62,200	--	--	--	--	--	--	--	--
Nickel	27.4	--	--	--	--	0.018	0.001	--	0.018
Potassium	3,820	--	--	--	--	--	--	--	--
Sodium	1,270	--	--	--	--	--	--	--	--
Vanadium	26.8	--	--	--	--	--	--	--	--
Zinc	376	--	--	--	--	0.024	0.001	--	0.025
Cyanide	6.5	--	--	--	--	0.004	0.000	--	0.004
Totals:		0E+00	0E+00	5E-13	5E-13	0.127	0.007	0.000	0.134
Inorganics Totals:					5E-13				0.134
SB12 (2.5-5 feet deep)									
Aluminum	11,600	--	--	--	--	--	--	--	--
Barium	342	--	--	--	--	0.062	0.003	--	0.066
Cadmium	1.1	--	--	3.7E-13	3.7E-13	0.014	0.001	--	0.015
Calcium	112,000	--	--	--	--	--	--	--	--
Chromium (5)	46.9	--	--	--	--	0.001	0.000	--	0.001
Cobalt	12.4	--	--	--	--	--	--	--	--
Copper	131	--	--	--	--	--	--	--	--
Lead	406	--	--	--	--	--	--	--	--
Magnesium	61,000	--	--	--	--	--	--	--	--
Nickel	20.3	--	--	--	--	0.013	0.001	--	0.014
Potassium	2,240	--	--	--	--	--	--	--	--
Sodium	1,020	--	--	--	--	--	--	--	--
Zinc	218	--	--	--	--	0.014	0.001	--	0.015
Cyanide	6.8	--	--	--	--	0.004	0.000	--	0.005
Totals:		0E+00	0E+00	4E-13	4E-13	0.108	0.006	0.000	0.114
Inorganics Totals:					4E-13				0.114

TABLE A-4
FUTURE ON-SITE RESIDENT SCENARIO SOIL RISKS
SHALLOW SOIL BORINGS - PHASE I
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk (3)				Hazard Index (3,4)			
		Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
SB12A (2.5-5 feet deep)									
Acetone	0.180	--	--	--	--	0.000	0.000	--	0.000
1,1-Dichloroethane	0.002	--	--	--	--	0.000	0.000	--	0.000
1,1,1-Trichloroethane	0.006	--	--	--	--	0.000	0.000	--	0.000
Trichloroethene	0.005	8.6E-11	2.5E-10	1.1E-11	3.5E-10	--	--	--	--
Benzene	0.015	6.8E-10	2.0E-09	5.5E-11	2.7E-09	--	--	--	--
Tetrachloroethene	0.011	8.8E-10	2.6E-09	2.5E-12	3.4E-09	0.000	0.000	--	0.000
Toluene	0.026	--	--	--	--	0.000	0.000	0.000	0.000
Ethyl benzene	0.021	--	--	--	--	0.000	0.000	0.000	0.000
Xylenes (total)	0.168	--	--	--	--	0.000	0.000	--	0.000
Phenanthrene	0.089	--	--	--	--	--	--	--	--
Fluoranthene	0.090	--	--	--	--	0.000	0.000	--	0.000
Pyrene	0.069	--	--	--	--	0.000	0.000	--	0.000
bis(2-Ethylhexyl)phthalate	0.088	1.9E-09	2.3E-09	--	4.2E-09	0.000	0.000	--	0.000
Aluminum	13,400	--	--	--	--	--	--	--	--
Barium	379	--	--	--	--	0.069	0.004	--	0.073
Cadmium	1.2	--	--	4.0E-13	4.0E-13	0.015	0.001	--	0.016
Calcium	70,500	--	--	--	--	--	--	--	--
Chromium (5)	41.1	--	--	--	--	0.001	0.000	--	0.001
Cobalt	17.8	--	--	--	--	--	--	--	--
Copper	255	--	--	--	--	--	--	--	--
Iron	24,500	--	--	--	--	--	--	--	--
Lead	417	--	--	--	--	--	--	--	--
Nickel	30.0	--	--	--	--	0.019	0.001	--	0.020
Potassium	2,640	--	--	--	--	--	--	--	--
Sodium	2,160	--	--	--	--	--	--	--	--
Zinc	639	--	--	--	--	0.041	0.002	--	0.043
Cyanide	1.5	--	--	--	--	0.001	0.000	--	0.001
Totals:		4E-09	7E-09	7E-11	1E-08	0.146	0.008	0.000	0.154
Inorganics Totals:					4E-13				0.154
SB13 (0-1.7 feet deep)									
1,1,1-Trichloroethane	0.003	--	--	--	--	0.000	0.000	--	0.000
Tetrachloroethene	0.007	5.6E-10	1.6E-09	1.6E-12	2.2E-09	0.000	0.000	--	0.000
Phenanthrene	2.9	--	--	--	--	--	--	--	--
Anthracene	0.740	--	--	--	--	0.000	0.000	--	0.000
Fluoranthene	4.1	--	--	--	--	0.001	0.001	--	0.002
Pyrene	3.3	--	--	--	--	0.001	0.001	--	0.002
Benzo(a)anthracene	1.8	2.4E-06	2.8E-06	2.0E-07	**5.3E-06**	--	--	--	--
Chrysene	2.5	1.0E-07	1.2E-07	8.5E-09	2.3E-07	--	--	--	--
Benzo(b)fluoranthene	1.9	2.4E-06	2.8E-06	2.0E-07	**5.4E-06**	--	--	--	--
Benzo(k)fluoranthene	1.8	1.1E-06	1.2E-06	9.1E-08	**2.4E-06**	--	--	--	--
Benzo(a)pyrene	2.3	2.1E-05	2.4E-05	1.8E-06	**4.7E-05**	--	--	--	--
Aluminum	13,600	--	--	--	--	--	--	--	--
Barium	483	--	--	--	--	0.088	0.005	--	0.093
Cadmium	0.71	--	--	2.4E-13	2.4E-13	0.009	0.000	--	0.010
Calcium	95,600	--	--	--	--	--	--	--	--
Chromium (5)	39.0	--	--	--	--	0.000	0.000	--	0.001
Cobalt	12.0	--	--	--	--	--	--	--	--
Copper	65.6	--	--	--	--	--	--	--	--
Lead	171	--	--	--	--	--	--	--	--
Magnesium	48,900	--	--	--	--	--	--	--	--
Nickel	17.8	--	--	--	--	0.011	0.001	--	0.012
Potassium	1,960	--	--	--	--	--	--	--	--
Sodium	1,940	--	--	--	--	--	--	--	--
Zinc	159	--	--	--	--	0.010	0.001	--	0.011
Cyanide	1.3	--	--	--	--	0.001	0.000	--	0.001
Totals:		3E-05	3E-05	2E-06	6E-05	0.123	0.008	0.000	0.131
Inorganics Totals:					2E-13				0.127

TABLE A-4
FUTURE ON-SITE RESIDENT SCENARIO SOIL RISKS
SHALLOW SOIL BORINGS - PHASE I
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk (3)				Hazard Index (3,4)			
		Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
SB14 (0-4.5 feet deep)									
Phenanthrene	2.3	--	--	--	--	--	--	--	--
Anthracene	1.2	--	--	--	--	0.000	0.000	--	0.000
Fluoranthene	7.4	--	--	--	--	0.002	0.001	--	0.004
Pyrene	6.8	--	--	--	--	0.003	0.002	--	0.004
Benzo(a)anthracene	5.0	6.6E-06	7.7E-06	5.5E-07	1.5E-05	--	--	--	--
Chrysene	5.7	2.3E-07	2.7E-07	1.9E-08	5.2E-07	--	--	--	--
Benzo(b)fluoranthene	5.5	7.0E-06	8.1E-06	5.9E-07	1.6E-05	--	--	--	--
Benzo(k)fluoranthene	3.9	2.3E-06	2.7E-06	2.0E-07	5.2E-06	--	--	--	--
Benzo(a)pyrene	4.5	4.1E-05	4.8E-05	3.5E-06	9.2E-05	--	--	--	--
Indeno(1,2,3-cd)pyrene	3.2	6.5E-06	7.6E-06	5.6E-07	1.5E-05	--	--	--	--
Benzo(g,h,i)perylene	2.6	5.3E-07	6.2E-07	4.3E-08	1.2E-06	--	--	--	--
Aluminum	11,100	--	--	--	--	--	--	--	--
Barium	311	--	--	--	--	0.057	0.003	--	0.060
Calcium	104,000	--	--	--	--	--	--	--	--
Chromium (5)	34.8	--	--	--	--	0.000	0.000	--	0.000
Cobalt	11.9	--	--	--	--	--	--	--	--
Copper	40.6	--	--	--	--	--	--	--	--
Lead	314	--	--	--	--	--	--	--	--
Magnesium	63,700	--	--	--	--	--	--	--	--
Potassium	2,110	--	--	--	--	--	--	--	--
Sodium	1,470	--	--	--	--	--	--	--	--
Zinc	175	--	--	--	--	0.011	0.001	--	0.012
Cyanide	0.33	--	--	--	--	0.000	0.000	--	0.000
Totals:		6E-05	7E-05	5E-06	1E-04	0.074	0.006	0.000	0.080
Inorganics Totals:					0E+00				0.072
SB15R (2.5-4.5 feet deep)									
Benzene	0.011	5.0E-10	1.5E-09	4.0E-11	2.0E-09	--	--	--	--
Ethyl benzene	0.016	--	--	--	--	0.000	0.000	0.000	0.000
Phenanthrene	0.077	--	--	--	--	--	--	--	--
Fluoranthene	0.110	--	--	--	--	0.000	0.000	--	0.000
Pyrene	0.120	--	--	--	--	0.000	0.000	--	0.000
Chrysene	0.096	3.9E-09	4.6E-09	3.3E-10	8.8E-09	--	--	--	--
Benzo(a)pyrene	0.098	8.9E-07	1.0E-06	7.5E-08	2.0E-06	--	--	--	--
Aluminum	13,500	--	--	--	--	--	--	--	--
Barium	57.4	--	--	--	--	0.010	0.001	--	0.011
Calcium	108,000	--	--	--	--	--	--	--	--
Chromium (5)	31.8	--	--	--	--	0.000	0.000	--	0.000
Cobalt	17.3	--	--	--	--	--	--	--	--
Copper	18.9	--	--	--	--	--	--	--	--
Lead	110	--	--	--	--	--	--	--	--
Magnesium	47,900	--	--	--	--	--	--	--	--
Potassium	2,310	--	--	--	--	--	--	--	--
Sodium	2,840	--	--	--	--	--	--	--	--
Vanadium	30.9	--	--	--	--	--	--	--	--
Zinc	91.2	--	--	--	--	0.006	0.000	--	0.006
Totals:		9E-07	1E-06	8E-08	2E-06	0.017	0.001	0.000	0.018
Inorganics Totals:					0E+00				0.018

TABLE A-4
FUTURE ON-SITE RESIDENT SCENARIO SOIL RISKS
SHALLOW SOIL BORINGS - PHASE I
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk (3)				Hazard Index (3,4)			
		Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
SB16R (0-4.5 feet deep)									
Tetrachloroethene	0.003	2.4E-10	7.0E-10	6.8E-13	9.4E-10	0.000	0.000	--	0.000
Phenanthrene	0.078	--	--	--	--	--	--	--	--
Fluoranthene	0.130	--	--	--	--	0.000	0.000	--	0.000
Pyrene	0.097	--	--	--	--	0.000	0.000	--	0.000
Chrysene	0.072	2.9E-09	3.4E-09	2.5E-10	6.6E-09	--	--	--	--
4,4'-DDD	0.260	9.8E-08	1.1E-07	--	2.1E-07	--	--	--	--
4,4'-DDE	0.019	1.0E-08	1.2E-08	--	2.2E-08	--	--	--	--
4,4'-DDT	0.380	2.0E-07	2.4E-07	--	4.4E-07	0.010	0.005	--	0.015
Antimony	17.3000	--	--	--	--	0.553	0.029	--	0.582
Arsenic	19.0000	--	--	5.2E-11	5.2E-11	0.810	0.042	--	0.852
Barium	59.1000	--	--	--	--	0.011	0.001	--	0.011
Calcium	92,100	--	--	--	--	--	--	--	--
Chromium (5)	31.3	--	--	--	--	0.000	0.000	--	0.000
Cobalt	11.6	--	--	--	--	--	--	--	--
Lead	110	--	--	--	--	--	--	--	--
Magnesium	55,500	--	--	--	--	--	--	--	--
Potassium	4,680	--	--	--	--	--	--	--	--
Sodium	1,020	--	--	--	--	--	--	--	--
Vanadium	64.7	--	--	--	--	--	--	--	--
Totals:		3E-07	4E-07	3E-10	7E-07	1.384	0.077	0.000	1.461
Inorganics Totals:					5E-11				1.446
SB17 (0-3.8 feet deep)									
Tetrachloroethene	0.002	1.6E-10	4.7E-10	4.5E-13	6.3E-10	0.000	0.000	--	0.000
Toluene	0.004	--	--	--	--	0.000	0.000	0.000	0.000
Ethyl benzene	0.011	--	--	--	--	0.000	0.000	0.000	0.000
Xylenes (total)	0.079	--	--	--	--	0.000	0.000	--	0.000
Naphthalene	0.060	--	--	--	--	0.000	0.000	--	0.000
2-Methylnaphthalene	0.150	--	--	--	--	--	--	--	--
Acenaphthene	0.270	--	--	--	--	0.000	0.000	--	0.000
Dibenzofuran	0.170	--	--	--	--	--	--	--	--
Fluorene	0.370	--	--	--	--	0.000	0.000	--	0.000
Phenanthrene	2.4	--	--	--	--	--	--	--	--
Anthracene	0.560	--	--	--	--	0.000	0.000	--	0.000
Fluoranthene	2.5	--	--	--	--	0.001	0.000	--	0.001
Pyrene	2.3	--	--	--	--	0.001	0.001	--	0.001
Benzo(a)anthracene	1.0	1.3E-06	1.5E-06	1.1E-07	3.0E-06	--	--	--	--
Chrysene	1.1	4.5E-08	5.2E-08	3.7E-09	1.0E-07	--	--	--	--
bis(2-Ethylhexyl)phthalate	0.200	4.4E-09	5.1E-09	--	9.5E-09	0.000	0.000	--	0.000
Benzo(b)fluoranthene	1.1	1.4E-06	1.6E-06	1.2E-07	3.1E-06	--	--	--	--
Benzo(k)fluoranthene	0.610	3.6E-07	4.2E-07	3.1E-08	8.2E-07	--	--	--	--
Benzo(a)pyrene	0.810	7.4E-06	8.6E-06	6.2E-07	1.7E-05	--	--	--	--
Indeno(1,2,3-cd)pyrene	0.560	1.1E-06	1.3E-06	9.9E-08	2.6E-06	--	--	--	--
Benzo(g,h,i)perylene	0.520	1.1E-07	1.2E-07	8.5E-09	2.4E-07	--	--	--	--
Aluminum	22,300	--	--	--	--	--	--	--	--
Barium	614	--	--	--	--	0.112	0.006	--	0.118
Chromium (5)	59.1	--	--	--	--	0.001	0.000	--	0.001
Cobalt	14.1	--	--	--	--	--	--	--	--
Copper	72.0	--	--	--	--	--	--	--	--
Iron	36,600	--	--	--	--	--	--	--	--
Lead	151	--	--	--	--	--	--	--	--
Mercury	0.13	--	--	--	--	0.006	0.000	0.000	0.006
Potassium	6,910	--	--	--	--	--	--	--	--
Sodium	3,010	--	--	--	--	--	--	--	--
Vanadium	64.4	--	--	--	--	--	--	--	--
Zinc	233	--	--	--	--	0.015	0.001	--	0.016
Cyanide	1.3	--	--	--	--	0.001	0.000	--	0.001
Totals:		1E-05	1E-05	1E-06	3E-05	0.136	0.008	0.000	0.144
Inorganics Totals:					0E+00				0.141

TABLE A-4
FUTURE ON-SITE RESIDENT SCENARIO SOIL RISKS
SHALLOW SOIL BORINGS - PHASE I
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk (3)				Hazard Index (3,4)			
		Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
SB18 (0-5 feet deep)									
Methylene chloride	0.100	1.2E-09	3.4E-09	--	4.6E-09	0.000	0.000	0.000	0.000
1,1-Dichloroethane	0.004	--	--	--	--	0.000	0.000	--	0.000
Trichloroethene	0.011	1.9E-10	5.5E-10	2.4E-11	7.7E-10	--	--	--	--
Tetrachloroethene	0.015	1.2E-09	3.5E-09	3.4E-12	4.7E-09	0.000	0.000	--	0.000
Toluene	0.031	--	--	--	--	0.000	0.000	0.000	0.000
trans-1,2-Dichloroethene	0.008	--	--	--	--	0.000	0.000	--	0.000
Naphthalene	0.048	--	--	--	--	0.000	0.000	--	0.000
2-Methylnaphthalene	0.130	--	--	--	--	--	--	--	--
Acenaphthene	0.110	--	--	--	--	0.000	0.000	--	0.000
Fluorene	0.100	--	--	--	--	0.000	0.000	--	0.000
Phenanthrene	0.570	--	--	--	--	--	--	--	--
Anthracene	0.110	--	--	--	--	0.000	0.000	--	0.000
Fluoranthene	0.670	--	--	--	--	0.000	0.000	--	0.000
Pyrene	0.570	--	--	--	--	0.000	0.000	--	0.000
Benzo(a)anthracene	0.210	2.8E-07	3.2E-07	2.3E-08	6.2E-07	--	--	--	--
Chrysene	0.280	1.1E-08	1.3E-08	9.5E-10	2.6E-08	--	--	--	--
bis(2-Ethylhexyl)phthalate	0.280	6.1E-09	7.2E-09	--	1.3E-08	0.000	0.000	--	0.000
Benzo(b)fluoranthene	0.200	2.5E-07	3.0E-07	2.1E-08	5.7E-07	--	--	--	--
Benzo(k)fluoranthene	0.160	9.5E-08	1.1E-07	8.1E-09	2.1E-07	--	--	--	--
Aluminum	50,000	--	--	--	--	--	--	--	--
Barium	3,060	--	--	--	--	0.559	0.029	--	0.588
Calcium	65,100	--	--	--	--	--	--	--	--
Chromium (5)	65.2	--	--	--	--	0.001	0.000	--	0.001
Copper	47.3	--	--	--	--	--	--	--	--
Iron	57,200	--	--	--	--	--	--	--	--
Lead	102	--	--	--	--	--	--	--	--
Potassium	9,640	--	--	--	--	--	--	--	--
Selenium	1.8	--	--	--	--	0.005	0.000	--	0.005
Sodium	14,900	--	--	--	--	--	--	--	--
Vanadium	77.7	--	--	--	--	--	--	--	--
Zinc	181	--	--	--	--	0.012	0.001	--	0.012
Cyanide	1.3	--	--	--	--	0.001	0.000	--	0.001
Totals:		6E-07	8E-07	5E-08	1E-06	0.578	0.031	0.000	0.608
Inorganics Totals:					0E+00				0.607
SB19 (0-2.6 feet deep)									
1,1,1-Trichloroethane	0.007	--	--	--	--	0.000	0.000	--	0.000
Trichloroethene	0.003	5.2E-11	1.5E-10	6.4E-12	2.1E-10	--	--	--	--
Tetrachloroethene	0.006	4.8E-10	1.4E-09	1.4E-12	1.9E-09	0.000	0.000	--	0.000
2-Methylnaphthalene	0.072	--	--	--	--	--	--	--	--
Phenanthrene	0.220	--	--	--	--	--	--	--	--
Fluoranthene	0.320	--	--	--	--	0.000	0.000	--	0.000
Pyrene	0.320	--	--	--	--	0.000	0.000	--	0.000
Chrysene	0.230	9.4E-09	1.1E-08	7.8E-10	2.1E-08	--	--	--	--
Aroclor-1242	10	1.2E-04	1.4E-04	--	2.6E-04	--	--	--	--
Aroclor-1254	1.3	1.6E-05	1.8E-05	--	3.4E-05	--	--	--	--
Aluminum	13,900	--	--	--	--	--	--	--	--
Barium	406	--	--	--	--	0.074	0.004	--	0.078
Chromium (5)	35.5	--	--	--	--	0.000	0.000	--	0.000
Cobalt	18.3	--	--	--	--	--	--	--	--
Copper	234	--	--	--	--	--	--	--	--
Lead	325	--	--	--	--	--	--	--	--
Potassium	4,930	--	--	--	--	--	--	--	--
Sodium	1,160	--	--	--	--	--	--	--	--
Vanadium	67.1	--	--	--	--	--	--	--	--
Zinc	491	--	--	--	--	0.031	0.002	--	0.033
Totals:		1E-04	2E-04	8E-10	3E-04	0.106	0.006	0.000	0.112
Inorganics Totals:					0E+00				0.112

TABLE A-4
FUTURE ON-SITE RESIDENT SCENARIO SOIL RISKS
SHALLOW SOIL BORINGS - PHASE I
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk (3)				Hazard Index (3,4)			
		Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
SB20 (0-5 feet deep)									
Benzene	0.011	5.0E-10	1.5E-09	4.0E-11	2.0E-09	--	--	--	--
1,1,1-Trichloroethane	0.003	--	--	--	--	0.000	0.000	--	0.000
Ethyl benzene	0.008	--	--	--	--	0.000	0.000	0.000	0.000
Phenanthrene	0.220	--	--	--	--	--	--	--	--
Anthracene	0.065	--	--	--	--	0.000	0.000	--	0.000
Fluoranthene	0.430	--	--	--	--	0.000	0.000	--	0.000
Pyrene	0.460	--	--	--	--	0.000	0.000	--	0.000
Benzo(a)anthracene	0.250	3.3E-07	3.8E-07	2.8E-08	7.4E-07	--	--	--	--
Chrysene	0.310	1.3E-08	1.5E-08	1.1E-09	2.8E-08	--	--	--	--
Benzo(b)fluoranthene	0.270	3.4E-07	4.0E-07	2.9E-08	7.7E-07	--	--	--	--
Benzo(k)fluoranthene	0.230	1.4E-07	1.6E-07	1.2E-08	3.1E-07	--	--	--	--
Indeno(1,2,3-cd)pyrene	0.220	4.5E-07	5.2E-07	3.9E-08	1.0E-06	--	--	--	--
Benzo(g,h,i)perylene	0.210	4.3E-08	5.0E-08	3.4E-09	9.6E-08	--	--	--	--
Aluminum	14,700	--	--	--	--	--	--	--	--
Barium	187	--	--	--	--	0.034	0.002	--	0.036
Calcium	70,500	--	--	--	--	--	--	--	--
Chromium (5)	33.5	--	--	--	--	0.000	0.000	--	0.000
Cobalt	21.6	--	--	--	--	--	--	--	--
Copper	49.2	--	--	--	--	--	--	--	--
Iron	25,000	--	--	--	--	--	--	--	--
Lead	147	--	--	--	--	--	--	--	--
Manganese	683	--	--	--	--	--	--	0.000	0.000
Potassium	6,150	--	--	--	--	--	--	--	--
Sodium	470	--	--	--	--	--	--	--	--
Vanadium	67.2	--	--	--	--	--	--	--	--
Zinc	171	--	--	--	--	0.011	0.001	--	0.012
Cyanide	0.60	--	--	--	--	0.000	0.000	--	0.000
Totals:		1E-06	2E-06	1E-07	3E-06	0.046	0.003	0.000	0.049
Inorganics Totals:					0E+00				0.048

TABLE A-4
FUTURE ON-SITE RESIDENT SCENARIO SOIL RISKS
SHALLOW SOIL BORINGS - PHASE I
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk (3)				Hazard Index (3,4)			
		Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
SB21 (2.5-4.5 feet deep)									
1,1-Dichloroethane	0.032	--	--	--	--	0.000	0.000	--	0.000
Trichloroethene	0.070	1.2E-09	3.5E-09	1.5E-10	4.9E-09	--	--	--	--
Tetrachloroethene	0.280	2.2E-08	6.5E-08	6.4E-11	8.8E-08	0.000	0.000	--	0.001
Toluene	0.074	--	--	--	--	0.000	0.000	0.000	0.000
Ethyl benzene	0.020	--	--	--	--	0.000	0.000	0.000	0.000
Xylenes (total)	0.074	--	--	--	--	0.000	0.000	--	0.000
Naphthalene	0.240	--	--	--	--	0.000	0.000	--	0.000
2-Methylnaphthalene	0.640	--	--	--	--	--	--	--	--
Acenaphthene	0.140	--	--	--	--	0.000	0.000	--	0.000
Dibenzofuran	0.070	--	--	--	--	--	--	--	--
Phenanthrene	0.660	--	--	--	--	--	--	--	--
Anthracene	0.078	--	--	--	--	0.000	0.000	--	0.000
Fluoranthene	0.510	--	--	--	--	0.000	0.000	--	0.000
Pyrene	0.570	--	--	--	--	0.000	0.000	--	0.000
Benzo(a)anthracene	0.220	2.9E-07	3.4E-07	2.4E-08	6.5E-07	--	--	--	--
Chrysene	0.320	1.3E-08	1.5E-08	1.1E-09	2.9E-08	--	--	--	--
bis(2-Ethylhexyl)phthalate	1.8	3.9E-08	4.6E-08	--	8.5E-08	0.001	0.001	--	0.002
Indeno(1,2,3-cd)pyrene	0.200	4.1E-07	4.7E-07	3.5E-08	9.2E-07	--	--	--	--
Benzo(g,h,i)perylene	0.220	4.5E-08	5.2E-08	3.6E-09	1.0E-07	--	--	--	--
Aroclor-1248	0.680	8.2E-06	9.6E-06	--	**1.8E-05**	--	--	--	--
Aroclor-1254	0.340	4.1E-06	4.8E-06	--	**8.9E-06**	--	--	--	--
Aluminum	19,000	--	--	--	--	--	--	--	--
Barium	735	--	--	--	--	0.134	0.007	--	0.141
Cadmium	2.0	--	--	6.7E-13	6.7E-13	0.026	0.001	--	0.027
Calcium	86,400	--	--	--	--	--	--	--	--
Chromium (5)	63.5	--	--	--	--	0.001	0.000	--	0.001
Cobalt	15.6	--	--	--	--	--	--	--	--
Copper	143	--	--	--	--	--	--	--	--
Iron	27,600	--	--	--	--	--	--	--	--
Lead	592	--	--	--	--	--	--	--	--
Magnesium	47,500	--	--	--	--	--	--	--	--
Nickel	28.7	--	--	--	--	0.018	0.001	--	0.019
Potassium	3,590	--	--	--	--	--	--	--	--
Sodium	2,790	--	--	--	--	--	--	--	--
Vanadium	32.8	--	--	--	--	--	--	--	--
Zinc	340	--	--	--	--	0.022	0.001	--	0.023
Cyanide	7.7	--	--	--	--	0.005	0.000	--	0.005
Totals:		1E-05	2E-05	6E-08	3E-05	0.208	0.012	0.000	0.220
Inorganics Totals:					7E-13				0.216

TABLE A-4
FUTURE ON-SITE RESIDENT SCENARIO SOIL RISKS
SHALLOW SOIL BORINGS - PHASE I
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk (3)				Hazard Index (3,4)			
		Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
SB22 (0-5 feet deep)									
Trichloroethene	0.004	6.9E-11	2.0E-10	8.6E-12	2.8E-10	--	--	--	--
trans-1,3-Dichloropropene	0.007	2.0E-09	5.8E-09	1.1E-10	7.8E-09	0.000	0.000	0.000	0.001
Tetrachloroethene	0.014	1.1E-09	3.3E-09	3.2E-12	4.4E-09	0.000	0.000	--	0.000
Phenanthrene	0.170	--	--	--	--	--	--	--	--
Fluoranthene	0.250	--	--	--	--	0.000	0.000	--	0.000
Pyrene	0.230	--	--	--	--	0.000	0.000	--	0.000
Benzo(a)anthracene	0.089	1.2E-07	1.4E-07	9.9E-09	2.6E-07	--	--	--	--
Chrysene	0.120	4.9E-09	5.7E-09	4.1E-10	1.1E-08	--	--	--	--
bis(2-Ethylhexyl)phthalate	0.091	2.0E-09	2.3E-09	--	4.3E-09	0.000	0.000	--	0.000
Aroclor-1254	0.540	6.5E-06	7.6E-06	--	**1.4E-05**	--	--	--	--
Aroclor-1260	0.240	2.9E-06	3.4E-06	--	**6.3E-06**	--	--	--	--
Aluminum	12,900	--	--	--	--	--	--	--	--
Arsenic	17.9	--	--	4.9E-11	4.9E-11	0.763	0.040	--	0.803
Barium	339	--	--	--	--	0.062	0.003	--	0.065
Calcium	72,000	--	--	--	--	--	--	--	--
Chromium (5)	51.5	--	--	--	--	0.001	0.000	--	0.001
Cobalt	17.1	--	--	--	--	--	--	--	--
Copper	79.8	--	--	--	--	--	--	--	--
Lead	513	--	--	--	--	--	--	--	--
Magnesium	38,900	--	--	--	--	--	--	--	--
Potassium	2,300	--	--	--	--	--	--	--	--
Sodium	11,010	--	--	--	--	--	--	--	--
Zinc	281	--	--	--	--	0.018	0.001	--	0.019
Totals:		1E-05	1E-05	1E-08	2E-05	0.844	0.045	0.000	0.889
Inorganics Totals:					5E-11				0.888

TABLE A-4
FUTURE ON-SITE RESIDENT SCENARIO SOIL RISKS
SHALLOW SOIL BORINGS - PHASE I
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk (3)				Hazard Index (3,4)			
		Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
SB23R (2.8-4.5 feet deep)									
Acetone	0.450	--	--	--	--	0.000	0.000	--	0.000
Benzene	0.008	3.6E-10	1.1E-09	2.9E-11	1.5E-09	--	--	--	--
Toluene	0.081	--	--	--	--	0.000	0.000	0.000	0.000
Ethyl benzene	0.041	--	--	--	--	0.000	0.000	0.000	0.000
Xylenes (total)	0.390	--	--	--	--	0.000	0.000	--	0.000
Naphthalene	0.058	--	--	--	--	0.000	0.000	--	0.000
2-Methylnaphthalene	0.061	--	--	--	--	--	--	--	--
Aluminum	12,700	--	--	--	--	--	--	--	--
Barium	74.7	--	--	--	--	0.014	0.001	--	0.014
Cadmium	0.59	--	--	2.0E-13	2.0E-13	0.008	0.000	--	0.008
Chromium (5)	37.6	--	--	--	--	0.000	0.000	--	0.001
Cobalt	20.8	--	--	--	--	--	--	--	--
Lead	108	--	--	--	--	--	--	--	--
Potassium	2,600	--	--	--	--	--	--	--	--
Sodium	286	--	--	--	--	--	--	--	--
Vanadium	28.2	--	--	--	--	--	--	--	--
Cyanide	0.90	--	--	--	--	0.001	0.000	--	0.001
Totals:		4E-10	1E-09	3E-11	1E-09	0.022	0.001	0.000	0.023
Inorganics Totals:					2E-13				0.023

Notes:

(1) Only detected organic parameters and inorganics detected above the background concentrations (i.e., the highest detected value in samples from borings SB213, SB214 and SB216) are shown.

(2) Values shown are the highest detected concentrations between the sample and its duplicate, and/or between the results of the Round 1 and Round 2 samples. Analytical results that exceeded the instrument calibration range were not used if a diluted reanalysis was available.

(3) The oral and dermal risks are calculated in accordance with the procedures indicated in Section 5 and Appendix J of the Baseline Risk Assessment. The inhalation risks were calculated in accordance with the procedures in the Illinois Environmental Protection Agency's *Tiered Approach for Corrective Action Objectives*, dated September 16, 1996.

(4) Zero values indicate that the hazard indices are less than 5×10^{-4}.

(5) The calculations use the toxicity factors for trivalent chromium, although the laboratory reported total chromium.

Key:

-- = No toxicity factor is available for this chemical.

= Indicates a total carcinogenic risk above 1×10^{-4} for this parameter.

= Indicates a total carcinogenic risk above 1×10^{-4} or a total hazard index above 1 for this parameter.

TABLE A-5
FUTURE ON-SITE RESIDENT SCENARIO SOIL RISKS
SHALLOW SOIL BORINGS - PHASE II
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk (3)				Hazard Index (3,4)			
		Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
SB04 (0-5 feet deep)									
1,1-Dichloroethane	0.003	–	--	--	--	0.000	0.000	–	0.000
1,1,1-Trichloroethane	0.006	–	--	--	--	0.000	0.000	–	0.000
Trichloroethene	0.004	6.9E-11	2.0E-10	8.6E-12	2.8E-10	–	–	–	–
Tetrachloroethene	0.006	4.8E-10	1.4E-09	1.4E-12	1.9E-09	0.000	0.000	–	0.000
Toluene	0.05	–	--	--	--	0.000	0.000	0.000	0.000
Ethyl benzene	0.038	–	--	--	--	0.000	0.000	0.000	0.000
Xylenes (total)	0.19	–	--	--	--	0.000	0.000	–	0.000
2-Methylnaphthalene	0.4	–	--	--	--	–	–	–	–
Phenanthrene	0.45	–	--	--	--	–	–	–	–
Fluoranthene	0.38	–	--	--	--	0.000	0.000	–	0.000
Pyrene	0.38	–	--	--	--	0.000	0.000	–	0.000
Chrysene	0.16	6.5E-09	7.6E-09	5.4E-10	1.5E-08	–	–	–	–
Benzo(b)fluoranthene	0.36	4.6E-07	5.3E-07	3.9E-08	1.0E-06	–	–	–	–
Aroclor-1242	0.42	5.1E-06	5.9E-06	–	1.1E-05	–	–	–	–
Aroclor-1260	0.15	1.8E-06	2.1E-06	–	3.9E-06	–	–	–	–
Aluminum	21,200	–	–	–	–	–	–	–	–
Antimony	8.3	–	--	--	--	0.265	0.014	–	0.279
Barium	882	–	--	–	--	0.161	0.008	–	0.170
Beryllium	1.2	8.1E-06	9.4E-07	5.5E-13	9.0E-06	0.003	0.000	–	0.003
Calcium	133,000	–	--	--	--	–	–	–	–
Chromium (5)	36.8	–	--	--	--	0.000	0.000	–	0.000
Cobalt	8.6	–	--	--	--	–	–	–	–
Copper	111	–	--	--	--	–	–	–	–
Iron	23,300	–	--	--	--	–	–	–	–
Lead	518	–	--	--	--	–	–	–	–
Magnesium	63,700	–	--	--	--	–	–	–	–
Mercury	0.12	–	--	--	--	0.005	0.000	0.000	0.005
Nickel	33.4	–	--	--	--	0.021	0.001	–	0.022
Potassium	3,080	–	--	--	--	–	–	–	–
Silver	1.7	–	--	--	--	0.004	0.000	–	0.005
Sodium	2,800	–	--	--	--	–	–	–	–
Vanadium	34.4	–	--	--	--	–	–	–	–
Zinc	292	–	--	--	--	0.019	0.001	–	0.020
Cyanide	8.3	–	--	--	--	0.005	0.000	–	0.006
Totals:		2E-05	1E-05	4E-08	2E-05	0.485	0.026	0.000	0.511
Inorganics Totals:					9E-06				0.510
SB08 (0-5 feet deep)									
1,1,1-Trichloroethane	0.006	–	--	--	--	0.000	0.000	–	0.000
Tetrachloroethene	0.011	8.8E-10	2.6E-09	2.5E-12	3.4E-09	0.000	0.000	–	0.000
Toluene	0.023	–	--	--	--	0.000	0.000	0.000	0.000
Ethyl benzene	0.019	–	--	--	--	0.000	0.000	0.000	0.000
Xylenes (total)	0.078	–	--	--	--	0.000	0.000	–	0.000
Aroclor-1242	0.12	1.4E-06	1.7E-06	--	3.1E-06	–	–	–	–
Aroclor-1260	0.034	4.1E-07	4.8E-07	--	8.9E-07	–	–	–	–
Aluminum	13,100	–	--	--	--	–	–	–	–
Barium	163	–	--	--	--	0.030	0.002	–	0.031
Chromium (5)	20.1	–	--	--	--	0.000	0.000	–	0.000
Copper	67.8	–	--	--	--	–	–	–	–
Lead	202	–	--	--	--	–	–	–	–
Mercury	0.16	–	--	--	--	0.007	0.000	0.000	0.007
Nickel	20.8	–	--	--	--	0.013	0.001	–	0.014
Potassium	1,820	–	--	--	--	–	–	–	–
Sodium	415	–	--	--	--	–	–	–	–
Zinc	132	–	--	--	--	0.008	0.000	–	0.009
Totals:		2E-06	2E-06	2E-12	4E-06	0.059	0.003	0.000	0.062
Inorganics Totals:					0E+00				0.062

TABLE A-5
FUTURE ON-SITE RESIDENT SCENARIO SOIL RISKS
SHALLOW SOIL BORINGS - PHASE II
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk (3)				Hazard Index (3,4)			
		Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
SB10 (0-5 feet deep)									
1,1,1-Trichloroethane	0.029	--	--	--	--	0.000	0.000	--	0.000
Toluene	0.018	--	--	--	--	0.000	0.000	0.000	0.000
Fluoranthene	0.089	--	--	--	--	0.000	0.000	--	0.000
Pyrene	0.089	--	--	--	--	0.000	0.000	--	0.000
Aroclor-1242	0.11	1.3E-06	1.5E-06	--	2.9E-06	--	--	--	--
Aroclor-1260	0.031	3.7E-07	4.4E-07	--	8.1E-07	--	--	--	--
Aluminum	18,400	--	--	--	--	--	--	--	--
Barium	506	--	--	--	--	0.092	0.005	--	0.097
Beryllium	0.83	5.6E-06	6.5E-07	3.8E-13	6.2E-06	0.002	0.000	--	0.002
Calcium	63,300	--	--	--	--	--	--	--	--
Chromium (5)	40.1	--	--	--	--	0.001	0.000	--	0.001
Cobalt	9.1	--	--	--	--	--	--	--	--
Copper	189	--	--	--	--	--	--	--	--
Iron	27,600	--	--	--	--	--	--	--	--
Lead	381	--	--	--	--	--	--	--	--
Manganese	1110	--	--	--	--	--	--	0.000	0.000
Mercury	0.79	--	--	--	--	0.034	0.002	0.000	0.035
Nickel	33.5	--	--	--	--	0.021	0.001	--	0.023
Potassium	2,870	--	--	--	--	--	--	--	--
Sodium	1,540	--	--	--	--	--	--	--	--
Vanadium	38.4	--	--	--	--	--	--	--	--
Zinc	376	--	--	--	--	0.024	0.001	--	0.025
Totals:		7E-06	3E-06	4E-13	1E-05	0.174	0.009	0.000	0.183
Inorganics Totals:					6E-06				0.183
SB11 (0-5 feet deep)									
1,1,1-Trichloroethane	0.008	--	--	--	--	0.000	0.000	--	0.000
Trichloroethene	0.006	1.0E-10	3.0E-10	1.3E-11	4.2E-10	--	--	--	--
Tetrachloroethene	0.023	1.8E-09	5.4E-09	5.2E-12	7.2E-09	0.000	0.000	--	0.000
Toluene	0.044	--	--	--	--	0.000	0.000	0.000	0.000
Ethyl benzene	0.029	--	--	--	--	0.000	0.000	0.000	0.000
Xylenes (total)	0.12	--	--	--	--	0.000	0.000	--	0.000
2-Methylnaphthalene	0.072	--	--	--	--	--	--	--	--
Phenanthrene	0.24	--	--	--	--	--	--	--	--
Anthracene	0.046	--	--	--	--	0.000	0.000	--	0.000
Fluoranthene	0.31	--	--	--	--	0.000	0.000	--	0.000
Pyrene	0.28	--	--	--	--	0.000	0.000	--	0.000
Benzo(a)anthracene	0.077	1.0E-07	1.2E-07	8.5E-09	2.3E-07	--	--	--	--
Chrysene	0.1	4.1E-09	4.7E-09	3.4E-10	9.2E-09	--	--	--	--
Aroclor-1242	0.33	4.0E-06	4.6E-06	--	8.6E-06	--	--	--	--
Aroclor-1260	0.083	1.0E-06	1.2E-06	--	2.2E-06	--	--	--	--
Aluminum	16,400	--	--	--	--	--	--	--	--
Barium	576	--	--	--	--	0.105	0.006	--	0.111
Beryllium	0.94	6.3E-06	7.4E-07	4.3E-13	7.1E-06	0.002	0.000	--	0.003
Calcium	150,000	--	--	--	--	--	--	--	--
Chromium (5)	33.2	--	--	--	--	0.000	0.000	--	0.000
Cobalt	7.6	--	--	--	--	--	--	--	--
Copper	107	--	--	--	--	--	--	--	--
Iron	27,200	--	--	--	--	--	--	--	--
Lead	460	--	--	--	--	--	--	--	--
Magnesium	78,800	--	--	--	--	--	--	--	--
Nickel	26.6	--	--	--	--	0.017	0.001	--	0.018
Potassium	3,040	--	--	--	--	--	--	--	--
Silver	2.9	--	--	--	--	0.007	0.000	--	0.008
Sodium	1,540	--	--	--	--	--	--	--	--
Vanadium	28.9	--	--	--	--	--	--	--	--
Zinc	286	--	--	--	--	0.018	0.001	--	0.019
Totals:		1E-05	7E-06	9E-09	2E-05	0.151	0.008	0.000	0.159
Inorganics Totals:					7E-06				0.159

TABLE A-5
FUTURE ON-SITE RESIDENT SCENARIO SOIL RISKS
SHALLOW SOIL BORINGS - PHASE II
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk (3)				Hazard Index (3,4)			
		Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
SB12 (0-5 feet deep)									
Ethyl benzene	0.82	--	--	--	--	0.000	0.000	0.000	0.000
Xylenes (total)	4.1	--	--	--	--	0.000	0.000	--	0.000
1,2-Dichlorobenzene	0.14	--	--	--	--	0.000	0.000	--	0.000
2-Methylnaphthalene	1.2	--	--	--	--	--	--	--	--
Acenaphthene	0.064	--	--	--	--	0.000	0.000	--	0.000
Fluorene	0.14	--	--	--	--	0.000	0.000	--	0.000
Phenanthrene	0.37	--	--	--	--	--	--	--	--
Anthracene	0.045	--	--	--	--	0.000	0.000	--	0.000
di-n-Butylphthalate	0.043	--	--	--	--	0.000	0.000	--	0.000
Fluoranthene	0.21	--	--	--	--	0.000	0.000	--	0.000
Pyrene	0.2	--	--	--	--	0.000	0.000	--	0.000
Chrysene	0.098	4.0E-09	4.7E-09	3.3E-10	9.0E-09	--	--	--	--
Aroclor-1242	0.37	4.5E-06	5.2E-06	--	9.7E-06	--	--	--	--
Aroclor-1260	0.062	7.5E-07	8.7E-07	--	1.6E-06	--	--	--	--
Aluminum	12,400	--	--	--	--	--	--	--	--
Barium	230	--	--	--	--	0.042	0.002	--	0.044
Beryllium	0.76	5.1E-06	6.0E-07	3.5E-13	5.7E-06	0.002	0.000	--	0.002
Chromium (5)	19.6	--	--	--	--	0.000	0.000	--	0.000
Cobalt	7.7	--	--	--	--	--	--	--	--
Copper	60.8	--	--	--	--	--	--	--	--
Lead	157	--	--	--	--	--	--	--	--
Nickel	19	--	--	--	--	0.012	0.001	--	0.013
Silver	1.3	--	--	--	--	0.003	0.000	--	0.003
Sodium	1,120	--	--	--	--	--	--	--	--
Zinc	149	--	--	--	--	0.010	0.000	--	0.010
Totals:		1E-05	7E-06	3E-10	2E-05	0.070	0.004	0.000	0.074
Inorganics Totals:					6E-06				0.073
SB22 (0-5 feet deep)									
Acetone	0.096	--	--	--	--	0.000	0.000	--	0.000
Toluene	0.018	--	--	--	--	0.000	0.000	0.000	0.000
Ethyl benzene	0.014	--	--	--	--	0.000	0.000	0.000	0.000
Xylenes (total)	0.1	--	--	--	--	0.000	0.000	--	0.000
2-Methylnaphthalene	0.073	--	--	--	--	--	--	--	--
Phenanthrene	0.19	--	--	--	--	--	--	--	--
Anthracene	0.031	--	--	--	--	0.000	0.000	--	0.000
Fluoranthene	0.18	--	--	--	--	0.000	0.000	--	0.000
Pyrene	0.18	--	--	--	--	0.000	0.000	--	0.000
Chrysene	0.11	4.5E-09	5.2E-09	3.7E-10	1.0E-08	--	--	--	--
Aroclor-1242	0.33	4.0E-06	4.6E-06	--	8.6E-06	--	--	--	--
Aroclor-1254	0.09	1.1E-06	1.3E-06	--	2.4E-06	--	--	--	--
Aluminum	17,300	--	--	--	--	--	--	--	--
Barium	652	--	--	--	--	0.119	0.006	--	0.125
Beryllium	1	6.7E-06	7.9E-07	4.6E-13	7.5E-06	0.003	0.000	--	0.003
Cadmium	1.7	--	--	5.7E-13	5.7E-13	0.022	0.001	--	0.023
Calcium	83,800	--	--	--	--	--	--	--	--
Chromium (5)	40.5	--	--	--	--	0.001	0.000	--	0.001
Cobalt	9.2	--	--	--	--	--	--	--	--
Copper	268	--	--	--	--	--	--	--	--
Iron	22,300	--	--	--	--	--	--	--	--
Lead	471	--	--	--	--	--	--	--	--
Magnesium	38,800	--	--	--	--	--	--	--	--
Nickel	34.2	--	--	--	--	0.022	0.001	--	0.023
Potassium	2,390	--	--	--	--	--	--	--	--
Silver	2.6	--	--	--	--	0.007	0.000	--	0.007
Sodium	1,810	--	--	--	--	--	--	--	--
Vanadium	30.1	--	--	--	--	--	--	--	--
Zinc	328	--	--	--	--	0.021	0.001	--	0.022
Totals:		1E-05	7E-06	4E-10	2E-05	0.194	0.010	0.000	0.204
Inorganics Totals:					8E-06				0.204

TABLE A-5
FUTURE ON-SITE RESIDENT SCENARIO SOIL RISKS
SHALLOW SOIL BORINGS - PHASE II
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk (3)				Hazard Index (3,4)			
		Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
SB201 (0-3 feet deep)									
Acetone	0.013	--	--	--	--	0.000	0.000	--	0.000
1,1,1-Trichloroethane	0.037	--	--	--	--	0.000	0.000	--	0.000
Trichloroethene	0.007	1.2E-10	3.5E-10	1.5E-11	4.9E-10	--	--	--	--
Tetrachloroethene	0.012	9.6E-10	2.8E-09	2.7E-12	3.8E-09	0.000	0.000	--	0.000
Toluene	0.003	--	--	--	--	0.000	0.000	0.000	0.000
Phenanthrene	2.6	--	--	--	--	--	--	--	--
Anthracene	0.67	--	--	--	--	0.000	0.000	--	0.000
Fluoranthene	3.8	--	--	--	--	0.001	0.001	--	0.002
Pyrene	4.1	--	--	--	--	0.002	0.001	--	0.003
Benzo(a)anthracene	1.8	2.4E-06	2.8E-06	2.0E-07	**5.3E-06**	--	--	--	--
Chrysene	1.8	7.3E-08	8.5E-08	6.1E-09	1.6E-07	--	--	--	--
Benzo(b)fluoranthene	3.3	4.2E-06	4.9E-06	3.5E-07	**9.4E-06**	--	--	--	--
Benzo(a)pyrene	1.7	1.5E-05	1.8E-05	1.3E-06	**3.5E-05**	--	--	--	--
Aroclor-1242	0.24	2.9E-06	3.4E-06	--	**6.3E-06**	--	--	--	--
Aroclor-1254	0.32	3.9E-06	4.5E-06	--	**8.4E-06**	--	--	--	--
Aluminum	12,500	--	--	--	--	--	--	--	--
Barium	198	--	--	--	--	0.036	0.002	--	0.038
Beryllium	0.66	4.4E-06	5.2E-07	3.0E-13	**5.0E-06**	0.002	0.000	--	0.002
Chromium (5)	26.6	--	--	--	--	0.000	0.000	--	0.000
Cobalt	9.7	--	--	--	--	--	--	--	--
Copper	92.2	--	--	--	--	--	--	--	--
Iron	22,100	--	--	--	--	--	--	--	--
Lead	240	--	--	--	--	--	--	--	--
Mercury	0.24	--	--	--	--	0.010	0.001	0.000	0.011
Nickel	28.1	--	--	--	--	0.018	0.001	--	0.019
Potassium	2,060	--	--	--	--	--	--	--	--
Sodium	385	--	--	--	--	--	--	--	--
Zinc	229	--	--	--	--	0.015	0.001	--	0.015
Totals:		3E-05	3E-05	2E-06	7E-05	0.084	0.006	0.000	0.090
Inorganics Totals:					5E-06				0.085

TABLE A-5
FUTURE ON-SITE RESIDENT SCENARIO SOIL RISKS
SHALLOW SOIL BORINGS - PHASE II
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk (3)				Hazard Index (3,4)			
		Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
SB201 (3-5 feet deep)									
Trichloroethene	0.007	1.2E-10	3.5E-10	1.5E-11	4.9E-10	–	–	–	–
Benzene	0.004	1.8E-10	5.3E-10	1.5E-11	7.3E-10	–	–	–	–
Tetrachloroethene	0.016	1.3E-09	3.7E-09	3.6E-12	5.0E-09	0.000	0.000	–	0.000
Toluene	0.012	–	–	–	–	0.000	0.000	0.000	0.000
Ethyl benzene	0.062	–	–	–	–	0.000	0.000	0.000	0.000
Xylenes (total)	0.18	–	–	–	–	0.000	0.000	–	0.000
Naphthalene	0.63	–	–	–	–	0.000	0.000	–	0.000
2-Methylnaphthalene	0.6	–	–	–	–	–	–	–	–
Acenaphthene	1.1	–	–	–	–	0.000	0.000	–	0.000
Dibenzofuran	0.83	–	–	–	–	–	–	–	–
Fluorene	1.4	–	–	–	–	0.000	0.000	–	0.001
Phenanthrene	7.3	–	–	–	–	–	–	–	–
Anthracene	1.7	–	–	–	–	0.000	0.000	–	0.000
Fluoranthene	7.2	–	–	–	–	0.002	0.001	–	0.004
Pyrene	6.4	–	–	–	–	0.003	0.001	–	0.004
Benzo(a)anthracene	2.7	3.6E-06	4.1E-06	3.0E-07	**8.0E-06**	–	–	–	–
Chrysene	2.8	1.1E-07	1.3E-07	9.5E-09	2.6E-07	–	–	–	–
bis(2-Ethylhexyl)phthalate	2.4	5.3E-08	6.1E-08	–	1.1E-07	0.002	0.001	–	0.002
Benzo(b)fluoranthene	4.7	6.0E-06	7.0E-06	5.0E-07	**1.3E-05**	–	–	–	–
Benzo(a)pyrene	2.3	2.1E-05	2.4E-05	1.8E-06	**4.7E-05**	–	–	–	–
Aroclor-1242	0.66	8.0E-06	9.3E-06	–	**1.7E-05**	–	–	–	–
Aroclor-1254	0.94	1.1E-05	1.3E-05	–	**2.5E-05**	–	–	–	–
Barium	201	–	–	–	–	0.037	0.002	–	0.039
Calcium	89,900	–	–	–	–	–	–	–	–
Chromium (5)	24	–	–	–	–	0.000	0.000	–	0.000
Copper	27.7	–	–	–	–	–	–	–	–
Lead	72.6	–	–	–	–	–	–	–	–
Magnesium	45,300	–	–	–	–	–	–	–	–
Nickel	29.8	–	–	–	–	0.019	0.001	–	0.020
Silver	2.4	–	–	–	–	0.006	0.000	–	0.006
Sodium	907	–	–	–	–	–	–	–	–
Totals:		5E-05	6E-05	3E-06	1E-04	0.070	0.007	0.000	0.077
Inorganics Totals:					0E+00				0.065

TABLE A-5
FUTURE ON-SITE RESIDENT SCENARIO SOIL RISKS
SHALLOW SOIL BORINGS - PHASE II
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk (3)				Hazard Index (3,4)			
		Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
SB202 (0-3 feet deep)									
1,2-Dichloroethene (total)	0.007	--	--	--	--	0.000	0.000	--	0.000
Phenol	2.7	--	--	--	--	0.000	0.000	--	0.000
1,2-Dichlorobenzene	0.89	--	--	--	--	0.000	0.000	--	0.000
Cresol	3.1	--	--	--	--	--	--	--	--
Isophorone	3.5	5.2E-09	6.1E-09	--	1.1E-08	0.000	0.000	--	0.000
2,4-Dimethylphenol	0.57	--	--	--	--	0.000	0.000	--	0.001
Naphthalene	2.1	--	--	--	--	0.001	0.000	--	0.001
2-Methylnaphthalene	2.1	--	--	--	--	--	--	--	--
Phenanthrene	1.4	--	--	--	--	--	--	--	--
Anthracene	0.37	--	--	--	--	0.000	0.000	--	0.000
di-n-Butylphthalate	0.42	--	--	--	--	0.000	0.000	--	0.000
Fluoranthene	0.78	--	--	--	--	0.000	0.000	--	0.000
Pyrene	1.1	--	--	--	--	0.000	0.000	--	0.001
Butylbenzylphthalate	3.2	--	--	--	--	0.000	0.000	--	0.000
Chrysene	1.1	4.5E-08	5.2E-08	3.7E-09	1.0E-07	--	--	--	--
bis(2-Ethylhexyl)phthalate	7.4	1.6E-07	1.9E-07	--	3.5E-07	0.005	0.002	--	0.007
Aroclor-1242	1	1.2E-05	1.4E-05	--	2.6E-05	--	--	--	--
Aluminum	10,900	--	--	--	--	--	--	--	--
Arsenic	14.4	--	--	4.0E-11	4.0E-11	0.614	0.032	--	0.646
Barium	101	--	--	--	--	0.018	0.001	--	0.019
Beryllium	0.76	5.1E-06	6.0E-07	3.5E-13	5.7E-06	0.002	0.000	--	0.002
Chromium (5)	18.7	--	--	--	--	0.000	0.000	--	0.000
Cobalt	10.1	--	--	--	--	--	--	--	--
Copper	26.5	--	--	--	--	--	--	--	--
Lead	54.2	--	--	--	--	--	--	--	--
Nickel	24	--	--	--	--	0.015	0.001	--	0.016
Sodium	328	--	--	--	--	--	--	--	--
Zinc	116	--	--	--	--	0.007	0.000	--	0.008
Totals:		2E-05	1E-05	4E-09	3E-05	0.665	0.038	0.000	0.703
Inorganics Totals:					6E-06				0.692
SB202 (3-5 feet deep)									
Xylenes (total)	0.004	--	--	--	--	0.000	0.000	--	0.000
Acenaphthene	0.061	--	--	--	--	0.000	0.000	--	0.000
Phenanthrene	0.69	--	--	--	--	--	--	--	--
di-n-Butylphthalate	0.28	--	--	--	--	0.000	0.000	--	0.000
Fluoranthene	0.91	--	--	--	--	0.000	0.000	--	0.000
Pyrene	0.95	--	--	--	--	0.000	0.000	--	0.001
Butylbenzylphthalate	1.2	--	--	--	--	0.000	0.000	--	0.000
Benzo(a)anthracene	0.46	6.1E-07	7.1E-07	5.1E-08	1.4E-06	--	--	--	--
Chrysene	0.35	1.4E-08	1.7E-08	1.2E-09	3.2E-08	--	--	--	--
Benzo(b)fluoranthene	0.92	1.2E-06	1.4E-06	9.9E-08	2.6E-06	--	--	--	--
Benzo(a)pyrene	0.46	4.2E-06	4.9E-06	3.5E-07	9.4E-06	--	--	--	--
Indeno(1,2,3-cd)pyrene	0.28	5.7E-07	6.6E-07	4.9E-08	1.3E-06	--	--	--	--
Benzo(g,h,i)perylene	0.26	5.3E-08	6.2E-08	4.3E-09	1.2E-07	--	--	--	--
Aroclor-1254	0.97	1.2E-05	1.4E-05	--	2.5E-05	--	--	--	--
Barium	155	--	--	--	--	0.028	0.001	--	0.030
Cadmium	3.8	--	--	1.3E-12	1.3E-12	0.049	0.003	--	0.051
Chromium (5)	98.1	--	--	--	--	0.001	0.000	--	0.001
Copper	120	--	--	--	--	--	--	--	--
Lead	473	--	--	--	--	--	--	--	--
Mercury	0.38	--	--	--	--	0.016	0.001	0.000	0.017
Nickel	34.7	--	--	--	--	0.022	0.001	--	0.023
Sodium	273	--	--	--	--	--	--	--	--
Zinc	490	--	--	--	--	0.031	0.002	--	0.033
Totals:		2E-05	2E-05	6E-07	4E-05	0.149	0.008	0.000	0.157
Inorganics Totals:					1E-12				0.156

TABLE A-5
FUTURE ON-SITE RESIDENT SCENARIO SOIL RISKS
SHALLOW SOIL BORINGS - PHASE II
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk (3)				Hazard Index (3,4)			
		Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
SB203 (0-3 feet deep)									
1,1,1-Trichloroethane	0.1	–	--	--	--	0.000	0.000	–	0.000
Toluene	0.008	–	--	--	--	0.000	0.000	0.000	0.000
Phenanthrene	0.41	–	--	--	--	–	–	–	–
Anthracene	0.11	–	--	--	--	0.000	0.000	–	0.000
Fluoranthene	0.51	–	--	--	--	0.000	0.000	–	0.000
Pyrene	0.35	–	--	--	--	0.000	0.000	–	0.000
Benzo(a)anthracene	0.2	2.6E-07	3.1E-07	2.2E-08	5.9E-07	–	--	--	–
Chrysene	0.22	9.0E-09	1.0E-08	7.5E-10	2.0E-08	–	–	–	–
Benzo(b)fluoranthene	0.12	1.5E-07	1.8E-07	1.3E-08	3.4E-07	–	–	–	–
Benzo(k)fluoranthene	0.18	1.1E-07	1.2E-07	9.1E-09	2.4E-07	–	–	–	–
Indeno(1,2,3-cd)pyrene	0.18	3.7E-07	4.3E-07	3.2E-08	8.3E-07	–	–	–	–
Aldrin	0.0019	5.1E-08	5.9E-08	4.1E-09	1.1E-07	0.001	0.000	–	0.001
4,4'-DDE	0.0072	3.8E-09	4.5E-09	--	8.3E-09	–	–	–	–
4,4'-DDD	0.0091	3.4E-09	4.0E-09	--	7.4E-09	–	–	–	–
4,4'-DDT	0.0035	1.9E-09	2.2E-09	--	4.0E-09	0.000	0.000	–	0.000
Calcium	98,400	–	--	--	–	–	–	–	–
Magnesium	51,800	–	--	--	--	–	–	–	–
Sodium	194	–	--	--	--	–	–	–	–
Totals:		1E-06	1E-06	8E-08	2E-06	0.001	0.001	0.000	0.002
Inorganics Totals:					0E+00				0.000
SB203 (3-5 feet deep)									
Methylene chloride	0.006	7.0E-11	2.1E-10	--	2.8E-10	0.000	0.000	0.000	0.000
1,1,1-Trichloroethane	0.052	–	--	--	–	0.000	0.000	–	0.000
Acenaphthene	0.056	–	--	--	–	0.000	0.000	–	0.000
Dibenzofuran	0.044	–	--	--	–	–	–	–	–
Fluorene	0.081	–	--	--	--	0.000	0.000	–	0.000
Phenanthrene	0.94	–	--	--	--	–	–	–	–
Anthracene	0.16	–	--	--	--	0.000	0.000	–	0.000
Fluoranthene	1.8	–	--	--	--	0.001	0.000	–	0.001
Pyrene	1.5	–	--	--	--	0.001	0.000	–	0.001
Benzo(a)anthracene	0.69	9.1E-07	1.1E-06	7.7E-08	**2.0E-06**	–	–	–	–
Chrysene	0.58	2.4E-08	2.8E-08	2.0E-09	5.3E-08	–	–	–	–
Benzo(b)fluoranthene	1.5	1.9E-06	2.2E-06	1.6E-07	**4.3E-06**	–	–	–	–
Benzo(a)pyrene	0.48	4.4E-06	5.1E-06	3.7E-07	**9.8E-06**	–	–	–	–
4,4'-DDE	0.026	1.4E-08	1.6E-08	--	3.0E-08	–	–	–	–
4,4'-DDD	0.07	2.6E-08	3.1E-08	--	5.7E-08	–	–	–	–
4,4'-DDT	0.025	1.3E-08	1.6E-08	--	2.9E-08	0.001	0.000	–	0.001
Methoxychlor	0.13	–	--	--	--	0.000	0.000	–	0.001
Totals:		7E-06	8E-06	6E-07	2E-05	0.002	0.001	0.000	0.003
Inorganics Totals:					0E+00				0.000
SB204 (0-3 feet deep)									
1,1-Dichloroethane	0.004	–	--	--	--	0.000	0.000	–	0.000
1,1,1-Trichloroethane	0.081	–	--	--	--	0.000	0.000	–	0.000
Tetrachloroethene	0.008	6.4E-10	1.9E-09	1.8E-12	2.5E-09	0.000	0.000	–	0.000
Toluene	0.008	–	--	--	--	0.000	0.000	0.000	0.000
Aluminum	12,500	–	--	--	--	–	–	–	–
Barium	857	–	--	--	--	0.157	0.008	–	0.165
Beryllium	0.66	4.4E-06	5.2E-07	3.0E-13	**5.0E-06**	0.002	0.000	–	0.002
Calcium	61,000	–	--	--	–	–	–	–	–
Chromium (5)	30.1	–	--	--	--	0.000	0.000	–	0.000
Copper	93.4	–	--	--	–	–	–	–	–
Lead	270	–	--	--	--	–	–	–	–
Mercury	0.17	–	--	--	–	0.007	0.000	0.000	0.008
Nickel	23.1	–	--	--	--	0.015	0.001	–	0.016
Sodium	3,300	–	--	--	--	–	–	–	–
Zinc	229	–	--	--	--	0.015	0.001	–	0.015
Totals:		4E-06	5E-07	2E-12	5E-06	0.195	0.010	0.000	0.206
Inorganics Totals:					5E-06				0.206

TABLE A-5
FUTURE ON-SITE RESIDENT SCENARIO SOIL RISKS
SHALLOW SOIL BORINGS - PHASE II
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk (3)				Hazard Index (3,4)			
		Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
SB204 (3-5 feet deep)									
Methylene chloride	0.005	5.9E-11	1.7E-10	--	2.3E-10	0.000	0.000	0.000	0.000
Acetone	0.26	--	--	--	--	0.000	0.000	--	0.000
1,1,1-Trichloroethane	0.007	--	--	--	--	0.000	0.000	--	0.000
Toluene	0.004	--	--	--	--	0.000	0.000	0.000	0.000
Ethyl benzene	0.007	--	--	--	--	0.000	0.000	0.000	0.000
Xylenes (total)	0.022	--	--	--	--	0.000	0.000	--	0.000
Aldrin	0.0018	4.8E-08	5.6E-08	3.9E-09	1.1E-07	0.001	0.000	--	0.001
Aluminum	16,800	--	--	--	--	--	--	--	--
Barium	433	--	--	--	--	0.079	0.004	--	0.083
Beryllium	0.96	6.5E-06	7.5E-07	4.4E-13	7.2E-06	0.002	0.000	--	0.003
Chromium (5)	26.7	--	--	--	--	0.000	0.000	--	0.000
Cobalt	8	--	--	--	--	--	--	--	--
Copper	106	--	--	--	--	--	--	--	--
Iron	27,100	--	--	--	--	--	--	--	--
Lead	258	--	--	--	--	--	--	--	--
Mercury	0.12	--	--	--	--	0.005	0.000	0.000	0.005
Nickel	21.3	--	--	--	--	0.014	0.001	--	0.014
Potassium	2,080	--	--	--	--	--	--	--	--
Sodium	2,060	--	--	--	--	--	--	--	--
Vanadium	27.8	--	--	--	--	--	--	--	--
Zinc	164	--	--	--	--	0.010	0.001	--	0.011
Totals:		7E-06	8E-07	4E-09	7E-06	0.112	0.006	0.000	0.118
Inorganics Totals:					7E-06				0.117
SB205 (0-3 feet deep)									
1,1,1-Trichloroethane	0.025	--	--	--	--	0.000	0.000	--	0.000
Fluoranthene	0.18	--	--	--	--	0.000	0.000	--	0.000
Pyrene	0.14	--	--	--	--	0.000	0.000	--	0.000
4,4'-DDD	0.019	7.1E-09	8.3E-09	--	1.5E-08	--	--	--	--
4,4'-DDE	0.053	2.8E-08	3.3E-08	--	6.1E-08	--	--	--	--
4,4'-DDT	0.03	1.6E-08	1.9E-08	--	3.5E-08	0.001	0.000	--	0.001
Barium	181	--	--	--	--	0.033	0.002	--	0.035
Calcium	106,000	--	--	--	--	--	--	--	--
Chromium (5)	29.6	--	--	--	--	0.000	0.000	--	0.000
Copper	96.1	--	--	--	--	--	--	--	--
Lead	414	--	--	--	--	--	--	--	--
Magnesium	56,300	--	--	--	--	--	--	--	--
Mercury	0.24	--	--	--	--	0.010	0.001	0.000	0.011
Nickel	20.7	--	--	--	--	0.013	0.001	--	0.014
Potassium	1,920	--	--	--	--	--	--	--	--
Silver	3.5	--	--	--	--	0.009	0.000	--	0.009
Sodium	688	--	--	--	--	--	--	--	--
Zinc	270	--	--	--	--	0.017	0.001	--	0.018
Totals:		5E-08	6E-08	0E+00	1E-07	0.084	0.005	0.000	0.089
Inorganics Totals:					0E+00				0.087

TABLE A-5
FUTURE ON-SITE RESIDENT SCENARIO SOIL RISKS
SHALLOW SOIL BORINGS - PHASE II
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk (3)				Hazard Index (3,4)			
		Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
SB205 (3-5 feet deep)									
Acetone	0.088	--	--	--	--	0.000	0.000	--	0.000
1,1,1-Trichloroethane	0.043	--	--	--	--	0.000	0.000	--	0.000
Toluene	0.006	--	--	--	--	0.000	0.000	0.000	0.000
Phenanthrene	0.75	--	--	--	--	--	--	--	--
Anthracene	0.16	--	--	--	--	0.000	0.000	--	0.000
Fluoranthene	0.88	--	--	--	--	0.000	0.000	--	0.000
Pyrene	0.7	--	--	--	--	0.000	0.000	--	0.000
Benzo(a)anthracene	0.42	5.5E-07	6.4E-07	4.7E-08	1.2E-06	--	--	--	--
Chrysene	0.4	1.6E-08	1.9E-08	1.4E-09	3.7E-08	--	--	--	--
Benzo(b)fluoranthene	0.54	6.8E-07	8.0E-07	5.8E-08	1.5E-06	--	--	--	--
Benzo(k)fluoranthene	0.2	1.2E-07	1.4E-07	1.0E-08	2.7E-07	--	--	--	--
Benzo(a)pyrene	0.35	3.2E-06	3.7E-06	2.7E-07	7.2E-06	--	--	--	--
Indeno(1,2,3-cd)pyrene	0.26	5.3E-07	6.2E-07	4.6E-08	1.2E-06	--	--	--	--
Aroclor-1242	0.16	1.9E-06	2.3E-06	--	4.2E-06	--	--	--	--
Aroclor-1254	0.08	9.6E-07	1.1E-06	--	2.1E-06	--	--	--	--
Arsenic	13.2	--	--	3.6E-11	3.6E-11	0.563	0.029	--	0.592
Barium	70.1	--	--	--	--	0.013	0.001	--	0.013
Beryllium	0.69	4.6E-06	5.4E-07	3.2E-13	5.2E-06	0.002	0.000	--	0.002
Chromium (5)	19.5	--	--	--	--	0.000	0.000	--	0.000
Cobalt	14.6	--	--	--	--	--	--	--	--
Copper	47.7	--	--	--	--	--	--	--	--
Iron	25,400	--	--	--	--	--	--	--	--
Lead	119	--	--	--	--	--	--	--	--
Nickel	33.5	--	--	--	--	0.021	0.001	--	0.023
Potassium	1,920	--	--	--	--	--	--	--	--
Sodium	487	--	--	--	--	--	--	--	--
Thallium	0.95	--	--	--	--	0.174	0.009	--	0.183
Zinc	161	--	--	--	--	0.010	0.001	--	0.011
Totals:		1E-05	1E-05	4E-07	2E-05	0.783	0.041	0.000	0.825
Inorganics Totals:					5E-06				0.824
SB206 (0-3 feet deep)									
Acetone	0.15	--	--	--	--	0.000	0.000	--	0.000
Trichloroethene	0.011	1.9E-10	5.5E-10	2.4E-11	7.7E-10	--	--	--	--
Ethyl benzene	0.042	--	--	--	--	0.000	0.000	0.000	0.000
Xylenes (total)	0.028	--	--	--	--	0.000	0.000	--	0.000
4,4'-DDD	0.0017	6.4E-10	7.5E-10	--	1.4E-09	--	--	--	--
4,4'-DDE	0.0011	5.9E-10	6.8E-10	--	1.3E-09	--	--	--	--
4,4'-DDT	0.0051	2.7E-09	3.2E-09	--	5.9E-09	0.000	0.000	--	0.000
Barium	170	--	--	--	--	0.031	0.002	--	0.033
Cadmium	1.9	--	--	6.4E-13	6.4E-13	0.024	0.001	--	0.026
Calcium	109,000	--	--	--	--	--	--	--	--
Chromium (5)	26.3	--	--	--	--	0.000	0.000	--	0.000
Copper	60.2	--	--	--	--	--	--	--	--
Lead	397	--	--	--	--	--	--	--	--
Magnesium	51,500	--	--	--	--	--	--	--	--
Mercury	0.13	--	--	--	--	0.006	0.000	0.000	0.006
Potassium	1,970	--	--	--	--	--	--	--	--
Silver	3.4	--	--	--	--	0.009	0.000	--	0.009
Sodium	1,330	--	--	--	--	--	--	--	--
Zinc	200	--	--	--	--	0.013	0.001	--	0.013
Totals:		4E-09	5E-09	2E-11	9E-09	0.083	0.004	0.000	0.087
Inorganics Totals:					6E-13				0.087

TABLE A-5
FUTURE ON-SITE RESIDENT SCENARIO SOIL RISKS
SHALLOW SOIL BORINGS - PHASE II
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk (3)				Hazard Index (3,4)			
		Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
SB207 (0-3 feet deep)									
Methylene chloride	0.016	1.9E-10	5.5E-10	--	7.4E-10	0.000	0.000	0.000	0.000
1,1,1-Trichloroethane	0.009	--	--	--	--	0.000	0.000	--	0.000
Fluoranthene	0.17	--	--	--	--	0.000	0.000	--	0.000
Pyrene	0.16	--	--	--	--	0.000	0.000	--	0.000
Endosulfan I	0.0052	--	--	--	--	0.001	0.001	--	0.002
4,4'-DDD	0.0031	1.2E-09	1.4E-09	--	2.5E-09	--	--	--	--
4,4'-DDE	0.00072	3.8E-10	4.5E-10	--	8.3E-10	--	--	--	--
4,4'-DDT	0.0012	6.4E-10	7.5E-10	--	1.4E-09	0.000	0.000	--	0.000
alpha-Chlordane	0.0037	7.5E-09	8.8E-09	6.1E-10	1.7E-08	0.001	0.000	--	0.001
gamma-Chlordane	0.0036	7.3E-09	8.5E-09	5.9E-10	1.6E-08	0.001	0.000	--	0.001
Barium	66.6	--	--	--	--	0.012	0.001	--	0.013
Calcium	133,000	--	--	--	--	--	--	--	--
Chromium (5)	18.1	--	--	--	--	0.000	0.000	--	0.000
Copper	28	--	--	--	--	--	--	--	--
Lead	91.8	--	--	--	--	--	--	--	--
Magnesium	78,400	--	--	--	--	--	--	--	--
Mercury	0.19	--	--	--	--	0.008	0.000	0.000	0.009
Sodium	305	--	--	--	--	--	--	--	--
Zinc	107	--	--	--	--	0.007	0.000	--	0.007
Totals:		2E-08	2E-08	1E-09	4E-08	0.030	0.003	0.000	0.033
Inorganics Totals:					0E+00				0.029
SB207 (3-5 feet deep)									
Methylene chloride	0.004	4.7E-11	1.4E-10	--	1.8E-10	0.000	0.000	0.000	0.000
Acetone	0.07	--	--	--	--	0.000	0.000	--	0.000
1,1,1-Trichloroethane	0.006	--	--	--	--	0.000	0.000	--	0.000
Toluene	0.003	--	--	--	--	0.000	0.000	0.000	0.000
Calcium	150,000	--	--	--	--	--	--	--	--
Magnesium	42,600	--	--	--	--	--	--	--	--
Sodium	297	--	--	--	--	--	--	--	--
Totals:		5E-11	1E-10	0E+00	2E-10	0.000	0.000	0.000	0.000
Inorganics Totals:					0E+00				0.000
SB208 (0-3 feet deep)									
Methylene chloride	0.009	1.1E-10	3.1E-10	--	4.1E-10	0.000	0.000	0.000	0.000
Acetone	0.011	--	--	--	--	0.000	0.000	--	0.000
1,1,1-Trichloroethane	0.004	--	--	--	--	0.000	0.000	--	0.000
Toluene	0.002	--	--	--	--	0.000	0.000	0.000	0.000
Pyrene	0.062	--	--	--	--	0.000	0.000	--	0.000
gamma-BHC (Lindane)	0.00075	1.5E-09	1.8E-09	--	3.3E-09	0.000	0.000	--	0.000
Endosulfan I	0.0032	--	--	--	--	0.001	0.000	--	0.001
alpha-Chlordane	0.003	6.1E-09	7.1E-09	4.9E-10	1.4E-08	0.001	0.000	--	0.001
gamma-Chlordane	0.0019	3.9E-09	4.5E-09	3.1E-10	8.7E-09	0.000	0.000	--	0.001
Calcium	115,000	--	--	--	--	--	--	--	--
Copper	20.4	--	--	--	--	--	--	--	--
Magnesium	70,100	--	--	--	--	--	--	--	--
Mercury	0.12	--	--	--	--	0.005	0.000	0.000	0.005
Sodium	251	--	--	--	--	--	--	--	--
Totals:		1E-08	1E-08	8E-10	3E-08	0.007	0.001	0.000	0.008
Inorganics Totals:					0E+00				0.005
SB208 (3-5 feet deep)									
Acetone	0.034	--	--	--	--	0.000	0.000	--	0.000
1,1,1-Trichloroethane	0.015	--	--	--	--	0.000	0.000	--	0.000
Toluene	0.002	--	--	--	--	0.000	0.000	0.000	0.000
Calcium	126,000	--	--	--	--	--	--	--	--
Magnesium	75,700	--	--	--	--	--	--	--	--
Sodium	170	--	--	--	--	--	--	--	--
Totals:		0E+00	0E+00	0E+00	0E+00	0.000	0.000	0.000	0.000
Inorganics Totals:					0E+00				0.000

TABLE A-5
FUTURE ON-SITE RESIDENT SCENARIO SOIL RISKS
SHALLOW SOIL BORINGS - PHASE II
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk (3)				Hazard Index (3,4)			
		Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
SB209 (0-3 feet deep)									
4,4'-DDD	0.0083	3.1E-09	3.6E-09	--	6.8E-09	--	--	--	--
4,4'-DDE	0.00092	4.9E-10	5.7E-10	--	1.1E-09	--	--	--	--
4,4'-DDT	0.0047	2.5E-09	2.9E-09	--	5.4E-09	0.000	0.000	--	0.000
Calcium	114,000	--	--	--	--	--	--	--	--
Lead	51.3	--	--	--	--	--	--	--	--
Magnesium	68,700	--	--	--	--	--	--	--	--
Mercury	0.18	--	--	--	--	0.008	0.000	0.000	0.008
Silver	4.8	--	--	--	--	0.012	0.001	--	0.013
Sodium	430	--	--	--	--	--	--	--	--
Totals:		6E-09	7E-09	0E+00	1E-08	0.020	0.001	0.000	0.021
Inorganics Totals:					0E+00				0.021
SB209 (3-5 feet deep)									
Methylene chloride	0.004	4.7E-11	1.4E-10	--	1.8E-10	0.000	0.000	0.000	0.000
1,1,1-Trichloroethane	0.006	--	--	--	--	0.000	0.000	--	0.000
Calcium	128,000	--	--	--	--	--	--	--	--
Magnesium	73,400	--	--	--	--	--	--	--	--
Silver	5	--	--	--	--	0.013	0.001	--	0.013
Sodium	335	--	--	--	--	--	--	--	--
Totals:		5E-11	1E-10	0E+00	2E-10	0.013	0.001	0.000	0.013
Inorganics Totals:					0E+00				0.013
SB211 (0-3 feet deep)									
Methylene chloride	0.014	1.6E-10	4.8E-10	--	6.4E-10	0.000	0.000	0.000	0.000
Acetone	0.22	--	--	--	--	0.000	0.000	--	0.000
1,1-Dichloroethane	0.014	--	--	--	--	0.000	0.000	--	0.000
1,1,1-Trichloroethane	0.014	--	--	--	--	0.000	0.000	--	0.000
Benzene	0.13	5.9E-09	1.7E-08	4.8E-10	2.4E-08	--	--	--	--
Toluene	0.03	--	--	--	--	0.000	0.000	0.000	0.000
Ethyl benzene	0.13	--	--	--	--	0.000	0.000	0.000	0.000
Xylenes (total)	0.28	--	--	--	--	0.000	0.000	--	0.000
2-Methylnaphthalene	0.2	--	--	--	--	--	--	--	--
Acenaphthene	0.15	--	--	--	--	0.000	0.000	--	0.000
Phenanthrene	1.7	--	--	--	--	--	--	--	--
Dieldrin	0.0057	1.4E-07	1.7E-07	1.1E-08	3.2E-07	0.001	0.001	--	0.002
Barium	78.9	--	--	--	--	0.014	0.001	--	0.015
Calcium	135,000	--	--	--	--	--	--	--	--
Lead	232	--	--	--	--	--	--	--	--
Magnesium	83,700	--	--	--	--	--	--	--	--
Mercury	0.26	--	--	--	--	0.011	0.001	0.000	0.012
Sodium	313	--	--	--	--	--	--	--	--
Totals:		1E-07	2E-07	1E-08	3E-07	0.027	0.002	0.000	0.029
Inorganics Totals:					0E+00				0.027
SB211 (3-5 feet deep)									
Acetone	0.046	--	--	--	--	0.000	0.000	--	0.000
Calcium	136,000	--	--	--	--	--	--	--	--
Magnesium	84,400	--	--	--	--	--	--	--	--
Mercury	0.11	--	--	--	--	0.005	0.000	0.000	0.005
Sodium	146	--	--	--	--	--	--	--	--
Totals:		0E+00	0E+00	0E+00	0E+00	0.005	0.000	0.000	0.005
Inorganics Totals:					0E+00				0.005

TABLE A-5
FUTURE ON-SITE RESIDENT SCENARIO SOIL RISKS
SHALLOW SOIL BORINGS - PHASE II
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk (3)				Hazard Index (3,4)			
		Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
SB212 (0-3 feet deep)									
Calcium	122,000	--	--	--	--	--	--	--	--
Lead	714	--	--	--	--	--	--	--	--
Magnesium	74,500	--	--	--	--	--	--	--	--
Mercury	0.18	--	--	--	--	0.008	0.000	0.000	0.008
Sodium	290	--	--	--	--	--	--	--	--
Totals:		0E+00	0E+00	0E+00	0E+00	0.008	0.000	0.000	0.008
Inorganics Totals:					0E+00				0.008

Notes:

(1) Only detected organic parameters and inorganics detected above the background concentrations (i.e., the highest detected value in samples from borings SB213, SB214 and SB216) are shown.

(2) Values shown are the highest detected concentrations between the sample and its duplicate, and/or between the results of the Round 1 and Round 2 samples. Analytical results that exceeded the instrument calibration range were not used if a diluted reanalysis was available.

(3) The oral and dermal risks are calculated in accordance with the procedures indicated in Section 5 and Appendix J of the Baseline Risk Assessment. The inhalation risks were calculated in accordance with the procedures in the Illinois Environmental Protection Agency's *Tiered Approach for Corrective Action Objectives*, dated September 16, 1996.

(4) Zero values indicate that the hazard indices are less than 5×10^{-4}.

(5) The calculations use the toxicity factors for trivalent chromium, although the laboratory reported total chromium.

Key:

-- = No toxicity factor is available for this chemical.

= Indicates a total carcinogenic risk above 1×10^{-4} or a total hazard index above 1 for this parameter.

TABLE A-6
CURRENT ADJACENT AND FUTURE ON-SITE RESIDENT SCENARIOS SOIL RISKS
DEEP SOIL BORINGS - PHASE I
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk		Hazard Index (3)	
		Inhalation	Total	Inhalation	Total
SB01 (5-9 feet deep)					
Acetone	0.140	--	--	--	--
trans-1,3-Dichloropropene	0.006	1.3E-08	1.3E-08	0.000	0.000
Phenanthrene	0.360	--	--	--	--
Anthracene	0.079	--	--	--	--
Fluoranthene	0.410	--	--	--	--
Pyrene	0.360	--	--	--	--
Benzo(a)anthracene	0.180	2.1E-13	2.1E-13	--	--
Benzo(a)pyrene	0.180	1.4E-13	1.4E-13	--	--
Indeno(1,2,3-cd)pyrene	0.081	2.6E-14	2.6E-14	--	--
Benzo(g,h,i)perylene	0.082	2.9E-15	2.9E-15	--	--
Aluminum	14,100	--	--	--	--
Chromium (4)	35.0	--	--	--	--
Cobalt	20.6	--	--	--	--
Copper	32.2	--	--	--	--
Iron	25,900	--	--	--	--
Lead	123	--	--	--	--
Mercury	0.14	--	--	--	--
Potassium	2,930	--	--	--	--
Sodium	484	--	--	--	--
Thallium	0.70	--	--	--	--
Vanadium	29.7	--	--	--	--
Zinc	161	--	--	--	--
Totals:		1E-08	1E-08	0.000	0.000
Inorganics Totals:			0E+00		0.000
SB02 (5-7.5 feet deep)					
trans-1,3-Dichloropropene	0.006	1.3E-08	1.3E-08	0.000	0.000
Aluminum	12,000	--	--	--	--
Arsenic	15.3	--	--	--	--
Calcium	79,700	--	--	--	--
Chromium (4)	32.1	--	--	--	--
Cobalt	12.9	--	--	--	--
Lead	107	--	--	--	--
Magnesium	48,900	--	--	--	--
Potassium	2,610	--	--	--	--
Sodium	4,460	--	--	--	--
Vanadium	26.5	--	--	--	--
Totals:		1E-08	1E-08	0.000	0.000
Inorganics Totals:			0E+00		0.000
SB02 (7.5-8.7 feet deep)					
Acetone	1.6	--	--	--	--
Carbon disulfide	0.110	--	--	0.001	0.001
2-Butanone	0.360	--	--	--	--
trans-1,3-Dichloropropene	0.014	3.0E-08	3.0E-08	0.000	0.000
Aluminum	12,500	--	--	--	--
Arsenic	87.4	--	--	--	--
Chromium (4)	54.9	--	--	--	--
Cobalt	20.7	--	--	--	--
Copper	38.9	--	--	--	--
Iron	53,000	--	--	--	--
Lead	29.3	--	--	--	--
Mercury	0.25	--	--	--	--
Potassium	2,370	--	--	--	--
Sodium	15,200	--	--	--	--
Vanadium	27.1	--	--	--	--
Totals:		3E-08	3E-08	0.001	0.001
Inorganics Totals:			0E+00		0.000

TABLE A-6
CURRENT ADJACENT AND FUTURE ON-SITE RESIDENT SCENARIOS SOIL RISKS
DEEP SOIL BORINGS - PHASE I
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk		Hazard Index (3)	
		Inhalation	Total	Inhalation	Total
SB05 (5-9 feet deep)					
Acetone	0.064	--	--	--	--
1,1,1-Trichloroethane	0.003	--	--	--	--
Tetrachloroethene	0.007	2.4E-10	2.4E-10	--	--
Toluene	0.010	--	--	0.000	0.000
Ethyl benzene	0.008	--	--	0.000	0.000
Xylenes (total)	0.041	--	--	--	--
Naphthalene	0.099	--	--	--	--
2-Methylnaphthalene	0.420	--	--	--	--
Phenanthrene	0.130	--	--	--	--
Fluoranthene	0.053	--	--	--	--
Pyrene	0.059	--	--	--	--
Aroclor-1242	0.250	--	--	--	--
Cadmium	1.2	--	--	--	--
Calcium	150,000	--	--	--	--
Chromium (4)	46.7	--	--	--	--
Cobalt	19.1	--	--	--	--
Copper	81.0	--	--	--	--
Lead	433	--	--	--	--
Magnesium	85,600	--	--	--	--
Nickel	18.4	--	--	--	--
Potassium	2,750	--	--	--	--
Sodium	816	--	--	--	--
Zinc	149	--	--	--	--
Totals:		2E-10	2E-10	0.000	0.000
Inorganics Totals:			0E+00		0.000
SB06 (5-9 feet deep)					
Acetone	0.180	--	--	--	--
Benzene	0.025	1.6E-08	1.6E-08	--	--
Ethyl benzene	0.031	--	--	0.000	0.000
Naphthalene	0.180	--	--	--	--
2-Methylnaphthalene	0.550	--	--	--	--
Dibenzofuran	0.092	--	--	--	--
Fluorene	0.310	--	--	--	--
Phenanthrene	0.760	--	--	--	--
Anthracene	0.470	--	--	--	--
Fluoranthene	0.210	--	--	--	--
Pyrene	0.310	--	--	--	--
bis(2-Ethylhexyl)phthalate	1.8	--	--	--	--
Aluminum	15,000	--	--	--	--
Cadmium	1.2	--	--	--	--
Chromium (4)	47.6	--	--	--	--
Cobalt	17.7	--	--	--	--
Copper	148	--	--	--	--
Iron	24,900	--	--	--	--
Lead	361	--	--	--	--
Nickel	34.5	--	--	--	--
Potassium	2,420	--	--	--	--
Sodium	1,420	--	--	--	--
Vanadium	26.3	--	--	--	--
Zinc	208	--	--	--	--
Cyanide	1.7	--	--	--	--
Totals:		2E-08	2E-08	0.000	0.000
Inorganics Totals:			0E+00		0.000

TABLE A-6
CURRENT ADJACENT AND FUTURE ON-SITE RESIDENT SCENARIOS SOIL RISKS
DEEP SOIL BORINGS - PHASE I
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk		Hazard Index (3)	
		Inhalation	Total	Inhalation	Total
SB07 (5-9 feet deep)					
Methylene chloride	0.220	--	--	0.000	0.000
Acetone	0.920	--	--	--	--
1,1-Dichloroethane	0.150	--	--	--	--
2-Butanone	0.240	--	--	--	--
Trichloroethene	0.380	1.8E-07	1.8E-07	--	--
Benzene	0.039	2.5E-08	2.5E-08	--	--
Tetrachloroethene	0.510	1.7E-08	1.7E-08	--	--
Toluene	1.8	--	--	0.000	0.000
Ethyl benzene	1.0	--	--	0.000	0.000
Xylenes (total)	7.5	--	--	--	--
Phenol	1.1	--	--	--	--
Naphthalene	0.500	--	--	--	--
2-Methylnaphthalene	0.800	--	--	--	--
Acenaphthene	0.180	--	--	--	--
Dibenzofuran	0.065	--	--	--	--
Phenanthrene	0.740	--	--	--	--
Anthracene	0.083	--	--	--	--
Fluoranthene	0.480	--	--	--	--
Pyrene	0.340	--	--	--	--
Benzo(a)anthracene	0.170	2.0E-13	2.0E-13	--	--
Chrysene	0.230	2.8E-14	2.8E-14	--	--
bis(2-Ethylhexyl)phthalate	0.440	--	--	--	--
Benzo(b)fluoranthene	0.180	7.4E-13	7.4E-13	--	--
Benzo(k)fluoranthene	0.110	2.1E-13	2.1E-13	--	--
Benzo(a)pyrene	0.150	1.2E-13	1.2E-13	--	--
Aldrin	0.0093	5.2E-11	5.2E-11	--	--
Aroclor-1242	0.410	--	--	--	--
Aluminum	11,700	--	--	--	--
Cadmium	0.97	--	--	--	--
Calcium	116,000	--	--	--	--
Chromium (4)	47.0	--	--	--	--
Cobalt	11.2	--	--	--	--
Copper	167	--	--	--	--
Lead	561	--	--	--	--
Magnesium	54,000	--	--	--	--
Nickel	25.2	--	--	--	--
Potassium	2,940	--	--	--	--
Sodium	981	--	--	--	--
Zinc	308	--	--	--	--
Cyanide	12.0	--	--	--	--
Totals:		2E-07	2E-07	0.000	0.000
Inorganics Totals:			0E+00		0.000

TABLE A-6
CURRENT ADJACENT AND FUTURE ON-SITE RESIDENT SCENARIOS SOIL RISKS
DEEP SOIL BORINGS - PHASE I
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk		Hazard Index (3)	
		Inhalation	Total	Inhalation	Total
SB09 (5-7 feet deep)					
1,1,1-Trichloroethane	0.005	--	--	--	--
Tetrachloroethene	0.008	2.7E-10	2.7E-10	--	--
Naphthalene	0.053	--	--	--	--
2-Methylnaphthalene	0.097	--	--	--	--
Acenaphthene	0.110	--	--	--	--
Dibenzofuran	0.089	--	--	--	--
Fluorene	0.120	--	--	--	--
Phenanthrene	0.880	--	--	--	--
Anthracene	0.190	--	--	--	--
Fluoranthene	1.0	--	--	--	--
Pyrene	0.710	--	--	--	--
Benzo(a)anthracene	0.340	4.0E-13	4.0E-13	--	--
Chrysene	0.480	5.8E-14	5.8E-14	--	--
bis(2-Ethylhexyl)phthalate	0.110	--	--	--	--
Benzo(b)fluoranthene	0.310	1.3E-12	1.3E-12	--	--
Benzo(k)fluoranthene	0.230	4.4E-13	4.4E-13	--	--
Benzo(a)pyrene	0.320	2.6E-13	2.6E-13	--	--
Benzo(g,h,i)perylene	0.170	5.9E-15	5.9E-15	--	--
Aroclor-1254	0.370	--	--	--	--
Cadmium	0.67	--	--	--	--
Cobalt	15.1	--	--	--	--
Copper	73.2	--	--	--	--
Lead	134	--	--	--	--
Nickel	17.5	--	--	--	--
Selenium	0.25	--	--	--	--
Sodium	120	--	--	--	--
Zinc	103	--	--	--	--
Totals:		3E-10	3E-10	0.000	0.000
Inorganics Totals:			0E+00		0.000
SB15R (4.5-9.5 feet deep)					
1,1-Dichloroethane	0.130	--	--	--	--
1,1,1-Trichloroethane	0.160	--	--	--	--
Trichloroethene	0.780	3.7E-07	3.7E-07	--	--
Tetrachloroethene	2.8	9.5E-08	9.5E-08	--	--
Ethyl benzene	0.980	--	--	0.000	0.000
Xylenes (total)	2.30	--	--	--	--
Naphthalene	4.50	--	--	--	--
2-Methylnaphthalene	45	--	--	--	--
Dibenzofuran	1.1	--	--	--	--
Fluorene	2.5	--	--	--	--
Phenanthrene	3.9	--	--	--	--
Pyrene	0.210	--	--	--	--
bis(2-Ethylhexyl)phthalate	0.580	--	--	--	--
Aroclor-1248	0.640	--	--	--	--
Aroclor-1254	0.260	--	--	--	--
Aroclor-1260	0.220	--	--	--	--
Antimony	63.5	--	--	--	--
Calcium	146,000	--	--	--	--
Chromium (4)	23.6	--	--	--	--
Cobalt	12.3	--	--	--	--
Magnesium	77,900	--	--	--	--
Potassium	2,560	--	--	--	--
Sodium	1,090	--	--	--	--
Totals:		5E-07	5E-07	0.000	0.000
Inorganics Totals:			0E+00		0.000

TABLE A-6
CURRENT ADJACENT AND FUTURE ON-SITE RESIDENT SCENARIOS SOIL RISKS
DEEP SOIL BORINGS - PHASE I
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk		Hazard Index (3)	
		Inhalation	Total	Inhalation	Total
SB18 (7.5-9.5 feet deep)					
2-Butanone	0.270	--	--	--	--
1,1,1-Trichloroethane	0.003	--	--	--	--
Benzene	0.014	8.9E-09	8.9E-09	--	--
Toluene	0.013	--	--	0.000	0.000
Ethyl benzene	0.028	--	--	0.000	0.000
Xylenes (total)	0.250	--	--	--	--
Aluminum	23,400	--	--	--	--
Arsenic	31.1	--	--	--	--
Chromium (4)	46.1	--	--	--	--
Cobalt	28.4	--	--	--	--
Copper	46.1	--	--	--	--
Iron	31,000	--	--	--	--
Lead	141	--	--	--	--
Potassium	9,580	--	--	--	--
Sodium	9,140	--	--	--	--
Vanadium	94.2	--	--	--	--
Zinc	233	--	--	--	--
Totals:		9E-09	9E-09	0.000	0.000
Inorganics Totals:			0E+00		0.000
SB20 (4.5-9.5 feet deep)					
Benzene	0.015	9.6E-09	9.6E-09	--	--
Aluminum	17,700	--	--	--	--
Cadmium	1.1	--	--	--	--
Chromium (4)	52.1	--	--	--	--
Cobalt	19.9	--	--	--	--
Copper	30.1	--	--	--	--
Iron	25,300	--	--	--	--
Lead	147	--	--	--	--
Nickel	26.1	--	--	--	--
Potassium	3,700	--	--	--	--
Selenium	2.8	--	--	--	--
Sodium	520	--	--	--	--
Vanadium	34.3	--	--	--	--
Zinc	137	--	--	--	--
Totals:		1E-08	1E-08	0.000	0.000
Inorganics Totals:			0E+00		0.000

TABLE A-6
CURRENT ADJACENT AND FUTURE ON-SITE RESIDENT SCENARIOS SOIL RISKS
DEEP SOIL BORINGS - PHASE I
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk		Hazard Index (3)	
		Inhalation	Total	Inhalation	Total
SB22 (7.5-9.5 feet deep)					
Acetone	0.140	--	--	--	--
Benzene	0.014	8.9E-09	8.9E-09	--	--
trans-1,3-Dichloropropene	0.006	1.3E-08	1.3E-08	0.000	0.000
Totals:		2E-08	2E-08	0.000	0.000
Inorganics Totals:			0E+00		0.000

Notes:

(1) Only detected organic parameters and inorganics detected above the background concentrations (i.e., the highest detected value in samples from borings SB213, SB214 and SB216) are shown.

(2) Values shown are the highest detected concentrations between the sample and its duplicate, and/or between the results of the Round 1 and Round 2 samples. Analytical results that exceeded the instrument calibration range were not used if a diluted reanalysis was available.

(3) Zero values indicate that the hazard indices are less than 5×10^{-4}.

(4) The calculations use the toxicity factors for trivalent chromium, although the laboratory reported total chromium.

Key:

— = No toxicity factor is available for this chemical.

TABLE A-7
CURRENT ADJACENT AND FUTURE ON-SITE RESIDENT SCENARIOS SOIL RISKS
DEEP SOIL BORINGS - PHASE II
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk		Hazard Index (3)	
		Inhalation	Total	Inhalation	Total
SB04 (5-8 feet deep)					
1,1,1-Trichloroethane	0.004	--	--	--	--
Toluene	0.013	--	--	0.000	0.000
Ethyl benzene	0.008	--	--	0.000	0.000
Xylenes (total)	0.032	--	--	--	--
Phenanthrene	0.2	--	--	--	--
Fluoranthene	0.38	--	--	--	--
Pyrene	0.36	--	--	--	--
Benzo(a)anthracene	0.18	2.1E-13	2.1E-13	--	--
Chrysene	0.18	2.2E-14	2.2E-14	--	--
Benzo(b)fluoranthene	0.32	1.3E-12	1.3E-12	--	--
Benzo(k)fluoranthene	0.16	3.1E-13	3.1E-13	--	--
Aroclor-1242	0.2	--	--	--	--
Aroclor-1260	0.094	--	--	--	--
Aluminum	11,400	--	--	--	--
Barium	254	--	--	--	--
Beryllium	0.75	--	--	--	--
Calcium	101,000	--	--	--	--
Chromium (4)	31	--	--	--	--
Copper	95.2	--	--	--	--
Lead	483	--	--	--	--
Magnesium	41,200	--	--	--	--
Nickel	20.5	--	--	--	--
Potassium	2,000	--	--	--	--
Sodium	770	--	--	--	--
Thallium	0.62	--	--	--	--
Zinc	281	--	--	--	--
Cyanide	8.2	--	--	--	--
Totals:		2E-12	2E-12	0.000	0.000
Inorganics Totals:			0E+00		0.000
SB08 (5-7.5 feet deep)					
1,1,1-Trichloroethane	0.009	--	--	--	--
Toluene	0.01	--	--	0.000	0.000
Barium	79	--	--	--	--
Calcium	134,000	--	--	--	--
Lead	150	--	--	--	--
Magnesium	80,500	--	--	--	--
Potassium	2,210	--	--	--	--
Silver	4.3	--	--	--	--
Sodium	634	--	--	--	--
Totals:		0E+00	0E+00	0.000	0.000
Inorganics Totals:			0E+00		0.000
SB10 (5-7.5 feet deep)					
1,1,1-Trichloroethane	0.01	--	--	--	--
Trichloroethene	0.007	3.3E-09	3.3E-09	--	--
Toluene	0.014	--	--	0.000	0.000
Xylenes (total)	0.037	--	--	--	--
Totals:		3E-09	3E-09	0.000	0.000
Inorganics Totals:			0E+00		0.000

TABLE A-7
CURRENT ADJACENT AND FUTURE ON-SITE RESIDENT SCENARIOS SOIL RISKS
DEEP SOIL BORINGS - PHASE II
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk		Hazard Index (3)	
		Inhalation	Total	Inhalation	Total
SB11 (5-7.5 feet deep)					
Toluene	0.019	--	--	0.000	0.000
Ethyl benzene	0.009	--	--	0.000	0.000
Xylenes (total)	0.019	--	--	--	--
Naphthalene	0.18	--	--	--	--
2-Methylnaphthalene	0.14	--	--	--	--
Acenaphthene	0.069	--	--	--	--
Phenanthrene	0.27	--	--	--	--
Anthracene	0.054	--	--	--	--
Fluoranthene	0.25	--	--	--	--
Pyrene	0.26	--	--	--	--
Chrysene	0.13	1.6E-14	1.6E-14	--	--
Aroclor-1242	0.14	--	--	--	--
Aroclor-1260	0.042	--	--	--	--
Aluminum	16,300	--	--	--	--
Barium	493	--	--	--	--
Beryllium	0.98	--	--	--	--
Calcium	109,000	--	--	--	--
Chromium (4)	34.3	--	--	--	--
Copper	99.2	--	--	--	--
Lead	498	--	--	--	--
Magnesium	47,400	--	--	--	--
Nickel	22.2	--	--	--	--
Potassium	3,190	--	--	--	--
Sodium	1,880	--	--	--	--
Vanadium	27.2	--	--	--	--
Zinc	278	--	--	--	--
Cyanide	6.9	--	--	--	--
Totals:		2E-14	2E-14	0.000	0.000
Inorganics Totals:			0E+00		0.000
SB12 (5-8.1 feet deep)					
Toluene	10	--	--	0.001	0.001
Ethyl benzene	11	--	--	0.000	0.000
Xylenes (total)	42	--	--	--	--
1,2-Dichlorobenzene	1.9	--	--	--	--
Naphthalene	10	--	--	--	--
2-Methylnaphthalene	34	--	--	--	--
Phenanthrene	5.4	--	--	--	--
Aroclor-1242	1.6	--	--	--	--
Aroclor-1260	0.24	--	--	--	--
Calcium	137,000	--	--	--	--
Magnesium	73,300	--	--	--	--
Mercury	0.11	--	--	--	--
Silver	5.2	--	--	--	--
Sodium	617	--	--	--	--
Totals:		0E+00	0E+00	0.001	0.001
Inorganics Totals:			0E+00		0.000

TABLE A-7
CURRENT ADJACENT AND FUTURE ON-SITE RESIDENT SCENARIOS SOIL RISKS
DEEP SOIL BORINGS - PHASE II
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk		Hazard Index (3)	
		Inhalation	Total	Inhalation	Total
SB14 (5-10 feet deep)					
Methylene chloride	0.004	--	--	0.000	0.000
Acetone	0.036	--	--	--	--
Chloroform	0.006	1.1E-08	1.1E-08	--	--
1,1,1-Trichloroethane	0.007	--	--	--	--
2-Methylnaphthalene	0.42	--	--	--	--
Acenaphthene	1.2	--	--	--	--
Dibenzofuran	0.85	--	--	--	--
Fluorene	1.4	--	--	--	--
Phenanthrene	9.2	--	--	--	--
Anthracene	2.2	--	--	--	--
Carbazole	0.43	--	--	--	--
Fluoranthene	13	--	--	--	--
Pyrene	12	--	--	--	--
Benzo(a)anthracene	4.9	5.8E-12	5.8E-12	--	--
Chrysene	4.3	5.2E-13	5.2E-13	--	--
Benzo(b)fluoranthene	6.2	2.5E-11	2.5E-11	--	--
Benzo(k)fluoranthene	3.9	7.5E-12	7.5E-12	--	--
Benzo(a)pyrene	4.4	3.5E-12	3.5E-12	--	--
Aroclor-1242	0.89	--	--	--	--
Aroclor-1260	3.7	--	--	--	--
Totals:		1E-08	1E-08	0.000	0.000
Inorganics Totals:			0E+00		0.000
SB19 (5-10 feet deep) (5)					
1,1,1-Trichloroethane	0.12	--	--	--	--
Tetrachloroethene	0.018	6.1E-10	6.1E-10	--	--
Ethyl benzene	0.1	--	--	0.000	0.000
Xylenes (total)	0.92	--	--	--	--
2-Methylnaphthalene	0.29	--	--	--	--
Phenanthrene	0.46	--	--	--	--
di-n-Butylphthalate	0.092	--	--	--	--
Aroclor-1242	6.7	--	--	--	--
Aroclor-1254	1.7	--	--	--	--
gamma-Chlordane	0.0024	4.3E-13	4.3E-13	--	--
Barium	121	--	--	--	--
Beryllium	0.89	--	--	--	--
Chromium (4)	22.3	--	--	--	--
Nickel	21.1	--	--	--	--
Selenium	1.2	--	--	--	--
Silver	2.3	--	--	--	--
Zinc	110	--	--	--	--
Totals:		6E-10	6E-10	0.000	0.000
Inorganics Totals:			0E+00		0.000

TABLE A-7
CURRENT ADJACENT AND FUTURE ON-SITE RESIDENT SCENARIOS SOIL RISKS
DEEP SOIL BORINGS - PHASE II
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk		Hazard Index (3)	
		Inhalation	Total	Inhalation	Total
SB22 (5-10 feet deep)					
Chloroform	0.003	1.7E-13	1.7E-13	--	--
1,1,1-Trichloroethane	0.005	--	--	--	--
Toluene	0.006	--	--	0.000	0.000
Xylenes (total)	0.01	--	--	--	--
2-Methylnaphthalene	0.07	--	--	--	--
Acenaphthene	0.077	--	--	--	--
Fluorene	0.081	--	--	--	--
Phenanthrene	0.45	--	--	--	--
Anthracene	0.094	--	--	--	--
di-n-Butylphthalate	0.049	--	--	--	--
Fluoranthene	0.44	--	--	--	--
Pyrene	0.36	--	--	--	--
Benzo(a)anthracene	0.13	0.0E+00	--	--	--
Chrysene	0.16	0.0E+00	--	--	--
Benzo(b)fluoranthene	0.34	0.0E+00	--	--	--
Aroclor-1242	0.91	--	--	--	--
Aroclor-1254	0.18	--	--	--	--
Aluminum	10,600	--	--	--	--
Barium	313	--	--	--	--
Calcium	121,000	--	--	--	--
Chromium (4)	19.9	--	--	--	--
Copper	49.7	--	--	--	--
Lead	388	--	--	--	--
Magnesium	70,800	--	--	--	--
Potassium	2,730	--	--	--	--
Silver	6.2	--	--	--	--
Sodium	1,270	--	--	--	--
Zinc	187	--	--	--	--
Totals:		2E-13	2E-13	0.000	0.000
Inorganics Totals:			0E+00		0.000

Notes:

(1) Only detected organic parameters and inorganics detected above the background concentrations (i.e., the highest detected value in samples from borings SB213, SB214 and SB216) are shown.

(2) Values shown are the highest detected concentrations between the sample and its duplicate, and/or between the results of the Round 1 and Round 2 samples. Analytical results that exceeded the instrument calibration range were not used if a diluted reanalysis was available.

(3) Zero values indicate that the hazard indices are less than 5×10^{-4}.

(4) The calculations use the toxicity factors for trivalent chromium, although the laboratory reported total chromium.

(5) Shown incorrectly as a 0- to 5-foot deep sample in Appendix N of the Remedial Investigation Report.

Key:

-- = No toxicity factor is available for this chemical.

TABLE A-8
CURRENT ADJACENT AND FUTURE RESIDENT SCENARIOS SOIL RISKS
DEEP SOIL BORINGS - LNAPL INVESTIGATION
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk		Hazard Index (3)	
		Inhalation	Total	Inhalation	Total
P01 (8-10 feet deep)					
2-Butanone	0.05	--	--	--	--
Benzene	0.033	2.0E-08	2.0E-08	--	--
Toluene	0.003	--	--	0.000	0.000
Chlorobenzene	0.006	--	--	--	--
Ethylbenzene	0.35	--	--	0.000	0.000
Xylenes (total)	0.72	--	--	--	--
1,2-Dichlorobenzene	0.8	--	--	--	--
Naphthalene	1.6	--	--	--	--
2-Methylnaphthalene	39	--	--	--	--
Phenanthrene	5.3	--	--	--	--
Aroclor-1248	0.61	--	--	--	--
Aroclor-1254	0.6	--	--	--	--
Aroclor-1260	0.47	--	--	--	--
Aluminum	20,200	--	--	--	--
Arsenic	16.4	--	--	--	--
Barium	145	--	--	--	--
Beryllium	1.6	--	--	--	--
Chromium (4)	30.2	--	--	--	--
Cobalt	14.8	--	--	--	--
Copper	48.3	--	--	--	--
Iron	29,700	--	--	--	--
Lead	32.4	--	--	--	--
Nickel	39.4	--	--	--	--
Potassium	3,060	--	--	--	--
Selenium	4.5	--	--	--	--
Sodium	722	--	--	--	--
Vanadium	41.7	--	--	--	--
Zinc	117	--	--	--	--
Totals:		2E-08	2E-08	0.000	0.000
Inorganics Totals:			0E+00		0.000
P06 (6-8 feet deep)					
2-Butanone	0.086	--	--	--	--
Benzene	0.016	9.5E-09	9.5E-09	--	--
Toluene	0.022	--	--	0.000	0.000
Ethylbenzene	0.085	--	--	0.000	0.000
Xylenes (total)	0.57	--	--	--	--
2-Methylnaphthalene	0.79	--	--	--	--
Phenanthrene	2.4	--	--	--	--
di-n-Butylphthalate	2.4	--	--	--	--
Aroclor-1242	9.8	--	--	--	--
Aroclor-1254	6.9	--	--	--	--
Aluminum	16,600	--	--	--	--
Arsenic	12.1	--	--	--	--
Barium	106	--	--	--	--
Beryllium	1.6	--	--	--	--
Chromium (4)	23.6	--	--	--	--
Cobalt	8.7	--	--	--	--
Iron	49,500	--	--	--	--
Lead	79.3	--	--	--	--
Nickel	19.5	--	--	--	--
Potassium	2,040	--	--	--	--
Selenium	1	--	--	--	--
Silver	2	--	--	--	--
Sodium	749	--	--	--	--
Vanadium	43	--	--	--	--
Zinc	118	--	--	--	--
Totals:		1E-08	1E-08	0.000	0.000
Inorganics Totals:			0E+00		0.000

TABLE A-8
CURRENT ADJACENT AND FUTURE RESIDENT SCENARIOS SOIL RISKS
DEEP SOIL BORINGS - LNAPL INVESTIGATION
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk		Hazard Index (3)	
		Inhalation	Total	Inhalation	Total
P08 (6-8 feet deep)					
Methylene chloride	0.011	–	–	0.000	0.000
Acetone	0.031	–	–	–	–
Toluene	0.002	–	–	0.000	0.000
N-Nitrosodiphenylamine	1.9	–	–	–	–
Aroclor-1248	0.09	–	–	–	–
Aroclor-1254	0.059	–	–	–	–
Aroclor-1260	0.044	–	–	–	–
Calcium	157,000	–	–	–	–
Magnesium	95,300	–	–	–	–
Totals:		0E+00	0E+00	0.000	0.000
Inorganics Totals:			0E+00		0.000
P13 (8-10 feet deep)					
1,1-Dichloroethane	0.026	–	–	–	–
1,2-Dichloroethene (Total)	0.17	–	–	–	–
Trichloroethene	0.065	2.0E-08	2.0E-08	–	–
Benzene	0.014	8.3E-09	8.3E-09	–	–
Tetrachloroethene	0.001	4.9E-11	4.9E-11	–	–
Toluene	0.031	–	–	0.000	0.000
Ethylbenzene	0.001	–	–	0.000	0.000
Xylenes (total)	0.007	–	–	–	–
1,2-Dichlorobenzene	0.027	–	–	–	–
Naphthalene	0.11	–	–	–	–
2-Methylnaphthalene	0.18	–	–	–	–
Calcium	154,000	–	–	–	–
Magnesium	90,600	–	–	–	–
Totals:		3E-08	3E-08	0.000	0.000
Inorganics Totals:			0E+00		0.000

TABLE A-8
CURRENT ADJACENT AND FUTURE RESIDENT SCENARIOS SOIL RISKS
DEEP SOIL BORINGS - LNAPL INVESTIGATION
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk		Hazard Index (3)	
		Inhalation	Total	Inhalation	Total
P24 (8-10 feet deep)					
Acetone	0.032	--	--	--	--
1,1-Dichloroethane	0.024	--	--	--	--
1,2-Dichloroethene (Total)	0.14	--	--	--	--
1,1,1-Trichloroethane	0.022	--	--	--	--
Benzene	0.093	5.5E-08	5.5E-08	--	--
Toluene	0.71	--	--	0.000	0.000
Ethylbenzene	0.16	--	--	0.000	0.000
Xylenes (total)	0.74	--	--	--	--
2-Methylnaphthalene	1.6	--	--	--	--
2,6-Dinitrotoluene	0.097	--	--	--	--
Fluorene	0.2	--	--	--	--
Phenanthrene	0.48	--	--	--	--
di-n-Butylphthalate	0.24	--	--	--	--
bis(2-Ethylhexyl)phthalate	3.2	--	--	--	--
Aroclor-1242	0.049	--	--	--	--
Calcium	166,000	--	--	--	--
Magnesium	86,300	--	--	--	--
Totals:		6E-08	6E-08	0.000	0.000
Inorganics Totals:			0E+00		0.000

Notes:

(1) Only detected organic parameters and inorganics detected above the background concentrations (i.e., the highest detected value in samples from borings SB213, SB214 and SB216) are shown.

(2) Values shown are the highest detected concentrations between the sample and its duplicate. Analytical results that exceeded the instrument calibration range were not used if a diluted reanalysis was available.

(3) Zero values indicate that the hazard indices are less than 5×10^{4}.

(4) The calculations use the toxicity factors for trivalent chromium, although the laboratory reported total chromium.

Key:

-- = No toxicity factor is available for this chemical.

TABLE A-9
NONCARCINOGENIC RISK EVALUATION BASED ON HEALTH EFFECTS - FUTURE ON-SITE RESIDENT
LENZ OIL SITE
LEMONT, ILLINOIS

Location and Compound (1)	Total Hazard Index	Target Organ/Effect (2)								
		Skin	Eyes	Gastrointestinal System	Central Nervous System	Reproductive System	Hematotoxic	Tumorigenic	Mutagen	Teratogen
SB16R (0-4.5 feet deep)										
Tetrachloroethene	0.000		0.000		0.000	0.000			0.000	0.000
Fluoranthene	0.000								0.000	
Pyrene	0.000	0.000							0.000	
4,4'-DDT	0.015							0.015		0.015
Antimony	0.582						0.582			
Arsenic	0.852	0.852		0.852		0.852				0.852
Barium	0.011			0.011	0.011					
Chromium	0.000			0.000						
Totals:	1.461	0.853	0.000	0.864	0.011	0.852	0.582	0.015	0.000	0.867

Notes:

(1) Only parameters that exceed the total hazard index of 1 but do not have a single parameter that produces a hazard index of 1 are presented.

(2) From the United States Environmental Protection Agency's *Health Effects Assessment Tables,* dated May 1995, the United States Environmental Protection Agency's *Integrated Risk Information Service* (August 1996 search), and *Sax's Dangerous Properties of Industrial Materials,* Eighth Ed. 1992, by Richard J. Lewis, Sr., Van Nostrand Reinhold, New York, NY.

TABLE A-10
CURRENT ADJACENT RESIDENT SCENARIO SOIL RISKS
SHALLOW SOIL BORINGS - PHASE I
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk (3)				Hazard Index (3,4)			
		Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
SB01 (0-5 feet deep)									
Acetone	0.270	--	--	--	--	0.000	0.000	--	0.000
Trichloroethene	0.220	5.2E-11	5.3E-10	4.7E-10	1.0E-09	--	--	--	--
trans-1,3-Dichloropropene	0.007	2.7E-11	2.7E-10	1.1E-10	4.2E-10	0.000	0.000	0.000	0.000
Tetrachloroethene	0.110	1.2E-10	1.2E-09	2.5E-11	1.4E-09	0.000	0.000	--	0.000
Naphthalene	0.082	--	--	--	--	0.000	0.000	--	0.000
2-Methylnaphthalene	0.067	--	--	--	--	--	--	--	--
Acenaphthene	0.140	--	--	--	--	0.000	0.000	--	0.000
Dibenzofuran	0.120	--	--	--	--	--	--	--	--
Fluorene	0.300	--	--	--	--	0.000	0.000	--	0.000
Phenanthrene	2.0	--	--	--	--	--	--	--	--
Anthracene	0.660	--	--	--	--	0.000	0.000	--	0.000
Fluoranthene	3.1	--	--	--	--	0.000	0.000	--	0.000
Pyrene	2.5	--	--	--	--	0.000	0.000	--	0.000
Benzo(a)anthracene	1.6	2.9E-08	1.2E-07	1.8E-07	3.2E-07	--	--	--	--
Chrysene	1.5	8.3E-10	3.4E-09	5.1E-09	9.3E-09	--	--	--	--
Benzo(b)fluoranthene	1.5	2.6E-08	1.1E-07	1.6E-07	2.9E-07	--	--	--	--
Benzo(k)fluoranthene	1.4	1.1E-08	4.6E-08	7.1E-08	1.3E-07	--	--	--	--
Benzo(a)pyrene	0.8	1.0E-07	4.1E-07	6.2E-07	1.1E-06	--	--	--	--
Indeno(1,2,3-cd)pyrene	0.610	1.7E-08	6.9E-08	1.1E-07	1.9E-07	--	--	--	--
Benzo(g,h,i)perylene	0.650	1.8E-09	7.4E-09	1.1E-08	2.0E-08	--	--	--	--
Aroclor-1260	0.900	1.5E-07	6.0E-07	--	7.5E-07	--	--	--	--
Aluminum	16,200	--	--	--	--	--	--	--	--
Barium	214	--	--	--	--	0.000	0.000	--	0.000
Calcium	98,200	--	--	--	--	--	--	--	--
Chromium (5)	38.5	--	--	--	--	0.000	0.000	--	0.000
Cobalt	20.6	--	--	--	--	--	--	--	--
Copper	259	--	--	--	--	--	--	--	--
Iron	27,500	--	--	--	--	--	--	--	--
Lead	339	--	--	--	--	--	--	--	--
Magnesium	39,900	--	--	--	--	--	--	--	--
Mercury	0.18	--	--	--	--	0.000	0.000	0.000	0.000
Potassium	2,530	--	--	--	--	--	--	--	--
Selenium	0.55	--	--	--	--	0.000	0.000	--	0.000
Sodium	1,460	--	--	--	--	--	--	--	--
Vanadium	30.6	--	--	--	--	--	--	--	--
Zinc	553	--	--	--	--	0.000	0.000	--	0.000
Totals:		3E-07	1E-06	1E-06	3E-06	0.001	0.000	0.000	0.001
Inorganics Totals:					0E+00				0.001
SB02 (0-5 feet deep)									
Acetone	0.150	--	--	--	--	0.000	0.000	--	0.000
Methylene chloride	0.030	4.8E-12	4.9E-11	--	5.4E-11	0.000	0.000	0.000	0.000
Phenanthrene	0.140	--	--	--	--	--	--	--	--
Fluoranthene	0.150	--	--	--	--	0.000	0.000	--	0.000
Pyrene	0.150	--	--	--	--	0.000	0.000	--	0.000
Chrysene	0.090	5.0E-11	2.0E-10	3.1E-10	5.6E-10	--	--	--	--
bis(2-Ethylhexyl)phthalate	0.160	4.8E-11	1.9E-10	--	2.4E-10	0.000	0.000	--	0.000
Arsenic	12.1	--	--	3.3E-11	3.3E-11	0.003	0.001	--	0.004
Barium	128	--	--	--	--	0.000	0.000	--	0.000
Calcium	76,200	--	--	--	--	--	--	--	--
Chromium (5)	34.7	--	--	--	--	0.000	0.000	--	0.000
Cobalt	12.4	--	--	--	--	--	--	--	--
Copper	50.9	--	--	--	--	--	--	--	--
Iron	22,500	--	--	--	--	--	--	--	--
Lead	182	--	--	--	--	--	--	--	--
Magnesium	43,400	--	--	--	--	--	--	--	--
Manganese	1,590	--	--	--	--	--	--	0.000	0.000
Potassium	2,680	--	--	--	--	--	--	--	--
Sodium	2,430	--	--	--	--	--	--	--	--
Vanadium	32.9	--	--	--	--	--	--	--	--
Zinc	216	--	--	--	--	0.000	0.000	--	0.000
Totals:		1E-10	4E-10	3E-10	9E-10	0.003	0.001	0.000	0.004
Inorganics Totals:					3E-11				0.004

TABLE A-10
CURRENT ADJACENT RESIDENT SCENARIO SOIL RISKS
SHALLOW SOIL BORINGS - PHASE I
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk (3)				Hazard Index (3,4)			
		Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
SB03 (0-5 feet deep)									
trans-1,3-Dichloropropene	0.007	2.7E-11	2.7E-10	1.1E-10	4.2E-10	0.000	0.000	0.000	0.000
2-Methylnaphthalene	0.077	--	--	--	--	--	--	--	--
Phenanthrene	0.081	--	--	--	--	--	--	--	--
Fluoranthene	0.110	--	--	--	--	0.000	0.000	--	0.000
Pyrene	0.160	--	--	--	--	0.000	0.000	--	0.000
Butylbenzylphthalate	0.330	--	--	--	--	0.000	0.000	--	0.000
Chrysene	0.084	4.7E-11	1.9E-10	2.9E-10	5.2E-10	--	--	--	--
bis(2-Ethylhexyl)phthalate	0.088	2.6E-11	1.1E-10	--	1.3E-10	0.000	0.000	--	0.000
Aluminum	13,300	--	--	--	--	--	--	--	--
Barium	287	--	--	--	--	0.000	0.000	--	0.000
Calcium	92,900	--	--	--	--	--	--	--	--
Chromium (5)	35.0	--	--	--	--	0.000	0.000	--	0.000
Cobalt	20.6	--	--	--	--	--	--	--	--
Copper	87.2	--	--	--	--	--	--	--	--
Lead	309	--	--	--	--	--	--	--	--
Magnesium	53,000	--	--	--	--	--	--	--	--
Mercury	0.50	--	--	--	--	0.000	0.000	0.000	0.000
Potassium	2,150	--	--	--	--	--	--	--	--
Sodium	1,180	--	--	--	--	--	--	--	--
Zinc	221	--	--	--	--	0.000	0.000	--	0.000
Totals:		1E-10	6E-10	4E-10	1E-09	0.001	0.000	0.000	0.001
Inorganics Totals:					0E+00				0.001
SB04 (0-2.5 feet deep)									
Aluminum	12,400	--	--	--	--	--	--	--	--
Barium	379	--	--	--	--	0.000	0.000	--	0.001
Cadmium	1.3	--	--	4.4E-13	4.4E-13	0.000	0.000	--	0.000
Calcium	133,000	--	--	--	--	--	--	--	--
Chromium (5)	49.9	--	--	--	--	0.000	0.000	--	0.000
Cobalt	14.1	--	--	--	--	--	--	--	--
Copper	156	--	--	--	--	--	--	--	--
Lead	619	--	--	--	--	--	--	--	--
Magnesium	62,900	--	--	--	--	--	--	--	--
Mercury	0.11	--	--	--	--	0.000	0.000	0.000	0.000
Nickel	28.5000	--	--	--	--	0.000	0.000	--	0.000
Potassium	3,190	--	--	--	--	--	--	--	--
Sodium	1,260	--	--	--	--	--	--	--	--
Zinc	327	--	--	--	--	0.000	0.000	--	0.000
Cyanide	4.3	--	--	--	--	0.000	0.000	--	0.000
Totals:		0E+00	0E+00	4E-13	4E-13	0.001	0.000	0.000	0.001
Inorganics Totals:					4E-13				0.001
SB04 (2.5-5 feet deep)									
Aluminum	12,700	--	--	--	--	--	--	--	--
Barium	314	--	--	--	--	0.000	0.000	--	0.000
Cadmium	1.3	--	--	4.4E-13	4.4E-13	0.000	0.000	--	0.000
Chromium (5)	54.3	--	--	--	--	0.000	0.000	--	0.000
Cobalt	14.3	--	--	--	--	--	--	--	--
Copper	144	--	--	--	--	--	--	--	--
Lead	642	--	--	--	--	--	--	--	--
Nickel	25.2	--	--	--	--	0.000	0.000	--	0.000
Zinc	336	--	--	--	--	0.000	0.000	--	0.000
Cyanide	4.0	--	--	--	--	0.000	0.000	--	0.000
Totals:		0E+00	0E+00	4E-13	4E-13	0.001	0.000	0.000	0.001
Inorganics Totals:					4E-13				0.001

TABLE A-10
CURRENT ADJACENT RESIDENT SCENARIO SOIL RISKS
SHALLOW SOIL BORINGS - PHASE I
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk (3)				Hazard Index (3,4)			
		Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
SB05 (2.5-5 feet deep)									
Aluminum	11,500	--	--	--	--	--	--	--	--
Barium	363	--	--	--	--	0.000	0.000	--	0.000
Cadmium	1.1	--	--	3.7E-13	3.7E-13	0.000	0.000	--	0.000
Calcium	116,000	--	--	--	--	--	--	--	--
Chromium (5)	46.3	--	--	--	--	0.000	0.000	--	0.000
Cobalt	13.6	--	--	--	--	--	--	--	--
Copper	128	--	--	--	--	--	--	--	--
Lead	427	--	--	--	--	--	--	--	--
Magnesium	64,500	--	--	--	--	--	--	--	--
Mercury	0.099	--	--	--	--	0.000	0.000	0.000	0.000
Nickel	22.3	--	--	--	--	0.000	0.000	--	0.000
Potassium	3,070	--	--	--	--	--	--	--	--
Sodium	993	--	--	--	--	--	--	--	--
Zinc	210	--	--	--	--	0.000	0.000	--	0.000
Totals:		0E+00	0E+00	4E-13	4E-13	0.001	0.000	0.000	0.001
Inorganics Totals:					4E-13				0.001
SB06 (2.5-5 feet deep)									
Aroclor-1242	12	2.0E-06	8.0E-06	--	**1.0E-05**	--	--	--	--
Aroclor-1254	9.3	1.5E-06	6.2E-06	--	**7.8E-06**	--	--	--	--
Aroclor-1260	0.680	1.1E-07	4.6E-07	--	5.7E-07	--	--	--	--
beta-BHC	0.087	--	--	--	--	--	--	--	--
Aluminum	24,700	--	--	--	--	--	--	--	--
Barium	1,280	--	--	--	--	0.001	0.000	--	0.002
Cadmium	1.7	--	--	5.7E-13	5.7E-13	0.000	0.000	--	0.000
Calcium	78,700	--	--	--	--	--	--	--	--
Chromium (5)	92.8	--	--	--	--	0.000	0.000	--	0.000
Cobalt	16.6	--	--	--	--	--	--	--	--
Copper	670	--	--	--	--	--	--	--	--
Iron	38,400	--	--	--	--	--	--	--	--
Lead	683	--	--	--	--	--	--	--	--
Magnesium	37,300	--	--	--	--	--	--	--	--
Mercury	0.090	--	--	--	--	0.000	0.000	0.000	0.000
Nickel	46.7	--	--	--	--	0.000	0.000	--	0.000
Potassium	3,860	--	--	--	--	--	--	--	--
Sodium	3,370	--	--	--	--	--	--	--	--
Vanadium	43.4	--	--	--	--	--	--	--	--
Zinc	639	--	--	--	--	0.000	0.000	--	0.000
Cyanide	6.3	--	--	--	--	0.000	0.000	--	0.000
Totals:		4E-06	1E-05	6E-13	2E-05	0.002	0.001	0.000	0.003
Inorganics Totals:					6E-13				0.003
SB07 (2.5-5 feet deep)									
Aluminum	14,400	--	--	--	--	--	--	--	--
Barium	498	--	--	--	--	0.001	0.000	--	0.001
Cadmium	1.6	--	--	5.4E-13	5.4E-13	0.000	0.000	--	0.000
Calcium	99,000	--	--	--	--	--	--	--	--
Chromium (5)	55.1	--	--	--	--	0.000	0.000	--	0.000
Cobalt	14.2	--	--	--	--	--	--	--	--
Copper	277	--	--	--	--	--	--	--	--
Lead	687	--	--	--	--	--	--	--	--
Magnesium	49,300	--	--	--	--	--	--	--	--
Nickel	33.1	--	--	--	--	0.000	0.000	--	0.000
Potassium	2,910	--	--	--	--	--	--	--	--
Sodium	1,490	--	--	--	--	--	--	--	--
Vanadium	26.9	--	--	--	--	--	--	--	--
Zinc	382	--	--	--	--	0.000	0.000	--	0.000
Cyanide	5.3	--	--	--	--	0.000	0.000	--	0.000
Totals:		0E+00	0E+00	5E-13	5E-13	0.001	0.000	0.000	0.001
Inorganics Totals:					5E-13				0.001

TABLE A-10
CURRENT ADJACENT RESIDENT SCENARIO SOIL RISKS
SHALLOW SOIL BORINGS - PHASE I
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk (3)				Hazard Index (3,4)			
		Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
SB08 (0-2.5 feet deep)									
Aluminum	15,400	--	--	--	--	--	--	--	--
Barium	511	--	--	--	--	0.001	0.000	--	0.001
Cadmium	1.3	--	--	4.4E-13	4.4E-13	0.000	0.000	--	0.000
Calcium	99,400	--	--	--	--	--	--	--	--
Chromium (5)	51.5	--	--	--	--	0.000	0.000	--	0.000
Cobalt	19.0	--	--	--	--	--	--	--	--
Copper	193	--	--	--	--	--	--	--	--
Lead	663	--	--	--	--	--	--	--	--
Magnesium	48,300	--	--	--	--	--	--	--	--
Nickel	47.5	--	--	--	--	0.000	0.000	--	0.000
Potassium	3,410	--	--	--	--	--	--	--	--
Selenium	0.73	--	--	--	--	0.000	0.000	--	0.000
Sodium	1,680	--	--	--	--	--	--	--	--
Vanadium	27.5	--	--	--	--	--	--	--	--
Zinc	406	--	--	--	--	0.000	0.000	--	0.000
Cyanide	4.8	--	--	--	--	0.000	0.000	--	0.000
Totals:		0E+00	0E+00	4E-13	4E-13	0.001	0.000	0.000	0.001
Inorganics Totals:					4E-13				0.001
SB08 (2.5-5 feet deep)									
Aluminum	19,500	--	--	--	--	--	--	--	--
Arsenic	11.6	--	--	3.2E-11	3.2E-11	0.003	0.001	--	0.004
Barium	462	--	--	--	--	0.000	0.000	--	0.001
Cadmium	2.6	--	--	8.7E-13	8.7E-13	0.000	0.000	--	0.000
Calcium	126,000	--	--	--	--	--	--	--	--
Chromium (5)	96.9	--	--	--	--	0.000	0.000	--	0.000
Cobalt	22.8	--	--	--	--	--	--	--	--
Copper	190	--	--	--	--	--	--	--	--
Lead	909	--	--	--	--	--	--	--	--
Magnesium	57,900	--	--	--	--	--	--	--	--
Mercury	0.11	--	--	--	--	0.000	0.000	0.000	0.000
Nickel	31.0	--	--	--	--	0.000	0.000	--	0.000
Potassium	5,460	--	--	--	--	--	--	--	--
Sodium	1,250	--	--	--	--	--	--	--	--
Vanadium	32.8	--	--	--	--	--	--	--	--
Zinc	514	--	--	--	--	0.000	0.000	--	0.000
Cyanide	7.7	--	--	--	--	0.000	0.000	--	0.000
Totals:		0E+00	0E+00	3E-11	3E-11	0.004	0.001	0.000	0.005
Inorganics Totals:					3E-11				0.005
SB09 (2.5-5 feet deep)									
Aluminum	17,500	--	--	--	--	--	--	--	--
Barium	98.8	--	--	--	--	0.000	0.000	--	0.000
Chromium (5)	42.9	--	--	--	--	0.000	0.000	--	0.000
Cobalt	18.7	--	--	--	--	--	--	--	--
Copper	79.4	--	--	--	--	--	--	--	--
Iron	26,200	--	--	--	--	--	--	--	--
Lead	87.3	--	--	--	--	--	--	--	--
Nickel	28.4	--	--	--	--	0.000	0.000	--	0.000
Potassium	2,240	--	--	--	--	--	--	--	--
Sodium	183	--	--	--	--	--	--	--	--
Vanadium	35.9	--	--	--	--	--	--	--	--
Totals:		0E+00	0E+00	0E+00	0E+00	0.000	0.000	0.000	0.000
Inorganics Totals:					0E+00				0.000

TABLE A-10
CURRENT ADJACENT RESIDENT SCENARIO SOIL RISKS
SHALLOW SOIL BORINGS - PHASE I
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk (3)				Hazard Index (3,4)			
		Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
SB10 (0-2.5 feet deep)									
Aluminum	19,900	--	--	--	--	--	--	--	--
Barium	701	--	--	--	--	0.001	0.000	--	0.001
Cadmium	1.5	--	--	5.0E-13	5.0E-13	0.000	0.000	--	0.000
Calcium	76,500	--	--	--	--	--	--	--	--
Chromium (5)	50.3	--	--	--	--	0.000	0.000	--	0.000
Cobalt	21.1	--	--	--	--	--	--	--	--
Copper	564	--	--	--	--	--	--	--	--
Iron	25,400	--	--	--	--	--	--	--	--
Lead	476	--	--	--	--	--	--	--	--
Nickel	32.0	--	--	--	--	0.000	0.000	--	0.000
Potassium	3,390	--	--	--	--	--	--	--	--
Sodium	1,890	--	--	--	--	--	--	--	--
Vanadium	32.2	--	--	--	--	--	--	--	--
Zinc	243	--	--	--	--	0.000	0.000	--	0.000
Cyanide	2.0	--	--	--	--	0.000	0.000	--	0.000
Totals:		0E+00	0E+00	5E-13	5E-13	0.001	0.000	0.000	0.001
Inorganics Totals:					5E-13				0.001
SB10 (2.5-5 feet deep)									
Aluminum	20,400	--	--	--	--	--	--	--	--
Barium	1,100	--	--	--	--	0.001	0.000	--	0.002
Cadmium	1.0	--	--	3.3E-13	3.3E-13	0.000	0.000	--	0.000
Calcium	70,800	--	--	--	--	--	--	--	--
Chromium (5)	46.7	--	--	--	--	0.000	0.000	--	0.000
Cobalt	17.7	--	--	--	--	--	--	--	--
Copper	175	--	--	--	--	--	--	--	--
Iron	27,400	--	--	--	--	--	--	--	--
Lead	386	--	--	--	--	--	--	--	--
Nickel	31.4	--	--	--	--	0.000	0.000	--	0.000
Potassium	2,740	--	--	--	--	--	--	--	--
Sodium	3,820	--	--	--	--	--	--	--	--
Vanadium	36.6	--	--	--	--	--	--	--	--
Zinc	252	--	--	--	--	0.000	0.000	--	0.000
Cyanide	6.0	--	--	--	--	0.000	0.000	--	0.000
Totals:		0E+00	0E+00	3E-13	3E-13	0.001	0.000	0.000	0.002
Inorganics Totals:					3E-13				0.002
SB11 (0-2.5 feet deep)									
Aluminum	16,400	--	--	--	--	--	--	--	--
Barium	573	--	--	--	--	0.001	0.000	--	0.001
Cadmium	1.4	--	--	4.7E-13	4.7E-13	0.000	0.000	--	0.000
Calcium	111,000	--	--	--	--	--	--	--	--
Chromium (5)	50.6	--	--	--	--	0.000	0.000	--	0.000
Cobalt	16.1	--	--	--	--	--	--	--	--
Copper	174	--	--	--	--	--	--	--	--
Lead	606	--	--	--	--	--	--	--	--
Magnesium	52,000	--	--	--	--	--	--	--	--
Nickel	26.2	--	--	--	--	0.000	0.000	--	0.000
Potassium	3,400	--	--	--	--	--	--	--	--
Sodium	1,630	--	--	--	--	--	--	--	--
Vanadium	29.2	--	--	--	--	--	--	--	--
Zinc	425	--	--	--	--	0.000	0.000	--	0.000
Cyanide	3.7	--	--	--	--	0.000	0.000	--	0.000
Totals:		0E+00	0E+00	5E-13	5E-13	0.001	0.000	0.000	0.001
Inorganics Totals:					5E-13				0.001

TABLE A-10
CURRENT ADJACENT RESIDENT SCENARIO SOIL RISKS
SHALLOW SOIL BORINGS - PHASE I
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk (3)				Hazard Index (3,4)			
		Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
SB11 (2.5-5 feet deep)									
Aluminum	14,500	--	--	--	--	--	--	--	--
Barium	343	--	--	--	--	0.000	0.000	--	0.000
Cadmium	1.4	--	--	4.7E-13	4.7E-13	0.000	0.000	--	0.000
Calcium	136,000	--	--	--	--	--	--	--	--
Chromium (5)	52.9	--	--	--	--	0.000	0.000	--	0.000
Cobalt	18.8	--	--	--	--	--	--	--	--
Copper	167	--	--	--	--	--	--	--	--
Lead	685	--	--	--	--	--	--	--	--
Magnesium	62,200	--	--	--	--	--	--	--	--
Nickel	27.4	--	--	--	--	0.000	0.000	--	0.000
Potassium	3,820	--	--	--	--	--	--	--	--
Sodium	1,270	--	--	--	--	--	--	--	--
Vanadium	26.8	--	--	--	--	--	--	--	--
Zinc	376	--	--	--	--	0.000	0.000	--	0.000
Cyanide	6.5	--	--	--	--	0.000	0.000	--	0.000
Totals:		0E+00	0E+00	5E-13	5E-13	0.001	0.000	0.000	0.001
Inorganics Totals:					5E-13				0.001
SB12 (2.5-5 feet deep)									
Aluminum	11,600	--	--	--	--	--	--	--	--
Barium	342	--	--	--	--	0.000	0.000	--	0.000
Cadmium	1.1	--	--	3.7E-13	3.7E-13	0.000	0.000	--	0.000
Calcium	112,000	--	--	--	--	--	--	--	--
Chromium (5)	46.9	--	--	--	--	0.000	0.000	--	0.000
Cobalt	12.4	--	--	--	--	--	--	--	--
Copper	131	--	--	--	--	--	--	--	--
Lead	406	--	--	--	--	--	--	--	--
Magnesium	61,000	--	--	--	--	--	--	--	--
Nickel	20.3	--	--	--	--	0.000	0.000	--	0.000
Potassium	2,240	--	--	--	--	--	--	--	--
Sodium	1,020	--	--	--	--	--	--	--	--
Zinc	218	--	--	--	--	0.000	0.000	--	0.000
Cyanide	6.8	--	--	--	--	0.000	0.000	--	0.000
Totals:		0E+00	0E+00	4E-13	4E-13	0.001	0.000	0.000	0.001
Inorganics Totals:					4E-13				0.001

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CURRENT ADJACENT RESIDENT SCENARIO SOIL RISKS
SHALLOW SOIL BORINGS - PHASE I
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk (3)				Hazard Index (3,4)			
		Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
SB12A (2.5-5 feet deep)									
Acetone	0.180	--	--	--	--	0.000	0.000	--	0.000
1,1-Dichloroethane	0.002	--	--	--	--	0.000	0.000	--	0.000
1,1,1-Trichloroethane	0.006	--	--	--	--	0.000	0.000	--	0.000
Trichloroethene	0.005	1.2E-12	1.2E-11	1.1E-11	2.4E-11	--	--	--	--
Benzene	0.015	9.3E-12	9.5E-11	5.5E-11	1.6E-10	--	--	--	--
Tetrachloroethene	0.011	1.2E-11	1.2E-10	2.5E-12	1.4E-10	0.000	0.000	--	0.000
Toluene	0.026	--	--	--	--	0.000	0.000	0.000	0.000
Ethyl benzene	0.021	--	--	--	--	0.000	0.000	0.000	0.000
Xylenes (total)	0.168	--	--	--	--	0.000	0.000	--	0.000
Phenanthrene	0.089	--	--	--	--	--	--	--	--
Fluoranthene	0.090	--	--	--	--	0.000	0.000	--	0.000
Pyrene	0.069	--	--	--	--	0.000	0.000	--	0.000
bis(2-Ethylhexyl)phthalate	0.088	2.6E-11	1.1E-10	--	1.3E-10	0.000	0.000	--	0.000
Aluminum	13,400	--	--	--	--	--	--	--	--
Barium	379	--	--	--	--	0.000	0.000	--	0.001
Cadmium	1.2	--	--	4.0E-13	4.0E-13	0.000	0.000	--	0.000
Calcium	70,500	--	--	--	--	--	--	--	--
Chromium (5)	41.1	--	--	--	--	0.000	0.000	--	0.000
Cobalt	17.8	--	--	--	--	--	--	--	--
Copper	255	--	--	--	--	--	--	--	--
Iron	24,500	--	--	--	--	--	--	--	--
Lead	417	--	--	--	--	--	--	--	--
Nickel	30.0	--	--	--	--	0.000	0.000	--	0.000
Potassium	2,640	--	--	--	--	--	--	--	--
Sodium	2,160	--	--	--	--	--	--	--	--
Zinc	639	--	--	--	--	0.000	0.000	--	0.000
Cyanide	1.5	--	--	--	--	0.000	0.000	--	0.000
Totals:		5E-11	3E-10	7E-11	5E-10	0.001	0.000	0.000	0.001
Inorganics Totals:					4E-13				0.001
SB13 (0-1.7 feet deep)									
1,1,1-Trichloroethane	0.003	--	--	--	--	0.000	0.000	--	0.000
Tetrachloroethene	0.007	7.6E-12	7.8E-11	1.6E-12	8.7E-11	0.000	0.000	--	0.000
Phenanthrene	2.9	--	--	--	--	--	--	--	--
Anthracene	0.740	--	--	--	--	0.000	0.000	--	0.000
Fluoranthene	4.1	--	--	--	--	0.000	0.000	--	0.000
Pyrene	3.3	--	--	--	--	0.000	0.000	--	0.000
Benzo(a)anthracene	1.8	3.2E-08	1.3E-07	2.0E-07	3.6E-07	--	--	--	--
Chrysene	2.5	1.4E-09	5.7E-09	8.5E-09	1.6E-08	--	--	--	--
Benzo(b)fluoranthene	1.9	3.3E-08	1.3E-07	2.0E-07	3.7E-07	--	--	--	--
Benzo(k)fluoranthene	1.8	1.5E-08	6.0E-08	9.1E-08	1.6E-07	--	--	--	--
Benzo(a)pyrene	2.3	2.8E-07	1.2E-06	1.8E-06	3.2E-06	--	--	--	--
Aluminum	13,600	--	--	--	--	--	--	--	--
Barium	483	--	--	--	--	0.001	0.000	--	0.001
Cadmium	0.71	--	--	2.4E-13	2.4E-13	0.000	0.000	--	0.000
Calcium	95,600	--	--	--	--	--	--	--	--
Chromium (5)	39.0	--	--	--	--	0.000	0.000	--	0.000
Cobalt	12.0	--	--	--	--	--	--	--	--
Copper	65.6	--	--	--	--	--	--	--	--
Lead	171	--	--	--	--	--	--	--	--
Magnesium	48,900	--	--	--	--	--	--	--	--
Nickel	17.8	--	--	--	--	0.000	0.000	--	0.000
Potassium	1,960	--	--	--	--	--	--	--	--
Sodium	1,940	--	--	--	--	--	--	--	--
Zinc	159	--	--	--	--	0.000	0.000	--	0.000
Cyanide	1.3	--	--	--	--	0.000	0.000	--	0.000
Totals:		4E-07	1E-06	2E-06	4E-06	0.001	0.000	0.000	0.001
Inorganics Totals:					2E-13				0.001

TABLE A-10
CURRENT ADJACENT RESIDENT SCENARIO SOIL RISKS
SHALLOW SOIL BORINGS - PHASE I
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk (3)				Hazard Index (3,4)			
		Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
SB14 (0-4.5 feet deep)									
Phenanthrene	2.3	--	--	--	--	--	--	--	--
Anthracene	1.2	--	--	--	--	0.000	0.000	--	0.000
Fluoranthene	7.4	--	--	--	--	0.000	0.000	--	0.000
Pyrene	6.8	--	--	--	--	0.000	0.000	--	0.000
Benzo(a)anthracene	5.0	8.9E-08	3.7E-07	5.5E-07	1.0E-06	--	--	--	--
Chrysene	5.7	3.2E-09	1.3E-08	1.9E-08	3.5E-08	--	--	--	--
Benzo(b)fluoranthene	5.5	9.5E-08	3.9E-07	5.9E-07	1.1E-06	--	--	--	--
Benzo(k)fluoranthene	3.9	3.2E-08	1.3E-07	2.0E-07	3.6E-07	--	--	--	--
Benzo(a)pyrene	4.5	5.6E-07	2.3E-06	3.5E-06	6.3E-06	--	--	--	--
Indeno(1,2,3-cd)pyrene	3.2	8.9E-08	3.6E-07	5.6E-07	1.0E-06	--	--	--	--
Benzo(g,h,i)perylene	2.6	7.2E-09	2.9E-08	4.3E-08	7.9E-08	--	--	--	--
Aluminum	11,100	--	--	--	--	--	--	--	--
Barium	311	--	--	--	--	0.000	0.000	--	0.000
Calcium	104,000	--	--	--	--	--	--	--	--
Chromium (5)	34.8	--	--	--	--	0.000	0.000	--	0.000
Cobalt	11.9	--	--	--	--	--	--	--	--
Copper	40.6	--	--	--	--	--	--	--	--
Lead	314	--	--	--	--	--	--	--	--
Magnesium	63,700	--	--	--	--	--	--	--	--
Potassium	2,110	--	--	--	--	--	--	--	--
Sodium	1,470	--	--	--	--	--	--	--	--
Zinc	175	--	--	--	--	0.000	0.000	--	0.000
Cyanide	0.33	--	--	--	--	0.000	0.000	--	0.000
Totals:		9E-07	4E-06	5E-06	1E-05	0.000	0.000	0.000	0.001
Inorganics Totals:					0E+00				0.001
SB15R (2.5-4.5 feet deep)									
Benzene	0.011	6.8E-12	6.9E-11	4.0E-11	1.2E-10	--	--	--	--
Ethyl benzene	0.016	--	--	--	--	0.000	0.000	0.000	0.000
Phenanthrene	0.077	--	--	--	--	--	--	--	--
Fluoranthene	0.110	--	--	--	--	0.000	0.000	--	0.000
Pyrene	0.120	--	--	--	--	0.000	0.000	--	0.000
Chrysene	0.096	5.3E-11	2.2E-10	3.3E-10	6.0E-10	--	--	--	--
Benzo(a)pyrene	0.098	1.2E-08	4.9E-08	7.5E-08	1.4E-07	--	--	--	--
Aluminum	13,500	--	--	--	--	--	--	--	--
Barium	57.4	--	--	--	--	0.000	0.000	--	0.000
Calcium	108,000	--	--	--	--	--	--	--	--
Chromium (5)	31.8	--	--	--	--	0.000	0.000	--	0.000
Cobalt	17.3	--	--	--	--	--	--	--	--
Copper	18.9	--	--	--	--	--	--	--	--
Lead	110	--	--	--	--	--	--	--	--
Magnesium	47,900	--	--	--	--	--	--	--	--
Potassium	2,310	--	--	--	--	--	--	--	--
Sodium	2,840	--	--	--	--	--	--	--	--
Vanadium	30.9	--	--	--	--	--	--	--	--
Zinc	91.2	--	--	--	--	0.000	0.000	--	0.000
Totals:		1E-08	5E-08	8E-08	1E-07	0.000	0.000	0.000	0.000
Inorganics Totals:					0E+00				0.000

TABLE A-10
CURRENT ADJACENT RESIDENT SCENARIO SOIL RISKS
SHALLOW SOIL BORINGS - PHASE I
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk (3)				Hazard Index (3,4)			
		Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
SB16R (0-4.5 feet deep)									
Tetrachloroethene	0.003	3.3E-12	3.3E-11	6.8E-13	3.7E-11	0.000	0.000	--	0.000
Phenanthrene	0.078	--	--	--	--	--	--	--	--
Fluoranthene	0.130	--	--	--	--	0.000	0.000	--	0.000
Pyrene	0.097	--	--	--	--	0.000	0.000	--	0.000
Chrysene	0.072	4.0E-11	1.6E-10	2.5E-10	4.5E-10	--	--	--	--
4,4'-DDD	0.260	1.3E-09	5.4E-09	--	6.8E-09	--	--	--	--
4,4'-DDE	0.019	1.4E-10	5.6E-10	--	7.0E-10	--	--	--	--
4,4'-DDT	0.380	2.8E-09	1.1E-08	--	1.4E-08	0.000	0.000	--	0.000
Antimony	17.3000	--	--	--	--	0.003	0.001	--	0.004
Arsenic	19.0000	--	--	5.2E-11	5.2E-11	0.005	0.001	--	0.006
Barium	59.1000	--	--	--	--	0.000	0.000	--	0.000
Calcium	92,100	--	--	--	--	--	--	--	--
Chromium (5)	31.3	--	--	--	--	0.000	0.000	--	0.000
Cobalt	11.6	--	--	--	--	--	--	--	--
Lead	110	--	--	--	--	--	--	--	--
Magnesium	55,500	--	--	--	--	--	--	--	--
Potassium	4,680	--	--	--	--	--	--	--	--
Sodium	1,020	--	--	--	--	--	--	--	--
Vanadium	64.7	--	--	--	--	--	--	--	--
Totals:		4E-09	2E-08	3E-10	2E-08	0.008	0.003	0.000	0.011
Inorganics Totals:					5E-11				0.010
SB17 (0-3.8 feet deep)									
Tetrachloroethene	0.002	2.2E-12	2.2E-11	4.5E-13	2.5E-11	0.000	0.000	--	0.000
Toluene	0.004	--	--	--	--	0.000	0.000	0.000	0.000
Ethyl benzene	0.011	--	--	--	--	0.000	0.000	0.000	0.000
Xylenes (total)	0.079	--	--	--	--	0.000	0.000	--	0.000
Naphthalene	0.060	--	--	--	--	0.000	0.000	--	0.000
2-Methylnaphthalene	0.150	--	--	--	--	--	--	--	--
Acenaphthene	0.270	--	--	--	--	0.000	0.000	--	0.000
Dibenzofuran	0.170	--	--	--	--	--	--	--	--
Fluorene	0.370	--	--	--	--	0.000	0.000	--	0.000
Phenanthrene	2.4	--	--	--	--	--	--	--	--
Anthracene	0.560	--	--	--	--	0.000	0.000	--	0.000
Fluoranthene	2.5	--	--	--	--	0.000	0.000	--	0.000
Pyrene	2.3	--	--	--	--	0.000	0.000	--	0.000
Benzo(a)anthracene	1.0	1.8E-08	7.3E-08	1.1E-07	2.0E-07	--	--	--	--
Chrysene	1.1	6.1E-10	2.5E-09	3.7E-09	6.8E-09	--	--	--	--
bis(2-Ethylhexyl)phthalate	0.200	6.0E-11	2.4E-10	--	3.0E-10	0.000	0.000	--	0.000
Benzo(b)fluoranthene	1.1	1.9E-08	7.8E-08	1.2E-07	2.1E-07	--	--	--	--
Benzo(k)fluoranthene	0.610	4.9E-09	2.0E-08	3.1E-08	5.6E-08	--	--	--	--
Benzo(a)pyrene	0.810	1.0E-07	4.1E-07	6.2E-07	1.1E-06	--	--	--	--
Indeno(1,2,3-cd)pyrene	0.560	1.6E-08	6.3E-08	9.9E-08	1.8E-07	--	--	--	--
Benzo(g,h,i)perylene	0.520	1.4E-09	5.9E-09	8.5E-09	1.6E-08	--	--	--	--
Aluminum	22,300	--	--	--	--	--	--	--	--
Barium	614	--	--	--	--	0.001	0.000	--	0.001
Chromium (5)	59.1	--	--	--	--	0.000	0.000	--	0.000
Cobalt	14.1	--	--	--	--	--	--	--	--
Copper	72.0	--	--	--	--	--	--	--	--
Iron	36,600	--	--	--	--	--	--	--	--
Lead	151	--	--	--	--	--	--	--	--
Mercury	0.13	--	--	--	--	0.000	0.000	0.000	0.000
Potassium	6,910	--	--	--	--	--	--	--	--
Sodium	3,010	--	--	--	--	--	--	--	--
Vanadium	64.4	--	--	--	--	--	--	--	--
Zinc	233	--	--	--	--	0.000	0.000	--	0.000
Cyanide	1.3	--	--	--	--	0.000	0.000	--	0.000
Totals:		2E-07	7E-07	1E-06	2E-06	0.001	0.000	0.000	0.001
Inorganics Totals:					0E+00				0.001

TABLE A-10
CURRENT ADJACENT RESIDENT SCENARIO SOIL RISKS
SHALLOW SOIL BORINGS - PHASE I
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk (3)				Hazard Index (3,4)			
		Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
SB18 (0-5 feet deep)									
Methylene chloride	0.100	1.6E-11	1.6E-10	--	1.8E-10	0.000	0.000	0.000	0.000
1,1-Dichloroethane	0.004	--	--	--	--	0.000	0.000	--	0.000
Trichloroethene	0.011	2.6E-12	2.6E-11	2.4E-11	5.2E-11	--	--	--	--
Tetrachloroethene	0.015	1.6E-11	1.7E-10	3.4E-12	1.9E-10	0.000	0.000	--	0.000
Toluene	0.031	--	--	--	--	0.000	0.000	0.000	0.000
trans-1,2-Dichloroethene	0.008	--	--	--	--	0.000	0.000	--	0.000
Naphthalene	0.048	--	--	--	--	0.000	0.000	--	0.000
2-Methylnaphthalene	0.130	--	--	--	--	--	--	--	--
Acenaphthene	0.110	--	--	--	--	0.000	0.000	--	0.000
Fluorene	0.100	--	--	--	--	0.000	0.000	--	0.000
Phenanthrene	0.570	--	--	--	--	--	--	--	--
Anthracene	0.110	--	--	--	--	0.000	0.000	--	0.000
Fluoranthene	0.670	--	--	--	--	0.000	0.000	--	0.000
Pyrene	0.570	--	--	--	--	0.000	0.000	--	0.000
Benzo(a)anthracene	0.210	3.8E-09	1.5E-08	2.3E-08	4.2E-08	--	--	--	--
Chrysene	0.280	1.6E-10	6.3E-10	9.5E-10	1.7E-09	--	--	--	--
bis(2-Ethylhexyl)phthalate	0.280	8.3E-11	3.4E-10	--	4.2E-10	0.000	0.000	--	0.000
Benzo(b)fluoranthene	0.200	3.5E-09	1.4E-08	2.1E-08	3.9E-08	--	--	--	--
Benzo(k)fluoranthene	0.160	1.3E-09	5.3E-09	8.1E-09	1.5E-08	--	--	--	--
Aluminum	50,000	--	--	--	--	--	--	--	--
Barium	3,060	--	--	--	--	0.003	0.001	--	0.004
Calcium	65,100	--	--	--	--	--	--	--	--
Chromium (5)	65.2	--	--	--	--	0.000	0.000	--	0.000
Copper	47.3	--	--	--	--	--	--	--	--
Iron	57,200	--	--	--	--	--	--	--	--
Lead	102	--	--	--	--	--	--	--	--
Potassium	9,640	--	--	--	--	--	--	--	--
Selenium	1.8	--	--	--	--	0.000	0.000	--	0.000
Sodium	14,900	--	--	--	--	--	--	--	--
Vanadium	77.7	--	--	--	--	--	--	--	--
Zinc	181	--	--	--	--	0.000	0.000	--	0.000
Cyanide	1.3	--	--	--	--	0.000	0.000	--	0.000
Totals:		9E-09	4E-08	5E-08	1E-07	0.003	0.001	0.000	0.004
Inorganics Totals:					0E+00				0.004
SB19 (0-2.6 feet deep)									
1,1,1-Trichloroethane	0.007	--	--	--	--	0.000	0.000	--	0.000
Trichloroethene	0.003	7.0E-13	7.2E-12	6.4E-12	1.4E-11	--	--	--	--
Tetrachloroethene	0.006	6.5E-12	6.7E-11	1.4E-12	7.4E-11	0.000	0.000	--	0.000
2-Methylnaphthalene	0.072	--	--	--	--	--	--	--	--
Phenanthrene	0.220	--	--	--	--	--	--	--	--
Fluoranthene	0.320	--	--	--	--	0.000	0.000	--	0.000
Pyrene	0.320	--	--	--	--	0.000	0.000	--	0.000
Chrysene	0.230	1.3E-10	5.2E-10	7.8E-10	1.4E-09	--	--	--	--
Aroclor-1242	10	1.6E-06	6.7E-06	--	8.3E-06	--	--	--	--
Aroclor-1254	1.3	2.1E-07	8.7E-07	--	1.1E-06	--	--	--	--
Aluminum	13,900	--	--	--	--	--	--	--	--
Barium	406	--	--	--	--	0.000	0.000	--	0.001
Chromium (5)	35.5	--	--	--	--	0.000	0.000	--	0.000
Cobalt	18.3	--	--	--	--	--	--	--	--
Copper	234	--	--	--	--	--	--	--	--
Lead	325	--	--	--	--	--	--	--	--
Potassium	4,930	--	--	--	--	--	--	--	--
Sodium	1,160	--	--	--	--	--	--	--	--
Vanadium	67.1	--	--	--	--	--	--	--	--
Zinc	491	--	--	--	--	0.000	0.000	--	0.000
Totals:		2E-06	8E-06	8E-10	9E-06	0.001	0.000	0.000	0.001
Inorganics Totals:					0E+00				0.001

TABLE A-10
CURRENT ADJACENT RESIDENT SCENARIO SOIL RISKS
SHALLOW SOIL BORINGS - PHASE I
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk (3)				Hazard Index (3,4)			
		Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
SB20 (0-5 feet deep)									
Benzene	0.011	6.8E-12	6.9E-11	4.0E-11	1.2E-10	--	--	--	--
1,1,1-Trichloroethane	0.003	--	--	--	--	0.000	0.000	--	0.000
Ethyl benzene	0.008	--	--	--	--	0.000	0.000	0.000	0.000
Phenanthrene	0.220	--	--	--	--	--	--	--	--
Anthracene	0.065	--	--	--	--	0.000	0.000	--	0.000
Fluoranthene	0.430	--	--	--	--	0.000	0.000	--	0.000
Pyrene	0.460	--	--	--	--	0.000	0.000	--	0.000
Benzo(a)anthracene	0.250	4.5E-09	1.8E-08	2.8E-08	5.0E-08	--	--	--	--
Chrysene	0.310	1.7E-10	7.0E-10	1.1E-09	1.9E-09	--	--	--	--
Benzo(b)fluoranthene	0.270	4.7E-09	1.9E-08	2.9E-08	5.3E-08	--	--	--	--
Benzo(k)fluoranthene	0.230	1.9E-09	7.6E-09	1.2E-08	2.1E-08	--	--	--	--
Indeno(1,2,3-cd)pyrene	0.220	6.1E-09	2.5E-08	3.9E-08	7.0E-08	--	--	--	--
Benzo(g,h,i)perylene	0.210	5.8E-10	2.4E-09	3.4E-09	6.4E-09	--	--	--	--
Aluminum	14,700	--	--	--	--	--	--	--	--
Barium	187	--	--	--	--	0.000	0.000	--	0.000
Calcium	70,500	--	--	--	--	--	--	--	--
Chromium (5)	33.5	--	--	--	--	0.000	0.000	--	0.000
Cobalt	21.6	--	--	--	--	--	--	--	--
Copper	49.2	--	--	--	--	--	--	--	--
Iron	25,000	--	--	--	--	--	--	--	--
Lead	147	--	--	--	--	--	--	--	--
Manganese	683	--	--	--	--	--	--	0.000	0.000
Potassium	6,150	--	--	--	--	--	--	--	--
Sodium	470	--	--	--	--	--	--	--	--
Vanadium	67.2	--	--	--	--	--	--	--	--
Zinc	171	--	--	--	--	0.000	0.000	--	0.000
Cyanide	0.60	--	--	--	--	0.000	0.000	--	0.000
Totals:		2E-08	7E-08	1E-07	2E-07	0.000	0.000	0.000	0.000
Inorganics Totals:					0E+00				0.000

TABLE A-10
CURRENT ADJACENT RESIDENT SCENARIO SOIL RISKS
SHALLOW SOIL BORINGS - PHASE I
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk (3)				Hazard Index (3,4)			
		Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
SB21 (2.5-4.5 feet deep)									
1,1-Dichloroethane	0.032	--	--	--	--	0.000	0.000	--	0.000
Trichloroethene	0.070	1.6E-11	1.7E-10	1.5E-10	3.3E-10	--	--	--	--
Tetrachloroethene	0.280	3.0E-10	3.1E-09	6.4E-11	3.5E-09	0.000	0.000	--	0.000
Toluene	0.074	--	--	--	--	0.000	0.000	0.000	0.000
Ethyl benzene	0.020	--	--	--	--	0.000	0.000	0.000	0.000
Xylenes (total)	0.074	--	--	--	--	0.000	0.000	--	0.000
Naphthalene	0.240	--	--	--	--	0.000	0.000	--	0.000
2-Methylnaphthalene	0.640	--	--	--	--	--	--	--	--
Acenaphthene	0.140	--	--	--	--	0.000	0.000	--	0.000
Dibenzofuran	0.070	--	--	--	--	--	--	--	--
Phenanthrene	0.660	--	--	--	--	--	--	--	--
Anthracene	0.078	--	--	--	--	0.000	0.000	--	0.000
Fluoranthene	0.510	--	--	--	--	0.000	0.000	--	0.000
Pyrene	0.570	--	--	--	--	0.000	0.000	--	0.000
Benzo(a)anthracene	0.220	3.9E-09	1.6E-08	2.4E-08	4.4E-08	--	--	--	--
Chrysene	0.320	1.8E-10	7.2E-10	1.1E-09	2.0E-09	--	--	--	--
bis(2-Ethylhexyl)phthalate	1.8	5.4E-10	2.2E-09	--	2.7E-09	0.000	0.000	--	0.000
Indeno(1,2,3-cd)pyrene	0.200	5.5E-09	2.3E-08	3.5E-08	6.3E-08	--	--	--	--
Benzo(g,h,i)perylene	0.220	6.1E-10	2.5E-09	3.6E-09	6.7E-09	--	--	--	--
Aroclor-1248	0.680	1.1E-07	4.6E-07	--	5.7E-07	--	--	--	--
Aroclor-1254	0.340	5.6E-08	2.3E-07	--	2.8E-07	--	--	--	--
Aluminum	19,000	--	--	--	--	--	--	--	--
Barium	735	--	--	--	--	0.001	0.000	--	0.001
Cadmium	2.0	--	--	6.7E-13	6.7E-13	0.000	0.000	--	0.000
Calcium	86,400	--	--	--	--	--	--	--	--
Chromium (5)	63.5	--	--	--	--	0.000	0.000	--	0.000
Cobalt	15.6	--	--	--	--	--	--	--	--
Copper	143	--	--	--	--	--	--	--	--
Iron	27,600	--	--	--	--	--	--	--	--
Lead	592	--	--	--	--	--	--	--	--
Magnesium	47,500	--	--	--	--	--	--	--	--
Nickel	28.7	--	--	--	--	0.000	0.000	--	0.000
Potassium	3,590	--	--	--	--	--	--	--	--
Sodium	2,790	--	--	--	--	--	--	--	--
Vanadium	32.8	--	--	--	--	--	--	--	--
Zinc	340	--	--	--	--	0.000	0.000	--	0.000
Cyanide	7.7	--	--	--	--	0.000	0.000	--	0.000
Totals:		2E-07	7E-07	6E-08	1E-06	0.001	0.000	0.000	0.002
Inorganics Totals:					7E-13				0.002

TABLE A-10
CURRENT ADJACENT RESIDENT SCENARIO SOIL RISKS
SHALLOW SOIL BORINGS - PHASE I
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk (3)				Hazard Index (3,4)			
		Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
SB22 (0-5 feet deep)									
Trichloroethene	0.004	9.4E-13	9.6E-12	8.6E-12	1.9E-11	--	--	--	--
trans-1,3-Dichloropropene	0.007	2.7E-11	2.7E-10	1.1E-10	4.2E-10	0.000	0.000	0.000	0.000
Tetrachloroethene	0.014	1.5E-11	1.6E-10	3.2E-12	1.7E-10	0.000	0.000	--	0.000
Phenanthrene	0.170	--	--	--	--	--	--	--	--
Fluoranthene	0.250	--	--	--	--	0.000	0.000	--	0.000
Pyrene	0.230	--	--	--	--	0.000	0.000	--	0.000
Benzo(a)anthracene	0.089	1.6E-09	6.5E-09	9.9E-09	1.8E-08	--	--	--	--
Chrysene	0.120	6.6E-11	2.7E-10	4.1E-10	7.5E-10	--	--	--	--
bis(2-Ethylhexyl)phthalate	0.091	2.7E-11	1.1E-10	--	1.4E-10	0.000	0.000	--	0.000
Aroclor-1254	0.540	8.9E-08	3.6E-07	--	4.5E-07	--	--	--	--
Aroclor-1260	0.240	3.9E-08	1.6E-07	--	2.0E-07	--	--	--	--
Aluminum	12,900	--	--	--	--	--	--	--	--
Arsenic	17.9	--	--	4.9E-11	4.9E-11	0.004	0.001	--	0.006
Barium	339	--	--	--	--	0.000	0.000	--	0.000
Calcium	72,000	--	--	--	--	--	--	--	--
Chromium (5)	51.5	--	--	--	--	0.000	0.000	--	0.000
Cobalt	17.1	--	--	--	--	--	--	--	--
Copper	79.8	--	--	--	--	--	--	--	--
Lead	513	--	--	--	--	--	--	--	--
Magnesium	38,900	--	--	--	--	--	--	--	--
Potassium	2,300	--	--	--	--	--	--	--	--
Sodium	11,010	--	--	--	--	--	--	--	--
Zinc	281	--	--	--	--	0.000	0.000	--	0.000
Totals:		1E-07	5E-07	1E-08	7E-07	0.005	0.001	0.000	0.006
Inorganics Totals:					5E-11				0.006

TABLE A-10
CURRENT ADJACENT RESIDENT SCENARIO SOIL RISKS
SHALLOW SOIL BORINGS - PHASE I
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk (3)				Hazard Index (3,4)			
		Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
SB23R (2.8-4.5 feet deep)									
Acetone	0.450	--	--	--	--	0.000	0.000	--	0.000
Benzene	0.008	4.9E-12	5.0E-11	2.9E-11	8.5E-11	--	--	--	--
Toluene	0.081	--	--	--	--	0.000	0.000	0.000	0.000
Ethyl benzene	0.041	--	--	--	--	0.000	0.000	0.000	0.000
Xylenes (total)	0.390	--	--	--	--	0.000	0.000	--	0.000
Naphthalene	0.058	--	--	--	--	0.000	0.000	--	0.000
2-Methylnaphthalene	0.061	--	--	--	--	--	--	--	--
Aluminum	12,700	--	--	--	--	--	--	--	--
Barium	74.7	--	--	--	--	0.000	0.000	--	0.000
Cadmium	0.59	--	--	2.0E-13	2.0E-13	0.000	0.000	--	0.000
Chromium (5)	37.6	--	--	--	--	0.000	0.000	--	0.000
Cobalt	20.8	--	--	--	--	--	--	--	--
Lead	108	--	--	--	--	--	--	--	--
Potassium	2,600	--	--	--	--	--	--	--	--
Sodium	286	--	--	--	--	--	--	--	--
Vanadium	28.2	--	--	--	--	--	--	--	--
Cyanide	0.90	--	--	--	--	0.000	0.000	--	0.000
Totals:		5E-12	5E-11	3E-11	8E-11	0.000	0.000	0.000	0.000
Inorganics Totals:					2E-13				0.000

Notes:

(1) Only detected organic parameters and inorganics detected above the background concentrations (i.e., the highest detected value in samples from borings SB213, SB214 and SB216) are shown.

(2) Values shown are the highest detected concentrations between the sample and its duplicate, and/or between the results of the Round 1 and Round 2 samples. Analytical results that exceeded the instrument calibration range were not used if a diluted reanalysis was available.

(3) The oral and dermal risks are calculated in accordance with the procedures indicated in Section 5 and Appendix J of the Baseline Risk Assessment. The inhalation risks were calculated in accordance with the procedures in the Illinois Environmental Protection Agency's *Tiered Approach for Corrective Action Objectives*, dated September 16, 1996.

(4) Zero values indicate that the hazard indices are less than 5×10^{-4}.

(5) The calculations use the toxicity factors for trivalent chromium, although the laboratory reported total chromium.

Key:

— = No toxicity factor is available for this chemical.

= Indicates a total carcinogenic risk above 1×10^{-4} or a total hazard index above 1 for this parameter.

TABLE A-11
CURRENT ADJACENT RESIDENT SCENARIO SOIL RISKS
SHALLOW SOIL BORINGS - PHASE II
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk (3)				Hazard Index (3,4)			
		Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
SB04 (0-5 feet deep)									
1,1-Dichloroethane	0.003	--	--	--	--	0.000	0.000	--	0.000
1,1,1-Trichloroethane	0.006	--	--	--	--	0.000	0.000	--	0.000
Trichloroethene	0.004	9.4E-13	9.6E-12	8.6E-12	1.9E-11	--	--	--	--
Tetrachloroethene	0.006	6.5E-12	6.7E-11	1.4E-12	7.4E-11	0.000	0.000	--	0.000
Toluene	0.05	--	--	--	--	0.000	0.000	0.000	0.000
Ethyl benzene	0.038	--	--	--	--	0.000	0.000	0.000	0.000
Xylenes (total)	0.19	--	--	--	--	0.000	0.000	--	0.000
2-Methylnaphthalene	0.4	--	--	--	--	--	--	--	--
Phenanthrene	0.45	--	--	--	--	--	--	--	--
Fluoranthene	0.38	--	--	--	--	0.000	0.000	--	0.000
Pyrene	0.38	--	--	--	--	0.000	0.000	--	0.000
Chrysene	0.16	8.9E-11	3.6E-10	5.4E-10	1.0E-09	--	--	--	--
Benzo(b)fluoranthene	0.36	6.2E-09	2.5E-08	3.9E-08	7.0E-08	--	--	--	--
Aroclor-1242	0.42	6.9E-08	2.8E-07	--	3.5E-07	--	--	--	--
Aroclor-1260	0.15	2.5E-08	1.0E-07	--	1.3E-07	--	--	--	--
Aluminum	21,200	--	--	--	--	--	--	--	--
Antimony	8.3	--	--	--	--	0.002	0.000	--	0.002
Barium	882	--	--	--	--	0.001	0.000	--	0.001
Beryllium	1.2	1.1E-07	4.5E-08	5.5E-13	1.5E-07	0.000	0.000	--	0.000
Calcium	133,000	--	--	--	--	--	--	--	--
Chromium (5)	36.8	--	--	--	--	0.000	0.000	--	0.000
Cobalt	8.6	--	--	--	--	--	--	--	--
Copper	111	--	--	--	--	--	--	--	--
Iron	23,300	--	--	--	--	--	--	--	--
Lead	518	--	--	--	--	--	--	--	--
Magnesium	63,700	--	--	--	--	--	--	--	--
Mercury	0.12	--	--	--	--	0.000	0.000	0.000	0.000
Nickel	33.4	--	--	--	--	0.000	0.000	--	0.000
Potassium	3,080	--	--	--	--	--	--	--	--
Silver	1.7	--	--	--	--	0.000	0.000	--	0.000
Sodium	2,800	--	--	--	--	--	--	--	--
Vanadium	34.4	--	--	--	--	--	--	--	--
Zinc	292	--	--	--	--	0.000	0.000	--	0.000
Cyanide	8.3	--	--	--	--	0.000	0.000	--	0.000
Totals:		2E-07	5E-07	4E-08	7E-07	0.003	0.001	0.000	0.004
Inorganics Totals:					2E-07				0.004
SB08 (0-5 feet deep)									
1,1,1-Trichloroethane	0.006	--	--	--	--	0.000	0.000	--	0.000
Tetrachloroethene	0.011	1.2E-11	1.2E-10	2.5E-12	1.4E-10	0.000	0.000	--	0.000
Toluene	0.023	--	--	--	--	0.000	0.000	0.000	0.000
Ethyl benzene	0.019	--	--	--	--	0.000	0.000	0.000	0.000
Xylenes (total)	0.078	--	--	--	--	0.000	0.000	--	0.000
Aroclor-1242	0.12	2.0E-08	8.0E-08	--	1.0E-07	--	--	--	--
Aroclor-1260	0.034	5.6E-09	2.3E-08	--	2.8E-08	--	--	--	--
Aluminum	13,100	--	--	--	--	--	--	--	--
Barium	163	--	--	--	--	0.000	0.000	--	0.000
Chromium (5)	20.1	--	--	--	--	0.000	0.000	--	0.000
Copper	67.8	--	--	--	--	--	--	--	--
Lead	202	--	--	--	--	--	--	--	--
Mercury	0.16	--	--	--	--	0.000	0.000	0.000	0.000
Nickel	20.8	--	--	--	--	0.000	0.000	--	0.000
Potassium	1,820	--	--	--	--	--	--	--	--
Sodium	415	--	--	--	--	--	--	--	--
Zinc	132	--	--	--	--	0.000	0.000	--	0.000
Totals:		3E-08	1E-07	2E-12	1E-07	0.000	0.000	0.000	0.000
Inorganics Totals:					0E+00				0.000

TABLE A-11
CURRENT ADJACENT RESIDENT SCENARIO SOIL RISKS
SHALLOW SOIL BORINGS - PHASE II
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk (3)				Hazard Index (3,4)			
		Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
SB10 (0-5 feet deep)									
1,1,1-Trichloroethane	0.029	--	--	--	--	0.000	0.000	--	0.000
Toluene	0.018	--	--	--	--	0.000	0.000	0.000	0.000
Fluoranthene	0.089	--	--	--	--	0.000	0.000	--	0.000
Pyrene	0.089	--	--	--	--	0.000	0.000	--	0.000
Aroclor-1242	0.11	1.8E-08	7.4E-08	--	9.2E-08	--	--	--	--
Aroclor-1260	0.031	5.1E-09	2.1E-08	--	2.6E-08	--	--	--	--
Aluminum	18,400	--	--	--	--	--	--	--	--
Barium	506	--	--	--	--	0.001	0.000	--	0.001
Beryllium	0.83	7.6E-08	3.1E-08	3.8E-13	1.1E-07	0.000	0.000	--	0.000
Calcium	63,300	--	--	--	--	--	--	--	--
Chromium (5)	40.1	--	--	--	--	0.000	0.000	--	0.000
Cobalt	9.1	--	--	--	--	--	--	--	--
Copper	189	--	--	--	--	--	--	--	--
Iron	27,600	--	--	--	--	--	--	--	--
Lead	381	--	--	--	--	--	--	--	--
Manganese	1110	--	--	--	--	--	--	0.000	0.000
Mercury	0.79	--	--	--	--	0.000	0.000	0.000	0.000
Nickel	33.5	--	--	--	--	0.000	0.000	--	0.000
Potassium	2,870	--	--	--	--	--	--	--	--
Sodium	1,540	--	--	--	--	--	--	--	--
Vanadium	38.4	--	--	--	--	--	--	--	--
Zinc	376	--	--	--	--	0.000	0.000	--	0.000
Totals:		1E-07	1E-07	4E-13	2E-07	0.001	0.000	0.000	0.001
Inorganics Totals:					1E-07				0.001
SB11 (0-5 feet deep)									
1,1,1-Trichloroethane	0.008	--	--	--	--	0.000	0.000	--	0.000
Trichloroethene	0.006	1.4E-12	1.4E-11	1.3E-11	2.9E-11	--	--	--	--
Tetrachloroethene	0.023	2.5E-11	2.6E-10	5.2E-12	2.9E-10	0.000	0.000	--	0.000
Toluene	0.044	--	--	--	--	0.000	0.000	0.000	0.000
Ethyl benzene	0.029	--	--	--	--	0.000	0.000	0.000	0.000
Xylenes (total)	0.12	--	--	--	--	0.000	0.000	--	0.000
2-Methylnaphthalene	0.072	--	--	--	--	--	--	--	--
Phenanthrene	0.24	--	--	--	--	--	--	--	--
Anthracene	0.046	--	--	--	--	0.000	0.000	--	0.000
Fluoranthene	0.31	--	--	--	--	0.000	0.000	--	0.000
Pyrene	0.28	--	--	--	--	0.000	0.000	--	0.000
Benzo(a)anthracene	0.077	1.4E-09	5.6E-09	8.5E-09	1.6E-08	--	--	--	--
Chrysene	0.1	5.5E-11	2.3E-10	3.4E-10	6.2E-10	--	--	--	--
Aroclor-1242	0.33	5.4E-08	2.2E-07	--	2.8E-07	--	--	--	--
Aroclor-1260	0.083	1.4E-08	5.6E-08	--	6.9E-08	--	--	--	--
Aluminum	16,400	--	--	--	--	--	--	--	--
Barium	576	--	--	--	--	0.001	0.000	--	0.001
Beryllium	0.94	8.6E-08	3.5E-08	4.3E-13	1.2E-07	0.000	0.000	--	0.000
Calcium	150,000	--	--	--	--	--	--	--	--
Chromium (5)	33.2	--	--	--	--	0.000	0.000	--	0.000
Cobalt	7.6	--	--	--	--	--	--	--	--
Copper	107	--	--	--	--	--	--	--	--
Iron	27,200	--	--	--	--	--	--	--	--
Lead	460	--	--	--	--	--	--	--	--
Magnesium	78,800	--	--	--	--	--	--	--	--
Nickel	26.6	--	--	--	--	0.000	0.000	--	0.000
Potassium	3,040	--	--	--	--	--	--	--	--
Silver	2.9	--	--	--	--	0.000	0.000	--	0.000
Sodium	1,540	--	--	--	--	--	--	--	--
Vanadium	28.9	--	--	--	--	--	--	--	--
Zinc	286	--	--	--	--	0.000	0.000	--	0.000
Totals:		2E-07	3E-07	9E-09	5E-07	0.001	0.000	0.000	0.001
Inorganics Totals:					1E-07				0.001

TABLE A-11
CURRENT ADJACENT RESIDENT SCENARIO SOIL RISKS
SHALLOW SOIL BORINGS - PHASE II
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk (3)				Hazard Index (3,4)			
		Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
SB12 (0-5 feet deep)									
Ethyl benzene	0.82	--	--	--	--	0.000	0.000	0.000	0.000
Xylenes (total)	4.1	--	--	--	--	0.000	0.000	--	0.000
1,2-Dichlorobenzene	0.14	--	--	--	--	0.000	0.000	--	0.000
2-Methylnaphthalene	1.2	--	--	--	--	--	--	--	--
Acenaphthene	0.064	--	--	--	--	0.000	0.000	--	0.000
Fluorene	0.14	--	--	--	--	0.000	0.000	--	0.000
Phenanthrene	0.37	--	--	--	--	--	--	--	--
Anthracene	0.045	--	--	--	--	0.000	0.000	--	0.000
di-n-Butylphthalate	0.043	--	--	--	--	0.000	0.000	--	0.000
Fluoranthene	0.21	--	--	--	--	0.000	0.000	--	0.000
Pyrene	0.2	--	--	--	--	0.000	0.000	--	0.000
Chrysene	0.098	5.4E-11	2.2E-10	3.3E-10	6.1E-10	--	--	--	--
Aroclor-1242	0.37	6.1E-08	2.5E-07	--	3.1E-07	--	--	--	--
Aroclor-1260	0.062	1.0E-08	4.2E-08	--	5.2E-08	--	--	--	--
Aluminum	12,400	--	--	--	--	--	--	--	--
Barium	230	--	--	--	--	0.000	0.000	--	0.000
Beryllium	0.76	7.0E-08	2.8E-08	3.5E-13	9.8E-08	0.000	0.000	--	0.000
Chromium (5)	19.6	--	--	--	--	0.000	0.000	--	0.000
Cobalt	7.7	--	--	--	--	--	--	--	--
Copper	60.8	--	--	--	--	--	--	--	--
Lead	157	--	--	--	--	--	--	--	--
Nickel	19	--	--	--	--	0.000	0.000	--	0.000
Silver	1.3	--	--	--	--	0.000	0.000	--	0.000
Sodium	1,120	--	--	--	--	--	--	--	--
Zinc	149	--	--	--	--	0.000	0.000	--	0.000
Totals:		1E-07	3E-07	3E-10	5E-07	0.000	0.000	0.000	0.001
Inorganics Totals:					1E-07				0.001
SB22 (0-5 feet deep)									
Acetone	0.096	--	--	--	--	0.000	0.000	--	0.000
Toluene	0.018	--	--	--	--	0.000	0.000	0.000	0.000
Ethyl benzene	0.014	--	--	--	--	0.000	0.000	0.000	0.000
Xylenes (total)	0.1	--	--	--	--	0.000	0.000	--	0.000
2-Methylnaphthalene	0.073	--	--	--	--	--	--	--	--
Phenanthrene	0.19	--	--	--	--	--	--	--	--
Anthracene	0.031	--	--	--	--	0.000	0.000	--	0.000
Fluoranthene	0.18	--	--	--	--	0.000	0.000	--	0.000
Pyrene	0.18	--	--	--	--	0.000	0.000	--	0.000
Chrysene	0.11	6.1E-11	2.5E-10	3.7E-10	6.8E-10	--	--	--	--
Aroclor-1242	0.33	5.4E-08	2.2E-07	--	2.8E-07	--	--	--	--
Aroclor-1254	0.09	1.5E-08	6.0E-08	--	7.5E-08	--	--	--	--
Aluminum	17,300	--	--	--	--	--	--	--	--
Barium	652	--	--	--	--	0.001	0.000	--	0.001
Beryllium	1	9.2E-08	3.7E-08	4.6E-13	1.3E-07	0.000	0.000	--	0.000
Cadmium	1.7	--	--	5.7E-13	5.7E-13	0.000	0.000	--	0.000
Calcium	83,800	--	--	--	--	--	--	--	--
Chromium (5)	40.5	--	--	--	--	0.000	0.000	--	0.000
Cobalt	9.2	--	--	--	--	--	--	--	--
Copper	268	--	--	--	--	--	--	--	--
Iron	22,300	--	--	--	--	--	--	--	--
Lead	471	--	--	--	--	--	--	--	--
Magnesium	38,800	--	--	--	--	--	--	--	--
Nickel	34.2	--	--	--	--	0.000	0.000	--	0.000
Potassium	2,390	--	--	--	--	--	--	--	--
Silver	2.6	--	--	--	--	0.000	0.000	--	0.000
Sodium	1,810	--	--	--	--	--	--	--	--
Vanadium	30.1	--	--	--	--	--	--	--	--
Zinc	328	--	--	--	--	0.000	0.000	--	0.000
Totals:		2E-07	3E-07	4E-10	5E-07	0.001	0.000	0.000	0.001
Inorganics Totals:					1E-07				0.001

TABLE A-11
CURRENT ADJACENT RESIDENT SCENARIO SOIL RISKS
SHALLOW SOIL BORINGS - PHASE II
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk (3)				Hazard Index (3,4)			
		Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
SB201 (0-3 feet deep)									
Acetone	0.013	--	--	--	--	0.000	0.000	--	0.000
1,1,1-Trichloroethane	0.037	--	--	--	--	0.000	0.000	--	0.000
Trichloroethene	0.007	1.6E-12	1.7E-11	1.5E-11	3.3E-11	--	--	--	--
Tetrachloroethene	0.012	1.3E-11	1.3E-10	2.7E-12	1.5E-10	0.000	0.000	--	0.000
Toluene	0.003	--	--	--	--	0.000	0.000	0.000	0.000
Phenanthrene	2.6	--	--	--	--	--	--	--	--
Anthracene	0.67	--	--	--	--	0.000	0.000	--	0.000
Fluoranthene	3.8	--	--	--	--	0.000	0.000	--	0.000
Pyrene	4.1	--	--	--	--	0.000	0.000	--	0.000
Benzo(a)anthracene	1.8	3.2E-08	1.3E-07	2.0E-07	3.6E-07	--	--	--	--
Chrysene	1.8	1.0E-09	4.1E-09	6.1E-09	1.1E-08	--	--	--	--
Benzo(b)fluoranthene	3.3	5.7E-08	2.3E-07	3.5E-07	6.4E-07	--	--	--	--
Benzo(a)pyrene	1.7	2.1E-07	8.6E-07	1.3E-06	2.4E-06	--	--	--	--
Aroclor-1242	0.24	3.9E-08	1.6E-07	--	2.0E-07	--	--	--	--
Aroclor-1254	0.32	5.2E-08	2.1E-07	--	2.7E-07	--	--	--	--
Aluminum	12,500	--	--	--	--	--	--	--	--
Barium	198	--	--	--	--	0.000	0.000	--	0.000
Beryllium	0.66	6.0E-08	2.5E-08	3.0E-13	8.5E-08	0.000	0.000	--	0.000
Chromium (5)	26.6	--	--	--	--	0.000	0.000	--	0.000
Cobalt	9.7	--	--	--	--	--	--	--	--
Copper	92.2	--	--	--	--	--	--	--	--
Iron	22,100	--	--	--	--	--	--	--	--
Lead	240	--	--	--	--	--	--	--	--
Mercury	0.24	--	--	--	--	0.000	0.000	0.000	0.000
Nickel	28.1	--	--	--	--	0.000	0.000	--	0.000
Potassium	2,060	--	--	--	--	--	--	--	--
Sodium	385	--	--	--	--	--	--	--	--
Zinc	229	--	--	--	--	0.000	0.000	--	0.000
Totals:		5E-07	2E-06	2E-06	4E-06	0.000	0.000	0.000	0.001
Inorganics Totals:					9E-08				0.001

TABLE A-11
CURRENT ADJACENT RESIDENT SCENARIO SOIL RISKS
SHALLOW SOIL BORINGS - PHASE II
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk (3)				Hazard Index (3,4)			
		Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
SB201 (3-5 feet deep)									
Trichloroethene	0.007	1.6E-12	1.7E-11	1.5E-11	3.3E-11	--	--	--	--
Benzene	0.004	2.5E-12	2.5E-11	1.5E-11	4.2E-11	--	--	--	--
Tetrachloroethene	0.016	1.7E-11	1.8E-10	3.6E-12	2.0E-10	0.000	0.000	--	0.000
Toluene	0.012	--	--	--	--	0.000	0.000	0.000	0.000
Ethyl benzene	0.062	--	--	--	--	0.000	0.000	0.000	0.000
Xylenes (total)	0.18	--	--	--	--	0.000	0.000	--	0.000
Naphthalene	0.63	--	--	--	--	0.000	0.000	--	0.000
2-Methylnaphthalene	0.6	--	--	--	--	--	--	--	--
Acenaphthene	1.1	--	--	--	--	0.000	0.000	--	0.000
Dibenzofuran	0.83	--	--	--	--	--	--	--	--
Fluorene	1.4	--	--	--	--	0.000	0.000	--	0.000
Phenanthrene	7.3	--	--	--	--	--	--	--	--
Anthracene	1.7	--	--	--	--	0.000	0.000	--	0.000
Fluoranthene	7.2	--	--	--	--	0.000	0.000	--	0.000
Pyrene	6.4	--	--	--	--	0.000	0.000	--	0.000
Benzo(a)anthracene	2.7	4.8E-08	2.0E-07	3.0E-07	5.5E-07	--	--	--	--
Chrysene	2.8	1.6E-09	6.3E-09	9.5E-09	1.7E-08	--	--	--	--
bis(2-Ethylhexyl)phthalate	2.4	7.2E-10	2.9E-09	--	3.6E-09	0.000	0.000	--	0.000
Benzo(b)fluoranthene	4.7	8.1E-08	3.3E-07	5.0E-07	9.2E-07	--	--	--	--
Benzo(a)pyrene	2.3	2.8E-07	1.2E-06	1.8E-06	**3.2E-06**	--	--	--	--
Aroclor-1242	0.66	1.1E-07	4.4E-07	--	5.5E-07	--	--	--	--
Aroclor-1254	0.94	1.5E-07	6.3E-07	--	7.8E-07	--	--	--	--
Barium	201	--	--	--	--	0.000	0.000	--	0.000
Calcium	89,900	--	--	--	--	--	--	--	--
Chromium (5)	24	--	--	--	--	0.000	0.000	--	0.000
Copper	27.7	--	--	--	--	--	--	--	--
Lead	72.6	--	--	--	--	--	--	--	--
Magnesium	45,300	--	--	--	--	--	--	--	--
Nickel	29.8	--	--	--	--	0.000	0.000	--	0.000
Silver	2.4	--	--	--	--	0.000	0.000	--	0.000
Sodium	907	--	--	--	--	--	--	--	--
Totals:		7E-07	3E-06	3E-06	6E-06	0.000	0.000	0.000	0.001
Inorganics Totals:					0E+00				0.000

TABLE A-11
CURRENT ADJACENT RESIDENT SCENARIO SOIL RISKS
SHALLOW SOIL BORINGS - PHASE II
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk (3)				Hazard Index (3,4)			
		Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
SB202 (0-3 feet deep)									
1,2-Dichloroethene (total)	0.007	--	--	--	--	0.000	0.000	--	0.000
Phenol	2.7	--	--	--	--	0.000	0.000	--	0.000
1,2-Dichlorobenzene	0.89	--	--	--	--	0.000	0.000	--	0.000
Cresol	3.1	--	--	--	--	--	--	--	--
Isophorone	3.5	7.1E-11	2.9E-10	--	3.6E-10	0.000	0.000	--	0.000
2,4-Dimethylphenol	0.57	--	--	--	--	0.000	0.000	--	0.000
Naphthalene	2.1	--	--	--	--	0.000	0.000	--	0.000
2-Methylnaphthalene	2.1	--	--	--	--	--	--	--	--
Phenanthrene	1.4	--	--	--	--	--	--	--	--
Anthracene	0.37	--	--	--	--	0.000	0.000	--	0.000
di-n-Butylphthalate	0.42	--	--	--	--	0.000	0.000	--	0.000
Fluoranthene	0.78	--	--	--	--	0.000	0.000	--	0.000
Pyrene	1.1	--	--	--	--	0.000	0.000	--	0.000
Butylbenzylphthalate	3.2	--	--	--	--	0.000	0.000	--	0.000
Chrysene	1.1	6.1E-10	2.5E-09	3.7E-09	6.8E-09	--	--	--	--
bis(2-Ethylhexyl)phthalate	7.4	2.2E-09	9.0E-09	--	1.1E-08	0.000	0.000	--	0.000
Aroclor-1242	1	1.6E-07	6.7E-07	--	8.3E-07	--	--	--	--
Aluminum	10,900	--	--	--	--	--	--	--	--
Arsenic	14.4	--	--	4.0E-11	4.0E-11	0.004	0.001	--	0.005
Barium	101	--	--	--	--	0.000	0.000	--	0.000
Beryllium	0.76	7.0E-08	2.8E-08	3.5E-13	9.8E-08	0.000	0.000	--	0.000
Chromium (5)	18.7	--	--	--	--	0.000	0.000	--	0.000
Cobalt	10.1	--	--	--	--	--	--	--	--
Copper	26.5	--	--	--	--	--	--	--	--
Lead	54.2	--	--	--	--	--	--	--	--
Nickel	24	--	--	--	--	0.000	0.000	--	0.000
Sodium	328	--	--	--	--	--	--	--	--
Zinc	116	--	--	--	--	0.000	0.000	--	0.000
Totals:		2E-07	7E-07	4E-09	1E-06	0.004	0.001	0.000	0.005
Inorganics Totals:					1E-07				0.005
SB202 (3-5 feet deep)									
Xylenes (total)	0.004	--	--	--	--	0.000	0.000	--	0.000
Acenaphthene	0.061	--	--	--	--	0.000	0.000	--	0.000
Phenanthrene	0.69	--	--	--	--	--	--	--	--
di-n-Butylphthalate	0.28	--	--	--	--	0.000	0.000	--	0.000
Fluoranthene	0.91	--	--	--	--	0.000	0.000	--	0.000
Pyrene	0.95	--	--	--	--	0.000	0.000	--	0.000
Butylbenzylphthalate	1.2	--	--	--	--	0.000	0.000	--	0.000
Benzo(a)anthracene	0.46	8.2E-09	3.4E-08	5.1E-08	9.3E-08	--	--	--	--
Chrysene	0.35	1.9E-10	7.9E-10	1.2E-09	2.2E-09	--	--	--	--
Benzo(b)fluoranthene	0.92	1.6E-08	6.5E-08	9.9E-08	1.8E-07	--	--	--	--
Benzo(a)pyrene	0.46	5.7E-08	2.3E-07	3.5E-07	6.4E-07	--	--	--	--
Indeno(1,2,3-cd)pyrene	0.28	7.8E-09	3.2E-08	4.9E-08	8.9E-08	--	--	--	--
Benzo(g,h,i)perylene	0.26	7.2E-10	2.9E-09	4.3E-09	7.9E-09	--	--	--	--
Aroclor-1254	0.97	1.6E-07	6.5E-07	--	8.1E-07	--	--	--	--
Barium	155	--	--	--	--	0.000	0.000	--	0.000
Cadmium	3.8	--	--	1.3E-12	1.3E-12	0.000	0.000	--	0.000
Chromium (5)	98.1	--	--	--	--	0.000	0.000	--	0.000
Copper	120	--	--	--	--	--	--	--	--
Lead	473	--	--	--	--	--	--	--	--
Mercury	0.38	--	--	--	--	0.000	0.000	0.000	0.000
Nickel	34.7	--	--	--	--	0.000	0.000	--	0.000
Sodium	273	--	--	--	--	--	--	--	--
Zinc	490	--	--	--	--	0.000	0.000	--	0.000
Totals:		2E-07	1E-06	6E-07	2E-06	0.001	0.000	0.000	0.001
Inorganics Totals:					1E-12				0.001

TABLE A-11
CURRENT ADJACENT RESIDENT SCENARIO SOIL RISKS
SHALLOW SOIL BORINGS - PHASE II
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk (3)				Hazard Index (3,4)			
		Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
SB203 (0-3 feet deep)									
1,1,1-Trichloroethane	0.1	--	--	--	--	0.000	0.000	--	0.000
Toluene	0.008	--	--	--	--	0.000	0.000	0.000	0.000
Phenanthrene	0.41	--	--	--	--	--	--	--	--
Anthracene	0.11	--	--	--	--	0.000	0.000	--	0.000
Fluoranthene	0.51	--	--	--	--	0.000	0.000	--	0.000
Pyrene	0.35	--	--	--	--	0.000	0.000	--	0.000
Benzo(a)anthracene	0.2	3.6E-09	1.5E-08	2.2E-08	4.0E-08	--	--	--	--
Chrysene	0.22	1.2E-10	5.0E-10	7.5E-10	1.4E-09	--	--	--	--
Benzo(b)fluoranthene	0.12	2.1E-09	8.5E-09	1.3E-08	2.3E-08	--	--	--	--
Benzo(k)fluoranthene	0.18	1.5E-09	6.0E-09	9.1E-09	1.6E-08	--	--	--	--
Indeno(1,2,3-cd)pyrene	0.18	5.0E-09	2.0E-08	3.2E-08	5.7E-08	--	--	--	--
Aldrin	0.0019	6.9E-10	2.8E-09	4.1E-09	7.6E-09	0.000	0.000	--	0.000
4,4'-DDE	0.0072	5.2E-11	2.1E-10	--	2.7E-10	--	--	--	--
4,4'-DDD	0.0091	4.7E-11	1.9E-10	--	2.4E-10	--	--	--	--
4,4'-DDT	0.0035	2.5E-11	1.0E-10	--	1.3E-10	0.000	0.000	--	0.000
Calcium	98,400	--	--	--	--	--	--	--	--
Magnesium	51,800	--	--	--	--	--	--	--	--
Sodium	194	--	--	--	--	--	--	--	--
Totals:		1E-08	5E-08	8E-08	1E-07	0.000	0.000	0.000	0.000
Inorganics Totals:					0E+00				0.000
SB203 (3-5 feet deep)									
Methylene chloride	0.006	9.6E-13	9.8E-12	--	1.1E-11	0.000	0.000	0.000	0.000
1,1,1-Trichloroethane	0.052	--	--	--	--	0.000	0.000	--	0.000
Acenaphthene	0.056	--	--	--	--	0.000	0.000	--	0.000
Dibenzofuran	0.044	--	--	--	--	--	--	--	--
Fluorene	0.081	--	--	--	--	0.000	0.000	--	0.000
Phenanthrene	0.94	--	--	--	--	--	--	--	--
Anthracene	0.16	--	--	--	--	0.000	0.000	--	0.000
Fluoranthene	1.8	--	--	--	--	0.000	0.000	--	0.000
Pyrene	1.5	--	--	--	--	0.000	0.000	--	0.000
Benzo(a)anthracene	0.69	1.2E-08	5.0E-08	7.7E-08	1.4E-07	--	--	--	--
Chrysene	0.58	3.2E-10	1.3E-09	2.0E-09	3.6E-09	--	--	--	--
Benzo(b)fluoranthene	1.5	2.6E-08	1.1E-07	1.6E-07	2.9E-07	--	--	--	--
Benzo(a)pyrene	0.48	5.9E-08	2.4E-07	3.7E-07	6.7E-07	--	--	--	--
4,4'-DDE	0.026	1.9E-10	7.7E-10	--	9.6E-10	--	--	--	--
4,4'-DDD	0.07	3.6E-10	1.5E-09	--	1.8E-09	--	--	--	--
4,4'-DDT	0.025	1.8E-10	7.4E-10	--	9.2E-10	0.000	0.000	--	0.000
Methoxychlor	0.13	--	--	--	--	0.000	0.000	--	0.000
Totals:		1E-07	4E-07	6E-07	1E-06	0.000	0.000	0.000	0.000
Inorganics Totals:					0E+00				0.000
SB204 (0-3 feet deep)									
1,1-Dichloroethane	0.004	--	--	--	--	0.000	0.000	--	0.000
1,1,1-Trichloroethane	0.081	--	--	--	--	0.000	0.000	--	0.000
Tetrachloroethene	0.008	8.7E-12	8.9E-11	1.8E-12	9.9E-11	0.000	0.000	--	0.000
Toluene	0.008	--	--	--	--	0.000	0.000	0.000	0.000
Aluminum	12,500	--	--	--	--	--	--	--	--
Barium	857	--	--	--	--	0.001	0.000	--	0.001
Beryllium	0.66	6.0E-08	2.5E-08	3.0E-13	8.5E-08	0.000	0.000	--	0.000
Calcium	61,000	--	--	--	--	--	--	--	--
Chromium (5)	30.1	--	--	--	--	0.000	0.000	--	0.000
Copper	93.4	--	--	--	--	--	--	--	--
Lead	270	--	--	--	--	--	--	--	--
Mercury	0.17	--	--	--	--	0.000	0.000	0.000	0.000
Nickel	23.1	--	--	--	--	0.000	0.000	--	0.000
Sodium	3,300	--	--	--	--	--	--	--	--
Zinc	229	--	--	--	--	0.000	0.000	--	0.000
Totals:		6E-08	2E-08	2E-12	9E-08	0.001	0.000	0.000	0.001
Inorganics Totals:					9E-08				0.001

TABLE A-11
CURRENT ADJACENT RESIDENT SCENARIO SOIL RISKS
SHALLOW SOIL BORINGS - PHASE II
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk (3)				Hazard Index (3,4)			
		Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
SB204 (3-5 feet deep)									
Methylene chloride	0.005	8.0E-13	8.2E-12	--	9.0E-12	0.000	0.000	0.000	0.000
Acetone	0.26	--	--	--	--	0.000	0.000	--	0.000
1,1,1-Trichloroethane	0.007	--	--	--	--	0.000	0.000	--	0.000
Toluene	0.004	--	--	--	--	0.000	0.000	0.000	0.000
Ethyl benzene	0.007	--	--	--	--	0.000	0.000	0.000	0.000
Xylenes (total)	0.022	--	--	--	--	0.000	0.000	--	0.000
Aldrin	0.0018	6.5E-10	2.7E-09	3.9E-09	7.2E-09	0.000	0.000	--	0.000
Aluminum	16,800	--	--	--	--	--	--	--	--
Barium	433	--	--	--	--	0.000	0.000	--	0.001
Beryllium	0.96	8.8E-08	3.6E-08	4.4E-13	1.2E-07	0.000	0.000	--	0.000
Chromium (5)	26.7	--	--	--	--	0.000	0.000	--	0.000
Cobalt	8	--	--	--	--	--	--	--	--
Copper	106	--	--	--	--	--	--	--	--
Iron	27,100	--	--	--	--	--	--	--	--
Lead	258	--	--	--	--	--	--	--	--
Mercury	0.12	--	--	--	--	0.000	0.000	0.000	0.000
Nickel	21.3	--	--	--	--	0.000	0.000	--	0.000
Potassium	2,080	--	--	--	--	--	--	--	--
Sodium	2,060	--	--	--	--	--	--	--	--
Vanadium	27.8	--	--	--	--	--	--	--	--
Zinc	164	--	--	--	--	0.000	0.000	--	0.000
Totals:		9E-08	4E-08	4E-09	1E-07	0.001	0.000	0.000	0.001
Inorganics Totals:					1E-07				0.001
SB205 (0-3 feet deep)									
1,1,1-Trichloroethane	0.025	--	--	--	--	0.000	0.000	--	0.000
Fluoranthene	0.18	--	--	--	--	0.000	0.000	--	0.000
Pyrene	0.14	--	--	--	--	0.000	0.000	--	0.000
4,4'-DDD	0.019	9.7E-11	4.0E-10	--	4.9E-10	--	--	--	--
4,4'-DDE	0.053	3.8E-10	1.6E-09	--	2.0E-09	--	--	--	--
4,4'-DDT	0.03	2.2E-10	8.9E-10	--	1.1E-09	0.000	0.000	--	0.000
Barium	181	--	--	--	--	0.000	0.000	--	0.000
Calcium	106,000	--	--	--	--	--	--	--	--
Chromium (5)	29.6	--	--	--	--	0.000	0.000	--	0.000
Copper	96.1	--	--	--	--	--	--	--	--
Lead	414	--	--	--	--	--	--	--	--
Magnesium	56,300	--	--	--	--	--	--	--	--
Mercury	0.24	--	--	--	--	0.000	0.000	0.000	0.000
Nickel	20.7	--	--	--	--	0.000	0.000	--	0.000
Potassium	1,920	--	--	--	--	--	--	--	--
Silver	3.5	--	--	--	--	0.000	0.000	--	0.000
Sodium	688	--	--	--	--	--	--	--	--
Zinc	270	--	--	--	--	0.000	0.000	--	0.000
Totals:		7E-10	3E-09	0E+00	4E-09	0.000	0.000	0.000	0.001
Inorganics Totals:					0E+00				0.001

TABLE A-11
CURRENT ADJACENT RESIDENT SCENARIO SOIL RISKS
SHALLOW SOIL BORINGS - PHASE II
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk (3)				Hazard Index (3,4)			
		Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
SB205 (3-5 feet deep)									
Acetone	0.088	--	--	--	--	0.000	0.000	--	0.000
1,1,1-Trichloroethane	0.043	--	--	--	--	0.000	0.000	--	0.000
Toluene	0.006	--	--	--	--	0.000	0.000	0.000	0.000
Phenanthrene	0.75	--	--	--	--	--	--	--	--
Anthracene	0.16	--	--	--	--	0.000	0.000	--	0.000
Fluoranthene	0.88	--	--	--	--	0.000	0.000	--	0.000
Pyrene	0.7	--	--	--	--	0.000	0.000	--	0.000
Benzo(a)anthracene	0.42	7.5E-09	3.1E-08	4.7E-08	8.5E-08	--	--	--	--
Chrysene	0.4	2.2E-10	9.0E-10	1.4E-09	2.5E-09	--	--	--	--
Benzo(b)fluoranthene	0.54	9.3E-09	3.8E-08	5.8E-08	1.1E-07	--	--	--	--
Benzo(k)fluoranthene	0.2	1.6E-09	6.6E-09	1.0E-08	1.8E-08	--	--	--	--
Benzo(a)pyrene	0.35	4.3E-08	1.8E-07	2.7E-07	4.9E-07	--	--	--	--
Indeno(1,2,3-cd)pyrene	0.26	7.2E-09	2.9E-08	4.6E-08	8.3E-08	--	--	--	--
Aroclor-1242	0.16	2.6E-08	1.1E-07	--	1.3E-07	--	--	--	--
Aroclor-1254	0.08	1.3E-08	5.4E-08	--	6.7E-08	--	--	--	--
Arsenic	13.2	--	--	3.6E-11	3.6E-11	0.003	0.001	--	0.004
Barium	70.1	--	--	--	--	0.000	0.000	--	0.000
Beryllium	0.69	6.3E-08	2.6E-08	3.2E-13	8.9E-08	0.000	0.000	--	0.000
Chromium (5)	19.5	--	--	--	--	0.000	0.000	--	0.000
Cobalt	14.6	--	--	--	--	--	--	--	--
Copper	47.7	--	--	--	--	--	--	--	--
Iron	25,400	--	--	--	--	--	--	--	--
Lead	119	--	--	--	--	--	--	--	--
Nickel	33.5	--	--	--	--	0.000	0.000	--	0.000
Potassium	1,920	--	--	--	--	--	--	--	--
Sodium	487	--	--	--	--	--	--	--	--
Thallium	0.95	--	--	--	--	0.001	0.000	--	0.001
Zinc	161	--	--	--	--	0.000	0.000	--	0.000
Totals:		2E-07	5E-07	4E-07	1E-06	0.005	0.001	0.000	0.006
Inorganics Totals:					9E-08				0.006
SB206 (0-3 feet deep)									
Acetone	0.15	--	--	--	--	0.000	0.000	--	0.000
Trichloroethene	0.011	2.6E-12	2.6E-11	2.4E-11	5.2E-11	--	--	--	--
Ethyl benzene	0.042	--	--	--	--	0.000	0.000	0.000	0.000
Xylenes (total)	0.028	--	--	--	--	0.000	0.000	--	0.000
4,4'-DDD	0.0017	8.7E-12	3.5E-11	--	4.4E-11	--	--	--	--
4,4'-DDE	0.0011	8.0E-12	3.3E-11	--	4.1E-11	--	--	--	--
4,4'-DDT	0.0051	3.7E-11	1.5E-10	--	1.9E-10	0.000	0.000	--	0.000
Barium	170	--	--	--	--	0.000	0.000	--	0.000
Cadmium	1.9	--	--	6.4E-13	6.4E-13	0.000	0.000	--	0.000
Calcium	109,000	--	--	--	--	--	--	--	--
Chromium (5)	26.3	--	--	--	--	0.000	0.000	--	0.000
Copper	60.2	--	--	--	--	--	--	--	--
Lead	397	--	--	--	--	--	--	--	--
Magnesium	51,500	--	--	--	--	--	--	--	--
Mercury	0.13	--	--	--	--	0.000	0.000	0.000	0.000
Potassium	1,970	--	--	--	--	--	--	--	--
Silver	3.4	--	--	--	--	0.000	0.000	--	0.000
Sodium	1,330	--	--	--	--	--	--	--	--
Zinc	200	--	--	--	--	0.000	0.000	--	0.000
Totals:		6E-11	2E-10	2E-11	3E-10	0.000	0.000	0.000	0.001
Inorganics Totals:					6E-13				0.001

TABLE A-11
CURRENT ADJACENT RESIDENT SCENARIO SOIL RISKS
SHALLOW SOIL BORINGS - PHASE II
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk (3)				Hazard Index (3,4)			
		Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
SB207 (0-3 feet deep)									
Methylene chloride	0.016	2.6E-12	2.6E-11	--	2.9E-11	0.000	0.000	0.000	0.000
1,1,1-Trichloroethane	0.009	--	--	--	--	0.000	0.000	--	0.000
Fluoranthene	0.17	--	--	--	--	0.000	0.000	--	0.000
Pyrene	0.16	--	--	--	--	0.000	0.000	--	0.000
Endosulfan I	0.0052	--	--	--	--	0.000	0.000	--	0.000
4,4'-DDD	0.0031	1.6E-11	6.5E-11	--	8.1E-11	--	--	--	--
4,4'-DDE	0.00072	5.2E-12	2.1E-11	--	2.7E-11	--	--	--	--
4,4'-DDT	0.0012	8.7E-12	3.5E-11	--	4.4E-11	0.000	0.000	--	0.000
alpha-Chlordane	0.0037	1.0E-10	4.2E-10	6.1E-10	1.1E-09	0.000	0.000	--	0.000
gamma-Chlordane	0.0036	1.0E-10	4.1E-10	5.9E-10	1.1E-09	0.000	0.000	--	0.000
Barium	66.6	--	--	--	--	0.000	0.000	--	0.000
Calcium	133,000	--	--	--	--	--	--	--	--
Chromium (5)	18.1	--	--	--	--	0.000	0.000	--	0.000
Copper	28	--	--	--	--	--	--	--	--
Lead	91.8	--	--	--	--	--	--	--	--
Magnesium	78,400	--	--	--	--	--	--	--	--
Mercury	0.19	--	--	--	--	0.000	0.000	0.000	0.000
Sodium	305	--	--	--	--	--	--	--	--
Zinc	107	--	--	--	--	0.000	0.000	--	0.000
Totals:		2E-10	1E-09	1E-09	2E-09	0.000	0.000	0.000	0.000
Inorganics Totals:					0E+00				0.000
SB207 (3-5 feet deep)									
Methylene chloride	0.004	6.4E-13	6.5E-12	--	7.2E-12	0.000	0.000	0.000	0.000
Acetone	0.07	--	--	--	--	0.000	0.000	--	0.000
1,1,1-Trichloroethane	0.006	--	--	--	--	0.000	0.000	--	0.000
Toluene	0.003	--	--	--	--	0.000	0.000	0.000	0.000
Calcium	150,000	--	--	--	--	--	--	--	--
Magnesium	42,600	--	--	--	--	--	--	--	--
Sodium	297	--	--	--	--	--	--	--	--
Totals:		6E-13	7E-12	0E+00	7E-12	0.000	0.000	0.000	0.000
Inorganics Totals:					0E+00				0.000
SB208 (0-3 feet deep)									
Methylene chloride	0.009	1.4E-12	1.5E-11	--	1.6E-11	0.000	0.000	0.000	0.000
Acetone	0.011	--	--	--	--	0.000	0.000	--	0.000
1,1,1-Trichloroethane	0.004	--	--	--	--	0.000	0.000	--	0.000
Toluene	0.002	--	--	--	--	0.000	0.000	0.000	0.000
Pyrene	0.062	--	--	--	--	0.000	0.000	--	0.000
gamma-BHC (Lindane)	0.00075	2.1E-11	8.5E-11	--	1.1E-10	0.000	0.000	--	0.000
Endosulfan I	0.0032	--	--	--	--	0.000	0.000	--	0.000
alpha-Chlordane	0.003	8.3E-11	3.4E-10	4.9E-10	9.1E-10	0.000	0.000	--	0.000
gamma-Chlordane	0.0019	5.3E-11	2.1E-10	3.1E-10	5.8E-10	0.000	0.000	--	0.000
Calcium	115,000	--	--	--	--	--	--	--	--
Copper	20.4	--	--	--	--	--	--	--	--
Magnesium	70,100	--	--	--	--	--	--	--	--
Mercury	0.12	--	--	--	--	0.000	0.000	0.000	0.000
Sodium	251	--	--	--	--	--	--	--	--
Totals:		2E-10	7E-10	8E-10	2E-09	0.000	0.000	0.000	0.000
Inorganics Totals:					0E+00				0.000
SB208 (3-5 feet deep)									
Acetone	0.034	--	--	--	--	0.000	0.000	--	0.000
1,1,1-Trichloroethane	0.015	--	--	--	--	0.000	0.000	--	0.000
Toluene	0.002	--	--	--	--	0.000	0.000	0.000	0.000
Calcium	126,000	--	--	--	--	--	--	--	--
Magnesium	75,700	--	--	--	--	--	--	--	--
Sodium	170	--	--	--	--	--	--	--	--
Totals:		0E+00	0E+00	0E+00	0E+00	0.000	0.000	0.000	0.000
Inorganics Totals:					0E+00				0.000

TABLE A-11
CURRENT ADJACENT RESIDENT SCENARIO SOIL RISKS
SHALLOW SOIL BORINGS - PHASE II
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk (3)				Hazard Index (3,4)			
		Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
SB209 (0-3 feet deep)									
4,4'-DDD	0.0083	4.2E-11	1.7E-10	--	2.2E-10	--	--	--	--
4,4'-DDE	0.00092	6.7E-12	2.7E-11	--	3.4E-11	--	--	--	--
4,4'-DDT	0.0047	3.4E-11	1.4E-10	--	1.7E-10	0.000	0.000	--	0.000
Calcium	114,000	--	--	--	--	--	--	--	--
Lead	51.3	--	--	--	--	--	--	--	--
Magnesium	68,700	--	--	--	--	--	--	--	--
Mercury	0.18	--	--	--	--	0.000	0.000	0.000	0.000
Silver	4.8	--	--	--	--	0.000	0.000	--	0.000
Sodium	430	--	--	--	--	--	--	--	--
Totals:		8E-11	3E-10	0E+00	4E-10	0.000	0.000	0.000	0.000
Inorganics Totals:					0E+00				0.000
SB209 (3-5 feet deep)									
Methylene chloride	0.004	6.4E-13	6.5E-12	--	7.2E-12	0.000	0.000	0.000	0.000
1,1,1-Trichloroethane	0.006	--	--	--	--	0.000	0.000	--	0.000
Calcium	128,000	--	--	--	--	--	--	--	--
Magnesium	73,400	--	--	--	--	--	--	--	--
Silver	5	--	--	--	--	0.000	0.000	--	0.000
Sodium	335	--	--	--	--	--	--	--	--
Totals:		6E-13	7E-12	0E+00	7E-12	0.000	0.000	0.000	0.000
Inorganics Totals:					0E+00				0.000
SB211 (0-3 feet deep)									
Methylene chloride	0.014	2.2E-12	2.3E-11	--	2.5E-11	0.000	0.000	0.000	0.000
Acetone	0.22	--	--	--	--	0.000	0.000	--	0.000
1,1-Dichloroethane	0.014	--	--	--	--	0.000	0.000	--	0.000
1,1,1-Trichloroethane	0.014	--	--	--	--	0.000	0.000	--	0.000
Benzene	0.13	8.0E-11	8.2E-10	4.8E-10	1.4E-09	--	--	--	--
Toluene	0.03	--	--	--	--	0.000	0.000	0.000	0.000
Ethyl benzene	0.13	--	--	--	--	0.000	0.000	0.000	0.000
Xylenes (total)	0.28	--	--	--	--	0.000	0.000	--	0.000
2-Methylnaphthalene	0.2	--	--	--	--	--	--	--	--
Acenaphthene	0.15	--	--	--	--	0.000	0.000	--	0.000
Phenanthrene	1.7	--	--	--	--	--	--	--	--
Dieldrin	0.0057	1.9E-09	7.9E-09	1.1E-08	2.1E-08	0.000	0.000	--	0.000
Barium	78.9	--	--	--	--	0.000	0.000	--	0.000
Calcium	135,000	--	--	--	--	--	--	--	--
Lead	232	--	--	--	--	--	--	--	--
Magnesium	83,700	--	--	--	--	--	--	--	--
Mercury	0.26	--	--	--	--	0.000	0.000	0.000	0.000
Sodium	313	--	--	--	--	--	--	--	--
Totals:		2E-09	9E-09	1E-08	2E-08	0.000	0.000	0.000	0.000
Inorganics Totals:					0E+00				0.000
SB211 (3-5 feet deep)									
Acetone	0.046	--	--	--	--	0.000	0.000	--	0.000
Calcium	136,000	--	--	--	--	--	--	--	--
Magnesium	84,400	--	--	--	--	--	--	--	--
Mercury	0.11	--	--	--	--	0.000	0.000	0.000	0.000
Sodium	146	--	--	--	--	--	--	--	--
Totals:		0E+00	0E+00	0E+00	0E+00	0.000	0.000	0.000	0.000
Inorganics Totals:					0E+00				0.000

TABLE A-11
CURRENT ADJACENT RESIDENT SCENARIO SOIL RISKS
SHALLOW SOIL BORINGS - PHASE II
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (1)	Soil Conc. (2) (mg/kg)	Carcinogenic Risk (3)				Hazard Index (3,4)			
		Oral	Dermal	Inhalation	Total	Oral	Dermal	Inhalation	Total
SB212 (0-3 feet deep)									
Calcium	122,000	--	--	--	--	--	--	--	--
Lead	714	--	--	--	--	--	--	--	--
Magnesium	74,500	--	--	--	--	--	--	--	--
Mercury	0.18	--	--	--	--	0.000	0.000	0.000	0.000
Sodium	290	--	--	--	--	--	--	--	--
Totals:		0E+00	0E+00	0E+00	0E+00	0.000	0.000	0.000	0.000
Inorganics Totals:					0E+00				0.000

Notes:

(1) Only detected organic parameters and inorganics detected above the background concentrations (i.e., the highest detected value in samples from borings SB213, SB214 and SB216) are shown.

(2) Values shown are the highest detected concentrations between the sample and its duplicate, and/or between the results of the Round 1 and Round 2 samples. Analytical results that exceeded the instrument calibration range were not used if a diluted reanalysis was available.

(3) The oral and dermal risks are calculated in accordance with the procedures indicated in Section 5 and Appendix J of the Baseline Risk Assessment. The inhalation risks were calculated in accordance with the procedures in the Illinois Environmental Protection Agency's *Tiered Approach for Corrective Action Objectives*, dated September 16, 1996.

(4) Zero values indicate that the hazard indices are less than 5×10^{-4}.

(5) The calculations use the toxicity factors for trivalent chromium, although the laboratory reported total chromium.

Key:

-- = No toxicity factor is available for this chemical.

= Indicates a total carcinogenic risk above 1×10^{-6} or a total hazard index above 1 for this parameter.

APPENDIX B

CALCULATIONS OF TIER 2 SOIL CLEANUP OBJECTIVES FOR THE MIGRATION TO GROUND WATER PATHWAY

APPENDIX B CALCULATION OF TIER 2 SOIL CLEANUP OBJECTIVES FOR THE MIGRATION TO GROUND WATER PATHWAY

1.0 INTRODUCTION

This appendix presents the methodology followed to calculate soil cleanup objectives (CUOs) for the "migration to ground water pathway" in accordance with the American Society for Testing and Materials Standard E1739-95: *Standard Guide for Risk-based Corrective Action Applied at Petroleum Release Sites* (the "ASTM standard"). As described in Section 2.3.1 of this Feasibility Study Report, soil CUOs for the "migration to ground water pathway" are calculated to determine the need for capping of the soils within the former operational area. Although some of the parameters for which the CUOs were calculated have been detected in the ground water, their presence in the ground water is likely associated with past operation practices and the presence of the light nonaqueous phase liquid at the site. The analysis presented in this appendix was used to evaluate the potential of soil contaminants to impact the ground water to the extent that the Illinois Class I standards would be exceeded.

The calculations presented in this appendix are a combination of two transport models: (1) a leaching model to account for vertical migration of contaminants through the vadose zone, and (2) a steady-state advection-dispersion model to account for horizontal migration through the aquifer. The assumed compliance point for the steady-state advection-dispersion model was the site boundary (i.e., the Illinois Class I ground water standards, the MCLs, or risk-based concentrations would be met at the site boundary).

2.0 *CALCULATION FOR MIGRATION TO CLASS I GROUND WATER*

The calculations performed to determine soil concentrations that are protective of the ground water (i.e., "migration to ground water pathway") are outlined in this section with specific references to Table B-1 of this appendix:

- Column 1 shows (1) the Class I ground water standards, (2) the Maximum Contaminant Level (MCL), or (3) a risk-based calculated concentration for ground water ingestion.

  For those organic compounds exhibiting carcinogenic effects that do not have an Illinois Class I ground water standard or an MCL, ground water objectives were calculated by using the following equation from the ASTM standard:

$$GW_{Comp} = \frac{TR \bullet BW \bullet AT_c \bullet 365\ d/yr}{SF_o \bullet IR_w \bullet EF \bullet ED}$$

  Where:

  GW_{Comp} = Ground water objective at the compliance point, mg/L
  TR = Target cancer risk = 1×10^{-6}
  BW = Adult body weight = 70 Kg
  AT_c = Averaging time for carcinogens = 70 yr
  SF_o = Oral slope factor (compound specific)
  IR_w = Daily water ingestion rate = 2 L/d
  EF = Exposure frequency = 350 d/yr (residential)
  ED = Exposure duration = 30 yr (residential)

  For those organic compounds exhibiting noncarcinogenic effects for which an Illinois Class I ground water standard or an MCL do not exist, ground water objectives were calculated by using the following equation from the ASTM standard:

$$GW_{comp} = \frac{THQ \bullet RfD_O \bullet BW \bullet AT_n \bullet 365\ d/yr \bullet 1{,}000 \frac{\mu g}{mg}}{IR_w \bullet EF \bullet ED}$$

  Where:

  GW_{comp}, BW, IR_w, EF, and ED are as previously defined.
  THQ = Total hazard quotient = 1
  RfD_o = Oral reference dose (compound specific)
  AT_n = Averaging time for noncarcinogens = 30 yr

- Column 2 shows the distance, X, to the property line in feet. This is the distance that is available for attenuation of the contaminants. These distances were converted to centimeters for use in the calculations that follow.

- Column 3 shows the calculation of $C_{(x)}/C_{source}$ by using the advection-dispersion equation from the ASTM standard (the chemical-specific properties used in the calculations are included in Table B-2):

$$\frac{C_{(x)}}{C_{source}} = \exp\left\{\left[\frac{x}{2\alpha_x}\right]\bullet\left[1 - \sqrt{\frac{1 + 4\lambda\alpha_x}{U}}\right]\right\}\bullet \operatorname{erf}\left[\frac{S_w}{4\bullet\sqrt{\alpha_y x}}\right]\bullet \operatorname{erf}\left[\frac{S_d}{4\bullet\sqrt{\alpha_z x}}\right]$$

Where:

$C(x)$ =	Dissolved hydrocarbon concentration along centerline (x, y, = 0, z = 0) of dissolved plume, mg/L
C_{source} =	Dissolved hydrocarbon concentration in dissolved plume source area, mg/L
x =	Distance along centerline from downgradient edge of dissolved plume source zone, cm
α_x =	Longitudinal dispersivity, cm $\simeq$ 0.10 x
α_y =	Transverse dispersivity, cm $\simeq \alpha_x/3$
α_z =	Vertical dispersivity, cm $\simeq \alpha_x/20$
λ =	First-order degradation constant, d^{-1}
S_w =	Source width (perpendicular to flow in the horizontal plane) = assumed 10-foot (305 cm) diameter circle around each soil sampling location (based on the normal soil heterogeneity and the fact that the soil sampling locations had different type, number, and concentration of parameters)
S_d =	Source width (perpendicular to flow in the vertical plane) = 200 cm (ASTM standard default mixing zone thickness)
$U_{d,max}$ =	The maximum contaminant transport rate = $\frac{K_s \bullet i}{\theta_s \bullet R_c}$
R_c =	Contaminant retardation factor = $1 + k_s \bullet \rho_s / \theta_s$
K_s =	Hydraulic conductivity = 2,471 cm/yr (0.0286 cm/s) (geometric mean of unconsolidated materials)
i =	Hydraulic gradient = 0.0035 (site-specific data)
k_s =	Sorption coefficient ($f_{oc} \bullet K_{oc}$), (g/g-soil)/(g-cm^3-water),
f_{oc} =	Fraction of organic carbon in soil = 0.0133 (arithmetic mean of site data)
K_{oc} =	Carbon-water sorption coefficient (chemical-specific), cm^3-water/g-carbon (Table B-2)
ρ_s =	Soil bulk density = 2.2 g/cm^3 (site-specific data for silty gravel)
θ_s =	Porosity of the saturated zone = 0.36 cm^3/cm^3-soil

- Column 4 is the calculated concentration of the contaminant in the mixing zone (GW_{source}) (i.e., the leachate concentration beneath the assumed soil source) obtained by dividing Column 1 by Column 3.

- Column 5 is a published solubility of each compound in water (see Table B-2).

- Column 6 is the minimum concentration between the calculated GW_{source} and the solubility assuming the leachate concentration cannot exceed the solubility limit for a given chemical (i.e., the minimum of Columns 4 and 5).

- Column 7 shows the calculated leaching factor (LF) for contaminants migrating vertically through the vadose zone using the parameters from Table B-2 and the following equation from the ASTM standard:

$$LF = \frac{\rho_s}{\left[\theta_{ws} + (k_s \bullet \rho_s) + (H' \bullet \theta_{as})\right] \bullet \left[1 + \frac{U_{gw} \bullet \delta_{gw}}{I \bullet W}\right]}$$

ρ_s = Soil bulk density = 1.861 g/ cm^3 (site-specific data for silty clay)

θ_{ws} = Volumetric water content in vadose zone soils = 0.12 cm^3_{water}/cm^3_{soil} (ASTM standard default)

k_s = Soil-water partition coefficient: $(K_{oc})(f_{oc})$

K_{oc} = Carbon-water sorption coefficient (chemical-specific), cm^3/g

f_{oc} = Fraction of organic carbon in soil = 0.0133 g/g (arithmetic mean of site data)

H' = Henry's law constant (chemical-specific), dimensionless

θ_{as} = Volumetric air content in vadose zone soils = 0.26 cm^3_{air}/cm^3_{soil} (ASTM standard default)

U_{gw} = Ground water Darcy velocity = $K_s \bullet i$, cm/year

K_s = Hydraulic conductivity = 2,471 cm/yr (0.0286 cm/s) (geometric mean of unconsolidated materials)

i = Hydraulic gradient = 0.0035 (site-specific data)

δ_{gw} = Mixing zone thickness = 200 cm (ASTM standard default value)

W = Width of source area parallel to direction of ground water movement = 305 cm (10 ft) (assumed a 10-foot-diameter circle around each soil sampling location based on the normal soil heterogeneity and the fact that the soil sampling locations had different type, number, and concentration of parameters)

I = Infiltration rate = 30 cm/year (ASTM standard default value)

- Column 8 is the calculated soil concentration obtained by dividing the contaminant concentration in the mixing zone (Column 6) by the leaching factor (Column 7).

- Column 9 is a calculated soil saturation (C_{sat}) concentration for each compound.

  The soil saturation concentrations (C_{sat}) were calculated in accordance with the ASTM standard as follows:

  $$C_{sat} = \frac{S}{\rho_s} \bullet \left[(k_s \bullet \rho_s) + \theta_{ws} + (H' \bullet \theta_{as}) \right]$$

  All variables are defined as for leaching factor equation.

- Column 10 shows the RBCA Tier 2 CUO, which was selected as the minimum of the soil saturation concentration (Column 9) and the calculated soil concentration for the "migration to ground water pathway" (Column 8).

TABLES

TABLE B-1

CALCULATION OF RBCA TIER 2 SOIL CLEANUP OBJECTIVES
LENZ OIL SITE
LEMONT, ILLINOIS

Parameter	COLUMN 1 Ground Water Objectives[1] (mg/L)	COLUMN 2 X (feet)	COLUMN 3 $\frac{C_x}{C_{source}}$	COLUMN 4 Calculated GW_{source} (mg/L)	COLUMN 5 Water Solubility (mg/L)	COLUMN 6 Selected GW_{source} (mg/L)	COLUMN 7 Leaching Factor mg/L-water / mg/kg-soil	COLUMN 8 Calculated Soil concentration (mg/kg)	COLUMN 9 Soil Saturation Concentration (mg/kg)	COLUMN 10 RBCA Tier 2 CUO (mg/kg)
Methylene chloride	0.005	156	5.06E-04	9.9	13,000	9.9	0.04741	208	3,918	208
2-Butanone	21,900	158	6.82E-06	3,211,327,695	268,000	268,000	0.07153	3,746,822	53,527	53,527
Trichloroethene	0.005	68	5.03E-02	0.099	1,100	0.099	0.00601	16.6	2,616	16.6
Benzene	0.005	14	7.45E-01	0.0067	1,750	0.0067	0.01521	0.441	1,643	0.441
trans-1,3-Dichloropropene	0.487	36	2.48E-01	1.96	2,800	1.96	0.01796	109	2,227	109
Tetrachloroethene	0.005	68	2.98E-02	0.168	200	0.168	0.00634	26.5	451	26.5
4-Methylphenol	183	264	1.94E-26	9.40E+27	31,000	31,000	0.00210	14,756,180	210,807	210,807
Isophorone	0.2	300	5.78E-03	34.6	12,000	34.6	0.01872	1,847	9,158	1,847
2,6-Dinitrotoluene[2]	36.5	423	2.10E-05	1,735,637	182	182	0.01346	13,524	193	193
Dibenzofuran	146	68	1.82E-02	8,016	10.0	10.0	0.10225	97.8	1.40	1.40
n-Nitrosodiphenylamine	17.4	130	1.76E-18	9.85E+18	35.1	35.1	0.00082	42,564	608	608
Carbazole	4.26	110	3.28E-02	130	7.48	130	0.00032	412,052	NA	412,052
Benzo(a)anthracene	0.117	110	4.75E-66	2.45E+64	0.0094	0.0094	2.69E-06	3,489	49.8	49.8
Benzo(b)fluoranthene	0.117	110	1.14E-122	1.03E+121	0.0015	0.0015	8.72E-07	1,720	24.6	24.6
Dieldrin	0.005	14	1.76E-03	3.03	0.195	0.195	5.01E-05	3,893	55.6	55.6
Aroclor-1242	0.0005	256	6.15E-03	0.081	0.700	0.081	3.47E-06	23,430	2,881	2,881
Aroclor-1254	0.0005	215	8.70E-03	0.057	0.700	0.057	3.47E-06	16,551	2,881	2,881
Aroclor-1260	0.0005	110	3.28E-02	0.015	0.700	0.015	3.47E-06	4,397	2,881	2,881

Key:
RBCA = Risk-based corrective action
X = Distance along centerline from downgradient edge of dissolved plume source zone
C_x = Dissolved hydrocarbon concentration along centerline of dissolved plume
C_{source} = Dissolved hydrocarbon concentration in dissolved plume
CUO = Clean-up objective
NA = Information not available

[1] The values used were (in order of priority) the Illinois Class I ground water standard, the MCL, or a calculated risk-based value for ground water ingestion.
[2] 2,6-dinitrotoluene was detected at piezometer location P24 during the LNAPL investigation. The assumed compliance point was the Des Plaines River.

TABLE B-2

CHEMICAL PROPERTIES USED IN RBCA TIER 2 CALCULATIONS
LENZ OIL SITE
LEMONT, ILLINOIS

Parameter	*Solubility* (mg/L)		*Henry's Law Constant* (dimensionless)		*Organic Carbon Water Partition Coefficient (Koc)* (cm^3/g)		*Soil Water Sorption Coefficient (Ks)* [1] (cm^3/g)	*Half Life in Ground Water* (days)		*Degradation Constant* [2] ($days^{-1}$)
Methylene chloride	13,000	(3)	0.0898	(3)	11.7	(3)	0.16	56	(5)	0.012
2-Butanone	268,000	(4)	0.0011	(4)	4.5	(4)	0.06	14	(5)	0.050
Trichloroethene	1,100	(3)	0.422	(3)	166	(3)	2.21	1,643	(5)	0.0004
Benzene	1,750	(3)	0.228	(3)	58.9	(3)	0.78	720	(5)	0.0010
trans-1,3-Dichloropropene[7]	2800	(3)	0.726	(3)	45.7	(3)	0.61	112	(5)	0.0062
Tetrachloroethene	200	(3)	0.754	(3)	155	(3)	2.06	720	(5)	0.0010
4-Methylphenol	31,000	(4)	0.0000457	(4)	500	(4)	6.66	28	(5)	0.0248
Isophorone	12,000	(3)	0.000272	(3)	47	(3)	0.62	56	(5)	0.0124
2,6-Dinitrotoluene	182	(3)	0.0000306	(3)	69	(3)	0.92	360	(5)	0.0019
Dibenzofuran	10	(4)	NA		NA		NA	35	(5)	0.0199
n-Nitrosodiphenylamine	35.1	(3)	0.000205	(3)	1290	(3)	17.18	68	(5)	0.0102
Benzo(a)anthracene	0.0094	(3)	0.000137	(3)	398,000	(3)	5,302	1,360	(5)	0.0005
Benzo(b)fluoranthene	0.0015	(3)	0.00455	(3)	1,230,000	(3)	16,385	1,220	(5)	0.0006
Dieldrin	0.195	(3)	0.000619	(3)	21,400	(3)	285	2,160	(5)	0.0003
Aroclor-1242	0.7	(2,6)	NA		309,000	(2,6)	4,116			NA
Aroclor-1254	0.7	(2,6)	NA		309,000	(2,6)	4,116			NA
Aroclor-1260	0.7	(2,6)	NA		309,000	(2,6)	4,116			NA

Key:

NA = Not available

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(1) Calculated by mutiplying fraction organic carbon (0.0133 arithmetic mean of site data) by the organic carbon partition coefficient.

(2) Calculated by dividing the natural log of 2 by the half life expressed in units of days.

(3) From USEPA. *Soil Screening Guidance: User's Guide.* USEPA Office of Solid Waste and Emergency Response, April 1996 EPA/540/R-96/018 (PB96-963505).

(4) From U.S. EPA. *Superfund Public Health Evaluation Manual.* USEPA: Washington, D.C.; October 1986.

(5) The values used were the reported half lives in ground water from Howard P.H., Boethling R.S., Jarvis W.F., Meylan W.M., and *Michalenko E.M. Handbook of Environmental Degradation Rates.* Printup H.T., ed. Lewis Publishers: Chelsea, Michigan; 1991.

(6) Property is listed for polychlorinated biphenyls in *Soil Screening Grudance: User's Guide* as opposed to individual Aroclors.

(7) Values are reported for 1,3-dichloropropene.

APPENDIX C

COST ESTIMATES

APPENDIX C COST ESTIMATES

This appendix presents the calculations performed to obtain the cost estimates included in Section 3.0 of this Feasibility Study and used in the detailed evaluation of remedial alternatives. The cost estimates are presented as follows:

- Table C-1: Summary of the capital cost for each alternative.
- Tables C-2 through C-23: Capital cost for each activity.
- Table C-24: Summary of the operation and maintenance (O&M) cost for each alternative.
- Tables C-25 to C-30: O&M cost for each activity (as required).
- Table C-31 to C-33: Summary of the present value costs for 3%, 5%, and 10% discount rates.
- Table C-34: Present value calculations.
- Attachment 1: Basis for the cost estimates.
- Attachment 2: Predesign investigation cost estimates.
- Attachment 3: Cost estimates for the following additional scenarios, including only tables that need to be modified because of the change in the soil volumes:
    - Remediation of soils that exceed the 1×10^{-5} cancer risk under the future on-site resident scenario: Tables C-1a, C-7a, C-8a, C-9a, C-10a, C-31a, C-32a, C-33a, and C-34a.
    - Remediation of soils that exceeds the 1×10^{-6} cancer risk under the future on-site resident scenario: Tables C-1b, C-7b, C-8b, C-9b, C-10b, C-31b, C-32b, C-33b, and C-34b.
    - Remediation of soils that exceed the 1×10^{-5} cancer risk under the current adjacent resident scenario: Tables C-1c, C-7c, C-8c, C-9c, C-10c, C-31c, C-32c, C-33c, and C-34c.
    - Remediation of soils that exceed the 1×10^{-6} cancer risk under the current adjacent resident scenario: Tables C-1d, C-7d, C-8d, C-9d, C-10d, C-31d, C-32d, C-33d, and C-34d.

The soil volumes used in these additional cost calculations were determined by adding a 45° slope of excavation to the computer-generated areas of the various zones to be remediated and multiplying the result by a depth of 5 feet.

The following costs, which are the same for Alternatives 2 through 9, are included under the "Common Activities" category shown in the various cost tables:

- Installing the new monitoring wells and the new piezometers and performing the predesign investigation to determine the extent of the LNAPL and ground water contamination (included with the predesign investigation cost),

- Installing the fence and implementing the deed restrictions,

- Maintaining the fence for a period of 30 years, and

- Monitoring the ground water quality and the thickness of the LNAPL for a period of 30 years.

The calculations performed to determine the thickness of each geologic layer that would be encountered during excavation of the trenches and the light nonaqueous phase liquid areas are described in the next paragraphs. The actual data used and calculated thicknesses are shown in Table C-1-3 of Attachment 1 to this appendix. References to "columns" in the following paragraphs refer to the labeled columns on Table C-1-3.

In order to estimate the soil management costs of the trench installation, excavated materials were divided into the following six categories:

- Clean soils which are present at the ground surface and have not come into contact with the ground water or LNAPL,

- Ground water saturated soils and gravels which are soils and gravels that have likely been in contact with ground water at the site but do not appear to be LNAPL impacted,

- LNAPL impacted soils which are those the boring logs indicate are stained with LNAPL,

- Clean bedrock which has not come into contact with the ground water due to confined aquifer conditions,

- Ground water saturated bedrock which is beneath the ground water table part of the year, and

- LNAPL impacted bedrock where piezometers and boring logs indicate that LNAPL is present in the bedrock but the exact thickness is unclear.

The calculation of the predicted material thicknesses was performed as indicated below.

The aquifer conditions (Column A) were determined by reviewing the RI and Technical Memorandum No. 4. Unconfined conditions are generally present at the future location of Trench N and Area 2, while confined conditions are generally present at the future locations of Trenches M, S, and P. It is important to determine the aquifer conditions because the true thickness of saturated soil is dependent not only on the piezometric surface elevation but also which soils will be saturated. At confined locations, the depth to water (Column B) was estimated from boring logs to predict the water table elevation for confined conditions.

The October 25, 1994 water levels (Column C) from Technical Memorandum No. 4 were used to estimate the maximum elevation of saturated materials (Column D) for unconfined conditions by subtracting the October 25, 1994 ground water elevation G106L from the maximum ground water elevation observed at G106L during all investigations at the site and adding the difference to the October 25, 1996 ground water elevation at each well location. At confined locations, maximum elevation of saturated materials was selected as the minimum of: 1) the maximum elevation of saturated materials calculated for unconfined conditions, and 2) the water table elevation determined from the depth to water during drilling.

The minimum predicted elevation of saturated materials was calculated for unconfined conditions by subtracting the minimum ground water elevation observed at G106L during all investigations at the site from the October 25, 1994 ground water elevation G106L, and subtracting the difference from the October 25, 1994 ground water elevation at each well location. At confined locations, the minimum predicted elevation of saturated materials was selected as the minimum of: 1) the minimum elevation of saturated materials calculated for unconfined conditions, and 2) the water table elevation determined from the depth to water during drilling. The ground elevation (Column F), bedrock elevation (Column G), depth to LNAPL impacted materials (Column H), maximum depth of LNAPL impact (Column I), maximum elevation of LNAPL impact (Column J), and minimum elevation of LNAPL impact (Column K) were

determined from soil boring log descriptions and the associated survey data.

The elevation of the base of the trench (Column L) was calculated by subtracting 2.5 feet from the minimum predicted elevation of saturated materials in order to consider draw dawn of the ground water table during ground water extraction.

The thickness of each soil type (represented as Columns M through R on Table C-1-3) was calculated as follows:

Column M = Column F - *Maximum* (Columns D, F, G, J)

Column N = Column D - (*Maximum* (Columns F, L) + Column O)

Column O = *If* Column G < Column J *then* Column O is equal to Column J - *Maximum* (Columns K, L) *else* it is 0

Column P = *If* Column G > Column D *then* Column P is equal to Column G - Column D *else* it is 0

Column Q = *If* Column L < Column G *then* Column Q is the *Minimum*(Columns D, N) - Column L - Column R) *else* it is 0

Column R= *If* Column G > Column K *then* {*If* Column J > Column G then Column R is equal to Column G - *Maximum*(Columns K, L) *else* it is Column J - *Maximum*(Columns K, L)} *else* Column R is 0

The footage along Trenches N, M, S, and P (Columns S through V on Table C-1-3) were measured from the site survey map and proposed trench locations. Weighted average statistics for each trench and area were determined by multiplying the value by the footage along the trench(es) and dividing this derived quantity by the total footage of the trench(es).

TABLES

TABLE C-1
CAPITAL COST ESTIMATE SUMMARY - FUTURE ON-SITE RESIDENT, 1E-04 SOIL
LENZ OIL SITE
LEMONT, ILLINOIS

Process Option	Table Number	1	2	3	4	5	5a	6	6a	7	8	9
Common Activities	Table C-2	$ -	$ 314,389	$ 314,389	$ 314,389	$ 314,389	$ 314,389	$ 314,389	$ 314,389	$ 314,389	$ 314,389	$ 314,389
Covers												
Multilayered Cap	Table C-3	$ -	$ 3,014,381	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Solid Waste Cap	Table C-4	$ -	$ -	$ 1,715,515	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Asphalt Cap	Table C-5	$ -	$ -	$ -	$ 2,066,638	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Concrete Cap	Table C-6	$ -	$ -	$ -	$ 2,167,828	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Remediation of 1.0E-04 Unconsolidated Soils												
Off-Site Disposal												
RCRA Subtitle D	Table C-8	$ -	$ -	$ -	$ -	$ 515,483	$ -	$ 515,483	$ -	$ -	$ -	$ -
On-Site Treatment												
Ex Situ Solidification/Stabilization (S/S)	Table C-9	$ -	$ -	$ -	$ -	$ -	$ 670,710	$ -	$ 670,710	$ 670,710	$ 670,710	$ 670,710
Low Temperature Thermal Desorption (LTTD)	Table C-10	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,501,705	$ 2,501,705	$ 2,501,705
LNAPL												
LNAPL Recovery - Passive 4 trenches	Table C-11	$ -	$ 1,679,842	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
LNAPL Recovery - Active 2 trenches	Table C-12	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,696,350	$ -	$ -
LNAPL Recovery - Active 3 Trenches	Table C-13	$ -	$ -	$ 2,136,928	$ 2,136,928	$ 2,136,928	$ 2,136,928	$ -	$ -	$ -	$ 2,136,928	$ -
LNAPL Recovery - Active 4 Trenches	Table C-14	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,444,342	$ 2,444,342	$ -	$ -	$ -
Enhanced LNAPL Recovery - Surfactants 3 trenches	Table C-15	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,323,598	$ -
Enhanced LNAPL Recovery - Surfactants 4 trenches	Table C-16	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,178,684	$ 2,178,684	$ -	$ -	$ -
LNAPL Soil Excavation and LTTD Treatment	Table C-19	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,578,525	$ 5,578,525	$ -
LNAPL Soil Excavation and *Ex Situ* S/S	Table C-19a	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,161,739	$ 3,161,739	$ -
LNAPL Soil & Rock Excavation and LTTD Treatment	Table C-20	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 8,089,469
LNAPL Soil & Rock Excavation and *Ex Situ* S/S	Table C-20a	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,204,770
Ground Water												
Ground Water Recovery Wells - No surfactant	Table C-21	$ -	$ -	$ 677,311	$ 677,311	$ 677,311	$ 677,311	$ -	$ -	$ 677,311	$ -	$ -
Ground Water Recovery Wells - Surfactants	Table C-21	$ -	$ -	$ -	$ -	$ -	$ -	$ 677,311	$ 677,311	$ -	$ 677,311	$ -
Ground Water Treatment System												
Active Recovery with 2 trenches	Table C-22	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,664,765	$ -	$ -
Active Recovery with 3 trenches	Table C-22	$ -	$ -	$ 2,664,765	$ 2,664,765	$ 2,664,765	$ 2,664,765	$ -	$ -	$ -	$ -	$ -
Enhanced Recovery with 3 trenches	Table C-23	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,425,424	$ -
Enhanced Recovery with 4 trenches	Table C-23	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,425,424	$ 3,425,424	$ -	$ -	$ -
Total Cost (minimum)		$ -	$ 5,008,612	$ 7,508,909	$ 7,860,032	$ 6,308,877	$ 6,464,104	$ 9,555,633	$ 9,710,860	$ 9,185,264	$ 11,710,099	$ 6,189,869
Total Cost (maximum)		$ -	$ 5,008,612	$ 7,508,909	$ 7,961,222	$ 6,308,877	$ 6,464,104	$ 9,555,633	$ 9,710,860	$ 13,433,045	$ 15,957,880	$ 10,905,563

Table C-2
Lenz Oil - Capital Cost Estimate
Common Activities

Item	Units	Calculated Quantity	Design Quantity	Unit Price	Total Price	Calculated Quantity or Disposal Remarks	Unit Price Source (1)
Institutional Controls							
Fencing	lf	1,938	1,950	$ 14.39	$ 28,064	Property perimeter	Means 015-304-0100
Signs	ea	10	10	$ 25.00	$ 250	One every 200 feet of fence	ERM estimate
Deed restrictions	ls	1	1	$ 10,000	$ 10,000	ERM estimate	ERM estimate
Groundwater Monitoring (included in predesign ground water and LNAPL sampling below)	ls	0	0	$ -	$ -		
Subtotal					$ 38,314		
Design engineering	%	15.00%			$ 5,747		
Construction management	%	25.00%			$ 9,579		
Insurance	%	2.50%			$ 958		
Permitting and legal fees	ls	1	1	$ 10,000	$ 10,000		ERM estimate
Predesign ground water and LNAPL sampling	ls	1	1	$ 177,240	$ 177,240	See page 1 of Table C-2-1 in Attachment 2.	ERM estimate
Subtotal					$ 241,838		
Contingency	%	30.00%			$ 72,551		
Total					$ 314,389		

Notes
1 ERM estimate includes overhead and profit. 1996 Means Site Work - 15th Edition, plus 12% overhead and profit.
1996 Means Mechanical Work - 19th Edition, plus 12% overhead and profit.

Table C-3
Lenz Oil - Capital Cost Estimate
Multilayered Cap

Item	Units	Calculated Quantity	Design Quantity	Unit Price	Total Price	Calculated Quantity Remarks	Unit Price Source (1)
Mobilization	ls	1	1	$ 10,000	$ 10,000	ERM estimate	ERM estimate
Surveying	ls	1	1	$ 2,000	$ 2,000	ERM estimate	ERM estimate
Site clearing	sf	214,789	215,000	$ 0.07	$ 14,096	Property area	Means 021-104-0250
Fence removal	lf	1,938	1,950	$ 2.61	$ 5,089	Property perimeter	Means 020-554-0700
Rubbish disposal	cy	100	100	$ 53.20	$ 5,320	ERM estimate	Means 020-620-3000
Ditch excavation	cy	1,054	1,100	$ 9.07	$ 9,979	Cover perimeter length of 1,898 ft (2) Cross-section volume of 0.56 cy/ft	Means 022-242-4440
Ditch leveling	days	5	5	$ 600	$ 3,000	ERM estimate	ERM estimate
Multilayered cap (2)							
Additional fill layer	cy	18,414	18,500	$ 7.00	$ 129,500	Assumed flat surface - area of 195,814 sf, depth of 2.55 ft Require 3 % slope	S&K Excavation
Fill placement	cy	18,414	18,500	$ 3.10	$ 57,394	See above	Means 022-246-1050
Fill compaction	cy	18,414	18,500	$ 0.35	$ 6,423	See above	Means 022-226-5000
Fill grading	sy	21,757	21,800	$ 1.97	$ 42,972	Area of 195,814 sf	Means 025-122-1050
Clay layer	cy	14,711	14,800	$ 11.00	$ 162,800	Area of 195,814 sf - thickness of 2 ft	S&K Excavation
Clay placement	cy	14,711	14,800	$ 3.10	$ 45,916	See above	Means 022-246-1050
Clay compaction	cy	14,711	14,800	$ 0.35	$ 5,139	See above	Means 022-226-5000
Flexible membrane liner	sf	195,814	196,000	$ 0.70	$ 137,200	Area of 195,814 sf - 40 mil thickness	National Seal
Sand layer	cy	3,678	3,700	$ 12.56	$ 46,454	Area of 195,814 sf - thickness of 0.5 ft	Dee-N-Dee Trucking
Sand placement	cy	3,678	3,700	$ 3.10	$ 11,479	See above	Means 022-246-1050
Sand compaction	cy	3,678	3,700	$ 0.35	$ 1,285	See above	Means 022-226-5000
Geocomposite drainage layer	sf	195,814	196,000	$ 0.68	$ 133,280	Area of 195,814 sf - 300 mil thickness	National Seal
Protective soil layer	cy	17,138	17,200	$ 7.00	$ 120,400	Area of 195,814 sf - thickness of 2.33 ft	S&K Excavation
Soil placement	cy	17,138	17,200	$ 3.10	$ 53,361	See above	Means 022-246-1050
Soil compaction	cy	17,138	17,200	$ 0.35	$ 5,972	See above	Means 022-226-5000
Topsoil layer	cy	3,678	3,700	$ 13.00	$ 48,100	Area of 195,814 sf - thickness of 0.5 ft	S&K Excavation
Topsoil placement	cy	3,678	3,700	$ 3.10	$ 11,479	See above	Means 022-246-1050
Topsoil compaction	cy	3,678	3,700	$ 0.35	$ 1,285	See above	Means 022-226-5000
Seeding	sf	195,814	196,000	$ 0.52	$ 100,979	Area of 195,814 sf	Means 029-308-0200
Rip-rap stone	sf	47,996	48,000	$ 9.58	$ 459,648	6 in on perimeter - 1,846 ft cover perimeter by 26 ft slope length	Means 022-712-0400 & 0110
Demobilization	ls	1	1	$ 10,000	$ 10,000	ERM estimate	ERM estimate
Subtotal					$ 1,640,549		
Design engineering	%	15.00%			$ 246,082		
Construction management	%	20.00%			$ 328,110		
Insurance	%	2.50%			$ 41,014		
Permitting and legal fees	ls	1	1	$ 20,000	$ 20,000		ERM estimate
Testing	ls	1	1	$ 20,000	$ 20,000	Analysis of cover materials to verify they are free of contaminants and in place tests.	ERM estimate
Drainage and surface water effects study	ls	1	1	$ 23,000	$ 23,000	See page 2 of Table C-2-2 in Attachment 2.	ERM estimate
Subtotal					$ 2,318,755		
Contingency	%	30.00%			$ 695,626		
Total					$ 3,014,381		

Notes

1 ERM estimate includes overhead and profit. 1996 Means Site Work - 15th Edition, plus 12% overhead and profit.
1996 Means Mechanical Work - 19th Edition, plus 12% overhead and profit.

2 See Table C-1-2 of Attachment 1 for the calculation of the cover perimeter and the volumes of each layer.

Table C-4
Lenz Oil - Capital Cost Estimate
Solid Waste Cap

Item	Units	Calculated Quantity	Design Quantity	Unit Price	Total Price	Calculated Quantity Remarks	Unit Price Source (1)
Mobilization	ls	1	1	$ 10,000	$ 10,000	ERM estimate	ERM estimate
Surveying	ls	1	1	$ 2,000	$ 2,000	ERM estimate	ERM estimate
Site Clearing	sf	214,789	215,000	$ 0.07	$ 14,096	Property area	Means 021-104-0250
Fence Removal	lf	1,938	1,950	$ 2.61	$ 5,089	Property perimeter	Means 020-554-0700
Rubbish Disposal	cy	100	100	$ 53.20	$ 5,320	ERM estimate	Means 020-620-3000
Ditch Excavation	cy	1,054	1,100	$ 9.07	$ 9,979	Cover perimeter length of 1,898 ft (2) Cross-section volume of 0.56 cy/ft	Means 022-242-4440
Ditch Leveling	days	5	5	$ 600	$ 3,000	ERM estimate	ERM estimate
Solid Waste Cap (2)							
Additional fill layer	cy	12,276	12,300	$ 7.00	$ 86,100	Assumed flat surface - area of 195,814 sf, depth of 1.7 ft Require 2 % slope	S&K Excavation
Fill placement	cy	12,276	12,300	$ 3.10	$ 38,160	See above	Means 022-246-1050
Fill compaction	cy	12,276	12,300	$ 0.35	$ 4,271	See above	Means 022-226-5000
Fill grading	sy	21,757	21,800	$ 1.97	$ 42,972	Area of 195,814 sf	Means 025-122-1050
Protective soil layer	cy	18,388	18,400	$ 7.00	$ 128,800	Area of 195,814 sf - thickness of 2.5 ft	S&K Excavation
Soil placement	cy	18,388	18,400	$ 3.10	$ 57,084	See above	Means 022-246-1050
Soil compaction	cy	18,388	18,400	$ 0.35	$ 6,388	See above	Means 022-226-5000
Topsoil layer	cy	3,678	3,700	$ 13.00	$ 48,100	Area of 195,814 sf - thickness of 0.5 ft	S&K Excavation
Topsoil placement	cy	3,678	3,700	$ 3.10	$ 11,479	See above	Means 022-246-1050
Topsoil compaction	cy	3,678	3,700	$ 0.35	$ 1,285	See above	Means 022-226-5000
Seeding	sf	195,814	196,000	$ 0.52	$ 100,979	Area of 195,814 sf	Means 029-308-0200
Rip Rap Stone	sf	35,369	35,400	$ 9.58	$ 338,990	6 in on perimeter - 1,862 ft cover perimeter by 19 ft slope length	Means 022-712-0400 & 0110
Demobilization	ls	1	1	$ 10,000	$ 10,000	ERM estimate	ERM estimate
Subtotal					$ 924,092		
Design engineering	%	15.00%			$ 138,614		
Construction management	%	20.00%			$ 184,818		
Insurance	%	2.50%			$ 23,102		
Permitting and legal fees	ls	1	1	$ 20,000	$ 20,000		ERM estimate
Testing	ls	1	1	$ 6,000	$ 6,000	Analysis of cover materials to verify they are free of contaminants.	ERM estimate
Drainage and surface water effects study	ls	1	1	$ 23,000	$ 23,000	See page 2 of Table C-2-1 in Attachment 2.	ERM estimate
Subtotal					$ 1,319,627		
Contingency	%	30.00%			$ 395,888		
Total					$ 1,715,515		

Notes
1 ERM estimate includes overhead and profit. 1996 Means Site Work - 15th Edition, plus 12% overhead and profit.
1996 Means Mechanical Work - 19th Edition, plus 12% overhead and profit.
2 See Table C-1-1 of Attachment 1 for the calculation of the cover perimeter and the volumes of each layer.

Table C-5
Lenz Oil - Capital Cost Estimate
Asphalt Cap

Item	Units	Calculated Quantity	Design Quantity	Unit Price	Total Price	Calculated Quantity Remarks	Unit Price Source (1)
Mobilization	ls	1	1	$ 10,000	$ 10,000	ERM estimate	ERM estimate
Surveying	ls	1	1	$ 2,000	$ 2,000	ERM estimate	ERM estimate
Site Clearing	sf	214,789	215,000	$ 0.07	$ 14,096	Property area	Means 021-104-0250
Fence Removal	lf	1,938	1,950	$ 2.61	$ 5,089	Property perimeter	Means 020-554-0700
Rubbish Disposal	cy	100	100	$ 53.20	$ 5,320	ERM estimate	Means 020-620-3000
Ditch Excavation	cy	1,054	1,100	$ 9.07	$ 9,979	Cover perimeter length of 1,898 ft (2) Cross-section volume of 0.56 cy/ft	Means 022-242-4440
Ditch Leveling	days	5	5	$ 600	$ 3,000	ERM estimate	ERM estimate
Asphalt Cap (2)							
Additional fill layer	cy	6,138	6,200	$ 7.00	$ 43,400	Assumed flat surface - area of 195,814 sf, depth of 0.9 ft Require 1 % slope	S&K Excavation
Fill placement	cy	6,138	6,200	$ 3.10	$ 19,235	See above	Means 022-246-1050
Fill compaction	cy	6,138	6,200	$ 0.35	$ 2,153	See above	Means 022-226-5000
Fill grading	sy	21,757	21,800	$ 1.97	$ 42,972	Area of 195,814 sf	Means 025-122-1050
Aggregate base layer	cy	7,252	7,300	$ 15.15	$ 110,595	Area of 195,814 sf - thickness of 1 ft	Dee-N-Dee Trucking
Aggregate placement	cy	7,252	7,300	$ 3.10	$ 22,648	See above	Means 022-246-1050
Aggregate compaction	cy	7,252	7,300	$ 0.35	$ 2,535	See above	Means 022-226-5000
Binder coarse layer	sy	21,757	21,800	$ 19.08	$ 416,049	Area of 195,814 sf - thickness of 8 in	Means 025-104-0200
Wear resistant layer	sy	21,757	21,800	$ 4.63	$ 100,838	Area of 195,814 sf - thickness of 2 in	Means 025-104-0380
Surface treatment	sy	21,757	21,800	$ 1.59	$ 34,671	Area of 195,814 sf	Means 025-450-3040
Rip Rap Stone	sf	27,930	28,000	$ 9.58	$ 268,128	6 in on perimeter - 1,862 ft perimeter by 15 ft slope length	Means 022-712-0400 & 0110
Demobilization	ls	1	1	$ 10,000	$ 10,000	ERM estimate	ERM estimate
Subtotal					$ 1,122,707		
Design engineering	%	15.00%			$ 168,406		
Construction management	%	20.00%			$ 224,541		
Insurance	%	2.50%			$ 28,068		
Permitting and legal fees	ls	1	1	$ 20,000	$ 20,000		ERM estimate
Testing	ls	1	1	$ 3,000	$ 3,000	Analysis of cover materials to verify soils are free of contaminants.	ERM estimate
Drainage and surface water effects study	ls	1	1	$ 23,000	$ 23,000	See page 2 of Table C-2-1 in Attachment 2.	ERM estimate
Subtotal					$ 1,589,721		
Contingency	%	30.00%			$ 476,916		
Total					$ 2,066,638		

Notes
1 ERM estimate includes overhead and profit. 1996 Means Site Work - 15th Edition, plus 12% overhead and profit.
1996 Means Mechanical Work - 19th Edition, plus 12% overhead and profit.
2 See Table C-1-2 of Attachment 1 for the calculation of the cover perimeter and the volumes of each layer.

Table C-6
Lenz Oil - Capital Cost Estimate
Concrete Cap

Item	Units	Calculated Quantity	Design Quantity	Unit Price	Total Price	Calculated Quantity Remarks	Unit Price Source (1)
Mobilization	ls	1	1	$ 10,000	$ 10,000	ERM estimate	ERM estimate
Surveying	ls	1	1	$ 2,000	$ 2,000	ERM estimate	ERM estimate
Site Clearing	sf	214,789	215,000	$ 0.07	$ 14,096	Property area	Means 021-104-0250
Fence Removal	lf	1,938	1,950	$ 2.61	$ 5,089	Property perimeter	Means 020-554-0700
Rubbish Disposal	cy	100	100	$ 53.20	$ 5,320	ERM estimate	Means 020-620-3000
Ditch Excavation	cy	1,054	1,100	$ 9.07	$ 9,979	Cover perimeter length of 1,898 ft (2) Cross-section volume of 0.56 cy/ft	Means 022-242-4440
Ditch Leveling	days	5	5	$ 600	$ 3,000	ERM estimate	ERM estimate
Concrete cap (2)							
Additional fill layer	cy	6,138	6,200	$ 7.00	$ 43,400	Assumed flat surface - area of 195,814 sf, depth of 0.9 ft Require 1 % slope	S&K Excavation
Fill placement	cy	6,138	6,200	$ 3.10	$ 19,235	See above	Means 022-246-1050
Fill compaction	cy	6,138	6,200	$ 0.35	$ 2,153	See above	Means 022-226-5000
Fill grading	sy	21,757	21,800	$ 1.97	$ 42,972	Area of 195,814 sf	Means 025-122-1050
Aggregate base layer	cy	7,252	7,300	$ 15.15	$ 110,595	Area of 195,814 sf - thickness of 1 ft	Dee-N-Dee Trucking
Aggregate placement	cy	7,252	7,300	$ 3.10	$ 22,648	See above	Means 022-246-1050
Aggregate compaction	cy	7,252	7,300	$ 0.35	$ 2,535	See above	Means 022-226-5000
Slab on grade with joints	sf	195,814	195,200	$ 2.54	$ 496,167	8 in depth	Means 026-120-0100
Welded wire fabric	msf	1,958	2,000	$ 56.00	$ 112,000	6" x 6" size	Means 025-120-0600
Rip Rap Stone	sf	27,930	28,000	$ 9.58	$ 268,128	6 in on perimeter - 1,862 ft perimeter by 15 ft slope length	Means 022-712-0400 & 0110
Demobilization	ls	1	1	$ 10,000	$ 10,000	ERM estimate	ERM estimate
Subtotal					$ 1,179,316		
Design engineering	%	15.00%			$ 176,897		
Construction management	%	20.00%			$ 235,863		
Insurance	%	2.50%			$ 29,483		
Permitting and legal fees	ls	1	1	$ 20,000	$ 20,000		ERM estimate
Testing	ls	1	1	$ 3,000	$ 3,000	Analysis of cover materials to verify soils are free of contaminants.	ERM estimate
Drainage and surface water effects study	ls	1	1	$ 23,000	$ 23,000	See page 2 of Table C-2-1 in Attachment 2.	ERM estimate
Subtotal					$ 1,667,560		
Contingency	%	30.00%			$ 500,268		
Total					$ 2,167,828		

Notes
1 ERM estimate includes overhead and profit. 1996 Means Site Work - 15th Edition, plus 12% overhead and profit.
1996 Means Mechanical Work - 19th Edition, plus 12% overhead and profit.
2 See Table C-1-2 of Attachment 1 for the calculation of the cover perimeter and the volumes of each layer.

Table C-7
Lenz Oil - Capital Cost Estimate - Future On-site Resident
Remediation of 1.0E-04 Unconsolidated Soils - Base Costs

Item	Units	Calculated Quantity	Design Quantity	Unit Price	Total Price	Calculated Quantity Remarks	Unit Price Source (1)
Mobilization	ls	1	1	$ 10,000	$ 10,000	ERM estimate	ERM estimate
Surveying	ls	1	1	$ 1,000	$ 1,000	ERM estimate	ERM estimate
Excavation of areas							
Area X material to be treated/disposed	cy	1,844	1,850	$ 13.04	$ 24,126	126 ft by 71 ft by 5 ft depth + slopes = ((126+5)*(71+5)*5)/27	Means 022-238-0500/0020/4250
Area Y material to be treated/disposed	cy	74	80	$ 13.04	$ 1,043	16 ft by 14 ft by 5 ft depth + slopes = ((16+5)*(14+5)*5)/27	Means 022-238-0500/0020/4250
Area Z material to be treated/disposed	cy	224	230	$ 13.04	$ 2,999	34 ft by 26 ft by 5 ft depth + slopes = ((34+5)*(26+5)*5)/27	Means 022-238-0500/0020/4250
Subtotal excavated	cy	2,141	2,160				
Subtotal treated/disposed	cy	2,141	2,160				
Excavation/treatment duration	wk	2.4	3			Excavation/treatment rate of 900 cy/wk (2)	
Air monitoring with an HNu	wk	2.4	3	$ 2,000	$ 6,000	Labor and materials	ERM estimate
H&S equipment	wk	2.4	3	$ 2,000	$ 6,000	ERM estimate	ERM estimate
Decontamination materials and labor	wk	2.4	3	$ 300	$ 900	ERM estimate	ERM estimate
Decon water storage	gal	714	900	$ 0.10	$ 90	300 gal per week	Baker Tank
Decon water disposal (includes trucking)	gal	714	900	$ 0.73	$ 661	RCRA Subtitle C Treatment	Rollins Envir., Inc. @ Deer Park, TX
Demobilization	ls	1	1	$ 5,000	$ 5,000	ERM estimate	ERM estimate
Subtotal (Soils base)					$ 57,819		

Notes
1 ERM estimate includes overhead and profit. 1996 Means Site Work - 15th Edition, plus 12% overhead and profit.
1996 Means Mechanical Work - 19th Edition, plus 12% overhead and profit.
2 Excavation and treatment rates are based on the following assumptions:
LTTD
Treatment rate of 10 tons or 7.4 cubic yards per hour.
System operating 24 hours a day - 7 days a week, at 75 percent utilization.
Average treatment rate 932 cy/wk (used 900 cy/wk)
SS
Treatment rate of 30 cubic yards per hour.
System operating 8 hours a day - 5 days a week, at 75 percent utilization.
Average treatment rate 900 cy/wk
Off-site Disposal
Loading two to three 15 cubic yard trucks a hour.
Excavating 6 hours a day - 5 days a week.
Minimum excavation rate 900 cy/wk (used 900 cy/wk)
Maximum excavation rate 1,350 cy/wk

Table C-8
Lenz Oil - Capital Cost Estimate - Future On-site Resident
Remediation of 1.0E-04 Unconsolidated Soils
Off-Site Disposal - RCRA Subtitle D

Item	Units	Calculated Quantity	Design Quantity	Unit Price	Total Price	Calculated Quantity Remarks	Unit Price Source (1)
Soils Base					$ 57,819	See Soils Base Cost Estimate	See Soils Base Cost Estimate
Transportation to off-site facility	cy	2,156	2,160	$ 35.10	$ 75,816	RCRA Subtitle D Landfill	Peoria Disposal Company @ Clinton, IL
Disposal at off-site facility	cy	2,156	2,160	$ 24.30	$ 52,488	RCRA Subtitle D Landfill	Peoria Disposal Company @ Clinton, IL
Additional fill material	cy	2,156	2,160	$ 7.00	$ 15,120	See Soils Base Cost Estimate	S&K Excavation
Fill placement	cy	2,156	2,160	$ 3.10	$ 6,701	See Soils Base Cost Estimate	Means 022-246-1050
Fill compaction	cy	2,156	2,160	$ 0.35	$ 750	See Soils Base Cost Estimate	Means 022-226-5000
Fill grading	sy	1,117	1,120	$ 1.97	$ 2,208	Areas X, Y, and Z total surface area	Means 025-122-1050
Subtotal					$ 210,902		
Design engineering	%	15.00%			$ 31,635		
Construction management	%	25.00%			$ 52,725		
Insurance	%	2.50%			$ 5,273		
Permitting and legal fees	ls	1	1	$ 5,000	$ 5,000		ERM estimate
Predesign soil sampling	ls	1	1	$ 70,990	$ 70,990	See page 3 of Table C-2-1 in Attachment 2.	ERM estimate
Confirmatory sampling	ls	1	1	$ 20,000	$ 20,000		ERM estimate
Subtotal					$ 396,525		
Contingency	%	30.00%			$ 118,958		
Total					$ 515,483		

Notes
1 ERM estimate includes overhead and profit. 1996 Means Site Work - 15th Edition, plus 12% overhead and profit.
1996 Means Mechanical Work - 19th Edition, plus 12% overhead and profit.

Table C-9
Lenz Oil - Capital Cost Estimate - Future On-site Resident
Remediation of 1.0E-04 Unconsolidated Soils
***Ex Situ* Solidification/Stabilization**

Item	Units	Calculated Quantity	Design Quantity	Unit Price	Total Price	Calculated Quantity Remarks	Unit Price Source (1)
Soils Base					$ 57,819	See Soils Base Cost Estimate	See Soils Base Cost Estimate
On-site treatment mobilization	ls	1	1	$ 50,000	$ 50,000	Prepare site and obtain utilities	Millgard Environmental
Truck to on-site treatment	cy	2,156	2,160	$ 2.99	$ 6,459	See Soils Base Cost Estimate	Means 022-266-0020
Ex situ solidification/stabilization	cy	2,156	2,160	$ 50	$ 108,000	Solidification/stabilization on site	Millgard Environmental
Demobilization	ls	1	1	$ 10,000	$ 10,000	ERM estimate	ERM estimate
Fill placement	cy	2,156	2,160	$ 3.10	$ 6,701	See Soils Base Cost Estimate	Means 022-246-1050
Fill compaction	cy	2,156	2,160	$ 0.35	$ 750	See Soils Base Cost Estimate	Means 022-226-5000
Fill grading	sy	1,117	1,120	$ 1.97	$ 2,208	Areas X, Y, and Z surface area	Means 029-308-0200
Subtotal					$ 241,937		
Design engineering	%	15.00%			$ 36,291		
Construction management	%	25.00%			$ 60,484		
Insurance	%	2.50%			$ 6,048		
Permitting and legal fees	ls	1	1	$ 20,000	$ 20,000		ERM estimate
Confirmatory sampling	ls	1	1	$ 10,000	$ 10,000		ERM estimate
Predesign soil sampling	ls	1	1	$ 70,990	$ 70,990	See page 3 of Table C-2-1 in Attachment 2.	ERM estimate
S/S binder selection	ls	1	1	$ 70,180	$ 70,180	See page 3 of Table C-2-1 in Attachment 2.	ERM estimate
Subtotal					$ 515,931		
Contingency	%	30.00%			$ 154,779		
Total					$ 670,710		

Notes
1 ERM estimate includes overhead and profit. 1996 Means Site Work - 15th Edition, plus 12% overhead and profit.
1996 Means Mechanical Work - 19th Edition, plus 12% overhead and profit.

Table C-10
Lenz Oil - Capital Cost Estimate - Future On-site Resident
Remediation of 1.0E-04 Unconsolidated Soils
On-Site Treatment - Low Temperature Thermal Desorption

Item	Units	Calculated Quantity	Design Quantity	Unit Price	Total Price	Calculated Quantity Remarks	Unit Price Source (1)
Soils Base					$ 57,819	See Soils Base Cost Estimate	See Soils Base Cost Estimate
On-site treatment mobilization	ls	1	1	$ 600,000	$ 600,000	Prepare site and obtain utilities - 40% of charges The rest is included with the LNAPL-cont. mater.	Soiltech ATP Systems
Truck to on-site treatment	cy	2,156	2,160	$ 2.99	$ 6,459	See Soils Base Cost Estimate	Means 022-266-0020
Thermal desorption with offgas treatment	cy	2,156	2,160	$ 270	$ 583,200	Indirect w/ offgas treat - 1,100 degrees F	Soiltech ATP Systems
Disposal of LTTD residual by incineration							
Residual storage	gal	1,089	1,091	$ 0.10	$ 109	Estimated 0.25 % of treated volume	Baker Tank
Transportation to incineration facility	gal	1,089	1,091	$ 0.66	$ 719	TSCA and Subtitle C Incineration (liquid)	Clean Harbors Envir. Serv. @ Deer Park, TX
Disposal at incineration facility	gal	1,089	1,091	$ 4.09	$ 4,466	TSCA and Subtitle C Incineration (liquid)	Clean Harbors Envir. Serv. @ Deer Park, TX
Residual volume	cy	5	5				
Disposal of spent carbon by incineration						Estimated 0.5 % of treated volume	
Disposal at incineration facility (includes trucking)	cy	11	11	$ 945	$ 10,206	TSCA and Subtitle C Incineration (soil)	Waste Management @ Port Arthur, TX
Demobilization	ls	1	1	$ 10,000	$ 10,000	ERM estimate	ERM estimate
Fill placement	cy	2,156	2,160	$ 3.10	$ 6,701	See Soils Base Cost Estimate	Means 022-246-1050
Fill compaction	cy	2,156	2,160	$ 0.35	$ 750	See Soils Base Cost Estimate	Means 022-226-5000
Fill grading	sy	1,117	1,120	$ 1.97	$ 2,208	Areas X, Y, and Z surface area	Means 029-308-0200
Subtotal					$ 1,282,637		
Design engineering					$ 200,000		
Construction management	%	15.00%			$ 192,396		
Insurance	%	2.50%			$ 32,066		
Permitting and legal fees	ls	1	1	$ 20,000	$ 20,000		ERM estimate
Confirmatory sampling	ls	1	1	$ 37,000	$ 37,000		ERM estimate
Predesign soil sampling	ls	1	1	$ 70,990	$ 70,990	See page 3 of Table C-2-1 in Attachment 2.	
LTTD off-site test	ls	1	1	$ 89,300	$ 89,300	See page 7 of Table C-2-1 in Attachment 2.	ERM estimate
Subtotal					$ 1,924,388		
Contingency	%	30.00%			$ 577,317		
Total					$ 2,501,705		

Notes
1 ERM estimate includes overhead and profit. 1996 Means Site Work - 15th Edition, plus 12% overhead and profit.
1996 Means Mechanical Work - 19th Edition, plus 12% overhead and profit.

Table C-11
Lenz Oil - Capital Cost Estimate
LNAPL Recovery - Passive
Four Trenches

Item	Units	Calculated Quantity	Design Quantity	Unit Price	Total Price	Calculated Quantity Remarks	Unit Price Source (1)
Mobilization	ls	1	1	$ 15,000	$ 15,000	ERM estimate	ERM estimate
Surveying	ls	1	1	$ 3,000	$ 3,000	ERM estimate	ERM estimate
Trench box							
Trench No. N	sf	7,560	7,600	$ 2.00	$ 15,236	270 lf long by average 14 ft depth times 2 sides	Means 021-624-5250
Trench No. M	sf	8,320	8,400	$ 2.00	$ 16,840	260 lf long by average 16 ft depth times 2 sides	Means 021-624-5250
Trench No. S	sf	6,811	6,900	$ 2.00	$ 13,833	245 lf long by average 13.9 ft depth times 2 sides	Means 021-624-5250
Trench No. P	sf	5,978	6,000	$ 2.00	$ 12,029	245 lf long by average 12.2 ft depth times 2 sides	Means 021-624-5250
Clean unconsolidated soil/gravel excavation (2)							
Trench No. N	cy	342	340	$ 16.33	$ 5,552	270 lf long by 3 ft wide by average 11.4 ft depth	Means 022-254-0500, ERM adjusted
Trench No. M	cy	332	335	$ 16.33	$ 5,470	260 lf long by 3 ft wide by average 11.5 ft depth	Means 022-254-0500, ERM adjusted
Trench No. S	cy	286	285	$ 16.33	$ 4,654	245 lf long by 3 ft wide by average 10.5 ft depth	Means 022-254-0500, ERM adjusted
Trench No. P	cy	221	220	$ 16.33	$ 3,593	245 lf long by 3 ft wide by average 8.1 ft depth	Means 022-254-0500, ERM adjusted
Total	cy	1,181	1,180				
Stained unconsolidated soil/gravel excavation (2)							
Trench No. N	cy	15	15	$ 16.33	$ 245	270 lf long by 3 ft wide by average 0.5 ft depth	Means 022-254-0500, ERM adjusted
Total	cy	15	15				
Bedrock excavation (2)							
Trench No. N	cy	60	60	$ 150	$ 9,000	270 lf long by 3 ft wide by average 2 ft depth	TJ Lambercht Const.
Trench No. M	cy	130	130	$ 150	$ 19,500	260 lf long by 3 ft wide by average 4.5 ft depth	TJ Lambercht Const.
Trench No. S	cy	95	100	$ 150	$ 15,000	245 lf long by 3 ft wide by average 3.5 ft depth	TJ Lambercht Const.
Trench No. P	cy	112	115	$ 150	$ 17,250	245 lf long by 3 ft wide by average 4.1 ft depth	TJ Lambercht Const.
Total	cy	397	405				
Excavation dewatering							
Dewatering points and piping	ea	16	16	$ 2,000	$ 32,000	Pumps and controls	ERM estimate
Dewatering system operation	wk	5	5	$ 2,000	$ 10,000	Excavation rate of 200 cy/wk	ERM estimate
Dewatering storage tank	ea	1	1	$ 71,335	$ 71,335	125,000 gallon field erected tank - on grade	Modutank Inc.
Water disposal (includes trucking)	gal	252,546	252,000	$ 0.73	$ 184,948	ERM estimate of 5 gpm for noted duration RCRA Subtitle C Treatment	Rollins Envir., Inc. @ Deer Park, TX
Absorbent							
Material	cy	22	25	$ 75	$ 1,875	(270+260+245)* 3ft * 2 in/12 ft	
Disposal	cy	22	25	$ 945	$ 23,625	TSCA incineration (solid) - LNAPL w/absorbent	Waste Management @ Port Arthur, TX
Collection gravel	cy	584	590	$ 7.00	$ 4,130	Trench N: 8.1 ft*3ft*270 ft; M: 4.5 ft * 3ft * 260 ft S: 3.5 ft *3 ft * 245 ft; P: 4.25 ft * 3 ft * 245 ft	Dee-N-Dee Trucking
Geotextile membrane	sf	3,060	3,100	$ 0.68	$ 2,108	Trench areas	National Seal
LNAPL collection system							
Collection risers - 30 inch perforated	ea	24	12	$ 600	$ 7,200	6 per trench	ERM estimate
Trench seal	cy	227	230	$ 25.20	$ 5,796	Top 2 ft of trenches with bentonite	Means 021-684-0100
Backfilling excavations							
Clean soil and gravel	cy	782	785			Total excavated minus collection gravel and seal	
Placement	cy	1,592	1,600	$ 3.10	$ 4,964	Total excavation	Means 022-246-1050
Compaction	cy	1,592	1,600	$ 0.35	$ 556	Total excavation	Means 022-226-5000
Grading	sy	-	350	$ 1.97	$ 690	Trench areas	Means 029-308-0200
Disposal							
Contaminated soil, gravel & bedrock material	cy	300	305	$ 292	$ 88,938	RCRA Subtitle C Landfill	Clean Harbors Envir. Serv. @ Detroit, MI
Clean bedrock	cy	112	115	$ 59	$ 6,831	RCRA Subtitle D Landfill - Trench P bedrock	Peoria Disposal Company @ Clinton, IL
Excess excavated soil placement							
Clean soil & gravel placed on site	cy	399	400	$ 8.70	$ 3,481	Clean excavated less backfill soil & gravels	Means 022-216-4000 & 022-266-1150
Trench downstream barrier sheeting	sf	2,989	3,000	$ 15.68	$ 47,040	245 lf by 12.2 ft depth	Means 021-610-1200
Collection System							
Manhole frame assemblies	ea	24	24	$ 1,000	$ 24,000	cast covers	ERM estimate
Product removal pumps and piping	ea	24	24	$ 2,000	$ 48,000	ERM estimate	GeoGuard
Shop relocation	ls	1	1	$ 33,600	$ 33,600	ERM estimate	Means 020-620-3000
Shed demolition	ls	3	3	$ 2,000	$ 6,000	ERM estimate	ERM estimate
Trucking off-site and disposal	cy	20	20	$ 59	$ 1,188	RCRA Subtitle D Landfill	Peoria Disposal Company @ Clinton, IL
Temporary relocation							
Residents	wk	8	8	$ 6,300	$ 50,400	ERM estimate work duration; 3 residents, hotel with allocations for expenses @ $300/day	ERM estimate
Lost commercial production							
Landscaper	wk	7.9	8	$ 5,000	$ 40,000	ERM estimate work duration; lost income	ERM estimate
Excavation/treatment duration	wk	7.9	8			Excavation rate of 200 cy/wk (3)	
Air monitoring with an HNu	wk	7.9	8	$ 2,000	$ 16,000	Labor and materials	ERM estimate
H&S equipment	wk	7.9	8	$ 2,000	$ 16,000	ERM estimate	ERM estimate
Decontamination materials and labor	wk	7.9	8	$ 300	$ 2,366	ERM estimate	ERM estimate
Decon water storage	gal	2,366	2,400	$ 0.10	$ 237	300 gal per week	Baker Tank
Water disposal (includes trucking)	gal	2,366	2,400	$ 0.73	$ 1,761	RCRA Subtitle C Treatment	Rollins Envir., Inc. @ Deer Park, TX
Demobilization	ls	1	1	$ 5,000	$ 5,000	ERM estimate	ERM estimate
Subtotal					$ 896,271		
Design engineering	%	15.00%			$ 134,441		
Construction management	%	25.00%			$ 224,068		
Insurance	%	2.50%			$ 22,407		
Permitting and legal fees	ls	1	1	$ 10,000	$ 10,000		ERM estimate
Soil analysis before disposal	ls	1	1	$ 5,000	$ 5,000		ERM estimate
Subtotal					$ 1,292,186		
Contingency	%	30.00%			$ 387,656		
Total					$ 1,679,842		

Notes
1 ERM estimate includes overhead and profit. 1996 Means Site Work - 15th Edition, plus 12% overhead and profit.
1996 Means Mechanical Work - 19th Edition, plus 12% overhead and profit.
2 Depths from Table C-1-3 in Attachment 1.
3 Excavation rate of 5 to 10 cubics yards per hour.
Excavating 8 hours a day, 5 days a week.

Minimum excavation rate	200 cy/wk (used)
Maximum excavation rate	400 cy/wk

Table C-12
Lenz Oil - Capital Cost Estimate
LNAPL Recovery - Active
Two Trenches

Item	Units	Calculated Quantity	Design Quantity	Unit Price	Total Price	Calculated Quantity Remarks	Unit Price Source (note 1)
Mobilization	ls	1	1	$ 15,000	$ 15,000	ERM estimate	ERM estimate
Surveying	ls	1	1	$ 3,000	$ 3,000	ERM estimate	ERM estimate
Trench box							
Trench No. M	sf	8,320	8,400	$ 2.00	$ 16,840	260 lf long by average 16 ft depth times 2 sides	Means 021-624-5250
Trench No. S	sf	6,811	6,900	$ 2.00	$ 13,833	245 lf long by average 13.9 ft depth times 2 sides	Means 021-624-5250
Clean unconsolidated soil/gravel excavation (2)							
Trench No. M	cy	332	335	$ 16.33	$ 5,470	260 lf long by 3 ft wide by average 11.5 ft depth	Means 022-254-0500, ERM adjusted
Trench No. S	cy	286	285	$ 16.33	$ 4,654	245 lf long by 3 ft wide by average 10.5 ft depth	Means 022-254-0500, ERM adjusted
Total	cy	618	620				
Bedrock excavation (2)							
Trench No. M	cy	130	130	$ 150	$ 19,500	260 lf long by 3 ft wide by average 4.5 ft depth	TJ Lambercht Const.
Trench No. S	cy	95	100	$ 150	$ 15,000	245 lf long by 3 ft wide by average 3.5 ft depth	TJ Lambercht Const.
Total	cy	225	230				
Excavation dewatering							
Dewatering points and piping	ea	8	8	$ 2,000	$ 16,000	Pumps and controls	ERM estimate
Dewatering system operation	wk	2.7	3	$ 2,000	$ 5,343	Excavation rate of 200 cy/wk	ERM estimate
Dewatering storage tank	ea	1	1	$ 71,335	$ 71,335	125,000 gallon field erected tank - on grade	Modutank Inc.
Water disposal (includes trucking)	gal	134,645	136,080	$ 0.73	$ 99,872	ERM estimate of 5 gpm for noted duration RCRA Subtitle C Treatment	Rollins Envir., Inc. @ Deer Park, TX
Absorbent							
Material	cy	14	15	$ 75	$ 1,125	(260+245)* 3ft * 2 in/12 ft	
Disposal	cy	14	15	$ 945	$ 14,175	TSCA Incineration (solid) - LNAPL w/absorbent	Waste Management @ Port Arthur, TX
Collection gravel	cy	225	230	$ 7.00	$ 1,610	Total excavated less clean soil and seal	
Geotextile membrane	sf	1,515	1,600	$ 0.68	$ 1,088	Trench areas	National Seal
Water extraction system							
Collection piping - 6 inch perforated	lf	505	510	$ 5.01	$ 2,553	Total trench length	Means A12.3-530-2150
Collection risers - 12 inch	ea	6	6	$ 300	$ 1,800	3 per trench	ERM estimate
LNAPL collection system							
Collection risers - 30 inch perforated	ea	6	6	$ 600	$ 3,600	6 per trench	ERM estimate
Trench seal	cy	112	120	$ 25.20	$ 3,024	Top 2 ft of trenches with bentonite	Means 021-684-0100
Backfilling excavations							
Clean soil & gravel	cy	506	510			Clean unconsolidated soil less seal	
Placement	cy	843	850	$ 3.10	$ 2,637	Total excavation	Means 022-246-1050
Compaction	cy	843	850	$ 0.35	$ 295	Total excavation	Means 022-226-5000
Grading	sy	168	170	$ 1.97	$ 335	Trench areas	Means 029-308-0200
Disposal							
Contaminated bedrock	cy	225	230	$ 292	$ 67,068	RCRA Subtitle C Landfill	Clean Harbors Envir. Serv. @ Detroit, MI
Excess excavated soil placement							
Clean soil placed on site	cy	112	110	$ 8.70	$ 957	Clean excavated less backfill soil & gravels	Means 022-216-4000 & 022-266-1150
Collection System							
Piping manholes	ea	3	3	$ 2,000	$ 6,000	ERM estimate	ERM estimate
Compressed air piping system - 2 inch	lf	1,500	1,500	$ 9.90	$ 14,851	ERM estimate	Means A12.3-520-3090
Pump discharge piping system - 2 inch	lf	1,500	1,500	$ 4.41	$ 6,619	ERM estimate	Means A12.3-520-2090
System discharge flow meters	ea	2	2	$ 6,000	$ 12,000	ERM estimate	Fisher-Rosemount Magmeter
Pressure testing	ls	1	1	$ 2,000	$ 2,000	ERM estimate	ERM estimate
Buildings, including foundation, lights & heat	ea	6	6	$ 6,400	$ 38,400	8 ft by 8 ft building	ERM estimate
Product removal pumps and piping	ea	6	6	$ 2,000	$ 12,000	ERM estimate	GeoGuard
Extraction pumps with controllers	ea	6	6	$ 6,000	$ 36,000	ERM estimate	GeoGuard
Oil storage drums - double wall	ea	6	6	$ 250	$ 1,500	ERM estimate	ERM estimate
Electrical distribution system	ls	1	1	$ 20,000	$ 20,000	ERM estimate	ERM estimate
Building cost							ERM estimate
Foundation	sf	288	290	$ 2.32	$ 673	area of 12 ft by 24 ft	ERM estimate
Building, installed	sf	288	290	$ 130	$ 37,700	area of 12 ft by 24 ft	Parkline Buildings
Air compressor system	ea	1	1	$ 18,000	$ 18,000	70 scfm - 15 hp	Quincy Compressors
Roadway crossing	ls	1	1	$ 15,000	$ 15,000	ERM estimate	ERM estimate
Shop relocation	ls	1	1	$ 33,600	$ 33,600	ERM estimate	Means 020-620-3000
Shed demolition	ls	3	3	$ 2,000	$ 6,000	ERM estimate	ERM estimate
Trucking off-site and disposal	cy	20	20	$ 59	$ 1,188	RCRA Subtitle D Landfill	Peoria Disposal Company @ Clinton, IL
Temporary relocation							
Residents	wk	4.2	5	$ 6,300	$ 31,500	ERM estimate work duration; 3 residents, hotel with allocations for expenses @ $300/day	
Lost commercial production							
Landscaper	wk	4.2	5	$ 5,000	$ 25,000	ERM estimate work duration; lost income	
Excavation/treatment duration	wk	4.2	5			Excavation rate of 200 cy/wk	
Air monitoring with an HNu	wk	4.2	5	$ 2,000	$ 10,000	Labor and materials	ERM estimate
H&S equipment	wk	4.2	5	$ 2,000	$ 10,000	ERM estimate	ERM estimate
Decontamination materials and labor	wk	4.2	5	$ 300	$ 1,265	ERM estimate	Clean Harbors Envir., Services
Decon water storage	gal	1,265	1,500	$ 0.10	$ 127	300 gal per week	Baker Tank
Water disposal (includes trucking)	gal	1,265	1,500	$ 0.73	$ 1,101	RCRA Subtitle C Treatment	Rollins Envir., Inc. @ Deer Park, TX
Demobilization	ls	1	1	$ 5,000	$ 5,000	ERM estimate	ERM estimate
Subtotal					$ 731,639		
Design engineering	%	15.00%			$ 109,746		
Construction management	%	25.00%			$ 182,910		
Insurance	%	2.50%			$ 18,291		
Permitting and legal fees	ls	1	1	$ 10,000	$ 10,000		ERM estimate
Soil analysis before disposal	ls	1	1	$ 5,000	$ 5,000		ERM estimate
Recovery trench test	ls	1	1	$ 247,299	$ 247,299	See page 4 of Table C-2-1 in Attachment 2.	ERM estimate
Subtotal					$ 1,304,884		
Contingency	%	30.00%			$ 391,465		
Total					$ 1,696,350		

Notes
1 ERM estimate includes overhead and profit. 1996 Means Site Work - 15th Edition, plus 12% overhead and profit.
1996 Means Mechanical Work - 19th Edition, plus 12% overhead and profit.
2 Depths from Table C-1-3 in Attachment 1.

Table C-13
Lenz Oil - Capital Cost Estimate
LNAPL Recovery - Active
Three Trenches

Item	Units	Calculated Quantity	Design Quantity	Unit Price	Total Price	Calculated Quantity Remarks	Unit Price Source (1)
Mobilization	ls	1	1	$ 15,000	$ 15,000	ERM estimate	ERM estimate
Surveying	ls	1	1	$ 3,000	$ 3,000	ERM estimate	ERM estimate
Trench box							
Trench No. N	sf	7,560	7,600	$ 2.00	$ 15,236	270 lf long by average 14 ft depth times 2 sides	Means 021-624-5250
Trench No. M	sf	8,320	8,400	$ 2.00	$ 16,840	260 lf long by average 16 ft depth times 2 sides	Means 021-624-5250
Trench No. S	sf	6,811	6,900	$ 2.00	$ 13,833	245 lf long by average 13.9 ft depth times 2 sides	Means 021-624-5250
Clean unconsolidated soil/gravel excavation (2)							
Trench No. N	cy	342	345	$ 16.33	$ 5,634	270 lf long by 3 ft wide by average 11.4 ft depth	Means 022-254-0500, ERM adjusted
Trench No. M	cy	332	335	$ 16.33	$ 5,470	260 lf long by 3 ft wide by average 11.5 ft depth	Means 022-254-0500, ERM adjusted
Trench No. S	cy	286	285	$ 16.33	$ 4,654	245 lf long by 3 ft wide by average 10.5 ft depth	Means 022-254-0500, ERM adjusted
Total	cy	960	965				
Stained unconsolidated soil excavation (2)							
Trench No. N	cy	15	15	$ 16.33	$ 245	270 lf long by 3 ft wide by average 0.5 ft depth	Means 022-254-0500, ERM adjusted
Total	cy	15	15				
Bedrock excavation (2)							
Trench No. N	cy	60	60	$ 150	$ 9,000	270 lf long by 3 ft wide by average 2 ft depth	TJ Lambercht Const.
Trench No. M	cy	130	130	$ 150	$ 19,500	260 lf long by 3 ft wide by average 4.5 ft depth	TJ Lambercht Const.
Trench No. S	cy	95	100	$ 150	$ 15,000	245 lf long by 3 ft wide by average 3.5 ft depth	TJ Lambercht Const.
Total	cy	285	290				
Excavation dewatering							
Dewatering points and piping	ea	12	12	$ 2,000	$ 24,000	Pumps and controls	ERM estimate
Dewatering system operation	wk	3.9	4	$ 2,000	$ 7,803	Excavation rate of 200 cy/wk	ERM estimate
Dewatering storage tank	ea	1	1	$ 71,335	$ 71,335	125,000 gallon field erected tank - on grade	Modutank Inc.
Water disposal (includes trucking)	gal	196,637	201,600	$ 0.73	$ 147,958	ERM estimate of 5 gpm for noted duration RCRA Subtitle C Treatment	Rollins Envir., Inc. @ Deer Park, TX
Absorbent							
Material	cy	22	25	$ 75	$ 1,875	(270+260+245)* 3ft * 2 in/12 ft	
Disposal	cy	22	25	$ 945	$ 23,625	TSCA Incineration (solid) - LNAPL w/absorbent	Waste Management @ Port Arthur, TX
Collection gravel	cy	468	470	$ 7.00	$ 3,290	Trench N: 8.1 ft*3ft*270 ft; M: 4.5 ft * 3ft * 260 ft S: 3.5 ft *3 ft * 245 ft	Dee-N-Dee Trucking
Geotextile membrane	sf	2,325	2,400	$ 0.68	$ 1,632	Trench areas	National Seal
Water extraction system							
Collection piping - 6 inch perforated	lf	775	780	$ 5.01	$ 3,905	Total trench length	Means A12.3-530-2150
Collection risers - 12 inch	ea	9	18	$ 300	$ 5,400	3 per trench	ERM estimate
LNAPL collection system							
Collection risers - 30 inch perforated	ea	9	18	$ 600	$ 10,800	3 per trench	ERM estimate
Trench seal	cy	172	170	$ 25	$ 4,284	Top 2 ft of trenches with bentonite	Means 021-684-0100
Backfilling excavations							
Clean soil	cy	620	620			Total excavated minus collection gravel and seal	
Placement	cy	1,260	1,270	$ 3.10	$ 3,940	Total excavation	Means 022-246-1050
Compaction	cy	1,260	1,270	$ 0.35	$ 441	Total excavation	Means 022-226-5000
Grading	sy	258	250	$ 1.97	$ 493	Trench areas	Means 029-308-0200
Contaminated soil, gravel & bedrock material							
Disposal	cy	300	305	$ 292	$ 88,938	RCRA Subtitle C Landfill	Clean Harbors Envir. Serv. @ Detroit, MI
Excess excavated soil placement							
Clean soil placed on site	cy	340	345	$ 8.70	$ 3,002	Clean excavated less backfill soil & gravels	Means 022-216-4000 & 022-266-1150
Collection System							
Piping manholes	ea	5	5	$ 2,000	$ 10,000	ERM estimate	ERM estimate
Compressed air piping system - 2 inch	lf	2,000	2,000	$ 9.90	$ 19,802	Distance to treatment system and between trenches	Means A12.3-520-3090
Pump discharge piping system - 2 inch	lf	2,000	2,000	$ 4.41	$ 8,826	Distance to treatment system and between trenches	Means A12.3-520-2090
System discharge flow meters	ea	3	3	$ 6,000	$ 18,000	ERM estimate	Fisher-Rosemount Magmeter
Pressure testing	ls	1	1	$ 2,000	$ 2,000	ERM estimate	ERM estimate
Buildings, including foundation, lights & heat	ea	9	9	$ 6,400	$ 57,600	8 ft by 8 ft building	ERM estimate
Product removal pumps and piping	ea	9	9	$ 2,000	$ 18,000	ERM estimate	GeoGuard
Extraction pumps with controllers	ea	9	9	$ 6,000	$ 54,000	ERM estimate	GeoGuard
Oil storage drums - double wall	ea	9	9	$ 250	$ 2,250	55-gallon drums, one at each LNAPL collection point	ERM estimate
Electrical distribution system	ls	1	1	$ 25,000	$ 25,000	ERM estimate	ERM estimate
Building cost							ERM estimate
Foundation	sf	288	290	$ 2.32	$ 673	area of 12 ft by 24 ft	ERM estimate
Building, installed	sf	288	290	$ 130	$ 37,700	area of 12 ft by 24 ft	Parkline Buildings
Air compressor system	ea	1	1	$ 18,000	$ 18,000	70 scfm - 15 hp	Quincy Compressors
Roadway Crossing	ls	1	1	$ 15,000	$ 15,000	ERM estimate	ERM estimate
Shop relocation	ls	1	1	$ 33,600	$ 33,600	ERM estimate	Means 020-620-3000
Shed demolition	ls	3	3	$ 2,000	$ 6,000	ERM estimate	ERM estimate
Trucking off-site and disposal	cy	20	20	$ 59	$ 1,188	RCRA Subtitle D Landfill	Peoria Disposal Company @ Clinton, IL
Temporary relocation							
Residents	wk	6.2	7	$ 6,300	$ 44,100	ERM estimate work duration; 3 residents, hotel with allocations for expenses @ $300/day	
Lost commercial production							
Landscaper	wk	6.2	7	$ 5,000	$ 35,000	ERM estimate work duration; lost income	
Excavation/treatment duration	wk	6.2	7			Excavation rate of 200 cy/w	
Air monitoring with an HNu	wk	6.2	7	$ 2,000	$ 14,000	Labor and materials	ERM estimate
H&S equipment	wk	6.2	7	$ 2,000	$ 14,000	ERM estimate	ERM estimate
Decontamination materials and labor	wk	6.2	7	$ 300	$ 1,868	ERM estimate	Clean Harbors Envir., Services
Decon water storage	gal	1,868	2,100	$ 0.10	$ 187	300 gal per week	Baker Tank
Water disposal (includes trucking)	gal	1,868	2,100	$ 0.73	$ 1,541	RCRA Subtitle C Treatment	Rollins Envir., Inc. @ Deer Park, TX
Demobilization	ls	1	1	$ 5,000	$ 5,000	ERM estimate	ERM estimate
Subtotal					$ 969,468		
Design engineering	%	15.00%			$ 145,420		
Construction management	%	25.00%			$ 242,367		
Insurance	%	2.50%			$ 24,237		
Permitting and legal fees	ls	1	1	$ 10,000	$ 10,000		ERM estimate
Soil analysis before disposal	ls	1	1	$ 5,000	$ 5,000		ERM estimate
Recovery trench test	ls	1	1	$ 247,299	$ 247,299	See page 4 of Table C-2-1 in Attachment 2.	ERM estimate
Subtotal					$ 1,643,791		
Contingency	%	30.00%			$ 493,137		
Total					$ 2,136,928		

Notes
1 ERM estimate includes overhead and profit. 1996 Means Site Work - 15th Edition, plus 12% overhead and profit. 1996 Means Mechanical Work - 19th Edition, plus 12% overhead and profit.
2 Depths from Table C-1-3 in Attachment 1.

Table C-14
Lenz Oil - Capital Cost Estimate
LNAPL Recovery - Active
Four Trenches

Item	Units	Calculated Quantity	Design Quantity	Unit Price	Total Price	Calculated Quantity Remarks	Unit Price Source (1)
Mobilization	ls	1	1	$ 15,000	$ 15,000	ERM estimate	ERM estimate
Surveying	ls	1	1	$ 3,000	$ 3,000	ERM estimate	ERM estimate
Trench box (2)							
Trench No. N	sf	7,560	7,600	$ 2.00	$ 15,236	270 lf long by average 14 ft depth times 2 sides	Means 021-624-5250
Trench No. M	sf	8,320	8,400	$ 2.00	$ 16,840	260 lf long by average 16 ft depth times 2 sides	Means 021-624-5250
Trench No. S	sf	6,811	6,900	$ 2.00	$ 13,833	245 lf long by average 13.9 ft depth times 2 sides	Means 021-624-5250
Trench No. P	sf	5,978	6,000	$ 2.00	$ 12,029	245 lf long by average 12.2 ft depth times 2 sides	Means 021-624-5250
Clean unconsolidated soil/gravel excavation (3)							
Trench No. N	cy	342	345	$ 16.33	$ 5,634	270 lf long by 3 ft wide by average 11.4 ft depth	Means 022-254-0500, ERM adjusted
Trench No. M	cy	332	335	$ 16.33	$ 5,470	260 lf long by 3 ft wide by average 11.5 ft depth	Means 022-254-0500, ERM adjusted
Trench No. S	cy	286	285	$ 16.33	$ 4,654	245 lf long by 3 ft wide by average 10.5 ft depth	Means 022-254-0500, ERM adjusted
Trench No. P	cy	221	220	$ 16.33	$ 3,593	245 lf long by 3 ft wide by average 8.1 ft depth	Means 022-254-0500, ERM adjusted
Total	cy	1,181	1,185				
Stained unconsolidated soil excavation (3)							
Trench No. N	cy	15	15	$ 16.33	$ 245	270 lf long by 3 ft wide by average 0.5 ft depth	Means 022-254-0500, ERM adjusted
Total	cy	15	15				
Bedrock excavation (3)							
Trench No. N	cy	60	60	$ 150	$ 9,000	270 lf long by 3 ft wide by average 2 ft depth	TJ Lambercht Const.
Trench No. M	cy	130	130	$ 150	$ 19,500	260 lf long by 3 ft wide by average 4.5 ft depth	TJ Lambercht Const.
Trench No. S	cy	95	100	$ 150	$ 15,000	245 lf long by 3 ft wide by average 3.5 ft depth	TJ Lambercht Const.
Trench No. P	cy	112	115	$ 150	$ 17,250	245 lf long by 3 ft wide by average 4.1 ft depth	TJ Lambercht Const.
Total	cy	397	405				
Excavation dewatering							
Dewatering points and piping	ea	16	16	$ 2,000	$ 32,000	Pumps and controls	ERM estimate
Dewatering system operation	wk	5.01	5	$ 2,000	$ 10,022	Excavation rate of 200 cy/wk	ERM estimate
Dewatering storage tank	ea	1	1	$ 71,335	$ 71,335	125,000 gallon field erected tank - on grade	Modutank Inc.
Water disposal (includes trucking)	gal	252,548	252,000	$ 0.73	$ 184,948	ERM estimate of 5 gpm for noted duration RCRA Subtitle C Treatment	
Absorbent							
Material	cy	22	25	$ 75	$ 1,875	(270+260+245)* 3ft * 2 in/12 ft	
Disposal	cy	22	25	$ 945	$ 23,625	TSCA Incineration (solid) - LNAPL w/absorbent	Waste Management @ Port Arthur, TX
Collection gravel	cy	584	590	$ 7.00	$ 4,130	Trench N: 8.1 ft*3ft*270 ft; M: 4.5 ft * 3ft * 260 ft S: 3.5 ft *3 ft * 245 ft; P: 4.25 ft * 3 ft * 245 ft	Dee-N-Dee Trucking
Geotextile membrane	sf	3,060	3,100	$ 0.68	$ 2,106	Trench areas	National Seal
Water extraction system							
Collection piping - 6 inch perforated	lf	1,020	1,100	$ 5.01	$ 5,507	Total trench length	Means A12.3-530-2150
Collection risers - 12 inch	ea	12	12	$ 300	$ 3,600	3 per trench	ERM estimate
LNAPL collection system							
Collection risers - 30 inch perforated	ea	12	12	$ 600	$ 7,200	3 per trench	ERM estimate
Trench seal	cy	227	230	$ 25	$ 5,796	Top 2 ft of trenches with bentonite	Means 021-684-0100
Backfilling excavations							
Clean soil	cy	782	785			Total excavated minus collection gravel and seal	
Placement	cy	1,592	1,605	$ 3.10	$ 4,979	Total excavation	Means 022-246-1050
Compaction	cy	1,592	1,600	$ 0.35	$ 556	Total excavation	Means 022-226-5000
Grading	sy	340	350	$ 1.97	$ 690	Trench areas	Means 025-122-1050
Disposal							
Contaminated soil, gravel & bedrock material	cy	300	305	$ 292	$ 88,938	RCRA Subtitle C Landfill	Clean Harbors Envir. Serv. @ Detroit, MI
Clean bedrock	cy	112	115	$ 59	$ 6,831	RCRA Subtitle D Landfill - Trench P bedrock	Peoria Disposal Company @ Clinton, IL
Excess excavated soil placement							
Clean soil placed on site	cy	399	400	$ 8.70	$ 3,481	Clean excavated less backfill soil & gravels	Means 022-216-4000 & 022-266-1150
Collection system							
Piping manholes	ea	5	5	$ 2,000	$ 10,000	ERM estimate	ERM estimate
Compressed air piping system - 2 inch	lf	2,500	2,500	$ 9.90	$ 24,752	ERM estimate	Means A12.3-520-3090
Pump discharge piping system - 2 inch	lf	2,500	2,500	$ 4.41	$ 11,032	ERM estimate	Means A12.3-520-2090
System discharge flow meters	ea	4	4	$ 6,000	$ 24,000	ERM estimate	Fisher-Rosemount Magmeter
Pressure testing	ls	1	1	$ 2,000	$ 2,000	ERM estimate	ERM estimate
Buildings, including foundation, lights & heat	ea	12	12	$ 6,400	$ 76,800	8 ft by 8 ft building	ERM estimate
Product removal pumps and piping	ea	12	12	$ 2,000	$ 24,000	ERM estimate	GeoGuard
Extraction pumps with controllers	ea	12	12	$ 6,000	$ 72,000	ERM estimate	GeoGuard
Oil storage drums - double wall	ea	12	12	$ 250	$ 3,000	ERM estimate	ERM estimate
Electrical distribution system	ls	1	1	$ 30,000	$ 30,000	ERM estimate	ERM estimate
Building cost							ERM estimate
Foundation	sf	288	290	$ 2.32	$ 673	area of 12 ft by 24 ft	ERM estimate
Building, installed	sf	288	290	$ 130	$ 37,700	area of 12 ft by 24 ft	Parkline Buildings
Air compressor system	ea	1	1	$ 18,000	$ 18,000	70 scfm - 15 hp	Quincy Compressors
Roadway crossing	ls	1	1	$ 15,000	$ 15,000	ERM estimate	ERM estimate
Shop relocation	ls	1	1	$ 33,600	$ 33,600	ERM estimate	Means 020-620-3000
Shed demolition	ls	3	3	$ 2,000	$ 6,000	ERM estimate	ERM estimate
Trucking off-site and disposal	cy	20	20	$ 59	$ 1,188	RCRA Subtitle D Landfill	Peoria Disposal Company @ Clinton, IL
Temporary relocation							
Residents	wk	7.9	8	$ 6,300	$ 50,400	ERM estimate work duration; 3 residents, hotel with allocations for expenses @ $300/day	
Lost commercial production							
Landscaper	wk	7.9	8	$ 5,000	$ 40,000	ERM estimate work duration; lost income	
Excavation/treatment duration	wk	7.9	8			Excavation rate of 200 cy/w	
Air monitoring with an HNu	wk	7.9	8	$ 2,000	$ 16,000	Labor and materials	ERM estimate
H&S equipment	wk	7.9	8	$ 2,000	$ 16,000	ERM estimate	ERM estimate
Decontamination materials and labor	wk	7.9	8	$ 300	$ 2,366	ERM estimate	Clean Harbors Envir., Services
Decon water storage	gal	2,366	2,400	$ 0.10	$ 237	300 gal per week	Baker Tank
Water disposal (includes trucking)	gal	2,366	2,400	$ 0.73	$ 1,761	RCRA Subtitle C Treatment	Waste Management @ Port Arthur, TX
Demobilization	ls	1	1	$ 5,000	$ 5,000	ERM estimate	ERM estimate
Subtotal					$ 1,135,414		
Design engineering	%	15.00%			$ 170,312		
Construction management	%	25.00%			$ 283,853		
Insurance	%	2.50%			$ 28,385		
Permitting and legal fees	ls	1	1	$ 10,000	$ 10,000		ERM estimate
Soil analysis before disposal	ls	1	1	$ 5,000	$ 5,000		ERM estimate
Recovery trench test	ls	1	1	$ 247,299	$ 247,299	See page 4 of Table C-2-1 in Attachment 2.	ERM estimate
Subtotal					$ 1,880,263		
Contingency	%	30.00%			$ 564,079		
Total					$ 2,444,342		

Notes
1 ERM estimate includes overhead and profit. 1996 Means Site Work - 15th Edition, plus 12% overhead and profit.
1996 Means Mechanical Work - 19th Edition, plus 12% overhead and profit.
2 Total depth.
3 Depths from Table C-1-3 in Attachment 1.

Table C-15
Lenz Oil - Capital Cost Estimate
Enhanced LNAPL Recovery - Surfactants
Three Ground Water Recovery Trenches

Item	Units	Calculated Quantity	Reported Quantity	Unit Price	Total Price	Quantity Remarks	Unit Price Source (1)
Mobilization	ls	1	1	$ 10,000	$ 10,000	ERM estimate	ERM estimate
Surveying	ls	1	1	$ 1,000	$ 1,000	ERM estimate	ERM estimate
Southeast of road							
Excavation							
Clean unconsolidated soil excavation (2)	cy	4,822	4,900	$ 13.04	$ 63,901	Area of 18,600 sf - 7 ft depth	Means 022-238-0500/0020/4250
Shop relocation	ls	1	1	$ 33,600	$ 33,600	ERM estimate	ERM estimate
Shed demolition	ls	3	3	$ 2,000	$ 6,000	ERM estimate	ERM estimate
Trucking off-site and disposal	cy	20	20	$ 59	$ 1,188	RCRA Subtitle D Landfill	Peoria Disposal Company @ Clinton, IL
Surfactant feed system							
Storage system	ls	1	1	$ 10,000	$ 10,000	ERM estimate	ERM estimate
Feed system	ls	1	1	$ 10,000	$ 10,000	ERM estimate	ERM estimate
Pumping station, with tank & pumps	ea	1	1	$ 15,000	$ 15,000	4,000 gal with 2 pumps (60 gpm @ 2 hp)	ERM estimate
Piping system to trench area - 4 inch	lf	700	700	$ 10.93	$ 7,652	ERM estimate	Means A12.3-520-2130
Pressure testing	ls	1	1	$ 2,000	$ 2,000	ERM estimate	ERM estimate
Surfactant flow meters	ea	1	1	$ 6,720	$ 6,720	ERM estimate	Fisher-Rosemount Magmeter
Building cost							
Foundation	sf	360	360	$ 2.32	$ 835	Area of 12 ft by 30 ft	ERM estimate
Building, installed	sf	360	360	$ 130.00	$ 46,800	Area of 12 ft by 30 ft	Parkline Buildings
Distribution system							
Distribution manifold header, with controller	ea	3	3	$ 5,000	$ 15,000	ERM estimate	ERM estimate
Distribution piping - 4 inch, perforated	lf	750	750	$ 3.64	$ 2,730	ERM estimate - LNAPL recovery trenches	Means A12.3-530-2130
Distribution gravel	cy	689	700	$ 14.48	$ 10,133	Area of 18,600 sf at a depth of 1 ft	Dee-N-Dee Trucking
Distribution gravel placement	cy	689	700	$ 3.10	$ 2,172	Area of 18,600 sf at a depth of 1 ft	Means 022-246-1050
Distribution gravel grading	sy	2,067	2,100	$ 1.97	$ 4,140	Area of 18,600 sf	Means 025-122-1050
Geotextile membrane	sf	18,600	18,600	$ 0.68	$ 12,648	Area of 18,600 sf	ERM estimate
Backfilling excavations							
Required backfill volume	cy	4,133	4,200			Area of 18,600 sf at a depth of 6 ft	
Unconsolidated clean soil	cy	4,822	4,900	$ 3.10	$ 13,030	Excavated unconsolidated clean soil	Means 022-246-1050
Excess fill material placed on site	cy	689	700	$ 8.70	$ 42,642	Total excavated less gravel	Means 022-216-4000 & 022-266-1150
Compaction	cy	4,133	4,200	$ 0.35	$ 1,458	Total excavated less gravel	Means 022-226-5000
Grading	sy	2,067	2,100	$ 1.97	$ 4,140	Area of 18,600 sf	Means 025-122-1050
Seeding	sf	18,600	18,600	$ 0.52	$ 9,583	Area of 18,600 sf	Means 029-308-0200
Traffic reroute	ls	1	1	$ 10,000	$ 10,000	ERM estimate - back road	ERM estimate
Road repair	ls	1	1	$ 10,000	$ 10,000	ERM estimate - back road	ERM estimate
Temporary relocation							
Residents	wk	4.8	5	$ 6,300	$ 31,500	ERM estimate work duration; 3 residents, hotel with allocations for expenses @ $300/day	
Lost commercial production							
Landscaper	wk	4.8	5	$ 5,000	$ 25,000	ERM estimate work duration	
						Lost income	
Excavation/treatment duration	wk	4.8	5			Excavation rate of 200 cy/d, 5 d/wk	
Demobilization	ls	1	1	$ 10,000	$ 10,000	ERM estimate	ERM estimate
Subtotal					$ 418,870		
Design engineering	%	15.00%			$ 62,830		
Construction management	%	25.00%			$ 104,717		
Insurance	%	2.50%			$ 10,472		
Permitting and legal fees	ls	1	1	$ 10,000	$ 10,000		ERM estimate
Sampling for disposal	ls	1	1	$ 5,000	$ 5,000		ERM estimate
Surfactant selection laboratory test	ls	1	1	$ 163,115	$ 163,115	See page 5 of Table C-1-2 in Attachment 2.	ERM estimate
Surfactant selection pilot test	ls	1	1	$ 243,147	$ 243,147	See page 6 of Table C-1-2 in Attachment 2.	ERM estimate
Subtotal					$ 1,018,152		
Contingency	%	30.00%			$ 305,446		
Total					$ 1,323,598		

Notes
1 ERM estimate includes overhead and profit. 1996 Means Site Work - 15th Edition, plus 12% overhead and profit.
1996 Means Mechanical Work - 19th Edition, plus 12% overhead and profit.
2 Assumes a total depth of the gravel pit of 7 feet below ground surface.

Table C-16
Lenz Oil - Capital Cost Estimate
Enhanced LNAPL Recovery - Surfactants
Four Ground Water Recovery Trenches

Item	Units	Calculated Quantity	Reported Quantity	Unit Price	Total Price	Quantity Remarks	Unit Price Source (1)
Mobilization	ls	1	1	$ 10,000	$ 10,000	ERM estimate	ERM estimate
Surveying	ls	1	1	$ 1,000	$ 1,000	ERM estimate	ERM estimate
Road to the Northwest							
Excavation							
Clean unconsolidated soil excavation (2)	cy	6,481	6,500	$ 13.04	$ 84,767	Area of 25,000 sf - 7 ft depth	Means 022-238-0500/0020/4250
Replace water line (includes removal)	lf	250	300	$ 106	$ 31,752	ERM estimate - 6" pipe	Means A12.3-520-3150, ERM adjusted
Replace sewer line (includes removal)	lf	250	300	$ 106	$ 31,752	ERM estimate - 6" pipe	Means A12.3-520-3150, ERM adjusted
Replace gas line (included removal)	lf	250	300	$ 106	$ 31,752	ERM estimate - 6" pipe	Means A12.3-520-3150, ERM adjusted
Relocate power line	ls	1	1	$ 20,000	$ 20,000	ERM estimate	ERM estimate
Relocate phone line	ls	1	1	$ 10,000	$ 10,000	ERM estimate	ERM estimate
Pipe disposal (includes trucking)	cy	20	20	$ 59	$ 1,188	RCRA Subtitle D Landfill	Peoria Disposal Company @ Clinton, IL
Road removal	cy	148	150	$ 130	$ 19,488	300 lf long by 24 ft wide by 8 in thick	Means 020-020-2000
Road trucking off-site and disposal	cy	148	150	$ 59	$ 8,910	RCRA Subtitle D Landfill	Peoria Disposal Company @ Clinton, IL
New road							
Aggregate base layer	cy	311	310	$ 14.48	$ 4,487	300 lf long by 28 ft wide by 1 ft thick	Dee-N-Dee Trucking
Aggregate placement	cy	311	310	$ 3.10	$ 962	300 lf long by 24 ft wide by 8 in thick	Means 022-246-1050
Aggregate compaction	cy	311	310	$ 0.35	$ 108	300 lf long by 24 ft wide by 8 in thick	Means 022-226-5000
Slab on grade with joints	sf	7,200	7,200	$ 2.54	$ 18,301	300 lf long by 24 ft wide by 8 in thick	Means 026-120-0100
Welded wire fabric	msf	72	100	$ 56.00	$ 5,600	6 x 6 size	Means 025-120-0600
Curbs	lf	600	600	$ 8.29	$ 4,973	600 lf	Means 025-254-0300
Southeast of Road							
Excavation							
Clean unconsolidated soil excavation (2)	cy	4,822	4,900	$ 13.04	$ 63,901	Area of 18,600 sf - 7 ft depth	Means 022-238-0500/0020/4250
Shop relocation	ls	1	1	$ 33,600	$ 33,600	ERM estimate	ERM estimate
Shed demolition	ls	3	3	$ 2,000	$ 6,000	ERM estimate	ERM estimate
Trucking off-site and disposal	cy	20	20	$ 59	$ 1,188	RCRA Subtitle D Landfill	Peoria Disposal Company @ Clinton, IL
Surfactant Feed System							
Storage system	ls	1	1	$ 10,000	$ 10,000	ERM estimate	ERM estimate
Feed system	ls	1	1	$ 10,000	$ 10,000	ERM estimate	ERM estimate
Pumping station, with tank & pumps	ea	1	1	$ 15,000	$ 15,000	4,000 gal with 2 pumps (60 gpm @ 2 hp)	ERM estimate
Piping system to trench area - 4 inch	lf	700	700	$ 10.93	$ 7,652	ERM estimate	Means A12.3-520-2130
Pressure testing	ls	1	1	$ 2,000	$ 2,000	ERM estimate	ERM estimate
Surfactant flow meters	ea	1	1	$ 6,720	$ 6,720	ERM estimate	Fisher-Rosemount Magmeter
Building cost							
Foundation	sf	360	290	$ 2.32	$ 673	Area of 12 ft by 30 ft	ERM estimate
Building, installed	sf	360	290	$ 130.00	$ 37,700	Area of 12 ft by 30 ft	Parkline Buildings
Distribution system							
Distribution manifold header, with controller	ea	4	4	$ 5,000	$ 20,000	ERM estimate	ERM estimate
Distribution piping - 4 inch, perforated	lf	1,020	1,100	$ 3.64	$ 4,004	ERM estimate - LNAPL recovery trenches	Means A12.3-530-2130
Distribution gravel	cy	1,615	1,700	$ 14.48	$ 24,608	Area of 43,600 sf at a depth of 1 ft	Dee-N-Dee Trucking
Distribution gravel placement	cy	1,615	1,700	$ 3.10	$ 5,274	Area of 43,600 sf at a depth of 1 ft	Means 022-246-1050
Distribution gravel grading	sy	4,844	4,900	$ 1.97	$ 9,659	Area of 43,600 sf	Means 025-122-1050
Geotextile membrane	sf	43,600	43,600	$ 0.68	$ 29,648	Area of 43,600 sf	ERM estimate
Backfilling Excavations							
Required backfill volume	cy	9,689	9,700			Area of 43,600 sf at a depth of 6 ft	
Unconsolidated clean soil	cy	11,304	11,400	$ 3.10	$ 30,093	Excavated unconsolidated clean soil	Means 022-246-1050
Excess fill material placed on site	cy	1,615	1,700	$ 8.70	$ 99,207	Place on cap area	Means 022-216-4000 & 022-266-1150
Compaction	cy	9,689	9,700	$ 0.35	$ 3,368	Total excavated less gravel	Means 022-226-5000
Grading	sy	4,844	4,900	$ 1.97	$ 9,659	Area of 43,600 sf	Means 025-122-1050
Seeding	sf	43,600	43,600	$ 0.52	$ 22,463	Area of 43,600 sf	Means 029-308-0200
Traffic reroute	ls	1	1	$ 10,000	$ 10,000	ERM estimate - back road	ERM estimate
Road repair	ls	1	1	$ 10,000	$ 10,000	ERM estimate - back road	ERM estimate
Temporary relocation							
Residents	wk	9.7	10	$ 6,300	$ 63,000	ERM estimate work duration; 3 residents, hotel with allocations for expenses @ $300/day	
Lost commercial production							
Landscaper	wk	9.7	10	$ 5,000	$ 50,000	ERM estimate work duration	
						Lost income	
Excavation/treatment duration	wk	9.7	10			Excavation rate of 200 cy/d	
Demobilization	ls	1	1	$ 10,000	$ 10,000	ERM estimate	ERM estimate
Subtotal					$ 880,455		
Design engineering	%	15.00%			$ 132,068		
Construction management	%	25.00%			$ 220,114		
Insurance	%	2.50%			$ 22,011		
Permitting and legal fees	ls	1	1	$ 10,000	$ 10,000		ERM estimate
Sampling for disposal	ls	1	1	$ 5,000	$ 5,000		ERM estimate
Surfactant selection laboratory test	ls	1	1	$ 163,115	$ 163,115	See page 5 of Table C-1-2 in Attachment 2.	ERM estimate
Surfactant selection pilot test	ls	1	1	$ 243,147	$ 243,147	See page 6 of Table C-1-2 in Attachment 2.	ERM estimate
Subtotal					$ 1,675,911		
Contingency	%	30.00%			$ 502,773		
Total					$ 2,178,684		

Notes
1 ERM estimate includes overhead and profit. 1996 Means Site Work - 15th Edition, plus 12% overhead and profit.
1996 Means Mechanical Work - 19th Edition, plus 12% overhead and profit.
2 Assumes a total depth of the gravel pit of 7 feet below ground surface.

Table C-17
Lenz Oil - Capital Cost Estimate
Remediation of LNAPL-Contaminated Soils in Areas 1a and 2 - Base Costs

Item	Units	Calculated Quantity	Design Quantity	Unit Price	Total Price	Calculated Quantity Remarks	Unit Price Source (1)
Mobilization	ls	1	1	$ 10,000	$ 10,000	ERM estimate	ERM estimate
Surveying	ls	1	1	$ 3,000	$ 3,000	ERM estimate	ERM estimate
Excavation							
Area 1a overburden (2)							
Soil and gravel	cy	12,186	12,200	$ 16.33	$ 199,221	Area of 25,000 sf - 11.4 ft depth + slopes = (158*158+181*181)(1/2)(11.4)/27	Means 022-254-0500, ERM adjusted
Area 1a material to be treated (2)							
Stained soil and gravel	cy	463	470	$ 16.33	$ 7,675	Area of 25,000 sf - 0.5 ft depth	Means 022-254-0500, ERM adjusted
Stained bedrock	cy	1,389	1,400	$ 150	$ 210,000	Area of 25,000 sf - 1.5 ft depth	TJ Lambercht Const.
Area 2 material to be treated (2)	cy	734	740	$ 16.33	$ 12,084	30 ft by 30 ft - 11ft depth + slopes = ((52*52)+(30*30))*(1/2)*(11)/27	Means 022-254-0500, ERM adjusted
Subtotal	cy	14,772	14,810				
Subtotal to be treated	cy	2,586	2,610				
Absorbent							
Material	cy	157	160	$ 75	$ 12,000	25,000 sf by 2 inches	Absorbent Supplies
Disposal	cy	157	160	$ 945	$ 151,200	TSCA Incineration (LNAPL w/absorbent)	Waste Management @ Port Arthur, TX
Excavation dewatering - Area 1a							
Dewatering points and piping	ea	6	6	$ 2,000	$ 12,000	Pumps and controls	ERM estimate
Dewatering system operation	wk	2.1	3	$ 4,000	$ 12,000	Excavation/treatment rate of 900 cy/wk	ERM estimate
Excavation dewatering - Area 2							
Dewatering points and piping	ea	2	2	$ 2,000	$ 4,000	Pumps and controls	ERM estimate
Dewatering system operation	wk	0.8	1	$ 2,000	$ 2,000	Excavation/treatment rate of 900 cy/wk	ERM estimate
Dewatering storage tank	ea	1	1	$ 71,335	$ 71,335	125,000 gallon field erected tank - on grade	Modutank Inc.
Water disposal (includes trucking)	gal	144,816	201,600	$ 0.73	$ 147,958	ERM estimate of 5 gpm for noted duration RCRA Subtitle C Treatment	Rollins Envir., Inc. @ Deer Park, TX
Replace water line (includes removal)	lf	250	300	$ 106	$ 31,752	ERM estimate - 6" pipe	Means A12.3-520-3150, ERM adjusted for H&S
Replace sewer line (includes removal)	lf	250	300	$ 106	$ 31,752	ERM estimate - 6" pipe	Means A12.3-520-3150, ERM adjusted for H&S
Replace gas line (included removal)	lf	250	300	$ 106	$ 31,752	ERM estimate - 6" pipe	Means A12.3-520-3150, ERM adjusted for H&S
Relocate power line	ls	1	1	$ 20,000	$ 20,000	ERM estimate	ERM estimate
Relocate phone line	ls	1	1	$ 10,000	$ 10,000	ERM estimate	ERM estimate
Road removal	cy	148	150	$ 130	$ 19,488	300 lf long by 24 ft wide by 8 in thick	Means 020-020-2000
Trucking off-site and disposal	cy	148	150	$ 59	$ 8,910	RCRA Subtitle D Landfill	Peoria Disposal Company @ Clinton, IL
New road							
Aggregate base layer	cy	311	310	$ 14.48	$ 4,487	300 lf long by 28 ft wide by 12 in thick	Dee-N-Dee Trucking
Aggregate placement	cy	311	310	$ 3.10	$ 962	300 lf long by 24 ft wide by 8 in thick	Means 022-246-1050
Aggregate compaction	cy	311	310	$ 0.35	$ 108	300 lf long by 24 ft wide by 8 in thick	Means 022-226-5000
Slab on grade with joints	sf	7,200	7,200	$ 2.54	$ 18,301	300 lf long by 24 ft wide by 8 in thick	Means 026-120-0100
Welded wire fabric	msf	72	100	$ 56.00	$ 5,600	6" x 6" size	Means 025-120-0600
Curbs	lf	600	600	$ 8.29	$ 4,973	300 lf each side of road	Means 025-254-0300
Traffic reroute	ls	1	1	$ 10,000	$ 10,000	ERM estimate - back road	ERM estimate
Road repair	ls	1	1	$ 10,000	$ 10,000	ERM estimate - back road	ERM estimate
Temporary relocation							
Residents	wk	16.4	17	$ 6,300	$ 107,100	ERM estimate work duration; 3 residents, hotel with allocations for expenses @ $300/day	ERM estimate
Lost commercial production							
Landscaper	wk	16.4	17	$ 5,000	$ 85,000	ERM estimate work duration Lost income	ERM estimate
Air monitoring with an HNu	wk	16.4	17	$ 2,000	$ 34,000	ERM estimate work duration	ERM estimate
Excavation/treatment duration	wk	16.4	17			excavation/treatment rate of 900 cy/wk	
H&S equipment	wk	16.4	17	$ 2,000	$ 34,000	ERM estimate	ERM estimate
Decontamination materials and labor	wk	16.4	17	$ 300	$ 5,100	ERM estimate	ERM estimate
Utility pipe disposal (includes trucking)	cy	20	20	$ 59	$ 1,188	RCRA Subtitle D Landfill	Peoria Disposal Company @ Clinton, IL
Decon water storage	gal	4,924	5,100	$ 0.10	$ 510	300 gal per week	Baker Tank
Decon water disposal (includes trucking)	gal	4,924	5,100	$ 0.73	$ 3,743	RCRA Subtitle C Treatment	Rollins Envir., Inc. @ Deer Park, TX
Demobilization	ls	1	1	$ 10,000	$ 10,000	ERM estimate	ERM estimate
Subtotal (LNAPL Soil base)					$ 1,343,199		

Notes
1 ERM estimate includes overhead and profit. 1996 Means Site Work - 15th Edition, plus 12% overhead and profit.
1996 Means Mechanical Work - 19th Edition, plus 12% overhead and profit.
2 Depths from Table C-1-3 in Attachment 1.

Table C-18
Lenz Oil - Capital Cost Estimate
Remediation of LNAPL-Contaminated Soils and Bedrock in Area 1b - Base Cost

Item	Units	Calculated Quantity	Design Quantity	Unit Price	Total Price	Calculated Quantity Remarks	Unit Price Source (1)
Mobilization	ls	-	-	$ 10,000	$ -	Included with Area 1a	ERM estimate
Surveying	ls	-	-	$ 2,000	$ -	Included with Area 1a	ERM estimate
Excavation							
Area 1b overburden (2)							
Soil and gravel	cy	8,145	8,200	$ 16.33	$ 133,903	Area of 18,600 sf - 11 ft depth + slopes = ((136x136)+(136x158))(0.5)(11)/27 Common side with Area 1a is not included	Means 022-254-0500, ERM adjusted
Top of bedrock	cy	1,033	1,100	$ 125	$ 137,500	Area of 18,600 sf - 1.5 ft depth - no slopes (136x136)(1.5)/27	TJ Lambercht Const.
Area 1b material to be treated (2)							
Stained bedrock	cy	1,378	1,400	$ 150	$ 210,000	Area of 18,600 sf - 2 ft depth	TJ Lambercht Const.
Subtotal	cy	10,556	10,700				
Subtotal Treatment	cy	1,378	1,400				
Absorbent							
Material	cy	117	120	$ 75	$ 9,000	18,600 sf by 2 inches	Absorbent Supplies
Disposal	cy	117	120	$ 945	$ 113,400	TSCA Incineration	Waste Management @ Port Arthur, TX
Excavation Dewatering - Area 1b							
Dewatering points and piping	ea	6	6	$ 2,000	$ 12,000	Pumps and controls	ERM estimate
Dewatering system operation	wk	1.5	2	$ 4,000	$ 6,123	Excavation/treatment rate of 900 cy/wk	ERM estimate
Dewatering storage tank	ea	77,156	77,156	$ -	$ -	Included with Area 1a	Modutank Inc.
Water disposal (includes trucking)	gal	77,156	100,800	$ 0.73	$ 73,979	ERM estimate of 5 gpm for noted duration RCRA Subtitle C Treatment	Rollins Envir., Inc. @ Deer Park, TX
Shop relocation	ls	1	1	$ 33,600	$ 33,600	ERM estimate	ERM estimate
Shed demolition	ls	3	3	$ 2,000	$ 6,000	ERM estimate	ERM estimate
Trucking off-site and disposal	cy	20	20	$ 59	$ 1,188	RCRA Subtitle D Landfill	Peoria Disposal Company @ Clinton, IL
Traffic reroute	ls	1	1	$ 10,000	$ 10,000	ERM estimate - back road	ERM estimate
Road repair	ls	1	1	$ 10,000	$ 10,000	ERM estimate - back road	ERM estimate
Temporary relocation							
Residents	wk	11.7	12	$ 6,300	$ 75,600	ERM estimate work duration; 3 residents, hotel with allocations for expenses @ $300/day	ERM estimate
Lost commercial production							
Landscaper	wk	11.7	12	$ 5,000	$ 60,000	ERM estimate work duration Lost income	ERM estimate
Excavation/treatment duration	wk	11.7	12			Excavation/treatment rate of 900 cy/wk	
Air monitoring with an HNu	wk	11.7	12	$ 2,000	$ 24,000	Labor and materials	ERM estimate
H&S equipment	wk	11.7	12	$ 2,000	$ 24,000	ERM estimate	ERM estimate
Decontamination materials and labor	wk	11.7	12	$ 300	$ 3,600	ERM estimate	ERM estimate
Decon water storage	gal	3,519	3,600	$ -	$ -	Included with Area 1a	Baker Tank
Decon water disposal (includes trucking)	gal	3,519	3,600	$ 0.73	$ 2,642	ERM estimate of 5 gpm for noted duration RCRA Subtitle C Treatment	Rollins Envir., Inc. @ Deer Park, TX
Demobilization	ls	1	1	$ -	$ -	Included with Area 1a	ERM estimate
Subtotal (LNAPL Rock base)					$ 946,535		

Notes
1 ERM estimate includes overhead and profit. 1996 Means Site Work - 15th Edition, plus 12% overhead and profit.
1996 Means Mechanical Work - 19th Edition, plus 12% overhead and profit.
2 Depth from Table C-1-3 in Attachment 1.

Table C-19
Lenz Oil - Capital Cost Estimate
Remediation of LNAPL-Contaminated Soils in Areas 1a and 2
On-Site Treatment and Replacement - Low Temperature Thermal Desorption

Item	Units	Calculated Quantity	Design Quantity	Unit Price	Total Price	Calculated Quantity Remarks	Unit Price Source (1)
LNAPL Base					$ 1,343,199	See LNAPL Soil Base Cost Estimate	See LNAPL Base Cost Estimate
Rock crushing	cy	1,852	1,870	$ 50	$ 93,500	See LNAPL Soil Base Cost Estimate (gravel+bedrock)	ERM estimate
On-site treatment mobilization/demobilization	ls	1	1	$ 900,000	$ 900,000	Mobilize equipment, prepare site and obtain utilities 60% apportioned to LNAPL-cont. materials; rest soils>1E-4	Soiltech ATP Systems
Truck to on site treatment	cy	2,586	2,610	$ 2.99	$ 7,805	See LNAPL Soil Base Cost Estimate	Means 022-266-0020
Thermal desorption with off-gas treatment	cy	2,586	2,610	$ 270	$ 704,700	Indirect w/ off gas treat - 1,100 degrees F	Soiltech ATP Systems
Disposal of LTTD residual by incineration							
Residual storage	gal	15,895	15,900	$ 0.10	$ 1,590	Average of 0.085 ft depth - area of 25,000 sf	Baker Tank
Transportation to incineration facility	gal	15,895	15,900	$ 0.66	$ 10,476	TSCA and Subtitle C Incineration (liquid)	Clean Harbors Envir. Serv. @ Deer Park, TX
Disposal at incineration facility	gal	15,895	15,900	$ 4.09	$ 65,110	TSCA and Subtitle C Incineration (liquid)	Clean Harbors Envir. Serv. @ Deer Park, TX
Disposal of spent carbon by incineration						Estimated 0.5 % of treated volume	
Disposal at incineration facility (includes trucking)	cy	13	13	$ 945	$ 12,332	TSCA and Subtitle C Incineration (soil)	Waste Management @ Port Arthur, TX
Fill placement	cy	14,772	14,810	$ 3.10	$ 45,947	See LNAPL Soil Base Cost Estimate	Means 022-246-1050
Fill compaction	cy	14,772	14,810	$ 0.35	$ 5,142	See LNAPL Soil Base Cost Estimate	Means 022-226-5000
Fill grading	sy	2,878	3,000	$ 1.97	$ 5,914	Area 1a @ 25,000 sf & area 2 @ 900 sf	Means 025-122-1050
Seeding	sf	25,900	26,000	$ 0.52	$ 13,395	Area 1a @ 25,000 sf & area 2 @ 900 sf	Means 029-308-0200
Subtotal					$ 3,209,109	Includes 60% of mobilization cost for thermal desorption	
Design engineering					$ 250,000		
Construction management	%	15%			$ 481,366		
Insurance	%	2.5%			$ 80,228		
Permitting and legal fees	ls	1	1	$ 20,000	$ 20,000		ERM estimate
Confirmatory sampling	ls	1	1	$ 20,000	$ 20,000		ERM estimate
Predesign soil sampling	ls	1	1	$ 70,990	$ 70,990	See page 3 of Table C-2-1 in Attachment 2.	ERM estimate
S/S binder selection	ls	1	1	$ 70,180	$ 70,180	See page 3 of Table C-2-1 in Attachment 2.	ERM estimate
LTTD off-site test	ls	1	1	$ 89,300	$ 89,300	See page 7 of Table C-2-1 in Attachment 2.	ERM estimate
Subtotal					$ 4,291,173		
Contingency	%	30.00%			$ 1,287,352		
Total					$ 5,578,525		

Notes
1 ERM estimate includes overhead and profit. 1996 Means Site Work - 15th Edition, plus 12% overhead and profit.
1996 Means Mechanical Work - 19th Edition, plus 12% overhead and profit.

Table C-19a
Lenz Oil - Capital Cost Estimate
Remediation of LNAPL-Contaminated Soils in Areas 1a and 2
***Ex Situ* Solidification/Stabilization**

Item	Units	Calculated Quantity	Design Quantity	Unit Price	Total Price	Calculated Quantity Remarks	Unit Price Source (1)
LNAPL Base					$ 1,343,199	See LNAPL Soil Base Cost Estimate	See LNAPL Base Cost Estimate
Rock crushing	cy	1,852	1,870	$ 50	$ 93,500	See LNAPL Soil Base Cost Estimate (gravel+bedrock)	ERM estimate
On-site treatment mobilization/demobilization	ls	1	1	$ 50,000	$ 50,000	Prepare site and obtain utilities	Millgard Environmental
Truck to on site treatment	cy	2,586	2,610	$ 2.99	$ 7,805	See LNAPL Soil Base Cost Estimate	Means 022-266-0020
Ex situ solidification/stabilization	cy	2,586	2,610	$ 50	$ 130,500	Solidification/stabilization on site	Millgard Environmental
Fill placement	cy	14,772	14,810	$ 3.10	$ 45,947	See LNAPL Soil Base Cost Estimate	Means 022-246-1050
Fill compaction	cy	14,772	14,810	$ 0.35	$ 5,142	See LNAPL Soil Base Cost Estimate	Means 022-226-5000
Fill grading	sy	2,878	3,000	$ 1.97	$ 5,914	Area 1a @ 25,000 sf & area 2 @ 900 sf	Means 025-122-1050
Seeding	sf	25,900	26,000	$ 0.52	$ 13,395	Area 1a @ 25,000 sf & area 2 @ 900 sf	Means 029-308-0200
Subtotal					$ 1,695,401		
Design engineering	%	10%			$ 169,540		
Construction management	%	15%			$ 254,310		
Insurance	%	2.5%			$ 42,385		
Permitting and legal fees	ls	1	1	$ 20,000	$ 20,000		ERM estimate
Confirmatory sampling	ls	1	1	$ 20,000	$ 20,000		ERM estimate
Predesign soil sampling	ls	1	1	$ 70,990	$ 70,990	See page 3 of Table C-2-1 in Attachment 2.	ERM estimate
S/S binder selection	ls	1	1	$ 70,180	$ 70,180	See page 3 of Table C-2-1 in Attachment 2.	
LTTD off-site test	ls	1	1	$ 89,300	$ 89,300	See page 7 of Table C-2-1 in Attachment 2.	ERM estimate
Subtotal					$ 2,432,107		
Contingency	%	30.00%			$ 729,632		
Total					$ 3,161,739		

Notes
1 ERM estimate includes overhead and profit. 1996 Means Site Work - 15th Edition, plus 12% overhead and profit.
1996 Means Mechanical Work - 19th Edition, plus 12% overhead and profit.

Table C-20
Lenz Oil - Capital Cost Estimate
Remediation of LNAPL Contaminated Soil and Bedrock in Areas 1a & b, and 2
On-Site Treatment and Replacement - Low Temperature Thermal Desorption

Item	Units	Calculated Quantity	Design Quantity	Unit Price	Total Price	Calculated Quantity Remarks	Unit Price Source (1)
LNAPL Soil Base					$ 1,343,199	See LNAPL Soil Base Cost Estimate	See LNAPL Soil Base Cost Estimate
LNAPL Rock Base					$ 946,535	See LNAPL Rock Base Cost Estimate	See LNAPL Rock Base Cost Estimate
Rock crushing	cy	3,230	3,270	$ 50	$ 163,500	See LNAPL Soil & Rock Base Cost Estimates (gravel+bedrock)	ERM estimate
On-site treatment mobilization/demobilization	ls	1	1	$ 900,000	$ 900,000	Mobilize equipment, prepare site and obtain utilities	Soiltech ATP Systems
						60% apportioned to LNAPL-cont. materials; rest soils>1E-4	
Truck to on site treatment	cy	3,964	4,010	$ 2.99	$ 11,992	See LNAPL Soil & Rock Base Cost Estimates	Means 022-266-0020
Thermal desorption with off-gas treatment	cy	3,964	4,010	$ 270	$ 1,082,700	Indirect w/ off gas treat - 1,100 degrees F	Soiltech ATP Systems
Disposal of LTTD residual by incineration							
Residual storage	gal	28,293	28,300	$ 0.10	$ 2,830	Average of 0.085 ft depth over area of 44,500 sf	Baker Tank
Transportation to incineration facility	gal	28,293	28,300	$ 0.66	$ 18,646	TSCA and Subtitle C Incineration (liquid)	Clean Harbors Envir. Serv. @ Deer Park, TX
Disposal at incineration facility	gal	28,293	28,300	$ 4.09	$ 115,887	TSCA and Subtitle C Incineration (liquid)	Clean Harbors Envir. Serv. @ Deer Park, TX
Disposal of spent carbon by incineration						Estimated 0.5 % of treated volume	
Disposal at incineration facility (includes trucking)	cy	20	20	$ 945	$ 18,947	TSCA and Subtitle C Incineration (soil)	Waste Management @ Port Arthur, TX
Fill placement	cy	25,328	25,510	$ 3.10	$ 79,142	See LNAPL Soil & Rock Base Cost Estimates	Means 022-246-1050
Fill compaction	cy	25,328	25,510	$ 0.35	$ 8,857	See LNAPL Soil & Rock Base Cost Estimates	Means 022-226-5000
Fill grading	sy	4,944	5,000	$ 1.97	$ 9,856	Area of 44,500 sf	Means 025-122-1050
Seeding	sf	44,500	45,000	$ 0.52	$ 23,184	Area of 44,500 sf	Means 029-308-0200
Subtotal					$ 4,725,275		
Design engineering					$ 400,000		
Construction management	%	15.00%			$ 708,791		
Insurance	%	2.50%			$ 118,132		
Permitting and legal fees	ls	1	1	$ 20,000	$ 20,000		ERM estimate
Confirmatory sampling	ls	1	1	$ 20,000	$ 20,000		ERM estimate
Predesign soil sampling	ls	1	1	$ 70,990	$ 70,990	See page 3 of Table C-2-1 in Attachment 2.	ERM estimate
S/S binder selection	ls	1	1	$ 70,180	$ 70,180	See page 3 of Table C-2-1 in Attachment 2.	ERM estimate
LTTD off-site test	ls	1	1	$ 89,300	$ 89,300	See page 7 of Table C-2-1 in Attachment 2.	ERM estimate
Subtotal					$ 6,222,668		
Contingency	%	30.00%			$ 1,866,801		
Total					$ 8,089,469		

Notes
1 ERM estimate includes overhead and profit. 1996 Means Site Work - 15th Edition, plus 12% overhead and profit.
1996 Means Mechanical Work - 19th Edition, plus 12% overhead and profit.

Table C-20a
Lenz Oil - Capital Cost Estimate
Remediation of LNAPL Contaminated Soil and Bedrock in Areas 1a & b, and 2
On-Site Treatment and Replacement - *Ex Situ* Solidification/Stabilization

Item	Units	Calculated Quantity	Design Quantity	Unit Price	Total Price	Calculated Quantity Remarks	Unit Price Source (1)
LNAPL Soil Base					$ 1,343,199	See LNAPL Soil Base Cost Estimate	See LNAPL Soil Base Cost Estimate
LNAPL Rock Base					$ 946,535	See LNAPL Rock Base Cost Estimate	See LNAPL Rock Base Cost Estimate
Rock crushing	cy	3,230	3,270	$ 50	$ 163,500	See LNAPL Soil & Rock Base Cost Estimate (gravel+bedrock)	ERM estimate
On-site treatment mobilization/demobilization	ls	1	1	$ 50,000	$ 50,000	Prepare site and obtain utilities	Millgard Environmental
Truck to on site treatment	cy	3,964	4,010	$ 2.99	$ 11,992	See LNAPL Soil & Rock Base Cost Estimates	Means 022-266-0020
Ex situ solidification/stabilization	cy	3,964	4,010	$ 50	$ 200,500	Solidification/stabilization on site	Millgard Environmental
Fill placement	cy	25,328	25,510	$ 3.10	$ 79,142	See LNAPL Soil & Rock Base Cost Estimates	Means 022-246-1050
Fill compaction	cy	25,328	25,510	$ 0.35	$ 8,857	See LNAPL Soil & Rock Base Cost Estimates	Means 022-226-5000
Fill grading	sy	4,944	5,000	$ 1.97	$ 9,856	Area of 44,500 sf	Means 025-122-1050
Seeding	sf	44,500	45,000	$ 0.52	$ 23,184	Area of 44,500 sf	Means 029-308-0200
Subtotal					$ 2,836,765		
Design engineering					$ 400,000		
Construction management	%	15.00%			$ 425,515		
Insurance	%	2.50%			$ 70,919		
Permitting and legal fees	ls	1	1	$ 20,000	$ 20,000		ERM estimate
Confirmatory sampling	ls	1	1	$ 20,000	$ 20,000		ERM estimate
Predesign soil sampling	ls	1	1	$ 70,990	$ 70,990	See page 3 of Table C-2-1 in Attachment 2.	ERM estimate
S/S binder selection	ls	1	1	$ 70,180	$ 70,180	See page 3 of Table C-2-1 in Attachment 2.	ERM estimate
LTTD off-site test	ls	1	1	$ 89,300	$ 89,300	See page 7 of Table C-2-1 in Attachment 2.	ERM estimate
Subtotal					$ 4,003,669		
Contingency	%	30.00%			$ 1,201,101		
Total					$ 5,204,770		

Notes
1 ERM estimate includes overhead and profit. 1996 Means Site Work - 15th Edition, plus 12% overhead and profit.
1996 Means Mechanical Work - 19th Edition, plus 12% overhead and profit.

Table C-21
Lenz Oil - Capital Cost Estimate
Ground Water Recovery
Five Wells

Item	Units	Calculated Quantity	Design Quantity	Unit Price	Total Price	Calculated Quantity Remarks	Unit Price Source (1)
Mobilization	ls	1	1	$ 10,000	$ 10,000	ERM estimate	ERM estimate
Surveying	ls	1	1	$ 2,000	$ 2,000	ERM estimate	ERM estimate
Piping trench	cy	356	360	$ 16.33	$ 5,879	1,200 lf long by 2 ft wide by 4 ft depth	Means 022-254-0500, ERM adjusted
Piping manholes	cy	11	20	$ 13.04	$ 261	5 manholes - 4 ft dia by 5 ft depth	Means 022-238-0500/0020/4250
Total excavated	cy	367	380				
Extraction wells - 6 inch diameter by 20 ft deep	ea	5	5	$ 7,000	$ 35,000	ERM estimate	ERM estimate
Extraction well cuttings	cy	4	4			ERM calculated	
Transportation to off site Subtitle D Facility (2)	cy	4	4	$ 35.10	$ 140	RCRA Subtitle D Landfill	Peoria Disposal Company @ Clinton, IL
Disposal at Subtitle D facility	cy	4	4	$ 24.30	$ 97	RCRA Subtitle D Landfill	Peoria Disposal Company @ Clinton, IL
Sand bedding for piping	cy	89	90	$ 12.56	$ 1,130	1,200 lf by 2 ft wide by 1 ft depth	Dee-N-Dee Trucking
Backfilling Excavations							
Placement	cy	278	290	$ 3.10	$ 900	Total excavated less sand	Means 022-246-1050
Compaction	cy	278	290	$ 0.35	$ 101	Total excavated less gravel, sand, & seal	Means 022-226-5000
Grading	sy	267	300	$ 1.97	$ 591	1,200 lf long by 2 ft wide	Means 025-122-1050
Excess excavated soil placement	cy	89	90	$ 8.70	$ 783	Total excavated less backfill	Means 022-216-4000 & 022-266-1150
Clean soil placed on site							
Extraction Well Pumping System							
Pump vault	ea	5	5	$ 5,000	$ 25,000	ERM estimate	Midwest Tile & Concrete
Piping manholes	ea	4	4	$ 2,000	$ 8,000	ERM estimate	ERM estimate
Compressed air piping system - 2 inch	lf	1,440	1,500	$ 9.90	$ 14,851	ERM estimate	Means A12.3-520-3090
Extraction pumps with controllers	ea	5	5	$ 6,000	$ 30,000	ERM estimate	GeoGuard
Pump discharge piping system - 2 inch	lf	2,400	2,500	$ 4.41	$ 11,032	ERM estimate	Means A12.3-520-2090
System discharge flow meters	ea	5	5	$ 6,000	$ 30,000	ERM estimate	Fisher-Rosemount Magmeter
Pressure testing	ls	1	1	$ 2,000	$ 2,000	ERM estimate	ERM estimate
Building cost							
Foundation	sf	288	290	$ 2.32	$ 673	area of 12 ft by 24 ft	ERM estimate
Building, installed	sf	288	290	$ 130.00	$ 37,700	area of 12 ft by 24 ft	Parkline Buildings
Air compressor system	ea	1	1	$ 18,000	$ 18,000	70 scfm - 15 hp	Quincy Compressors
Roadway Crossing	ls	1	1	$ 15,000	$ 15,000	ERM estimate	ERM estimate
Air monitoring with an HNu	wk	3	4	$ 2,000	$ 8,000	ERM estimate work duration	ERM estimate
H&S equipment	wk	3	4	$ 2,000	$ 8,000	ERM estimate work duration	ERM estimate
Decontamination materials and labor	wk	3	4	$ 300	$ 1,200	ERM estimate	ERM estimate
Decon & well development water storage	gal	2,100	2,400	$ 0.10	$ 240	300 gal per week plus 200 gal per well	Baker Tank
Water disposal (includes trucking)	gal	2,100	2,400	$ 0.73	$ 1,761	RCRA Subtitle C Treatment	Rollins Envir., Inc. @ Deer Park, TX
Demobilization	ls	1	1	$ 5,000	$ 5,000	ERM estimate	ERM estimate
Subtotal					$ 273,339		
Design engineering	%	15.00%			$ 41,001		
Construction management	%	25.00%			$ 68,335		
Insurance	%	2.50%			$ 6,833		
Permitting and legal fees	ls	1	1	$ 10,000	$ 10,000		ERM estimate
Aquifer pump test	ls	1	1	$ 121,500	$ 121,500	See page 4 of Table C-2-1 in Attachment 2.	ERM estimate
Subtotal					$ 521,009		
Contingency	%	30.00%			$ 156,303		
Total					$ 677,311		

Notes
1 ERM estimate includes overhead and profit. 1996 Means Site Work - 15th Edition, plus 12% overhead and profit.
1996 Means Mechanical Work - 19th Edition, plus 12% overhead and profit.
2 The soil and bedrock near the river are not expected to be contaminated with LNAPL or to exceed the health levels specified in the Record of Decision for listed wastes.
Therefore, disposal at a Subtitle D landfill would be acceptable.

Table C-22
Lenz Oil - Capital Cost Estimate
Ground Water Treatment System
LNAPL Recovery - Active, with Ground Water Recovery
Design Flow Rate of 50 gpm

Item	Units	Quantity	Unit Price	Total	Quantity Remarks	Unit Price Source (1)
Building						
Prefabricated building	sf	4,000	$ 115.00	$ 460,000	50 ft wide by 80 ft long	Parkline Buildings
Building placement	sf	4,000	$ 15.00	$ 60,000	50 ft wide by 80 ft long	Parkline Buildings
Equipment support steel	lb	10,000	$ 2.09	$ 20,944	ERM estimate	Means 050-230-0450
Locker room hardware	ls	1	$ 2,000	$ 2,000	ERM estimate	ERM estimate
Office hardware	ls	1	$ 2,000	$ 2,000	ERM estimate	ERM estimate
Rest room hardware	ls	1	$ 2,000	$ 2,000	ERM estimate	ERM estimate
Safety equipment	ls	1	$ 2,000	$ 2,000	ERM estimate	ERM estimate
Decon equipment	ls	1	$ 2,000	$ 2,000	ERM estimate	ERM estimate
Parking lot - asphalt	sf	2,000	$ 3.92	$ 7,840	25 ft wide by 80 ft long	Asphalt cap cost
Utilities						
Electrical service	ls	1	$ 20,000	$ 20,000	ERM estimate	ERM estimate
Phone service	ls	1	$ 1,000	$ 1,000	ERM estimate	ERM estimate
Potable water service	ls	1	$ 20,000	$ 20,000	ERM estimate	ERM estimate
Connection to sanitary sewer	ls	1	$ 20,000	$ 20,000	ERM estimate	ERM estimate
Treatment Equipment Systems						
Oil - water separator	ea	2	$ 8,568	$ 17,136	1 operating & 1 standby (50 gpm each)	ECHOS 33-13-1212
Oil filters - gravity with disposable media	ea	2	$ 5,712	$ 11,424	1 operating & 1 standby (50 gpm each)	ECHOS 33-13-1212
Solids separator	ea	2	$ 8,568	$ 17,136	1 operating & 1 standby (50 gpm each)	ECHOS 33-13-1212
Solids thickener/holding tanks with pumps	ea	2	$ 6,720	$ 13,440	1,000 gal with 2 pumps (50 gpm @ 1.5 hp)	ECHOS 33-10-9657/29-0121
pH adjustment	ea	1	$ 2,576	$ 2,576	5,500 gal with 1/3 hp mixer	ECHOS 33-10-9656/13-0416
Chemical feed system, with tank & pumps	ea	1	$ 13,059	$ 13,059	500 gal SS with two 20 gph pumps	ECHOS 33-32-0118/0121
Pumping station, with tank & pumps	ea	2	$ 6,720	$ 13,440	1,000 gal with 2 pumps (50 gpm @ 1.5 hp)	ECHOS 33-10-9657/29-0121
Air stripper, with blower	ea	2	$ 23,318	$ 46,637	Package unit (50 gpm - 1,050 cfm @ 15 hp)	ECHOS 33-13-0714/0741/0752
Pumping station, with tank & pumps	ea	2	$ 6,720	$ 13,440	1,000 gal with 2 pumps (50 gpm @ 1.5 hp)	ECHOS 33-10-9657/29-0121
Solids filters - pressure with disposable media	ea	2	$ 9,957	$ 19,914	1 operating & 1 standby (65 gpm)	ECHOS 33-13-0102
Solids filters - pressure with disposable media	ea	2	$ 9,957	$ 19,914	1 operating & 1 standby (65 gpm)	ECHOS 33-13-0102
Utility air compressor unit	ea	1	$ 7,280	$ 7,280	13 scfm @ 200 psi - 6 hp motor	ECHOS 33-13-0201
Piping Systems						
Process water (2 inch CPVC)	lf	1,000	$ 42.22	$ 42,224	ERM estimate	Means151-551-5910, ERM adjusted
Process air (4 inch CPVC)	lf	500	$ 54.60	$ 27,300	ERM estimate	Means151-551-5940, ERM adjusted
Compressed air (2 inch steel)	lf	200	$ 47.88	$ 9,576	ERM estimate	Means151-701-5580, ERM adjusted
Potable water (1-1/2 inch steel)	lf	200	$ 26.71	$ 5,342	ERM estimate	Means151-701-5570, ERM adjusted
Instrumentation Systems						
Control panel	ls	1	$ 75,000	$ 75,000	ERM estimate	ERM estimate
Level control	ea	4	$ 5,000	$ 20,000	ERM estimate	ERM estimate
Flow control	ea	4	$ 5,000	$ 20,000	ERM estimate	ERM estimate
Pressure control	ea	3	$ 5,000	$ 15,000	ERM estimate	ERM estimate
pH control	ea	1	$ 5,000	$ 5,000	ERM estimate	ERM estimate
Communication	ls	1	$ 1,000	$ 1,000	ERM estimate	ERM estimate
Computer	ls	1	$ 5,000	$ 5,000	ERM estimate	ERM estimate
Subtotal				$ 1,040,622		
Electrical Systems (percent of above costs)						
Grounding	%	1%		$ 10,406	ERM estimate	
480 volt distribution	%	7.5%		$ 78,047	ERM estimate	
480/120 volt transformer	%	2%		$ 20,812	ERM estimate	
120 volt distribution	%	5%		$ 52,031	ERM estimate	
Instrumentation distribution	%	5%		$ 52,031	ERM estimate	
Mobilization	ls	1	$ 10,000	$ 10,000	ERM estimate	
Site Preparation						
Area leveling	sy	667	$ 1.97	$ 1,314	75 ft wide by 80 ft long	Means 025-122-1050
Membrane	sf	6,000	$ 0.50	$ 3,000	75 ft wide by 80 ft long	ERM estimate
Gravel	cy	148	$ 7.00	$ 1,037	50 ft wide by 80 ft long by 1 ft depth	Dee-N-Dee Trucking
Gravel placement	cy	148	$ 3.10	$ 460	50 ft wide by 80 ft long by 1 ft depth	Means 022-246-1050
Gravel compaction	cy	148	$ 0.35	$ 51	50 ft wide by 80 ft long by 1 ft depth	Means 022-226-5000
Gravel leveling	sy	444	$ 1.97	$ 876	75 ft wide by 80 ft long	Means 025-122-1050
Concrete Work						
Welded wire fabric	msf	400	$ 56.00	$ 22,400	6" x 6" size	Means 025-120-0600
Slab on grade with joints	sf	4,000	$ 2.54	$ 10,167	75 ft wide by 80 ft long	Means 026-120-0100
Air monitoring with an HNu	wk	1	$ 2,000	$ 2,000	Labor and materials	ERM estimate
H&S equipment	wk	1	$ 2,000	$ 2,000	ERM estimate	ERM estimate
Decontamination materials and equipment	ls	1	$ 2,000	$ 2,000	ERM estimate	ERM estimate
Decon water storage	gal	2,000	$ 0.10	$ 200	ERM estimate	Baker Tank
Decon waste disposal (includes trucking)	gal	2,000	$ 0.73	$ 1,468	RCRA Subtitle C Treatment	Rollins Envir., Inc. @ Deer Park, TX
Demobilization	ls	1	$ 5,000	$ 5,000		ERM estimate
Subtotal				$ 1,315,923		
Design engineering	%	15%		$ 197,388		
Construction management	%	25%		$ 328,981		
Insurance	%	2.5%		$ 32,898		
Permitting and legal fees	ls	1	$ 5,000	$ 5,000		ERM estimate
Ground water treatability testing	ls	1	$ 169,630	$ 169,630	See page 2 of Table C-2-1 in Attachment 2.	ERM estimate
Subtotal				$ 2,049,819		
Contingency	%	30%		$ 614,946		
Total				$ 2,664,765		

Notes
1 ERM estimate includes overhead and profit. 1996 Means Site Work - 15th Edition, plus 12% overhead and profit.
1996 Means Mechanical Work - 19th Edition, plus 12% overhead and profit.
1996 ECHOS Environmental Restoration, plus 12% overhead and profit.

Table C-23
Lenz Oil - Capital Cost Estimate
Ground Water Treatment System
LNAPL Recovery - Enhanced, with Ground Water Recovery
Design Flow Rate of 50 gpm

Item	Units	Quantity	Unit Price	Total	Quantity Remarks	Unit Price Source (1)
Building						
Prefabricated building	sf	5,000	$ 115.00	$ 575,000	50 ft wide by 100 ft long	Parkline Buildings
Building placement	sf	5,000	$ 15.00	$ 75,000	50 ft wide by 100 ft long	Parkline Buildings
Equipment support steel	lb	10,000	$ 2.09	$ 20,944	ERM estimate	Means 050-230-0450
Locker room hardware	ls	1	$ 2,000	$ 2,000	ERM estimate	ERM estimate
Office hardware	ls	1	$ 2,000	$ 2,000	ERM estimate	ERM estimate
Rest room hardware	ls	1	$ 2,000	$ 2,000	ERM estimate	ERM estimate
Safety equipment	ls	1	$ 2,000	$ 2,000	ERM estimate	ERM estimate
Decon equipment	ls	1	$ 2,000	$ 2,000	ERM estimate	ERM estimate
Parking lot - asphalt	sf	2,500	$ 3.92	$ 9,800	25 ft wide by 100 ft long	Asphalt cap cost
Utilities						
Electrical service	ls	1	$ 20,000	$ 20,000	ERM estimate	ERM estimate
Phone service	ls	1	$ 1,000	$ 1,000	ERM estimate	ERM estimate
Potable water service	ls	1	$ 20,000	$ 20,000	ERM estimate	ERM estimate
Connection to sanitary sewer	ls	1	$ 20,000	$ 20,000	ERM estimate	ERM estimate
Treatment Equipment Systems						
Oil - water separator	ea	2	$ 8,568	$ 17,136	1 operating & 1 standby (50 gpm each)	ECHOS 33-13-1212
Oil filters - gravity with disposable media	ea	2	$ 5,712	$ 11,424	1 operating & 1 standby (50 gpm each)	ECHOS 33-13-1212
Solids separator	ea	2	$ 8,568	$ 17,136	1 operating & 1 standby (50 gpm each)	ECHOS 33-13-1212
Solids thickener/holding tanks with pumps	ea	2	$ 6,720	$ 13,440	1,000 gal with 2 pumps (50 gpm @ 1.5 hp)	ECHOS 33-10-9657/29-0121
DAF unit with controls	ea	2	$ 50,000	$ 100,000	1 operating & 1 standby (50 gpm each - 15 hp)	Tenco-Hydro, Inc.
pH adjustment	ea	1	$ 2,576	$ 2,576	5,500 gal with 1/3 hp mixer	ECHOS 33-10-9656/13-0416
Chemical feed system, with tank & pumps	ea	1	$ 13,059	$ 13,059	500 gal SS with two 20 gph pumps	ECHOS 33-32-0118/0121
Pumping station, with tank & pumps	ea	2	$ 6,720	$ 13,440	1,000 gal with 2 pumps (50 gpm @ 1.5 hp each)	ECHOS 33-10-9657/29-0121
Air stripper, with blower	ea	2	$ 23,318	$ 46,637	Package unit (50 gpm and 1,050 cfm @ 15 hp each)	ECHOS 33-13-0714/0741/0752
Pumping station, with tank & pumps	ea	2	$ 6,720	$ 13,440	1,000 gal with 2 pumps (50 gpm @ 1.5 hp each)	ECHOS 33-10-9657/29-0121
Solids filters - pressure with disposable media	ea	2	$ 9,957	$ 19,914	1 operating & 1 standby (65 gpm each)	ECHOS 33-13-0102
Solids filters - pressure with disposable media	ea	2	$ 9,957	$ 19,914	1 operating & 1 standby (65 gpm each)	ECHOS 33-13-0102
Utility air compressor unit	ea	1	$ 7,280	$ 7,280	13 scfm @ 200 psi - 6 hp motor	ECHOS 33-13-0201
Piping Systems						
Process water (2 inch CPVC)	lf	1,200	$ 42.22	$ 50,669	ERM estimate	Means151-551-5910, ERM adjusted
Process air (4 inch CPVC)	lf	600	$ 54.60	$ 32,760	ERM estimate	Means151-551-5940, ERM adjusted
Compressed air (2 inch steel)	lf	200	$ 47.88	$ 9,576	ERM estimate	Means151-701-5580, ERM adjusted
Potable water (1-1/2 inch steel)	lf	200	$ 26.71	$ 5,342	ERM estimate	Means151-701-5570, ERM adjusted
Instrumentation Systems						
Control panel	ls	1	$ 75,000	$ 75,000	ERM estimate	ERM estimate
Level control	ea	4	$ 5,000	$ 20,000	ERM estimate	ERM estimate
Flow control	ea	6	$ 5,000	$ 30,000	ERM estimate	ERM estimate
Pressure control	ea	3	$ 5,000	$ 15,000	ERM estimate	ERM estimate
pH control	ea	1	$ 5,000	$ 5,000	ERM estimate	ERM estimate
Communication	ls	1	$ 1,000	$ 1,000	ERM estimate	ERM estimate
Computer	ls	1	$ 5,000	$ 5,000	ERM estimate	ERM estimate
Subtotal				$ 1,296,486		
Electrical Systems (percent of above costs)						
Grounding	%	1%		$ 12,965	ERM estimate	
480 volt distribution	%	7.5%		$ 97,236	ERM estimate	
480/120 volt transformer	%	2%		$ 25,930	ERM estimate	
120 volt distribution	%	5%		$ 64,824	ERM estimate	
Instrumentation distribution	%	5%		$ 64,824	ERM estimate	
Mobilization	ls	1	$ 10,000	$ 10,000	ERM estimate	
Site Preparation						
Area leveling	sy	833	$ 1.97	$ 1,643	75 ft wide by 100 ft long	Means 025-122-1050
Membrane	sf	7,500	$ 0.50	$ 3,750	75 ft wide by 100 ft long	ERM estimate
Gravel	cy	222	$ 7.00	$ 1,556	50 ft wide by 100 ft long by 1 ft depth	Dee-N-Dee Trucking
Gravel placement	cy	222	$ 3.10	$ 689	50 ft wide by 100 ft long by 1 ft depth	Means 022-246-1050
Gravel compaction	cy	222	$ 0.35	$ 77	50 ft wide by 100 ft long by 1 ft depth	Means 022-226-5000
Gravel leveling	sy	833	$ 1.97	$ 1,643	50 ft wide by 100 ft long	Means 025-122-1050
Concrete Work						
Welded wire fabric	msf	750	$ 56.00	$ 42,000	6" x 6" size	Means 025-120-0600
Slab on grade with joints	sf	7,500	$ 2.54	$ 19,064	75 ft wide by 100 ft long	Means 026-120-0100
Air monitoring with an HNu	wk	1	$ 2,000	$ 2,000	Labor and materials	ERM estimate
H&S equipment	wk	1	$ 2,000	$ 2,000	ERM estimate	ERM estimate
Decontamination materials and equipment	ls	1	$ 2,000	$ 2,000	ERM estimate	ERM estimate
Decon water storage	gal	2,000	$ 0.10	$ 200	ERM estimate	Baker Tank
Decon waste disposal (includes trucking)	gal	2,000	$ 0.73	$ 1,468	RCRA Subtitle C Treatment	Rollins Envir., Inc. @ Deer Park, TX
Demobilization	ls	1	$ 5,000	$ 5,000	ERM estimate	ERM estimate
Subtotal				$ 1,655,355		
Design engineering	%	15%		$ 248,303		
Construction management	%	25%		$ 413,839		
Insurance	%	2.5%		$ 41,384		
Permitting and legal fees	ls	1	$ 5,000	$ 5,000		ERM estimate
Ground water treatability testing	ls	1	$ 271,060	$ 271,060	See page 7 of Table C-2-1 in Attachment 2.	ERM estimate
Subtotal				$ 2,634,941		
Contingency	%	30%		$ 790,482		
Total				$ 3,425,424		

Notes
1 ERM estimate includes overhead and profit. 1996 Means Site Work - 15th Edition, plus 12% overhead and profit.
1996 Means Mechanical Work - 19th Edition, plus 12% overhead and profit.
1996 ECHOS Environmental Restoration, plus 12% overhead and profit.

Table C-24

Lenz Oil - Operation and Maintenance Cost Estimate Summary

Process Option	Table Number	1	2	3	4	5	5a	6	6a	7	8	9
Common Activities	Table C-26	$ -	$ 133,250	$ 133,250	$ 133,250	$ 133,250	$ 133,250	$ 133,250	$ 133,250	$ 133,250	$ 133,250	$ 133,250
Covers												
Multilayered Cap												
Years 1 to 5	Table C-27	$ -	$ 30,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Years 6+	Table C-27	$ -	$ 5,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Solid Waste Cap												
Years 1 to 5	Table C-28	$ -	$ -	$ 30,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Years 6+	Table C-28	$ -	$ -	$ 5,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Asphalt Cap												
Year 1 and 5	Table C-29	$ -	$ -	$ -	$ 25,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Year 11 and every 5	Table C-29	$ -	$ -	$ -	$ 56,250	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Concrete Cap												
Year 1 and 5	Table C-30	$ -	$ -	$ -	$ 12,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Year 11 and every 5	Table C-30	$ -	$ -	$ -	$ 56,250	$ -	$ -	$ -	$ -	$ -	$ -	$ -
LNAPL												
LNAPL Recovery - Passive 4 trenches	Table C-25	$ -	$ 27,163	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
LNAPL Recovery - Active 2 trenches	Table C-25	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 25,357	$ -	$ -
LNAPL Recovery - Active 3 trenches	Table C-25	$ -	$ -	$ 34,040	$ 34,040	$ 34,040	$ 34,040	$ -	$ -	$ -	$ 34,040	$ -
LNAPL Recovery - Active 4 trenches	Table C-25	$ -	$ -	$ -	$ -	$ -	$ -	$ 48,319	$ 48,319	$ -	$ -	$ -
Enhanced LNAPL Recovery - Surfactants 3 trenches	Table C-25	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 199,172	$ -
Enhanced LNAPL Recovery - Surfactants 4 trenches	Table C-25	$ -	$ -	$ -	$ -	$ -	$ -	$ 370,835	$ 370,835	$ -	$ -	$ -
Ground Water												
Recovery Wells with no surfactants, 2 trenches	Table C-25	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 19,618	$ -	$ -
Recovery Wells with no surfactants, 3 trenches	Table C-25	$ -	$ -	$ 18,901	$ 18,901	$ 18,901	$ 18,901	$ -	$ -	$ -	$ -	$ -
Recovery Wells with surfactants, 3 trenches	Table C-25	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 19,003	$ -
Recovery Wells with surfactants, 4 trenches	Table C-25	$ -	$ -	$ -	$ -	$ -	$ -	$ 19,003	$ 19,003	$ -	$ -	$ -
Ground Water Treatment System												
Treatment System with no surfactants, 2 trenches	Table C-25	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 321,775	$ -	$ -
Treatment System with no surfactants, 3 trenches	Table C-25	$ -	$ -	$ 347,756	$ 347,756	$ 347,756	$ 347,756	$ -	$ -	$ -	$ -	$ -
Treatment System with surfactants, 3 trenches	Table C-25	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 426,474	$ -
Treatment System with surfactants, 4 trenches	Table C-25	$ -	$ -	$ -	$ -	$ -	$ -	$ 509,738	$ 509,738	$ -	$ -	$ -
Total Cost (concrete cover, year 1)		$ -	$ 190,413	$ 563,946	$ 546,446	$ 533,946	$ 533,946	$1,081,145	$1,081,145	$ 499,999	$ 811,938	$ 133,250
Total Cost (asphalt cover, year 1)		$ -	$ 190,413	$ 563,946	$ 558,946	$ 533,946	$ 533,946	$1,081,145	$1,081,145	$ 499,999	$ 811,938	$ 133,250

Table C-25 (Page 1 of 4)
Lenz Oil - Operation and Maintenance Cost Estimate
Ground Water Treatment System

Option Description	Operation & Maintenance Cost Summary			Sewer Use Fee		Electrical				Maintenance (also phone & security)			Collected Oil Disposal		Trench Treatment System Solids Disposal		Extraction Well Treatment System Solids Disposal		Page 2 Total
	Total	Cont	Subtotal	Volume	Cost	System Hp	% load	Load	Cost	Equipment	Allot.	Cost	Volume	Cost	Volume	Cost	Volume	Cost	Cost
		% 30.00%		gal/year	per gallon $ 0.002	Hp	% (flow rate) base flow rate	kwhr	per kwhr $ 0.10	Cost	%		gallons TSCA Incineration	per gallon $ 4.75	cubic yard RCRA C disposal Absorbent addition at Landfill	per cubic yard $ 292 $ 200	cubic yard RCRA Subtitle D Absorbent addition at Landfill	per cubic yard $ 59 $ 200	
LNAPL Recovery Passive - Four trenches (Collected oil equal to two active trenches)	$ 27,163	$ 6,268	$ 20,894	0	$ -	20	0	-	$ -	$ 72,000	2.50%	$ 1,800	79	$ 374	-	$ -	-	$ -	$ 18,720
					$ -				$ -			$ 1,800		$ 374		$ -		$ -	
LNAPL Recovery Active - Two trenches	$ 25,357	$ 5,852	$ 19,505	0	$ -	20	0.3	52,560	$ 5,256	175,600	2.50%	$ 4,390	105	$ 499	-	$ -	-	$ -	$ 9,360
					$ -				$ 5,256			$ 4,390		$ 499		$ -		$ -	
LNAPL Recovery Active - Three trenches	$ 34,040	$ 7,855	$ 26,184	0	$ -	30	0.39	102,492	$ 10,249	230,550	2.50%	$ 5,764	171	$ 811	-	$ -	-	$ -	$ 9,360
					$ -				$ 10,249			$ 5,764		$ 811		$ -		$ -	
LNAPL Recovery Active - Four trenches	$ 48,319	$ 11,151	$ 37,168	0	$ -	40	0.56	196,224	$ 19,622	285,500	2.50%	$ 7,138	221	$ 1,049	-	$ -	-	$ -	$ 9,360
					$ -				$ 19,622			$ 7,138		$ 1,049		$ -		$ -	
Surfactant-enhanced LNAPL Recovery Feed System - 3 Trenches	$ 199,172	$ 45,963	$ 153,209	0	$ -	10	0.1	8,760	$ 876	88,520	2.50%	$ 2,213	-	$ -	-	$ -	-	$ -	$ 150,120
					$ -				$ 876			$ 2,213		$ -		$ -		$ -	
Surfactant-enhanced LNAPL Recovery Feed System - 4 Trenches	$ 370,835	$ 85,577	$ 285,258	0	$ -	10	0.2	17,520	$ 1,752	79,420	2.50%	$ 1,986	-	$ -	-	$ -	-	$ -	$ 281,520
					$ -				$ 1,752			$ 1,986		-		$ -		$ -	
Ground Water Recovery Extraction wells No surfactant - 2 Trenches	$ 19,618	$ 4,527	$ 15,091	0	$ -	15	0.216	28,382	$ 2,838	115,700	2.50%	$ 2,893	-	$ -	-	$ -	-	$ -	$ 9,360
					$ -				$ 2,838			2,893		-		$ -		$ -	
Ground Water Recovery Extraction wells No surfactant - 3 Trenches	$ 18,901	$ 4,362	$ 14,539	0	$ -	15	0.174	22,864	$ 2,286	115,700	2.50%	$ 2,893	-	$ -	-	$ -	-	$ -	$ 9,360
					$ -				$ 2,286			2,893		-		$ -		$ -	
Ground Water Recovery Extraction wells With surfactant - 3 Trenches	$ 19,003	$ 4,385	$ 14,618	0	$ -	15	0.18	23,652	$ 2,365	115,700	2.50%	$ 2,893	-	$ -	-	$ -	-	$ -	$ 9,360
					$ -				$ 2,365			2,893		-		$ -		$ -	
Ground Water Recovery Extraction wells With surfactant - 4 Trenches	$ 19,003	$ 4,385	$ 14,618	0	$ -	15	0.18	23,652	$ 2,365	115,700	2.50%	$ 2,893	-	$ -	-	$ -	-	$ -	$ 9,360
					$ -				$ 2,365			2,893		-		$ -		$ -	
Ground Water Treatment Active recovery with 2 trenches	$ 321,775	$ 74,256	$ 247,519	13,560,480	$ 27,121	35	0.516	158,206	$ 15,821	336,395	5.00%	$ 16,820	26	$ 125	91	$ 44,859	16	$ 4,204	$ 138,570
					$ 27,121				$ 15,821			16,820		125		$ 44,859		$ 4,204	
Ground Water Treatment Active recovery with 3 trenches	$ 347,756	$ 80,251	$ 267,505	14,821,920	$ 29,644	35	0.564	172,922	$ 17,292	336,395	5.00%	$ 16,820	51	$ 243	119	$ 58,316	13	$ 3,386	$ 141,803
					$ 29,644				$ 17,292			16,820		243		$ 58,316		$ 3,386	
Ground Water Treatment Enhanced recovery with 3 trenches	$ 426,474	$ 98,417	$ 328,057	15,768,000	$ 31,536	50	0.6	262,800	$ 26,280	446,395	5.00%	$ 22,320	55	$ 262	158	$ 77,755	14	$ 3,503	$ 166,401
					$ 31,536				$ 26,280			$ 22,320		$ 262		$ 77,755		$ 3,503	
Ground Water Treatment Enhanced recovery with 4 trenches	$ 509,738	$ 117,632	$ 392,106	19,447,200	$ 38,894	50	0.74	324,120	$ 32,412	446,395	5.00%	$ 22,320	110	$ 524	231	$ 113,642	14	$ 3,503	$ 180,811
					$ 38,894				$ 32,412			$ 22,320		$ 524		$ 113,642		$ 3,503	

Table C-25 (Page 2 of 4)
Lenz Oil - Operation and Maintenance Cost Estimate
Ground Water Treatment System

Option Description	Page 2 Total	Filter Media Disposal (includes new media)			Chemical Feeds			Manpower			Other Costs	
		Oil Filter Media - Grav.	Solids Filter Media	Solids Filter Media	pH Adjustment	Emulsion Breaker	Surfactant	Operating Labor/Exp.	Sampling Labor/Exp.	Supervision Labor/Exp.	Reports Labor/Exp.	Laboratory Analysis
		per pound	per pound	per pound	per pound	per pound	per pound				every 6 mo	every 6 mo
		$ 10.00	$ 2.00	$ 4.00	$ 1.00	$ 1.00	$ 2.00	$ 45.00	$ 75.00	$ 95.00	$ 4,000	$ 500
		TSCA Incinerat.	RCRA Subt. D	RCRA Subt. D								
		Disposal cost is included in above rates										
LNAPL Recovery Passive - Four trenches (Collected oil equal to two active trenches)	$ 18,720	$ -	$ -	$ - $ -	$ -	$ -	$ - $ -	$ 18,720	$ -	$ - $ 18,720	$ -	$ - $ -
LNAPL Recovery Active - Two trenches	$ 9,360	$ -	$ -	$ - $ -	$ -	$ -	$ - $ -	$ 9,360	$ -	$ - $ 9,360	$ -	$ - $ -
LNAPL Recovery Active - Three trenches	$ 9,360	$ -	$ -	$ - $ -	$ -	$ -	$ - $ -	$ 9,360	$ -	$ - $ 9,360	$ -	$ - $ -
LNAPL Recovery Active - Four trenches	$ 9,360	$ -	$ -	$ - $ -	$ -	$ -	$ - $ -	$ 9,360	$ -	$ - $ 9,360	$ -	$ - $ -
Surfactant-enhanced LNAPL Recovery Feed System - 3 Trenches	$ 150,120	$ -	$ -	$ - $ -	$ -	$ -	$ 131,400 $ 131,400	$ 18,720	$ -	$ - $ 18,720	$ -	$ - $ -
Surfactant-enhanced LNAPL Recovery Feed System - 4 Trenches	$ 281,520	$ -	$ -	$ - $ -	$ -	$ -	$ 262,800 $ 262,800	$ 18,720	$ -	$ - $ 18,720	$ -	$ - $ -
Ground Water Recovery Extraction wells No surfactant - 2 trenches	$ 9,360	$ -	$ -	$ - $ -	$ -	$ -	$ - $ -	$ 9,360	$ -	$ - $ 9,360	$ -	$ - $ -
Ground Water Recovery Extraction wells No surfactant - 3 trenches	$ 9,360	$ -	$ -	$ - $ -	$ -	$ -	$ - $ -	$ 9,360	$ -	$ - $ 9,360	$ -	$ - $ -
Ground Water Recovery Extraction wells With surfactant - 3 trenches	$ 9,360	$ -	$ -	$ - $ -	$ -	$ -	$ - $ -	$ 9,360	$ -	$ - $ 9,360	$ -	$ - $ -
Ground Water Recovery Extraction wells With surfactant - 4 trenches	$ 9,360	$ -	$ -	$ - $ -	$ -	$ -	$ - $ -	$ 9,360	$ -	$ - $ 9,360	$ -	$ - $ -
Ground Water Treatment Active recovery with 2 trenches	$ 138,570	$ 3,285	$ 9,040	$ 4,520 $ 16,845	$ 3,285	$ -	$ - $ 3,285	$ 74,880	$ 7,200	$ 27,360 $ 109,440	$ 8,000	$ 1,000 $ 9,000
Ground Water Treatment Active recovery with 3 trenches	$ 141,803	$ 4,271	$ 9,881	$ 4,941 $ 19,092	$ 4,271	$ -	$ - $ 4,271	$ 74,880	$ 7,200	$ 27,360 $ 109,440	$ 8,000	$ 1,000 $ 9,000
Ground Water Treatment Enhanced recovery with 3 trenches	$ 166,401	$ 4,599	$ 10,512	$ 5,256 $ 20,367	$ 4,599	$ 22,995	$ - $ 27,594	$ 74,880	$ 7,200	$ 27,360 $ 109,440	$ 8,000	$ 1,000 $ 9,000
Ground Water Treatment Enhanced recovery with 4 trenches	$ 180,811	$ 6,132	$ 12,965	$ 6,482 $ 25,579	$ 6,132	$ 30,660	$ - $ 36,792	$ 74,880	$ 7,200	$ 27,360 $ 109,440	$ 8,000	$ 1,000 $ 9,000

Table C-25 (Page 3 of 4)
Lenz Oil - Operation and Maintenance Cost Estimate
Ground Water Treatment System

Option Description	Flowrates			Trench Oil Production (1)		Treatment System Solids Disposal				Treatment System Oil Production		Electrical Load Base Flow Rate
						Trench Solids		EW Solids				
	Trenches	EW	Surfactant	30% oil		20% solids		20% solids		30% oil		
	(gpm - total)	(gpm - total)	(gpm - total)	ppm	(gal)	ppm	cy	ppm	cy	ppm	gal	gpm
Passive Recovery with 4 trenches	0	0	0	3	79	0	0	0	0	0	0	0
Active Recovery with 2 trenches	15	10.8	0	4	105	750	91	185	16	1.0	26	50
Active Recovery with 3 trenches	19.5	8.7	0	5	171	750	119	185	13	1.5	51	50
Enhanced Recovery with 3 trenches	21	9	5	6	221	750	158	185	14	2	55	50
Enhanced Recovery with 4 trenches	28	9	10	7.5	368	750	231	185	14	2.3	110	50
Recovery wells (all)												50
Treatment system (all)												50

Note:
(1) Assumes that the passive trenches would produce the same flow as the active two trenches.

Table C-25 (Page 4 of 4)
Lenz Oil - Operation and Maintenance Cost Estimate
Ground Water Treatment System

	Flowrates			Filter Media Disposal (includes new media)					
	Trenches	EW	Surfactant (1)	Gravity Oil Filter Media		Primary Solids Filter Media		Polishing Solids Filter Media	
Option Description	(gpm - total)	(gpm - total)	(gpm - total)	ppm	pounds	ppm	pounds	ppm	pounds
Passive Recovery with 4 trenches	0	0	0	0	0	0	0	0	0
Enhanced Recovery with 3 trenches	21	9	5						
Enhanced Recovery with 4 trenches	28	9	10						
Ground Water Treatment Active recovery with 2 trenches	15	10.8	0	5	329	40	4,520	10	1,130
Ground Water Treatment Active recovery with 3 trenches	19.5	8.7	0	5	427	40	4,941	10	1,235
Ground Water Treatment Enhanced recovery with 3 trenches	21	9	0	5	460	40	5,256	10	1,314
Ground Water Treatment Enhanced recovery with 4 trenches	28	9	0	5	613	40	6,482	10	1,621

	Chemical Feeds						Manpower		
	pH Adjustment		Emulsion Breaker		Surfactant		Operating	Sampling	Supervision
Option Description	ppm	pounds	ppm	pounds	ppm	pounds	hr/wk	hr/mo	hr/mo
Passive Recovery with 4 trenches	0	0	0	0	0	0	8	0	0
Active Recovery with 2 trenches	0	0	0	0	0	0	4	0	0
Active Recovery with 3 trenches	0	0	0	0	0	0	4	0	0
Active Recovery with 4 trenches	0	0	0	0	0	0	4	0	0
Enhanced Recovery with 3 trenches	0	0	0	0	3,000	65,700	8	0	0
Enhanced Recovery with 4 trenches	0	0	0	0	3,000	131,400	8	0	0
Ground Water Treatment Active recovery with 2 trenches	50	3,285	0	0	0	0	32	8	24
Ground Water Treatment Active recovery with 3 trenches	50	4,271	0	0	0	0	32	8	24
Ground Water Treatment Enhanced recovery with 3 trenches	50	4,599	250	22,995	0	0	32	8	24
Ground Water Treatment Enhanced recovery with 4 trenches	50	6,132	250	30,660	0	0	32	8	24
Extraction Wells	0	0	0	0	0	0	4	0	0

Note:
(1) The surfactant flow is included in the total flow from the extraction trenches. This flow is used only to calculate the amount of surfactant used per year.

Table C-26

Lenz Oil - Operation and Maintenance Cost Estimate

Common Activities

Description	Quantity	Annual O & M Costs Units	Unit Price	Total Price
Institutional Controls				
Fence Maintenance	1	LS	$1,000	$1,000
Groundwater Monitoring - twice a year				
Sample Collection / Expenses	180	HR	$75	$13,500
Analytical	40	EA	$1,800	$72,000
Data Review and Report	2	EA	$8,000	$16,000
Subtotal:				$102,500
Contingency (30%)				$30,750
TOTAL				$133,250

Table C-27

Lenz Oil - Operation and Maintenance Cost Estimate

Impermeable Cap - Multilayered Cap

Description	Quantity	Units	Unit Price	Total Price
		Annual O & M Costs		
Multilayered Cap				
Maintenance, years 1-5	1	LS	$30,000	$30,000
Maintenance, years 6+	1	LS	$5,000	$5,000
Annualized cost over 30 years				
3 % discount rate				$10,900
30% contingency				$3,270
Total				$14,170
5 % discount rate				$12,100
30% contingency				$3,630
Total				$15,730
10 % discount rate				$15,100
30% contingency				$4,530
Total				$19,630
Annual costs:	1	30000		
	2	30000		
	3	30000		
	4	30000		
	5	30000		
	6	5000		
	7	5000		
	8	5000		
	9	5000		
	10	5000		
	11	5000		
	12	5000		
	13	5000		
	14	5000		
	15	5000		
	16	5000		
	17	5000		
	18	5000		
	19	5000		
	20	5000		
	21	5000		
	22	5000		
	23	5000		
	24	5000		
	25	5000		
	26	5000		
	27	5000		
	28	5000		
	29	5000		
	30	5000		

Table C-28

Lenz Oil - Operation and Maintenance Cost Estimate

Solid Waste Cap

Description	Quantity	Units	Unit Price	Total Price
		Annual O & M Costs		
Solid Waste Cap				
Maintenance, years 1-5	1	LS	$30,000	$30,000
Maintenance, years 6+	1	LS	$5,000	$5,000
Annualized cost over 30 years				
3 % discount rate				$10,900
30% contingency				$3,270
Total				$14,170
5 % discount rate				$12,100
30% contingency				$3,630
Total				$15,730
10 % discount rate				$15,100
30% contingency				$4,530
Total				$19,630
Annual costs:	1	30000		
	2	30000		
	3	30000		
	4	30000		
	5	30000		
	6	5000		
	7	5000		
	8	5000		
	9	5000		
	10	5000		
	11	5000		
	12	5000		
	13	5000		
	14	5000		
	15	5000		
	16	5000		
	17	5000		
	18	5000		
	19	5000		
	20	5000		
	21	5000		
	22	5000		
	23	5000		
	24	5000		
	25	5000		
	26	5000		
	27	5000		
	28	5000		
	29	5000		
	30	5000		

Table C-29

Lenz Oil - Operation and Maintenance Cost Estimate

Asphalt Cap

Description	Quantity	Annual O & M Costs Units	Unit Price	Total Price
Asphalt cap				
Seal coating (including surface prep.), year 1 & every 5 years	25000	SY	$1.00	$25,000
Crack sealing, year 11 & every 5 years	25000	SY	$2.25	$56,250
Annualized cost over 30 years				
3 % discount rate				$13,800
30% contingency				$4,140
Total				$17,940
5 % discount rate				$12,900
30% contingency				$3,870
Total				$16,770
10 % discount rate				$11,200
30% contingency				$3,360
Total				$14,560
Annual costs:	1	25000		
	2	0		
	3	0		
	4	0		
	5	0		
	6	25000		
	7	0		
	8	0		
	9	0		
	10	0		
	11	81250		
	12	0		
	13	0		
	14	0		
	15	0		
	16	81250		
	17	0		
	18	0		
	19	0		
	20	0		
	21	81250		
	22	0		
	23	0		
	24	0		
	25	0		
	26	81250		
	27	0		
	28	0		
	29	0		
	30	81250		

Table C-30

Lenz Oil - Operation and Maintenance Cost Estimate

Concrete Cap

Description	Quantity	Annual O & M Costs Units	Unit Price	Total Price
Concrete cap				
Seal coating (including surface prep.), year 1 & every 5 years	25000	SY	$0.50	$12,500
Crack sealing, year 11 & every 5 years	25000	SY	$2.25	$56,250
Annualized cost over 30 years				
3 % discount rate				$10,900
30% contingency				$3,270
Total				$14,170
5 % discount rate				$10,000
30% contingency				$3,000
Total				$13,000
10 % discount rate				$8,200
30% contingency				$2,460
Total				$10,660
Annual costs:	1	12500		
	2	0		
	3	0		
	4	0		
	5	0		
	6	12500		
	7	0		
	8	0		
	9	0		
	10	0		
	11	68750		
	12	0		
	13	0		
	14	0		
	15	0		
	16	68750		
	17	0		
	18	0		
	19	0		
	20	0		
	21	68750		
	22	0		
	23	0		
	24	0		
	25	0		
	26	68750		
	27	0		
	28	0		
	29	0		
	30	68750		

TABLE C-31
PRESENT VALUE ANALYSIS OF REMEDIAL ALTERNATIVES - FUTURE ON-SITE RESIDENT, 1E-04 SOIL
5% DISCOUNT RATE
LENZ OIL SITE
LEMONT, ILLINOIS

PROCESS OPTIONS	PRESENT VALUE CAPITAL COST + 30-YRS O&M COST - 5.0% DISCOUNT RATE Alternative Number										
	1	2	3	4	5	5a	6	6a	7	8	9
No Action	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Common Activities	$ -	$ 2,362,768	$ 2,362,768	$ 2,362,768	$ 2,362,768	$ 2,362,768	$ 2,362,768	$ 2,362,768	$ 2,362,768	$ 2,362,768	$ 2,362,768
Covers											
Multilayered Cap	$ -	$ 3,256,190	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Solid Waste Cap	$ -	$ -	$ 1,957,324	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Asphalt Cap	$ -	$ -	$ -	$ 2,324,434	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Concrete Cap	$ -	$ -	$ -	$ 2,367,670	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Remediation of 1.0E-04 Unconsolidated Soils											
Off-Site Disposal											
RCRA Subtitle D	$ -	$ -	$ -	$ -	$ 515,483	$ -	$ 515,483	$ -	$ -	$ -	$ -
On-Site Treatment											
Ex Situ Solidification/Stabilization (S/S)	$ -	$ -	$ -	$ -	$ -	$ 670,710	$ -	$ 670,710	$ 670,710	$ 670,710	$ 670,710
Low Temperature Thermal Desorption (LTTD)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,501,705	$ 2,501,705	$ 2,501,705
Low Temperature Thermal Desorption and	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Solidification/Stabilization	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
LNAPL											
LNAPL Recovery - Passive 4 trenches	$ -	$ 2,097,401	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
LNAPL Recovery - Active 2 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,086,148	$ -	$ -
LNAPL Recovery - Active 3 trenches	$ -	$ -	$ 2,660,201	$ 2,660,201	$ 2,660,201	$ 2,660,201	$ -	$ -	$ -	$ 2,660,201	$ -
LNAPL Recovery - Active 4 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,187,123	$ 3,187,123	$ -	$ -	$ -
Enhanced LNAPL Recovery - Surfactants 3 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,385,355	$ -
Enhanced LNAPL Recovery - Surfactants 4 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,879,323	$ 7,879,323	$ -	$ -	$ -
LNAPL Soil Excavation and LTTD Treatment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,578,525	$ 5,578,525	$ -
LNAPL Soil Excavation and *Ex Situ* S/S	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,161,739	$ 3,161,739	$ -
LNAPL Soil & Rock Excavation and LTTD Treatment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 8,089,469
LNAPL Soil & Rock Excavation and *Ex Situ* S/S	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,204,770
Ground Water Recovery Wells											
Active Recovery with 2 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 978,887	$ -	$ -
Active Recovery with 3 trenches	$ -	$ -	$ 967,858	$ 967,858	$ 967,858	$ 967,858	$ -	$ -	$ -	$ -	$ -
Enhanced Recovery with 3 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 969,434	$ -
Enhanced Recovery with 4 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ 969,434	$ 969,434	$ -	$ -	$ -
Ground Water Treatment System											
Active Recovery with 2 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,611,230	$ -	$ -
Active Recovery with 3 trenches	$ -	$ -	$ 8,010,628	$ 8,010,628	$ 8,010,628	$ 8,010,628	$ -	$ -	$ -	$ -	$ -
Enhanced Recovery with 3 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 9,981,372	$ -
Enhanced Recovery with 4 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ 11,261,350	$ 11,261,350	$ -	$ -	$ -
Total Present Value (minimum)	$ -	$ 7,716,359	$ 15,958,780	$ 16,325,890	$ 14,516,939	$ 14,672,166	$ 26,175,482	$ 26,330,709	$ 16,871,482	$ 24,191,580	$ 8,238,249
Total Present Value (maximum)	$ -	$ 7,716,359	$ 15,958,780	$ 16,369,126	$ 14,516,939	$ 14,672,166	$ 26,175,482	$ 26,330,709	$ 21,119,263	$ 28,439,361	$ 12,953,942

TABLE C-32
PRESENT VALUE ANALYSIS OF REMEDIAL ALTERNATIVES - FUTURE ON-SITE RESIDENT, 1E-04 SOIL
3% DISCOUNT RATE
LENZ OIL SITE
LEMONT, ILLINOIS

PROCESS OPTIONS	PRESENT VALUE CAPITAL COST + 30-YRS O&M COST - 3.0% DISCOUNT RATE Alternative Number										
	1	2	3	4	5	5a	6	6a	7	8	9
No Action											
Common Activities	$ -	$ 2,926,148	$ 2,926,148	$ 2,926,148	$ 2,926,148	$ 2,926,148	$ 2,926,148	$ 2,926,148	$ 2,926,148	$ 2,926,148	$ 2,926,148
Covers											
Multilayered Cap	$ -	$ 3,292,120	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Solid Waste Cap	$ -	$ -	$ 1,993,253	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Asphalt Cap	$ -	$ -	$ -	$ 2,418,270	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Concrete Cap	$ -	$ -	$ -	$ 2,445,566	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Remediation of 1.0E-04 Unconsolidated Soils											
Off-Site Disposal											
RCRA Subtitle D	$ -	$ -	$ -	$ -	$ 515,483	$ -	$ 515,483	$ -	$ -	$ -	$ -
On-Site Treatment											
Ex Situ Solidification/Stabilization (S/S)	$ -	$ -	$ -	$ -	$ -	$ 921,160	$ -	$ 921,160	$ 921,160	$ 921,160	$ 921,160
Low Temperature Thermal Desorption (LTTD)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,501,705	$ 2,501,705	$ 2,501,705
LNAPL											
LNAPL Recovery - Passive 4 trenches	$ -	$ 2,212,245	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
LNAPL Recovery - Active 2 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,193,356	$ -	$ -
LNAPL Recovery - Active 3 trenches	$ -	$ -	$ 2,804,121	$ 2,804,121	$ 2,804,121	$ 2,804,121	$ -	$ -	$ -	$ 2,804,121	$ -
LNAPL Recovery - Active 4 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,391,416	$ 3,391,416	$ -	$ -	$ -
Enhanced LNAPL Recovery - Surfactants 3 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,266,016	$ -
Enhanced LNAPL Recovery - Surfactants 4 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,696,601	$ 7,696,601	$ -	$ -	$ -
LNAPL Soil Excavation and LTTD Treatment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,578,525	$ 5,578,525	$ -
LNAPL Soil Excavation and *Ex Situ* S/S	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,161,739	$ 3,161,739	$ -
LNAPL Soil & Rock Excavation and LTTD Treatment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 8,089,469
LNAPL Soil & Rock Excavation and *Ex Situ* S/S	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,204,770
Ground Water Recovery Wells											
Active Recovery with 2 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,061,832	$ -	$ -
Active Recovery with 3 trenches	$ -	$ -	$ 1,047,770	$ 1,047,770	$ 1,047,770	$ 1,047,770	$ -	$ -	$ -	$ -	$ -
Enhanced Recovery with 3 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,049,778	$ -
Enhanced Recovery with 4 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,049,778	$ 1,049,778	$ -	$ -	$ -
Ground Water Treatment System											
Active Recovery with 2 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 8,971,690	$ -	$ -
Active Recovery with 3 trenches	$ -	$ -	$ 9,480,937	$ 9,480,937	$ 9,480,937	$ 9,480,937	$ -	$ -	$ -	$ -	$ -
Enhanced Recovery with 3 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 11,784,500	$ -
Enhanced Recovery with 4 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ 13,416,519	$ 13,416,519	$ -	$ -	$ -
Total Present Value (minimum)	$ -	$ 8,430,515	$ 18,252,232	$ 21,122,815	$ 16,774,463	$ 17,180,135	$ 28,995,951	$ 29,401,622	$ 21,737,637	$26,913,470	$9,052,087
Total Present Value (maximum)	$ -	$ 8,430,515	$ 18,252,232	$ 21,122,815	$ 16,774,463	$ 17,180,135	$ 28,995,951	$ 29,401,622	$ 24,154,423	$30,910,801	$13,517,331

TABLE C-33
PRESENT VALUE ANALYSIS OF REMEDIAL ALTERNATIVES - FUTURE ON-SITE RESIDENT, 1E-04 SOIL
10% DISCOUNT RATE
LENZ OIL SITE
LEMONT, ILLINOIS

PROCESS OPTIONS	PRESENT VALUE CAPITAL COST + 30-YRS O&M COST - 10.0% DISCOUNT RATE Alternative Number										
	1	2	3	4	5	5a	6	6a	7	8	9
No Action	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Common Activities	$ -	$ 1,570,525	$ 1,570,525	$ 1,570,525	$ 1,570,525	$ 1,570,525	$ 1,570,525	$ 1,570,525	$ 1,570,525	$ 1,570,525	$ 1,570,525
Covers											
Multilayered Cap	$ -	$ 3,199,432	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Solid Waste Cap	$ -	$ -	$ 1,900,565	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Asphalt Cap	$ -	$ -	$ -	$ 2,203,894	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Concrete Cap	$ -	$ -	$ -	$ 2,268,319	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Remediation of 1.0E-04 Unconsolidated Soils											
Off-Site Disposal											
RCRA Subtitle D	$ -	$ -	$ -	$ -	$ 515,483	$ -	$ 515,483	$ -	$ -	$ -	$ -
On-Site Treatment											
Ex Situ Solidification/Stabilization (S/S)	$ -	$ -	$ -	$ -	$ -	$ 921,160	$ -	$ 921,160	$ 921,160	$ 921,160	$ 921,160
Low Temperature Thermal Desorption (LTTD)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,501,705	$ 2,501,705	$ 2,501,705
LNAPL											
LNAPL Recovery - Passive 4 trenches	$ -	$ 1,935,904	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
LNAPL Recovery - Active 2 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,935,387	$ -	$ -
LNAPL Recovery - Active 3 trenches	$ -	$ -	$ 2,457,817	$ 2,457,817	$ 2,457,817	$ 2,457,817	$ -	$ -	$ -	$ 2,457,817	$ -
LNAPL Recovery - Active 4 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,899,841	$ 2,899,841	$ -	$ -	$ -
Enhanced LNAPL Recovery - Surfactants 3 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,738,766	$ -
Enhanced LNAPL Recovery - Surfactants 4 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,832,549	$ 4,832,549	$ -	$ -	$ -
LNAPL Soil Excavation and LTTD Treatment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,578,525	$ 5,578,525	$ -
LNAPL Soil Excavation and *Ex Situ* S/S	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,161,739	$ 3,161,739	$ -
LNAPL Soil & Rock Excavation and LTTD Treatment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 8,089,469
LNAPL Soil & Rock Excavation and *Ex Situ* S/S	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,204,770
Ground Water Recovery Wells											
Active Recovery with 2 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 862,248	$ -	$ -
Active Recovery with 3 trenches	$ -	$ -	$ 855,485	$ 855,485	$ 855,485	$ 855,485	$ -	$ -	$ -	$ -	$ -
Enhanced Recovery with 3 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 856,451	$ -
Enhanced Recovery with 4 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ 856,451	$ 856,451	$ -	$ -	$ -
Ground Water Treatment System											
Active Recovery with 2 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,698,107	$ -	$ -
Active Recovery with 3 trenches	$ -	$ -	$ 5,943,032	$ 5,943,032	$ 5,943,032	$ 5,943,032	$ -	$ -	$ -	$ -	$ -
Enhanced Recovery with 3 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,445,756	$ -
Enhanced Recovery with 4 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$8,230,683	$8,230,683	$ -	$ -	$ -
Total Present Value (minimum)	$ -	$ 6,705,861	$ 12,727,424	$ 13,030,753	$ 11,342,342	$ 11,748,019	$ 18,905,532	$ 19,311,210	$ 14,149,167	$ 19,152,215	$ 7,696,456
Total Present Value (maximum)	$ -	$ 6,705,861	$ 12,727,424	$ 13,095,178	$ 11,342,342	$ 11,748,019	$ 18,905,532	$ 19,311,210	$ 18,146,498	$ 23,149,546	$ 12,161,699

TABLE C-34
PRESENT VALUE ANALYSIS OF PROCESS OPTIONS - FUTURE ON-SITE RESIDENT, 1E-04 SOIL
LENZ OIL SITE
LEMONT, ILLINOIS

PROCESS OPTIONS	CAPITAL COST	ANNUALIZED OPERATING & MAINTENANCE COSTS DISCOUNT RATES 3.00%	5.00%	10.00%	PRESENT VALUE OF 30 YEARS OPERATING & MAINTENANCE COSTS DISCOUNT RATES 3.00%	5.00%	10.00%	PRESENT VALUE CAPITAL COST + 30-YRS O&M COST DISCOUNT RATES 3.00%	5.00%	10.00%
No Action	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Common Activities	$ 314,389	$ 133,250	$ 133,250	$ 133,250	$ 2,611,759	$ 2,048,379	$ 1,256,136	$ 2,926,148	$ 2,362,768	$ 1,570,525
Covers										
Multilayered Cap	$ 3,014,381	$ 14,170	$ 15,730	$ 19,630	$ 277,738	$ 241,809	$ 185,050	$ 3,292,120	$ 3,256,190	$ 3,199,432
Solid Waste Cap	$ 1,715,515	$ 14,170	$ 15,730	$ 19,630	$ 277,738	$ 241,809	$ 185,050	$ 1,993,253	$ 1,957,324	$ 1,900,565
Asphalt Cap	$ 2,066,638	$ 17,940	$ 16,770	$ 14,560	$ 351,632	$ 257,796	$ 137,256	$ 2,418,270	$ 2,324,434	$ 2,203,894
Concrete Cap	$ 2,167,828	$ 14,170	$ 13,000	$ 10,660	$ 277,738	$ 199,842	$ 100,491	$ 2,445,566	$ 2,367,670	$ 2,268,319
Remediation of 1.0E-04 Unconsolidated Soils										
Off-Site Disposal										
RCRA Subtitle D	$ 515,483	$ -	$ -	$ -	$ -	$ -	$ -	$ 515,483	$ 515,483	$ 515,483
On-Site Treatment										
Ex Situ Solidification/Stabilization (S/S)	$ 670,710	$ -	$ -	$ -	$ -	$ -	$ -	$ 670,710	$ 670,710	$ 670,710
Low Temperature Thermal Desorption (LTTD)	$ 2,501,705	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,501,705	$ 2,501,705	$ 2,501,705
LNAPL										
LNAPL Recovery - Passive 4 trenches	$ 1,679,842	$ 27,163	$ 27,163	$ 27,163	$ 532,404	$ 417,559	$ 256,062	$ 2,212,245	$ 2,097,401	$ 1,935,904
LNAPL Recovery - Active 2 trenches	$ 1,696,350	$ 25,357	$ 25,357	$ 25,357	$ 497,007	$ 389,798	$ 239,037	$ 2,193,356	$ 2,086,148	$ 1,935,387
LNAPL Recovery - Active 3 trenches	$ 2,136,928	$ 34,040	$ 34,040	$ 34,040	$ 667,192	$ 523,273	$ 320,889	$ 2,804,121	$ 2,660,201	$ 2,457,817
LNAPL Recovery - Active 4 trenches	$ 2,444,342	$ 48,319	$ 48,319	$ 48,319	$ 947,074	$ 742,782	$ 455,499	$ 3,391,416	$ 3,187,123	$ 2,899,841
Enhanced LNAPL Recovery - Surfactants 3 trenches	$ 1,323,598	$ 199,172	$ 199,172	$ 199,172	$ 3,903,853	$ 3,061,757	$ 1,877,575	$ 5,227,451	$ 4,385,355	$ 3,201,172
Enhanced LNAPL Recovery - Surfactants 4 trenches	$ 2,178,684	$ 370,835	$ 370,835	$ 370,835	$ 7,268,525	$ 5,700,639	$ 3,495,827	$ 9,447,209	$ 7,879,323	$ 5,674,512
LNAPL Soil Excavation and LTTD Treatment	$ 5,578,525	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,578,525	$ 5,578,525	$ 5,578,525
LNAPL Soil Excavation and *Ex Situ* S/S	$ 3,161,739	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,161,739	$ 3,161,739	$ 3,161,739
LNAPL Soil & Rock Excavation and LTTD Treatment	$ 8,089,469	$ -	$ -	$ -	$ -	$ -	$ -	$ 8,089,469	$ 8,089,469	$ 8,089,469
LNAPL Soil & Rock Excavation and *Ex Situ* S/S	$ 5,204,770	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,204,770	$ 5,204,770	$ 5,204,770
Ground Water Recovery Wells										
Active Recovery with 2 trenches	$ 677,311	$ 19,618	$ 19,618	$ 19,618	$ 384,521	$ 301,576	$ 184,937	$ 1,061,832	$ 978,887	$ 862,248
Active Recovery with 3 trenches	$ 677,311	$ 18,901	$ 18,901	$ 18,901	$ 370,458	$ 290,547	$ 178,174	$ 1,047,770	$ 967,858	$ 855,485
Enhanced Recovery with 3 trenches	$ 677,311	$ 19,003	$ 19,003	$ 19,003	$ 372,467	$ 292,123	$ 179,140	$ 1,049,778	$ 969,434	$ 856,451
Enhanced Recovery with 4 trenches	$ 677,311	$ 19,003	$ 19,003	$ 19,003	$ 372,467	$ 292,123	$ 179,140	$ 1,049,778	$ 969,434	$ 856,451
Ground Water Treatment System										
Active Recovery with 2 trenches	$ 2,664,765	$ 321,775	$ 321,775	$ 321,775	$ 6,306,924	$ 4,946,464	$ 3,033,342	$ 8,971,690	$ 7,611,230	$ 5,698,107
Active Recovery with 3 trenches	$ 2,664,765	$ 347,756	$ 347,756	$ 347,756	$ 6,816,172	$ 5,345,863	$ 3,278,267	$ 9,480,937	$ 8,010,628	$ 5,943,032
Enhanced Recovery with 3 trenches	$ 3,425,424	$ 426,474	$ 426,474	$ 426,474	$ 8,359,076	$ 6,555,949	$ 4,020,333	$ 11,784,500	$ 9,981,372	$ 7,445,756
Enhanced Recovery with 4 trenches	$ 3,425,424	$ 509,738	$ 509,738	$ 509,738	$ 9,991,095	$ 7,835,927	$ 4,805,259	$ 13,416,519	$ 11,261,350	$ 8,230,683
Total Present Value (minimum)										
Total Present Value (maximum)										

ATTACHMENT 1 TO APPENDIX C

DESIGN CALCULATIONS

Table C-1-1
Lenz Oil - Capital Cost Estimate
Cap design Basis
Multilayered and Solid Waste Caps

Site Specifics

Item	Units	Quantity	Remarks
Site area - at fence line	sf	214,789	computer calculated
Perimeter length - at fence line	lf	1,938	computer calculated
Lengths			
North fence line	lf	596.1	computer calculated
South fence line	lf	633.8	computer calculated
West fence line	lf	313.7	computer calculated
East fence line	lf	393.9	computer calculated

Ditch Excavation

Item	Units	Quantity	Remarks
Width	ft	10	outside edge at fence line
Slope, length to drop ratio	unitless	3	
Center depth	ft	1.67	
Stone depth	ft	0.50	
Excavated area per foot of trench length	cy/lf	0.56	
Average trench length	lf	1,898	perimeter length less 40 ft
Volume to excavate	cy	1,054	
Area to level	sf	18,975	

Cap Approximate Area

Item	Units	Quantity	Remarks
Computer calculated area	sf	214,789	
Ditch area	sf	18,975	
Net cap area	sf	195,814	
Lengths			
North face of cap	ft	576.1	fence line less 20 ft
South fence line	ft	613.8	fence line less 20 ft
West fence line	ft	293.7	fence line less 20 ft
East fence line	ft	373.9	fence line less 20 ft
Average length, north and south lengths	lf	595.0	
Average width, west and east lengths	lf	333.8	
Site area, per average length and width	sf	198,594	
Area percent error, if use average lengths	%	101.4%	use average lengths for cap volume calculations

Cap Calculations (see the attached Figure 1)

	Multilayered Cap		Solid Waste Cap	
Item	Units	Quantity	Units	Quantity
Required surface slope	%	3%	%	2%
Vegetative soil layer				
thickness	ft	0.5	ft	0.5
volume	cy	3,678	cy	3,678
Topsoil layer				
thickness	ft	2.33	ft	2.5
volume	cy	17,138	cy	18,388
Synthetic geotextile layer	sf	198,594	sf	0
Sand layer				
thickness	ft	0.5	ft	0
volume	cy	3,678	cy	0
Flexible membrane liner	sf	198,594	sf	0
Clay layer				
thickness	ft	2.0	ft	0
volume	cy	14,711	cy	0
Fill layer				
East segment				
h center elevation	ft	5.0	ft	3.3
x horizontal line segment to cap edge	ft	166.9	ft	166.9
l east length	ft	333.8	ft	333.8
Volume, approximate (h*x*l)/(2*27)	cy	5,166	cy	3,444
West segment, same as east				
Volume, approximate	cy	5,166	cy	3,444
Center segment				
h center elevation	ft	5.0	ft	3.3
x horizontal line segment to cap edge	ft	166.9	ft	166.9
l length, total less segments	ft	261.2	ft	261.2
Volume, approximate (h*x*l)/(27)	cy	8,083	cy	5,389
Total fill volume	cy	18,414	cy	12,276
Rip Rap				
Width	lf	26	lf	19
Average trench length	lf	1,846	lf	1,862
Area	sf	47,983	sf	35,369

Table C-1-2
Lenz Oil - Capital Cost Estimate
Cap design Basis
Concrete and Asphalt Caps

Site Specifics

Item	Units	Quantity	Remarks
Site area - at fence line	sf	214,789	computer calculated
Perimeter length - at fence line	lf	1,938	computer calculated
Lengths			
North fence line	lf	596.1	computer calculated
South fence line	lf	633.8	computer calculated
West fence line	lf	313.7	computer calculated
East fence line	lf	393.9	computer calculated

Ditch Excavation

Item	Units	Quantity	Remarks
Width	ft	10	outside edge at fence line
Slope, length to drop ratio	unitless	3	
Center depth	ft	1.67	
Stone depth	ft	0.50	
Excavated volume per foot of trench length	cy/*lf	0.56	
Average trench length	lf	1,898	perimeter length less 40 ft
Volume to excavate	cy	1,054	
Area to level	sf	18,975	

Cap Approximate Area

Item	Units	Quantity	Remarks
Computer calculated area	sf	214,789	
Ditch area	sf	18,975	
Net cap area	sf	195,814	
Lengths			
North face of cap	ft	576.1	fence line less 20
South fence line	ft	613.8	fence line less 20
West fence line	ft	293.7	fence line less 20
East fence line	ft	373.9	fence line less 20
Average length, north and south lengths	lf	595.0	
Average width, west and east lengths	lf	333.8	
Site area, per average length and width	sf	198,594	
Area percent error, if use average lengths	%	101.4%	use average lengths for cap volume calculations

Cap Calculations (see the attached Figure 1)

	Concrete Cap		Asphalt Cap	
Item	Units	Quantity	Units	Quantity
Required surface slope	%	1%	%	1%
Concrete				
thickness	ft	0.67	ft	0
area	sf	195,814	sf	0
Wire mesh	msf	1,958	msf	0
Asphalt				
thickness	ft	0	ft	0.83
area	sf	0	sf	195,814
Gravel				
thickness	ft	1	ft	1
volume	cy	7,252	cy	7,252
Fill layer				
East segment				
h center elevation	ft	1.7	ft	1.7
x horizontal line segment to cap edge	ft	166.9	ft	166.9
l east length	ft	333.8	ft	333.8
Volume, approximate (h*x*l)/(2*27)	cy	1,722	cy	1,722
West segment, same as east				
Volume, approximate	cy	1,722	cy	1,722
Center segment				
h center elevation	ft	1.7	ft	1.7
x horizontal line segment to cap edge	ft	166.9	ft	166.9
l length, total less segments	ft	261.2	ft	261.2
Volume, approximate (h*x*l)/27	cy	2,694	cy	2,694
Total fill volume	cy	6,138	cy	6,138

Table C-1-3
SUMMARY OF PREDICTED WATER TABLE ELEVATION VARIATIONS IN LNAPL AREAS
AND PREDICTED STAINED SOILS AND DEPTHS OF EXCAVATION
LENZ OIL SITE
LEMONT, ILLINOIS

Column			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
Area	Location	Well/ Piezometer	General Aquifer Characteristic	Depth to Water Table at Confined Locations (feet)	10/25/94 Piezometric Elevation (feet AMSL)	Maximum Predicted Elevation of Saturated Material[1] (feet AMSL)	Minimum Predicted Elevation of Unsaturated Materials[2] (feet AMSL)	Ground Elevation (feet AMSL)	Elevation of Bedrock (feet AMSL)	Depth to LNAPL Impacted Materials (feet)	Maximum Depth of LNAPL Impact (feet)	Maximum Elevation of LNAPL Impact (feet AMSL)	Minimum Elevation of LNAPL Impact[2] (feet AMSL)	Elevation of Base of Trench[4] (feet AMSL)	Thickness of Clean Soils/Gravel (feet)	Thickness of Ground Water Saturated Soils/Gravel (feet)	Thickness of LNAPL Impacted Soils/Gravels (feet)	Thickness of Clean Bedrock (feet)	Thickness of Ground Water Saturated Bedrock (feet)	Thickness of LNAPL Excavated Impacted Bedrock[5] (feet)	Footage Along Trench N (feet)	Footage Along Trench M (feet)	Footage Along Trench S (feet)	Footage Along Trench P (feet)
	Reference Well	MW-5S	Unconfined		591.23	596.71	591.09	600.07	573.57	10.00	15.00	590.07	585.07	588.59	3.36	6.64	1.48							
Area 2	Area 2	P1			592.00	597.48	591.86	600.30	585.30	2.00	10.00	598.30	589.22	589.36	2.00	0.00	8.94							
Area 1A	Trench N	P13	Unconfined		591.28	596.76	591.14	601.68	586.68	12.00	14.75	589.68	586.93	588.64	4.92	7.08	1.04				60.00			
		P15	Unconfined		590.02	595.50	589.88	601.65	590.15	11.00	11.50	590.65	590.15	587.38	6.15	4.85	0.50		2.77		116.00			
		P16	Unconfined		590.41	595.89	590.27	601.74	590.24	11.50	13.00	590.24	588.74	587.77	5.85	5.65			0.97	1.5	94.00			
		Weighted Average			590.44	595.92	590.30	601.69	589.41	11.40	12.74	590.29	588.94	587.80	5.77	5.62	0.45		1.53	0.52				
Area 1B	Trench M	P19	Confined	13.50	589.51	587.78	587.78	601.28	589.78	13.50	14.50	587.78	586.78	585.28	11.50			2.00	1.50	1.0		260.00		
	Trench S	P20	Confined	12.00	589.41	587.68	587.68	599.68	588.18	12.00	13.00	587.68	586.68	585.18	11.50			0.50	1.50	1.0			138.00	
		P21	Confined	10.50	589.34	587.99	587.99	598.49	589.49	10.50	11.50	587.99	586.99	585.49	9.00			1.50	1.50	1.0			107.00	
		Weighted Average			589.38	587.82	587.82	599.16	588.75	11.34	12.34	587.82	586.82	585.32	10.41			0.94	1.50	1.00				
	Area 1B	Weighted Average													10.97			1.48	1.50	1.00				
Area 1		Weighted Average													8.68	1.49	0.12	0.97	1.38	0.79				
Trench P	Trench P	P24	Confined	9.50	589.19	586.26	586.26	595.76	585.76					583.76	9.50	0.50			2.00					70.00
		P25	Confined	9.50	589.34	586.16	586.16	595.66	586.66					583.66	9.00			0.50	2.50					122.00
		P26	Confined	10.00	589.48	586.00	586.00	596.00	593.00					583.50	3.00			7.00	2.50					53.00
		Weighted Average			589.33	586.15	586.15	595.76	587.77					583.65	7.84	0.14		1.76	2.36					

Notes:

[1] Maximum predicted saturated material elevation for unconfined conditions calculated by adding the difference between maximum water table elevation observed in G106L during the RI and the elevation observed on October 25, 1994 (the first date of depth to water measurements when all of the piezometers and wells are installed) to the elevation observed on October 25, 1994. For confined conditions, the minimum of: 1) the elevation calculated above and 2) the elevation of water encountered in the aquifer during drilling.

[2] Minimum predicted water table elevations for unconfined conditions calculated by subtracting the difference between minimum water table elevation observed in G106L during the RI and the elevation observed on October 25, 1994 (the first date of depth to water measurements when all of the piezometers and wells are installed). For confined conditions, the minimum of: 1) the minimum elevation calculated above and 2) the elevation of water encountered in the aquifer during drilling.

[3] The thickness of LNAPL impacted materials for confined conditions is assumed to be less than 1 foot.

[4] The elevation of the base of the trench is 2.5 feet below the minimum predicted water table elevation.

[5] The depths of silty clay and silty gravel vary across the site. It is assumed that both materials can be excavated by using a backhole.

Key:

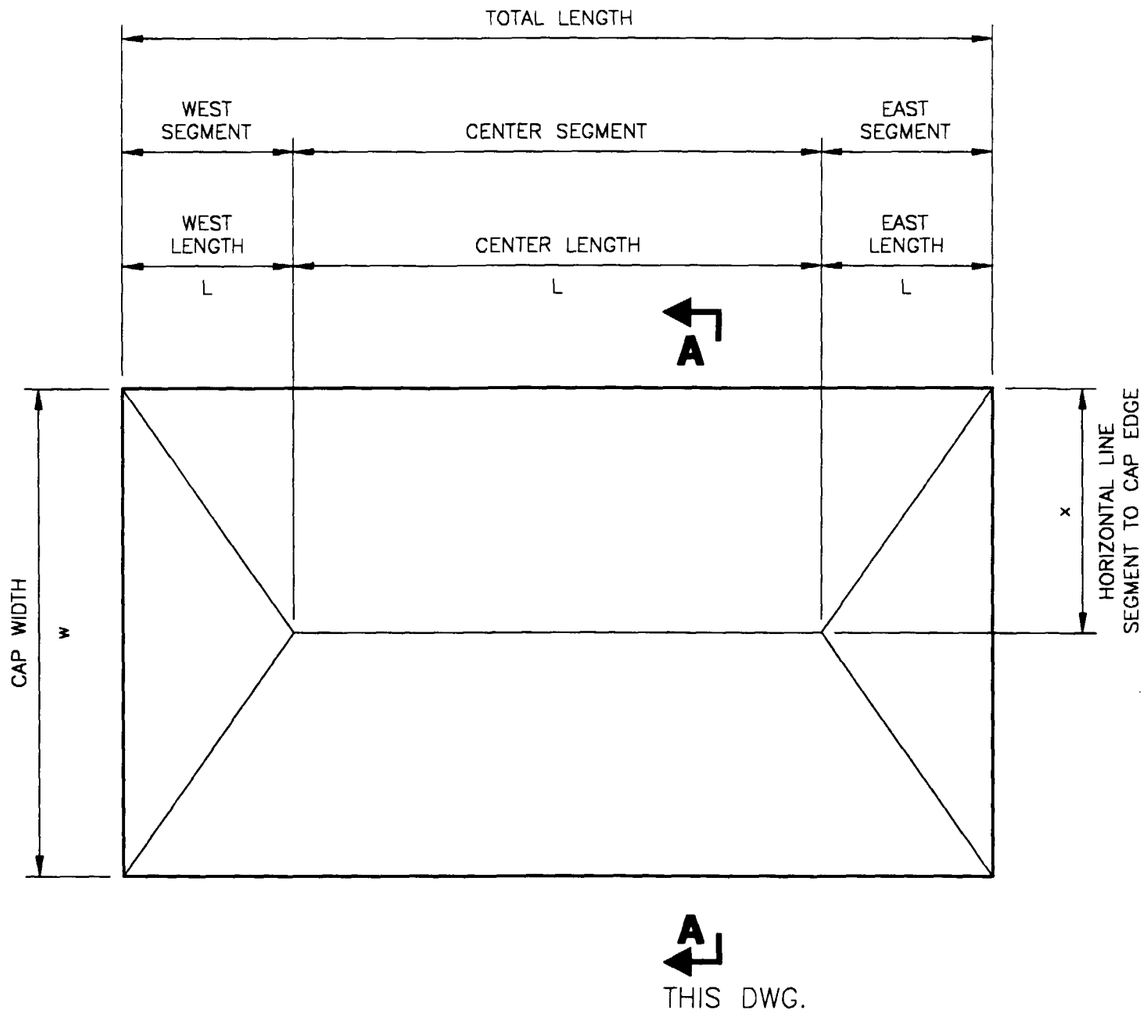
AMSL = Above mean sea level
LNAPL = Light nonaqueous phase liquids

Table C-1-4
Treatment and Disposal
Unit Rates

Source	Remarks	Units		Rate
Backfill Materials				
Dee-N-Dee Trucking	gravel (CA7) $10.10 per ton delivered	cy	$	15.15
Tom Kohlstedt @ 630-904-0036	gravel (CA5) $9.65 per ton delivered	cy	$	14.48
21-Aug-96	sand (FA1) $9.3 per ton delivered	cy	$	12.56
	sand (FA2) $9.9 per ton delivered	cy	$	13.37
S&K Excavation	clay	cy	$	11.00
Ralph Freeman @ 815-436-6300	fill soil	cy	$	7.00
21-Aug-96 verbal	top soil	cy	$	13.00
Storage Tanks				
ModuTank Inc.	125,000 gallon	ea	$	41,335
Reed Margulie @ 800-245-6964	installation and support (pumps, etc.)	ea	$	30,000
2-Feb-96				
Baker Tank	20,000 gallon delivered	ea	$	1,810
Andy Trull @ 800-327-7595	Two month rental	gal	$	0.10
5-Jun-95				
On Site Treatment - Solidification/Stabilization				
Millgard Environmental	Mobilization and support	ls	$	50,000
David Coleman @ 313-261-9760	Treatment in place	cy	$	150
1-Aug-94 reviewed 22-Aug-96	Treatment of excavated materials	cy	$	50
Terra Construction LTD	Mobilization and support	ls	$	70,000
Rick Graves @ 817-382-0899	Treatment in place	cy	$	135
28-Aug-96 verbal	Treatment of excavated materials	cy	$	39
Low Temperature Thermal Desorption - Indirect				
(Note: all contractors consider this project as a small treatment project - very inefficient operation)				
Westinghouse	Indirect w/ off gas treat - 1,100 degrees F			
Roger Pendry @ 708-261-7900	Mobilization	ls	$	2,000,000
14-Oct-96 verbal	Treatment range of $400 per ton			
	Treatment range of $540 per cy	cy	$	540
Midwest Soil Remediation	Indirect w/ off gas treat - 1,100 degrees F			
Bruce Penn @ 708-231-5115	Mobilization	ls	$	2,500
25-Oct-96 verbal	Treatment range of $96 per ton			
	Treatment range of $130 per cy	cy	$	130
Soiltech ATP Systems	Indirect w/ off gas treat - 1,100 degrees F			
Joe Hutton @ 303-790-1747	Mobilization	ls	$	1,500,000
25-Oct-96 verbal	Treatment range of $200 per ton			
	Treatment range of $270 per cy	cy	$	270
Miscellaneous Items				
National Seal	Geocomposite drainage layer, 300 mil, union inst.	sf	$	0.68
John Nyboer @ 906-387-3820	Flexible membrane layer (low density polyethylene, 40 mil, union installed	sf	$	0.70
GeoSyntec Consultants	Geosynthetic drainage layer	sf	$	0.98
Publication	Flexible membrane layer	sf	$	1.75
TJ Lambercht Const.	Pneumatic breaker - bedrock	cy	$	150
Tom Boleck @ 630-940-1704	Pneumatic breaker - weathered bedrock	cy	$	125
14-Mar-95 verbal				
	Absorbent	cy	$	75
1996 Means Site Work - 15th Edition	See noted items and reference numbers			
1996 Means Mech Work - 19th Edition				
1996 ECHOS Environmental Restoration				
ERM Estimate	Experience with other projects and professional judgment			

Table C-1-4 (cont'd)
Treatment and Disposal
Unit Rates

Source	Remarks	Units	Rate	Total Rate
TSCA & RCRA Incineration (soil)	Rollins Envir., Inc. @ Deer Park, TX			
	Trucking - $0.07 per pound	cy	$ 189	$ 729
	Disposal - $0.20 per pound	cy	$ 540	
	Waste Management @ Port Arthur, TX			
	Trucking - included in disposal cost	cy	$ -	$ 945
	Disposal - $0.35 per pound	cy	$ 945	
	Clean Harbors Envir. Serv. @ Deer Park, TX			
	Trucking - $0.092 per pound	cy	$ 248	$ 2,273
	Disposal - $0.75 per pound	cy	$ 2,025	
TSCA & RCRA Subtitle C Landfill (soil)	Clean Harbors Envir. Serv. @ Model City, NY			
	Trucking - $0.047 per pound	cy	$ 127	$ 500
	Disposal - $0.138 per pound	cy	$ 373	
	Waste Management @ Model City, NY			
	Trucking - included in disposal cost	cy	$ -	$ 383
	Disposal - $0.142 per pound	cy	$ 383	
	Rollins @ Grandview, ID			
	Trucking - $0.123 per pound	cy	$ 332	$ 459
	Disposal - $0.047 per pound	cy	$ 127	
RCRA Subtitle C Landfill (soil)	Envirosafe @ Oregon, OH			
	Trucking - $0.18 per pound	cy	$ 486	$ 791
	Disposal - $0.113 per pound	cy	$ 305	
	Rollins Envir., Inc. @ Peoria, IL			
	Trucking - $0.006 per pound	cy	$ 16	$ 173
	Disposal - $0.058 per pound	cy	$ 157	
	Waste Management @ Fort Wayne, IN			
	Trucking - $0.015 per pound	cy	$ 41	$ 243
	Disposal - $0.075 per pound	cy	$ 203	
	Clean Harbors Envir. Serv. @ Detroit, MI			
	Trucking - $0.010 per pound	cy	$ 27	$ 292
	Disposal - $0.098 per pound	cy	$ 265	
RCRA Subtitle D Landfill (soil)	Clean Harbors Envir. Serv. @ Central, IL			
	Trucking - $0.015 per pound	cy	$ 41	$ 143
	Disposal - $0.038 per pound	cy	$ 103	
	Peoria Disposal Company @ Clinton, IL			
	Trucking - $0.013 per pound	cy	$ 35	$ 59
	Disposal - $0.009 per pound	cy	$ 24	
	Envirosafe @ Grayslake, IL			
	Trucking - $0.006 per pound	cy	$ 16	$ 38
	Disposal - $0.008 per pound	cy	$ 22	
	Waste Management @ Elwood, IL			
	Trucking - $0.004 per pound	cy	$ 11	$ 32
	Disposal - $0.008 per pound	cy	$ 22	
TSCA & RCRA Incineration (liquid)	Rollins Envir., Inc. @ Deer Park, TX			
	Trucking - $0.070 per pound	gal	$ 0.58	$ 4.13
	Disposal - $0.425 per pound	gal	$ 3.54	
	Waste Management @ Port Arthur, TX			
	Trucking - $0.055 per pound	gal	$ 0.46	$ 7.90
	Disposal - $0.892 per pound	gal	$ 7.44	
	Clean Harbors Envir. Serv. @ Deer Park, TX			
	Trucking - $0.079 per pound	gal	$ 0.66	$ 4.75
	Disposal - $0.491 per pound	gal	$ 4.09	
TSCA & RCRA Subtitle C Treatment (liquid)	Envirosafe @ Grandview, ID			
	Trucking - $0.12 per pound	gal	$ 1.00	$ 2.50
	Disposal - $0.18 per pound	gal	$ 1.50	
	Rollins Envir., Inc.@ Plaquemine, LA			
	Trucking - $0.070 per pound	gal	$ 0.58	$ 3.09
	Disposal - $0.30 per pound	gal	$ 2.50	
	Waste Management @ Vickery, OH			
	Trucking - $0.027 per pound	gal	$ 0.23	$ 0.41
	Disposal - $0.022 per pound	gal	$ 0.18	
	Clean Harbors Envir. Serv. @ Chicago, IL			
	Trucking - $0.013 per pound	gal	$ 0.11	$ 2.06
	Disposal - $0.234 per pound	gal	$ 1.95	
RCRA Subtitle C Treatment (liquid)	Envirosafe @ Grandview, ID			
	Trucking - $0.12 per pound	gal	$ 1.00	$ 2.50
	Disposal - $0.18 per pound	gal	$ 1.50	
	Rollins Envir., Inc. @ Deer Park, TX			
	Trucking - $0.070 per pound	gal	$ 0.58	$ 0.73
	Disposal - $0.018 per pound	gal	$ 0.15	
	Waste Management @ Vickery, OH			
	Trucking - $0.027 per pound	gal	$ 0.23	$ 0.41
	Disposal - $0.022 per pound	gal	$ 0.18	
	Clean Harbors Envir. Serv. @ Cincinnati, OH			
	Trucking - $0.013 per pound	gal	$ 0.11	$ 0.66
	Disposal - $0.066 per pound	gal	$ 0.55	



CAP PLAN
NOT TO SCALE

EQUATIONS:

EAST OR WEST SEGMENT

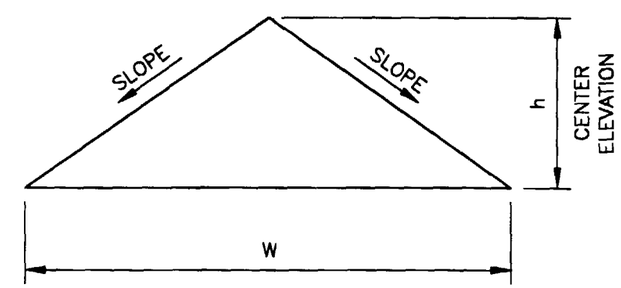
$V_{(cy)} = (h)(x)(L)/(2)(27)$ (APPROXIMATE)

CENTER SEGMENT

$V_{(cy)} = (h)(x)(L)/(27)$

OR

$V_{(cy)} = (h)(w)(L)/(2)(27)$



$h = (SLOPE)(W)/2$

SECTION A - A
NOT TO SCALE
THIS DWG.

FIGURE 1

VOLUME CALCULATION BASIS
LENZ OIL SITE
LEMONT, ILLINOIS

ERM

FILE: S:\CPFILES\ERM\S&A\94017\21\ACAD\GWES\FIG1.DWG OCT 22, 1996 1:14 PM
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ATTACHMENT 2 TO APPENDIX C

PREDESIGN INVESTIGATIONS COST ESTIMATES

TABLE C-2-1
PREDESIGN INVESTIGATIONS COST ESTIMATES
LENZ OIL SITE
LEMONT, ILLINOIS

Activity	Unit	Number of Units	Unit Cost $	Total Cost	Comments
Predesign ground water and LNAPL sampling - Alternatives 2 through 9					
Plan preparation	ls	1	20,000	20,000	Work plan, sampling plan, QAPP, H&S
Mobilization/demobilization	each	1	1,000	1,000	ERM estimate
Shallow well installation	well	3	5,000	15,000	ERM estimate based on past costs at the site
Deep well installation	well	4	8,000	32,000	ERM estimate based on past costs at the site
Piezometer installation	each	1	2,000	2,000	ERM estimate based on past costs at the site
Well and piezometer abandonment	each	9	3,000	27,000	ERM estimate
Air monitoring with HNu	ls	1	2,000	2,000	ERM estimate
H&S equipment	ls	1	2,000	2,000	ERM estimate
Decontamination materials and labor	ls	1	2,000	2,000	ERM estimate
Water storage in drums	gal	4740	0.10	474	ERM estimate
Water treatment	gal	4740	0.20	948	After treatment system is in place
Well development water disposal (inc. truck.)	gal	2500	0.73	1,825	After LNAPL removal; RCRA Subtitle C facility @ Deer Park, TX
Decon water disposal (includes trucking)	gal	2000	0.73	1,460	After LNAPL removal; RCRA Subtitle C facility @ Deer Park, TX
Well cuttings disposal (includes trucking)	cy	5	292	1,460	RCRA Subtitle C Landfill (soil) @ Detroit, MI
Well development	well	6	750	4,500	ERM estimate based on past costs at the site
Well purging water disposal					
8 deep wells	gallons	160	0.73	117	20 gal/deep well
8 shallow wells	gallons	80	0.73	58	10 gal/shallow well
LNAPL disposal	gallons	50	4.75	238	TSCA & RCRA incinerator (liquid) @ Deer Park, TX
Well purging and collection of samples	day	5	3,360	16,800	6 new and 10 existing wells; incl: labor & expenses
Sampling equipment	day	1	500	500	ERM estimate
Health and safety equipment	day	5	200	1,000	ERM estimate
Water laboratory analyses					Includes 30% QA/QC samples
VOCs	sample	21	200	4,200	ERM estimate
SVOCs	sample	21	350	7,350	ERM estimate
PCB	sample	21	200	4,200	ERM estimate
Total inorganics	sample	21	180	3,780	ERM estimate
LNAPL laboratory analyses					Includes 30% QA/QC samples
VOCs	sample	21	160	3,360	ERM estimate
SVOCs	sample	21	245	5,145	ERM estimate
PCB	sample	21	175	3,675	ERM estimate
Total organics	sample	21	150	3,150	ERM estimate
Data evaluation and report preparation	ls	1	10,000	10,000	To be submitted with the 30% design report
Total				177,240	

TABLE C-2-1
PREDESIGN INVESTIGATIONS COST ESTIMATES
LENZ OIL SITE
LEMONT, ILLINOIS

Activity	Unit	Number of Units	Unit Cost $	Total Cost	Comments
Drainage and surface water effects study- Alternatives 2, 3, and 4					
Plan preparation	ls	1	5,000	5,000	Work plan
Drainage study	ls	1	5,000	5,000	ERM estimate
Evaluation of surface water effects	ls	1	8,000	8,000	ERM estimate
Data evaluation and report preparation	ls	1	5,000	5,000	To be submitted with the 30% design report
Total				23,000	
Ground water treatability tests - Alternatives 3, 4, 5, 5a, and 7					
Plan preparation	ls	1	30,000	30,000	Work plan, sampling plan, QAPP, H&S
Well purging / sampling	hour	48	70	3,360	From 4 wells (G106L, MW-5S, G102L, MW-6S)
Purging and decon. water disposal (includes trucking)	gallons	260	0.73	190	After LNAPL removal; RCRA Subtitle C facility @ Deer Park, TX 10 gallons per shallow well and 20 per deep well
Well purging and collection of samples	day	2	3,360	6,720	Assume a total of 100 gal; labor & expenses
Sampling equipment	ls	1	2,000	2,000	ERM estimate
Field health and safety equipment	day	3	200	600	3 days of sampling
Water shipping fees	drum	2	500	1,000	Express shipping as hazardous waste; ERM estimate
Laboratory use fees	week	8	2,000	16,000	8 work weeks of testing
Testing laboratory health and safety equipment	day	40	200	8,000	8 work weeks of testing x 5 days/week
Tests	ls	1	28,000	28,000	Includes labor and materials
Analyses					7 processes; 6 runs each; 4 samples each run (incudes)
VOCs	sample	42	160	6,720	duplicates); 25% analyzed for each parameter, except
SVOCs	sample	42	245	10,290	general chemistry
PNAs	sample	42	150	6,300	
PCBs	sample	42	175	7,350	
Inorganics	sample	42	150	6,300	
General chemistry	sample	168	100	16,800	
Data evaluation and report preparation	ls	1	20,000	20,000	To be submitted with the 30% design report
Total				169,630	

TABLE C-2-1
PREDESIGN INVESTIGATIONS COST ESTIMATES
LENZ OIL SITE
LEMONT, ILLINOIS

Activity	Unit	Number of Units	Unit Cost $	Total Cost	Comments
Predesign soil sampling - Alternatives 5, 5a, 6, 6a, 7, 8, and 9					
Plan preparation	ls	1	15,000	15,000	Work plan, sampling plan, QAPP, H&S
Mobilization/demobilization	ls	1	1,000	1,000	Local contractor
Sample collection	day	5	1,680	8,400	5 days of sampling; includes labor and expenses
Sampling equipment	ls	1	1,000	1,000	ERM estimate
Health and safety equipment	day	5	200	1,000	ERM estimate
Decontamination water disposal (includes trucking)	gallons	55	0.73	40	After treatment system is in place and LNAPL is removed. RCRA Subtitle C facility @ Deer Park, TX
Analyses					20 samples around each sampling location; 6 locations; plus 20% QA/QC samples
PNAs - field test kit	sample	144	50	7,200	
PCBs - field test kit	sample	144	50	7,200	
PNAs - laboratory	sample	29	150	4,350	
PCBs - laboratory	sample	29	200	5,800	
Data & risk evaluation and report preparation	ls	1	20,000	20,000	To be submitted with the 30% design report
Total				70,990	
S/S binder selection - Alternatives 5a, 6a, 7, 8, and 9					
Plan preparation	ls	1	20,000	20,000	Work plan, sampling plan, QAPP, H&S
Mobilization/demobilization	ls	1	1,000	1,000	Local contractor
Sample collection	day	2	1,680	3,360	100 lb of soil; 2 days of sampling; includes labor & expenses
Sampling equipment	ls	1	1,000	1,000	2 days of sampling
Health and safety equipment	day	2	200	400	2 days of sampling
Decontamination water disposal	gallons	55	0.73	40	Disposal as hazardous waste
Soil shipping	lb	100	5	500	Express shipping as hazardous waste
Laboratory use fees	wk	2	2,000	4,000	Assumes 2 weeks of testing
Testing laboratory health and safety equipment	day	10	200	2,000	2 work weeks x 5 days per week
Tests	ls	1	9,000	9,000	Includes labor and materials
Analyses					10 runs; 6 binders/run; 20% of mixes analyzed; each sample in duplicate; 20% QA/QC samples
VOCs	sample	24	220	5,280	
PNAs	sample	24	150	3,600	
PCBs	sample	24	200	4,800	
Physical tests	sample	24	300	7,200	Compressive strength, permeability, density
Data evaluation and report preparation	ls	1	8,000	8,000	To be submitted with the 30% design report
Total				70,180	

TABLE C-2-1
PREDESIGN INVESTIGATIONS COST ESTIMATES
LENZ OIL SITE
LEMONT, ILLINOIS

Activity	Unit	Number of Units	Unit Cost $	Total Cost	Comments
Active recovery trench pilot tests - Alternatives 3 through 8					
Plan preparation	ls	1	20,000	20,000	Work plan, sampling plan, QAPP, H&S
Mobilization/demobilization	ls	1	2,000	2,000	Local contractor
Site preparation	ls	1	5,000	5,000	Excavation of water/LNAPL extraction trench (20 ft long) and pumps
Water storage	ea	1	71,335	71,335	125,000 gal field erected Modutank
Extracted and decon water disposal	gallons	94,118	0.73	68,706	Extraction at 20 gpm for 48 hours to achieve drawdown; 5 gpm for 5 days; Subtitle C-permitted facility disposal after LNAPL removal; includes transportation and disposal
Disposal of LNAPL	gallons	50	4.75	238	Off-site TSCA and RCRA incineration facility; includes disposal and transportation
Analyses	sample	28	115	3,220	Average of 4 samples per day; analysis for TPH @ $60/ea and oil and grease @ $55/ea
Health and safety equipment	day	9	200	1,800	7 days of testing plus 2 days of preparations
Test	days	9	5,000	45,000	Extraction of ground water and LNAPL and collection of samples; 7 days of testing @ 24 h/d; 2 days of prep.; includes labor, materials, and field expenses
Data evaluation and report preparation	ls	1	30,000	30,000	Includes modeling; to be submitted w/the 30% design report
Total				247,299	
Aquifer pump test - Alternatives 3 through 8					
Plan preparation	ls	1	15,000	15,000	Work plan, sampling plan, QAPP, H&S
Mobilization/demobilization	ls	1	1,000	1,000	Local contractor
Extraction well installation	well	1	3,000	3,000	ERM estimate based on past cost at the site
Piezometer installation	each	3	2,000	6,000	ERM estimate based on past cost at the site
Well development	well	4	750	3,000	ERM estimate based on past cost at the site
Test	days	4	5,000	20,000	Extraction of ground water and LNAPL and collection of samples; 2 days of testing @ 24 h/d & 2 days of prep.; includes labor, materials, and field expenses
Water storage	ea	0	71,335	0	Included in the active recovery trench pilot test
Development, decon, and extracted water disposal	gallons	57,600	0.73	42,000	Extraction at 20 gpm for 48 hours; disposal at RCRA facility at Deer Park, TX
Water treatment	gallons	57,600	0.2	11,500	After treatment system is in place
Data evaluation and report preparation	ls	1	20,000	20,000	Includes modeling; to be submitted w/30% design report
Total				121,500	

TABLE C-2-1
PREDESIGN INVESTIGATIONS COST ESTIMATES
LENZ OIL SITE
LEMONT, ILLINOIS

Activity	Unit	Number of Units	Unit Cost $	Total Cost	Comments
Surfactant selection laboratory tests - Alternatives 6, 6a, and 8					
Plan preparation	ls	1	20,000	20,000	Work plan, sampling plan, QAPP, H&S
Mobilization/demobilization	ls	1	1,000	1,000	Local contractor
Sample collection	day	5	150	750	100 lb of soil, 50 gallons of water, and 20 gallons of LNAPL; 5 days of sampling; includes labor & expenses
Sampling equipment	ls	1	1,000	1,000	2 days of sampling
Health and safety equipment	day	5	200	1,000	2 days of sampling
Purging & decon water disposal	gallons	500	0.73	365	After LNAPL removal, Subtitle C permitted facility
Soil, ground water and LNAPL shipping	lb	350	20	7,000	Express shipping as hazardous waste; 100 lb of soil, 20 gal water, 10 gal LNAPL
Laboratory use fees	wk	8	2,500	20,000	Assumes 8 work weeks of testing
Testing laboratory health and safety equipment	day	40	200	8,000	Assumes 8 work weeks of testing
Tests	ls	1	20,000	20,000	Includes labor, equipment, and materials
Analyses	sample	120	450	54,000	6 tests; 10 surfactants each test; 2 samples per surfactant for analysis of various parameters (critical micelle concentration, turbidity, oil and grease, etc.) column tests with PCB analyses
Data evaluation and report preparation	ls	1	30,000	30,000	To be submitted with the 30% design report
Total				163,115	

TABLE C-2-1
PREDESIGN INVESTIGATIONS COST ESTIMATES
LENZ OIL SITE
LEMONT, ILLINOIS

Activity	Unit	Number of Units	Unit Cost $	Total Cost	Comments
Surfactant selection pilot test - Alternatives 6, 6a, and 8					
Plan preparation	ls	1	30,000	30,000	Work plan, sampling plan, QAPP, H&S
Mobilization/demobilization	ls	1	1,000	1,000	Local contractor
Percolation tests with water	ls	1	1,500	1,500	Tests performed in uncontaminated areas
Site preparation	ls	1	6,000	6,000	Excavation of pit, installation of gravel, distribution piping (cost of the water/LNAPL extraction trench and pumps included in the active recovery trench pilot test)
Surfactant recovery test	days	5	2,000	10,000	Includes only the cost of the surfactant and the cost of application of the surfactant; the extraction of ground water and collection of samples for 7 days is included in the active recovery trench tests; includes labor, materials, and field expenses
Extracted and decon water disposal	gallons	7,236	0.73	5,282	1 gpm; disposal at RCRA Subtitle C-permitted facility after LNAPL removal; includes transportation and and disposal; ground water rate shown is only the additional surfactant rate, because the extracted ground water disposal cost is included in the active active recovery trench test cost
Ground water disposal add on for difficulty in recovering LNAPL versus active recovery trench pilot tests	gallons	94,118	0.89	83,765	1/2 the difference between RCRA and TSCA disposal
Analyses	sample	56	1,350	75,600	Average of 4 samples per day; analysis for VOCs, SVOCs, PCBs, inorganics, and surfactant; includes samples in duplicate
Health and safety equipment	day	0	200	0	Included in the active recovery trench tests
Data evaluation and report preparation	ls	1	30,000	30,000	To be submitted with the 30% design report
Total				243,147	

TABLE C-2-1
PREDESIGN INVESTIGATIONS COST ESTIMATES
LENZ OIL SITE
LEMONT, ILLINOIS

Activity	Unit	Number of Units	Unit Cost $	Total Cost	Comments
Ground water/surfactant treatability tests - Alternatives 6, 6a, and 8					
Plan preparation	ls	1	35,000	35,000	Work plan, sampling plan, QAPP, H&S
Water shipping fees	drum	3	500	1,500	Express shipping as hazardous waste of samples from the surfactant selection pilot test
Laboratory use fees	week	8	2,000	16,000	8 work weeks of testing
Testing laboratory health and safety equipment	day	40	200	8,000	8 work weeks of testing x 5 days/week
Tests	ls	1	31,000	31,000	Includes labor and materials
Analyses					8 processes; 6 runs each; 4 samples each run including duplicates; inorganics and general chemistry analyzed for 50% of the time
VOCs	sample	192	160	30,720	
SVOCs	sample	192	245	47,040	
PCBs	sample	192	175	33,600	
Inorganics	sample	96	150	14,400	
Surfactants	sample	192	100	19,200	
General chemistry	sample	96	100	9,600	
Data evaluation and report preparation	ls	1	25,000	25,000	To be submitted with the 30% design report
Total				271,060	
LTTD Treatability Test - Alternatives 7, 8, and 9					
Plan preparation	ls	1	20,000	20,000	Work plan, sampling plan, QAPP, H&S
Mobilization/demobilization	ls	1	1,000	1,000	Local contractor
Sample collection	day	2	1,680	3,360	100 lb of soil; 2 days of sampling; includes labor & expenses
Sampling equipment	ls	1	1,000	1,000	2 days of sampling
Health and safety equipment	day	2	200	400	2 days of sampling
Decontamination water disposal	gallons	55	0.73	40	Disposal as hazardous waste
Soil shipping	lb	100	5	500	Express shipping as hazardous waste
Tests	ls	1	50,000	50,000	Vendor estimate
Analyses	sample	10	500	5,000	ERM estimate
Data evaluation and report preparation	ls	1	8,000	8,000	To be submitted w/30% design report
Total				89,300	

TABLE C-2-2
SUMMARY OF PREDESIGN INVESTIGATION COST ESTIMATES
LENZ OIL SITE
LEMONT, ILLINOIS

	Alternative Number										
Predesign Investigation	**1**	**2**	**3**	**4**	**5**	**5a**	**6**	**6a**	**7**	**8**	**9**
Ground water and LNAPL sampling		$ 177,240	$ 177,240	$ 177,240	$ 177,240	$ 177,240	$ 177,240	$ 177,240	$ 177,240	$ 177,240	$ 177,240
Drainage study and surface water effects		$ 23,000	$ 23,000	$ 23,000							
Ground water treatability tests			$ 169,630	$ 169,630	$ 169,630	$ 169,630			$ 169,630		
Soil sampling					$ 70,990	$ 70,990	$ 70,990	$ 70,990	$ 70,990	$ 70,990	$ 70,990
Ex situ S/S binder selection						$ 70,180		$ 70,180	$ 70,180	$ 70,180	$ 70,180
Recovery trench test			$ 247,299	$ 247,299	$ 247,299	$ 247,299	$ 247,299	$ 247,299	$ 247,299	$ 247,299	
Aquifer pump test near the river			$ 121,500	$ 121,500	$ 121,500	$ 121,500	$ 121,500	$ 121,500	$ 121,500	$ 121,500	
Sufactant selection tests							$ 163,115	$ 163,115		$ 163,115	
Surfactant selection pilot test							$ 243,147	$ 243,147		$ 243,147	
Ground water/surfactant treatability tests							$ 271,060	$ 271,060		$ 271,060	
Low temperature thermal desorption tests									$ 89,300	$ 89,300	$ 89,300
Total	$ -	$ 200,200	$ 738,700	$ 738,700	$ 786,658	$ 856,838	$ 1,294,351	$ 1,364,531	$ 946,139	$ 1,453,831	$ 407,710

ATTACHMENT 3 OF APPENDIX C

ADDITIONAL COST ESTIMATE TABLES FOR DIFFERENT RISK LEVELS

TABLE C-1a
CAPITAL COST ESTIMATE SUMMARY -FUTURE ON-SITE RESIDENT, 1E-05 SOIL
LENZ OIL SITE
LEMONT, ILLINOIS

Process Option	Table Number	1	2	3	4	5	5a	6	6a	7	8	9
Common Activities	Table C-2	$ -	$ 314,389	$ 314,389	$ 314,389	$ 314,389	$ 314,389	$ 314,389	$ 314,389	$ 314,389	$ 314,389	$ 314,389
Covers												
Multilayered Cap	Table C-3	$ -	$ 3,014,381	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Solid Waste Cap	Table C-4	$ -	$ -	$ 1,715,515	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Asphalt Cap	Table C-5	$ -	$ -	$ -	$ 2,066,638	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Concrete Cap	Table C-6	$ -	$ -	$ -	$ 2,167,828	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Remediation of 1.0E-04 Unconsolidated Soils												
Off-Site Disposal												
RCRA Subtitle D	Table C-8	$ -	$ -	$ -	$ -	$ 1,924,270	$ -	$ 1,924,270	$ -	$ -	$ -	$ -
On-Site Treatment												
Ex Situ Solidification/Stabilization (S/S)	Table C-9	$ -	$ -	$ -	$ -	$ -	$ 1,857,168	$ -	$ 1,857,168	$ 1,857,168	$ 1,857,168	$ 1,857,168
Low Temperature Thermal Desorption (LTTD)	Table C-10	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 6,585,759	$ 6,585,759	$ 6,585,759
LNAPL												
LNAPL Recovery - Passive 4 trenches	Table C-11	$ -	$ 1,679,842	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
LNAPL Recovery - Active 2 trenches	Table C-12	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,696,350	$ -	$ -
LNAPL Recovery - Active 3 Trenches	Table C-13	$ -	$ -	$ 2,136,928	$ 2,136,928	$ 2,136,928	$ 2,136,928	$ -	$ -	$ -	$ 2,136,928	$ -
LNAPL Recovery - Active 4 Trenches	Table C-14	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,444,342	$ 2,444,342	$ -	$ -	$ -
Enhanced LNAPL Recovery - Surfactants 3 trenches	Table C-15	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,323,598	$ -
Enhanced LNAPL Recovery - Surfactants 4 trenches	Table C-16	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,178,684	$ 2,178,684	$ -	$ -	$ -
LNAPL Soil Excavation and LTTD Treatment	Table C-19	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,578,525	$ 5,578,525	$ -
LNAPL Soil Excavation and *Ex Situ* S/S	Table C-19a	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,161,739	$ 3,161,739	$ -
LNAPL Soil & Rock Excavation and LTTD Treatment	Table C-20	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 8,089,469
LNAPL Soil & Rock Excavation and *Ex Situ* S/S	Table C-20a	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,204,770
Ground Water												
Ground Water Recovery Wells - No surfactant	Table C-21	$ -	$ -	$ 677,311	$ 677,311	$ 677,311	$ 677,311	$ -	$ -	$ 677,311	$ -	$ -
Ground Water Recovery Wells - Surfactants	Table C-21	$ -	$ -	$ -	$ -	$ -	$ -	$ 677,311	$ 677,311	$ -	$ 677,311	$ -
Ground Water Treatment System												
Active Recovery with 2 trenches	Table C-22	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,664,765	$ -	$ -
Active Recovery with 3 trenches	Table C-22	$ -	$ -	$ 2,664,765	$ 2,664,765	$ 2,664,765	$ 2,664,765	$ -	$ -	$ -	$ -	$ -
Enhanced Recovery with 3 trenches	Table C-23	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,425,424	$ -
Enhanced Recovery with 4 trenches	Table C-23	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,425,424	$ 3,425,424	$ -	$ -	$ -
Total Cost (minimum)		$ -	$ 5,008,612	$ 7,508,909	$ 7,860,032	$ 7,717,664	$ 7,650,562	$ 10,964,420	$ 10,897,318	$ 10,371,722	$ 12,896,557	$ 7,376,327
Total Cost (maximum)		$ -	$ 5,008,612	$ 7,508,909	$ 7,961,222	$ 7,717,664	$ 7,650,562	$ 10,964,420	$ 10,897,318	$ 17,517,100	$ 20,041,935	$ 14,989,617

Table C-7a
Lenz Oil - Capital Cost Estimate - Future On-site Resident
Remediation of 1.0E-05 Unconsolidated Soils - Base Costs

Item	Units	Calculated Quantity	Design Quantity	Unit Price	Total Price	Calculated Quantity Remarks	Unit Price Source (1)
Mobilization	ls	1	1	$ 10,000	$ 10,000	ERM estimate	ERM estimate
Surveying	ls	1	1	$ 1,000	$ 1,000	ERM estimate	ERM estimate
Excavation of areas							
Material to be treated/disposed	cy	11,108	11,110	$ 13.04	$ 144,886	See Figure 2-1	Means 022-238-0500/0020/4250
Subtotal excavated	cy	11,108	11,110				
Subtotal treated/disposed	cy	11,108	11,110				
Excavation/treatment duration	wk	12.3	3			Excavation/treatment rate of 900 cy/wk (2)	
Air monitoring with an HNu	wk	12.3	3	$ 2,000	$ 6,000	Labor and materials	ERM estimate
H&S equipment	wk	12.3	3	$ 2,000	$ 6,000	ERM estimate	ERM estimate
Decontamination materials and labor	wk	12.3	3	$ 300	$ 900	ERM estimate	ERM estimate
Decon water storage	gal	3,703	900	$ 0.10	$ 90	300 gal per week	Baker Tank
Decon water disposal (includes trucking)	gal	3,703	900	$ 0.73	$ 661	RCRA Subtitle C Treatment	Rollins Envir., Inc. @ Deer Park, TX
Demobilization	ls	1	1	$ 5,000	$ 5,000	ERM estimate	ERM estimate
Subtotal (Soils base)					$ 174,536		

Notes
1 ERM estimate includes overhead and profit. 1996 Means Site Work - 15th Edition, plus 12% overhead and profit.
1996 Means Mechanical Work - 19th Edition, plus 12% overhead and profit.
2 Excavation and treatment rates are based on the following assumptions:
LTTD
Treatment rate of 10 tons or 7.4 cubic yards per hour.
System operating 24 hours a day - 7 days a week, at 75 percent utilization.
Average treatment rate 932 cy/wk (used 900 cy/wk)
SS
Treatment rate of 30 cubic yards per hour.
System operating 8 hours a day - 5 days a week, at 75 percent utilization.
Average treatment rate 900 cy/wk
Off-site Disposal
Loading two to three 15 cubic yard trucks a hour.
Excavating 6 hours a day - 5 days a week.
Minimum excavation rate 900 cy/wk (used 900 cy/wk)
Maximum excavation rate 1,350 cy/wk

Table C-8a
Lenz Oil - Capital Cost Estimate - Future On-site Resident
Remediation of 1.0E-05 Unconsolidated Soils
Off-Site Disposal - RCRA Subtitle D

Item	Units	Calculated Quantity	Design Quantity	Unit Price	Total Price	Calculated Quantity Remarks	Unit Price Source (1)
Soils Base					$ 174,536	See Soils Base Cost Estimate	See Soils Base Cost Estimate
Transportation to off-site facility	cy	11,108	11,110	$ 35.10	$ 389,961	RCRA Subtitle D Landfill	Peoria Disposal Company @ Clinton, IL
Disposal at off-site facility	cy	11,108	11,110	$ 24.30	$ 269,973	RCRA Subtitle D Landfill	Peoria Disposal Company @ Clinton, IL
Additional fill material	cy	11,108	11,110	$ 7.00	$ 77,770	See Soils Base Cost Estimate	S&K Excavation
Fill placement	cy	11,108	11,110	$ 3.10	$ 34,468	See Soils Base Cost Estimate	Means 022-246-1050
Fill compaction	cy	11,108	11,110	$ 0.35	$ 3,857	See Soils Base Cost Estimate	Means 022-226-5000
Fill grading	sy	10,258	10,560	$ 1.97	$ 20,816	1E-04 and 1E-05 soils total surface area	Means 025-122-1050
Subtotal					$ 971,381		
Design engineering	%	15.00%			$ 145,707		
Construction management	%	25.00%			$ 242,845		
Insurance	%	2.50%			$ 24,285		
Permitting and legal fees	ls	1	1	$ 5,000	$ 5,000		ERM estimate
Predesign soil sampling	ls	1	1	$ 70,990	$ 70,990	See page 3 of Table C-2-1 in Attachment 2.	ERM estimate
Confirmatory sampling	ls	1	1	$ 20,000	$ 20,000		ERM estimate
Subtotal					$ 1,480,208		
Contingency	%	30.00%			$ 444,062		
Total					$ 1,924,270		

Notes
1 ERM estimate includes overhead and profit. 1996 Means Site Work - 15th Edition, plus 12% overhead and profit.
1996 Means Mechanical Work - 19th Edition, plus 12% overhead and profit.

Table C-9a
Lenz Oil - Capital Cost Estimate - Future On-site Resident
Remediation of 1.0E-05 Unconsolidated Soils
***Ex Situ* Solidification/Stabilization**

Item	Units	Calculated Quantity	Design Quantity	Unit Price	Total Price	Calculated Quantity Remarks	Unit Price Source (1)
Soils Base					$ 174,536	See Soils Base Cost Estimate	See Soils Base Cost Estimate
On-site treatment mobilization	ls	1	1	$ 50,000	$ 50,000	Prepare site and obtain utilities	Millgard Environmental
Truck to on-site treatment	cy	11,108	11,110	$ 2.99	$ 33,223	See Soils Base Cost Estimate	Means 022-266-0020
Ex situ solidification/stabilization	cy	11,108	11,110	$ 50	$ 555,500	Solidification/stabilization on site	Millgard Environmental
Demobilization	ls	1	1	$ 10,000	$ 10,000	ERM estimate	ERM estimate
Fill placement	cy	11,108	11,110	$ 3.10	$ 34,468	See Soils Base Cost Estimate	Means 022-246-1050
Fill compaction	cy	11,108	11,110	$ 0.35	$ 3,857	See Soils Base Cost Estimate	Means 022-226-5000
Fill grading	sy	10,258	10,560	$ 1.97	$ 20,816	1E-04 and 1E-05 soils total surface area	Means 029-308-0200
Subtotal					$ 882,400		
Design engineering	%	15.00%			$ 132,360		
Construction management	%	25.00%			$ 220,600		
Insurance	%	2.50%			$ 22,060		
Permitting and legal fees	ls	1	1	$ 20,000	$ 20,000		ERM estimate
Confirmatory sampling	ls	1	1	$ 10,000	$ 10,000		ERM estimate
Predesign soil sampling	ls	1	1	$ 70,990	$ 70,990	See page 3 of Table C-2-1 in Attachment 2.	ERM estimate
S/S binder selection	ls	1	1	$ 70,180	$ 70,180	See page 3 of Table C-2-1 in Attachment 2.	ERM estimate
Subtotal					$ 1,428,591		
Contingency	%	30.00%			$ 428,577		
Total					$ 1,857,168		

Notes
1 ERM estimate includes overhead and profit. 1996 Means Site Work - 15th Edition, plus 12% overhead and profit.
1996 Means Mechanical Work - 19th Edition, plus 12% overhead and profit.

Table C-10a
Lenz Oil - Capital Cost Estimate - Future On-site Resident
Remediation of 1.0E-05 Unconsolidated Soils
On-Site Treatment - Low Temperature Thermal Desorption

Item	Units	Calculated Quantity	Design Quantity	Unit Price	Total Price	Calculated Quantity Remarks	Unit Price Source (1)
Soils Base					$ 174,536	See Soils Base Cost Estimate	See Soils Base Cost Estimate
On-site treatment mobilization	ls	1	1	$ 600,000	$ 600,000	Prepare site and obtain utilities - 40% of charges The rest is included with the LNAPL-cont. mater.	Soiltech ATP Systems
Truck to on-site treatment	cy	11,108	11,110	$ 2.99	$ 33,223	See Soils Base Cost Estimate	Means 022-266-0020
Thermal desorption with offgas treatment	cy	11,108	11,110	$ 270	$ 2,999,700	Indirect w/ offgas treat - 1,100 degrees F	Soiltech ATP Systems
Disposal of LTTD residual by incineration							
Residual storage	gal	5,608	5,609	$ 0.10	$ 561	Estimated 0.25 % of treated volume	Baker Tank
Transportation to incineration facility	gal	5,608	5,609	$ 0.66	$ 3,696	TSCA and Subtitle C Incineration (liquid)	Clean Harbors Envir. Serv. @ Deer Park, TX
Disposal at incineration facility	gal	5,608	5,609	$ 4.09	$ 22,970	TSCA and Subtitle C Incineration (liquid)	Clean Harbors Envir. Serv. @ Deer Park, TX
Residual volume	cy	28	28				
Disposal of spent carbon by incineration						Estimated 0.5 % of treated volume	
Disposal at incineration facility (includes trucking)	cy	56	56	$ 945	$ 52,495	TSCA and Subtitle C Incineration (soil)	Waste Management @ Port Arthur, TX
Demobilization	ls	1	1	$ 10,000	$ 10,000	ERM estimate	ERM estimate
Fill placement	cy	11,108	11,110	$ 3.10	$ 34,468	See Soils Base Cost Estimate	Means 022-246-1050
Fill compaction	cy	11,108	11,110	$ 0.35	$ 3,857	See Soils Base Cost Estimate	Means 022-226-5000
Fill grading	sy	10,258	10,560	$ 1.97	$ 20,816	1E-04 and 1E-05 soils total surface area	Means 029-308-0200
Subtotal					$ 3,956,322		
Design engineering					$ 200,000		
Construction management	%	15.00%			$ 593,448		
Insurance	%	2.50%			$ 98,908		
Permitting and legal fees	ls	1	1	$ 20,000	$ 20,000		ERM estimate
Confirmatory sampling	ls	1	1	$ 37,000	$ 37,000		ERM estimate
Predesign soil sampling	ls	1	1	$ 70,990	$ 70,990	See page 3 of Table C-2-1 in Attachment 2.	
LTTD off-site test	ls	1	1	$ 89,300	$ 89,300	See page 7 of Table C-2-1 in Attachment 2.	ERM estimate
Subtotal					$ 5,065,969		
Contingency	%	30.00%			$ 1,519,791		
Total					$ 6,585,759		

Notes
1 ERM estimate includes overhead and profit. 1996 Means Site Work - 15th Edition, plus 12% overhead and profit.
1996 Means Mechanical Work - 19th Edition, plus 12% overhead and profit.

TABLE C-31a
PRESENT VALUE ANALYSIS OF REMEDIAL ALTERNATIVES - FUTURE ON-SITE RESIDENT, 1E-05 SOIL
5% DISCOUNT RATE
LENZ OIL SITE
LEMONT, ILLINOIS

PROCESS OPTIONS	PRESENT VALUE CAPITAL COST + 30-YRS O&M COST - 5.0% DISCOUNT RATE Alternative Number										
	1	2	3	4	5	5a	6	6a	7	8	9
No Action	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Common Activities	$ -	$ 2,362,768	$ 2,362,768	$ 2,362,768	$ 2,362,768	$ 2,362,768	$ 2,362,768	$ 2,362,768	$ 2,362,768	$ 2,362,768	$ 2,362,768
Covers											
Multilayered Cap	$ -	$ 3,256,190	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Solid Waste Cap	$ -	$ -	$ 1,957,324	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Asphalt Cap	$ -	$ -	$ -	$ 2,324,434	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Concrete Cap	$ -	$ -	$ -	$ 2,367,670	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Remediation of 1.0E-04 Unconsolidated Soils											
Off-Site Disposal											
RCRA Subtitle D	$ -	$ -	$ -	$ -	$ 1,924,270	$ -	$ 1,924,270	$ -	$ -	$ -	$ -
On-Site Treatment											
Ex Situ Solidification/Stabilization (S/S)	$ -	$ -	$ -	$ -	$ -	$ 1,857,168	$ -	$ 1,857,168	$ 1,857,168	$ 1,857,168	$ 1,857,168
Low Temperature Thermal Desorption (LTTD)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 6,585,759	$ 6,585,759	$ 6,585,759
LNAPL											
LNAPL Recovery - Passive 4 trenches	$ -	$ 2,097,401	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
LNAPL Recovery - Active 2 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,086,148	$ -	$ -
LNAPL Recovery - Active 3 trenches	$ -	$ -	$ 2,660,201	$ 2,660,201	$ 2,660,201	$ 2,660,201	$ -	$ -	$ -	$ 2,660,201	$ -
LNAPL Recovery - Active 4 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,187,123	$ 3,187,123	$ -	$ -	$ -
Enhanced LNAPL Recovery - Surfactants 3 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,385,355	$ -
Enhanced LNAPL Recovery - Surfactants 4 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,879,323	$ 7,879,323	$ -	$ -	$ -
LNAPL Soil Excavation and LTTD Treatment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,578,525	$ 5,578,525	$ -
LNAPL Soil Excavation and *Ex Situ* S/S	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,161,739	$ 3,161,739	$ -
LNAPL Soil & Rock Excavation and LTTD Treatment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 8,089,469
LNAPL Soil & Rock Excavation and *Ex Situ* S/S	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,204,770
Ground Water Recovery Wells											
Active Recovery with 2 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 978,887	$ -	$ -
Active Recovery with 3 trenches	$ -	$ -	$ 967,858	$ 967,858	$ 967,858	$ 967,858	$ -	$ -	$ -	$ -	$ -
Enhanced Recovery with 3 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 969,434	$ -
Enhanced Recovery with 4 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ 969,434	$ 969,434	$ -	$ -	$ -
Ground Water Treatment System											
Active Recovery with 2 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,611,230	$ -	$ -
Active Recovery with 3 trenches	$ -	$ -	$ 8,010,628	$ 8,010,628	$ 8,010,628	$ 8,010,628	$ -	$ -	$ -	$ -	$ -
Enhanced Recovery with 3 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 9,981,372	$ -
Enhanced Recovery with 4 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ 11,261,350	$ 11,261,350	$ -	$ -	$ -
Total Present Value (minimum)	$ -	$ 7,716,359	$ 15,958,780	$ 16,325,890	$ 15,925,726	$ 15,858,624	$ 27,584,270	$ 27,517,167	$ 18,057,940	$ 25,378,038	$ 9,424,706
Total Present Value (maximum)	$ -	$ 7,716,359	$ 15,958,780	$ 16,369,126	$ 15,925,726	$ 15,858,624	$ 27,584,270	$ 27,517,167	$ 25,203,317	$ 32,523,415	$ 17,037,997

TABLE C-32a
PRESENT VALUE ANALYSIS OF REMEDIAL ALTERNATIVES - FUTURE ON-SITE RESIDENT, 1E-05 SOIL
3% DISCOUNT RATE
LENZ OIL SITE
LEMONT, ILLINOIS

PROCESS OPTIONS	PRESENT VALUE CAPITAL COST + 30-YRS O&M COST - 3.0% DISCOUNT RATE Alternative Number										
	1	2	3	4	5	5a	6	6a	7	8	9
No Action											
Common Activities	$ -	$ 2,926,148	$ 2,926,148	$ 2,926,148	$ 2,926,148	$ 2,926,148	$ 2,926,148	$ 2,926,148	$ 2,926,148	$ 2,926,148	$ 2,926,148
Covers											
Multilayered Cap	$ -	$ 3,292,120	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Solid Waste Cap	$ -	$ -	$ 1,993,253	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Asphalt Cap	$ -	$ -	$ -	$ 2,418,270	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Concrete Cap	$ -	$ -	$ -	$ 2,445,566	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Remediation of 1.0E-04 Unconsolidated Soils											
Off-Site Disposal											
RCRA Subtitle D	$ -	$ -	$ -	$ -	$ 1,924,270	$ -	$ 1,924,270	$ -	$ -	$ -	$ -
On-Site Treatment											
Ex Situ Solidification/Stabilization (S/S)	$ -	$ -	$ -	$ -	$ -	$ 3,408,141	$ -	$ 3,408,141	$ 3,408,141	$ 3,408,141	$ 3,408,141
Low Temperature Thermal Desorption (LTTD)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 6,585,759	$ 6,585,759	$ 6,585,759
LNAPL											
LNAPL Recovery - Passive 4 trenches	$ -	$ 2,212,245	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
LNAPL Recovery - Active 2 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,193,356	$ -	$ -
LNAPL Recovery - Active 3 trenches	$ -	$ -	$ 2,804,121	$ 2,804,121	$ 2,804,121	$ 2,804,121	$ -	$ -	$ -	$ 2,804,121	$ -
LNAPL Recovery - Active 4 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,391,416	$ 3,391,416	$ -	$ -	$ -
Enhanced LNAPL Recovery - Surfactants 3 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,266,016	$ -
Enhanced LNAPL Recovery - Surfactants 4 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,696,601	$ 7,696,601	$ -	$ -	$ -
LNAPL Soil Excavation and LTTD Treatment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,578,525	$ 5,578,525	$ -
LNAPL Soil Excavation and *Ex Situ* S/S	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,161,739	$ 3,161,739	$ -
LNAPL Soil & Rock Excavation and LTTD Treatment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 8,089,469
LNAPL Soil & Rock Excavation and *Ex Situ* S/S	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,204,770
Ground Water Recovery Wells											
Active Recovery with 2 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,061,832	$ -	$ -
Active Recovery with 3 trenches	$ -	$ -	$ 1,047,770	$ 1,047,770	$ 1,047,770	$ 1,047,770	$ -	$ -	$ -	$ -	$ -
Enhanced Recovery with 3 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,049,778	$ -
Enhanced Recovery with 4 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,049,778	$ 1,049,778	$ -	$ -	$ -
Ground Water Treatment System											
Active Recovery with 2 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 8,971,690	$ -	$ -
Active Recovery with 3 trenches	$ -	$ -	$ 9,480,937	$ 9,480,937	$ 9,480,937	$ 9,480,937	$ -	$ -	$ -	$ -	$ -
Enhanced Recovery with 3 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 11,784,500	$ -
Enhanced Recovery with 4 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ 13,416,519	$ 13,416,519	$ -	$ -	$ -
Total Present Value (minimum)	$ -	$ 8,430,515	$ 18,252,232	$ 21,122,815	$ 18,183,251	$ 19,667,117	$ 30,404,738	$ 31,888,603	$ 28,308,672	$29,400,451	$11,539,069
Total Present Value (maximum)	$ -	$ 8,430,515	$ 18,252,232	$ 21,122,815	$ 18,183,251	$ 19,667,117	$ 30,404,738	$ 31,888,603	$ 30,725,459	$34,994,855	$17,601,385

TABLE C-33a
PRESENT VALUE ANALYSIS OF REMEDIAL ALTERNATIVES - FUTURE ON-SITE RESIDENT, 1E-05 SOIL
10% DISCOUNT RATE
LENZ OIL SITE
LEMONT, ILLINOIS

PROCESS OPTIONS	PRESENT VALUE CAPITAL COST + 30-YRS O&M COST - 10.0% DISCOUNT RATE Alternative Number										
	1	2	3	4	5	5a	6	6a	7	8	9
No Action	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Common Activities	$ -	$ 1,570,525	$ 1,570,525	$ 1,570,525	$ 1,570,525	$ 1,570,525	$ 1,570,525	$ 1,570,525	$ 1,570,525	$ 1,570,525	$ 1,570,525
Covers											
Multilayered Cap	$ -	$ 3,199,432	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Solid Waste Cap	$ -	$ -	$ 1,900,565	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Asphalt Cap	$ -	$ -	$ -	$ 2,203,894	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Concrete Cap	$ -	$ -	$ -	$ 2,268,319	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Remediation of 1.0E-04 Unconsolidated Soils											
Off-Site Disposal											
RCRA Subtitle D	$ -	$ -	$ -	$ -	$ 1,924,270	$ -	$ 1,924,270	$ -	$ -	$ -	$ -
On-Site Treatment											
Ex Situ Solidification/Stabilization (S/S)	$ -	$ -	$ -	$ -	$ -	$ 3,408,141	$ -	$ 3,408,141	$ 3,408,141	$ 3,408,141	$ 3,408,141
Low Temperature Thermal Desorption (LTTD)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 6,585,759	$ 6,585,759	$ 6,585,759
LNAPL											
LNAPL Recovery - Passive 4 trenches	$ -	$ 1,935,904	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
LNAPL Recovery - Active 2 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,935,387	$ -	$ -
LNAPL Recovery - Active 3 trenches	$ -	$ -	$ 2,457,817	$ 2,457,817	$ 2,457,817	$ 2,457,817	$ -	$ -	$ -	$ 2,457,817	$ -
LNAPL Recovery - Active 4 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,899,841	$ 2,899,841	$ -	$ -	$ -
Enhanced LNAPL Recovery - Surfactants 3 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,738,766	$ -
Enhanced LNAPL Recovery - Surfactants 4 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,832,549	$ 4,832,549	$ -	$ -	$ -
LNAPL Soil Excavation and LTTD Treatment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,578,525	$ 5,578,525	$ -
LNAPL Soil Excavation and *Ex Situ* S/S	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,161,739	$ 3,161,739	$ -
LNAPL Soil & Rock Excavation and LTTD Treatment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 8,089,469
LNAPL Soil & Rock Excavation and *Ex Situ* S/S	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,204,770
Ground Water Recovery Wells											
Active Recovery with 2 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 862,248	$ -	$ -
Active Recovery with 3 trenches	$ -	$ -	$ 855,485	$ 855,485	$ 855,485	$ 855,485	$ -	$ -	$ -	$ -	$ -
Enhanced Recovery with 3 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 856,451	$ -
Enhanced Recovery with 4 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ 856,451	$ 856,451	$ -	$ -	$ -
Ground Water Treatment System											
Active Recovery with 2 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,698,107	$ -	$ -
Active Recovery with 3 trenches	$ -	$ -	$ 5,943,032	$ 5,943,032	$ 5,943,032	$ 5,943,032	$ -	$ -	$ -	$ -	$ -
Enhanced Recovery with 3 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,445,756	$ -
Enhanced Recovery with 4 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$8,230,683	$8,230,683	$ -	$ -	$ -
Total Present Value (minimum)	$ -	$ 6,705,861	$ 12,727,424	$ 13,030,753	$ 12,751,130	$ 14,235,001	$ 20,314,320	$ 21,798,191	$ 16,636,148	$ 21,639,196	$ 10,183,437
Total Present Value (maximum)	$ -	$ 6,705,861	$ 12,727,424	$ 13,095,178	$ 12,751,130	$ 14,235,001	$ 20,314,320	$ 21,798,191	$ 22,230,552	$ 27,233,601	$ 16,245,754

TABLE C-34a
PRESENT VALUE ANALYSIS OF REMEDIAL ALTERNATIVES - FUTURE ON-SITE RESIDENT, 1E-05 SOIL
LENZ OIL SITE
LEMONT, ILLINOIS

PROCESS OPTIONS	CAPITAL COST	ANNUALIZED OPERATING & MAINTENANCE COSTS DISCOUNT RATES 3.00%	5.00%	10.00%	PRESENT VALUE OF 30 YEARS OPERATING & MAINTENANCE COSTS DISCOUNT RATES 3.00%	5.00%	10.00%	PRESENT VALUE CAPITAL COST + 30-YRS O&M COST DISCOUNT RATES 3.00%	5.00%	10.00%
No Action	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Common Activities	$ 314,389	$ 133,250	$133,250	$ 133,250	$ 2,611,759	$ 2,048,379	$ 1,256,136	$ 2,926,148	$ 2,362,768	$ 1,570,525
Covers										
Multilayered Cap	$ 3,014,381	$14,170	$15,730	$19,630	$ 277,738	$ 241,809	$ 185,050	$ 3,292,120	$ 3,256,190	$ 3,199,432
Solid Waste Cap	$ 1,715,515	$14,170	$15,730	$19,630	$ 277,738	$ 241,809	$ 185,050	$ 1,993,253	$ 1,957,324	$ 1,900,565
Asphalt Cap	$ 2,066,638	$17,940	$16,770	$14,560	$ 351,632	$ 257,796	$ 137,256	$ 2,418,270	$ 2,324,434	$ 2,203,894
Concrete Cap	$ 2,167,828	$14,170	$13,000	$10,660	$ 277,738	$ 199,842	$ 100,491	$ 2,445,566	$ 2,367,670	$ 2,268,319
Remediation of 1.0E-04 Unconsolidated Soils										
Off-Site Disposal										
RCRA Subtitle D	$ 1,924,270	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,924,270	$ 1,924,270	$ 1,924,270
On-Site Treatment										
Ex Situ Solidification/Stabilization (S/S)	$ 1,857,168	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,857,168	$ 1,857,168	$ 1,857,168
Low Temperature Thermal Desorption (LTTD)	$ 6,585,759	$ -	$ -	$ -	$ -	$ -	$ -	$ 6,585,759	$ 6,585,759	$ 6,585,759
LNAPL										
LNAPL Recovery - Passive 4 trenches	$ 1,679,842	$ 27,163	$ 27,163	$ 27,163	$ 532,404	$ 417,559	$ 256,062	$ 2,212,245	$ 2,097,401	$ 1,935,904
LNAPL Recovery - Active 2 trenches	$ 1,696,350	$ 25,357	$ 25,357	$ 25,357	$ 497,007	$ 389,798	$ 239,037	$ 2,193,356	$ 2,086,148	$ 1,935,387
LNAPL Recovery - Active 3 trenches	$ 2,136,928	$ 34,040	$ 34,040	$ 34,040	$ 667,192	$ 523,273	$ 320,889	$ 2,804,121	$ 2,660,201	$ 2,457,817
LNAPL Recovery - Active 4 trenches	$ 2,444,342	$ 48,319	$ 48,319	$ 48,319	$ 947,074	$ 742,782	$ 455,499	$ 3,391,416	$ 3,187,123	$ 2,899,841
Enhanced LNAPL Recovery - Surfactants 3 trenches	$ 1,323,598	$ 199,172	$ 199,172	$ 199,172	$ 3,903,853	$ 3,061,757	$ 1,877,575	$ 5,227,451	$ 4,385,355	$ 3,201,172
Enhanced LNAPL Recovery - Surfactants 4 trenches	$ 2,178,684	$ 370,835	$ 370,835	$ 370,835	$ 7,268,525	$ 5,700,639	$ 3,495,827	$ 9,447,209	$ 7,879,323	$ 5,674,512
LNAPL Soil Excavation and LTTD Treatment	$ 5,578,525	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,578,525	$ 5,578,525	$ 5,578,525
LNAPL Soil Excavation and *Ex Situ* S/S	$ 3,161,739	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,161,739	$ 3,161,739	$ 3,161,739
LNAPL Soil & Rock Excavation and LTTD Treatment	$ 8,089,469	$ -	$ -	$ -	$ -	$ -	$ -	$ 8,089,469	$ 8,089,469	$ 8,089,469
LNAPL Soil & Rock Excavation and *Ex Situ* S/S	$ 5,204,770	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,204,770	$ 5,204,770	$ 5,204,770
Ground Water Recovery Wells										
Active Recovery with 2 trenches	$ 677,311	$ 19,618	$ 19,618	$ 19,618	$ 384,521	$ 301,576	$ 184,937	$ 1,061,832	$ 978,887	$ 862,248
Active Recovery with 3 trenches	$ 677,311	$ 18,901	$ 18,901	$ 18,901	$ 370,458	$ 290,547	$ 178,174	$ 1,047,770	$ 967,858	$ 855,485
Enhanced Recovery with 3 trenches	$ 677,311	$ 19,003	$ 19,003	$ 19,003	$ 372,467	$ 292,123	$ 179,140	$ 1,049,778	$ 969,434	$ 856,451
Enhanced Recovery with 4 trenches	$ 677,311	$ 19,003	$ 19,003	$ 19,003	$ 372,467	$ 292,123	$ 179,140	$ 1,049,778	$ 969,434	$ 856,451
Ground Water Treatment System										
Active Recovery with 2 trenches	$ 2,664,765	$ 321,775	$ 321,775	$ 321,775	$ 6,306,924	$ 4,946,464	$ 3,033,342	$ 8,971,690	$ 7,611,230	$ 5,698,107
Active Recovery with 3 trenches	$ 2,664,765	$ 347,756	$ 347,756	$ 347,756	$ 6,816,172	$ 5,345,863	$ 3,278,267	$ 9,480,937	$ 8,010,628	$ 5,943,032
Enhanced Recovery with 3 trenches	$ 3,425,424	$ 426,474	$ 426,474	$ 426,474	$ 8,359,076	$ 6,555,949	$ 4,020,333	$ 11,784,500	$ 9,981,372	$ 7,445,756
Enhanced Recovery with 4 trenches	$ 3,425,424	$ 509,738	$ 509,738	$ 509,738	$ 9,991,095	$ 7,835,927	$ 4,805,259	$ 13,416,519	$ 11,261,350	$ 8,230,683
Total Present Value (minimum)										
Total Present Value (maximum)										

TABLE C-1b
CAPITAL COST ESTIMATE SUMMARY - FUTURE ON-SITE RESIDENT, 1E-06 SOIL
LENZ OIL SITE
LEMONT, ILLINOIS

Process Option	Table Number	1	2	3	4	5	5a	6	6a	7	8	9
Common Activities	Table C-2	$ -	$ 314,389	$ 314,389	$ 314,389	$ 314,389	$ 314,389	$ 314,389	$ 314,389	$ 314,389	$ 314,389	$ 314,389
Covers												
Multilayered Cap	Table C-3	$ -	$ 3,014,381	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Solid Waste Cap	Table C-4	$ -	$ -	$ 1,715,515	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Asphalt Cap	Table C-5	$ -	$ -	$ -	$ 2,066,638	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Concrete Cap	Table C-6	$ -	$ -	$ -	$ 2,167,828	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Remediation of 1.0E-04 Unconsolidated Soils												
Off-Site Disposal												
RCRA Subtitle D	Table C-8	$ -	$ -	$ -	$ -	$ 3,955,439	$ -	$ 3,955,439	$ -	$ -	$ -	$ -
On-Site Treatment												
Ex Situ Solidification/Stabilization (S/S)	Table C-9	$ -	$ -	$ -	$ -	$ -	$ 3,564,158	$ -	$ 3,564,158	$ 3,564,158	$ 3,564,158	$ 3,564,158
Low Temperature Thermal Desorption (LTTD)	Table C-10	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 12,521,769	$ 12,521,769	$ 12,521,769
LNAPL												
LNAPL Recovery - Passive 4 trenches	Table C-11	$ -	$ 1,679,842	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
LNAPL Recovery - Active 2 trenches	Table C-12	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,696,350	$ -	$ -
LNAPL Recovery - Active 3 Trenches	Table C-13	$ -	$ -	$ 2,136,928	$ 2,136,928	$ 2,136,928	$ 2,136,928	$ -	$ -	$ -	$ 2,136,928	$ -
LNAPL Recovery - Active 4 Trenches	Table C-14	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,444,342	$ 2,444,342	$ -	$ -	$ -
Enhanced LNAPL Recovery - Surfactants 3 trenches	Table C-15	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,323,598	$ -
Enhanced LNAPL Recovery - Surfactants 4 trenches	Table C-16	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,178,684	$ 2,178,684	$ -	$ -	$ -
LNAPL Soil Excavation and LTTD Treatment	Table C-19	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,578,525	$ 5,578,525	$ -
LNAPL Soil Excavation and *Ex Situ* S/S	Table C-19a	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,161,739	$ 3,161,739	$ -
LNAPL Soil & Rock Excavation and LTTD Treatment	Table C-20	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 8,089,469
LNAPL Soil & Rock Excavation and *Ex Situ* S/S	Table C-20a	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,204,770
Ground Water												
Ground Water Recovery Wells - No surfactant	Table C-21	$ -	$ -	$ 677,311	$ 677,311	$ 677,311	$ 677,311	$ -	$ -	$ 677,311	$ -	$ -
Ground Water Recovery Wells - Surfactants	Table C-21	$ -	$ -	$ -	$ -	$ -	$ -	$ 677,311	$ 677,311	$ -	$ 677,311	$ -
Ground Water Treatment System												
Active Recovery with 2 trenches	Table C-22	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,664,765	$ -	$ -
Active Recovery with 3 trenches	Table C-22	$ -	$ -	$ 2,664,765	$ 2,664,765	$ 2,664,765	$ 2,664,765	$ -	$ -	$ -	$ -	$ -
Enhanced Recovery with 3 trenches	Table C-23	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,425,424	$ -
Enhanced Recovery with 4 trenches	Table C-23	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,425,424	$ 3,425,424	$ -	$ -	$ -
Total Cost (minimum)		$ -	$ 5,008,612	$ 7,508,909	$ 7,860,032	$ 9,748,833	$ 9,357,551	$ 12,995,589	$ 12,604,307	$ 12,078,712	$ 14,603,546	$ 9,083,317
Total Cost (maximum)		$ -	$ 5,008,612	$ 7,508,909	$ 7,961,222	$ 9,748,833	$ 9,357,551	$ 12,995,589	$ 12,604,307	$ 23,453,109	$ 25,977,944	$ 20,925,627

Table C-7b
Lenz Oil - Capital Cost Estimate - Future On-site Resident
Remediation of 1.0E-06 Unconsolidated Soils - Base Costs

Item	Units	Calculated Quantity	Design Quantity	Unit Price	Total Price	Calculated Quantity Remarks	Unit Price Source (1)
Mobilization	ls	1	1	$ 10,000	$ 10,000	ERM estimate	ERM estimate
Surveying	ls	1	1	$ 1,000	$ 1,000	ERM estimate	ERM estimate
Excavation of areas							
Material to be treated/disposed	cy	24,153	24,160	$ 13.04	$ 315,071	See Figure 2-1	Means 022-238-0500/0020/4250
Subtotal excavated	cy	24,153	24,160				
Subtotal treated/disposed	cy	24,153	24,160				
Excavation/treatment duration	wk	26.8	3			Excavation/treatment rate of 900 cy/wk (2)	
Air monitoring with an HNu	wk	26.8	3	$ 2,000	$ 6,000	Labor and materials	ERM estimate
H&S equipment	wk	26.8	3	$ 2,000	$ 6,000	ERM estimate	ERM estimate
Decontamination materials and labor	wk	26.8	3	$ 300	$ 900	ERM estimate	ERM estimate
Decon water storage	gal	8,051	900	$ 0.10	$ 90	300 gal per week	Baker Tank
Decon water disposal (includes trucking)	gal	8,051	900	$ 0.73	$ 661	RCRA Subtitle C Treatment	Rollins Envir., Inc. @ Deer Park, TX
Demobilization	ls	1	1	$ 5,000	$ 5,000	ERM estimate	ERM estimate
Subtotal (Soils base)					$ 344,721		

Notes
1 ERM estimate includes overhead and profit. 1996 Means Site Work - 15th Edition, plus 12% overhead and profit.
1996 Means Mechanical Work - 19th Edition, plus 12% overhead and profit.
2 Excavation and treatment rates are based on the following assumptions:
LTTD
Treatment rate of 10 tons or 7.4 cubic yards per hour.
System operating 24 hours a day - 7 days a week, at 75 percent utilization.
Average treatment rate 932 cy/wk (used 900 cy/wk)
SS
Treatment rate of 30 cubic yards per hour.
System operating 8 hours a day - 5 days a week, at 75 percent utilization.
Average treatment rate 900 cy/wk
Off-site Disposal
Loading two to three 15 cubic yard trucks a hour.
Excavating 6 hours a day - 5 days a week.
Minimum excavation rate 900 cy/wk (used 900 cy/wk)
Maximum excavation rate 1,350 cy/wk

Table C-8b
Lenz Oil - Capital Cost Estimate - Future On-site Resident
Remediation of 1.0E-06 Unconsolidated Soils
Off-Site Disposal - RCRA Subtitle D

Item	Units	Calculated Quantity	Design Quantity	Unit Price	Total Price	Calculated Quantity Remarks	Unit Price Source (1)
Soils Base					$ 344,721	See Soils Base Cost Estimate	See Soils Base Cost Estimate
Transportation to off-site facility	cy	24,153	24,160	$ 35.10	$ 848,016	RCRA Subtitle D Landfill	Peoria Disposal Company @ Clinton, IL
Disposal at off-site facility	cy	24,153	24,160	$ 24.30	$ 587,088	RCRA Subtitle D Landfill	Peoria Disposal Company @ Clinton, IL
Additional fill material	cy	24,153	24,160	$ 7.00	$ 169,120	See Soils Base Cost Estimate	S&K Excavation
Fill placement	cy	24,153	24,160	$ 3.10	$ 74,954	See Soils Base Cost Estimate	Means 022-246-1050
Fill compaction	cy	24,153	24,160	$ 0.35	$ 8,388	See Soils Base Cost Estimate	Means 022-226-5000
Fill grading	sy	18,023	18,030	$ 1.97	$ 35,541	1E-04, 1E-05 and 1E-06 soils total surface area	Means 025-122-1050
Subtotal					$ 2,067,828		
Design engineering	%	15.00%			$ 310,174		
Construction management	%	25.00%			$ 516,957		
Insurance	%	2.50%			$ 51,696		
Permitting and legal fees	ls	1	1	$ 5,000	$ 5,000		ERM estimate
Predesign soil sampling	ls	1	1	$ 70,990	$ 70,990	See page 3 of Table C-2-1 in Attachment 2.	ERM estimate
Confirmatory sampling	ls	1	1	$ 20,000	$ 20,000		ERM estimate
Subtotal					$ 3,042,645		
Contingency	%	30.00%			$ 912,794		
Total					$ 3,955,439		

Notes
1 ERM estimate includes overhead and profit. 1996 Means Site Work - 15th Edition, plus 12% overhead and profit.
1996 Means Mechanical Work - 19th Edition, plus 12% overhead and profit.

Table C-9b
Lenz Oil - Capital Cost Estimate - Future On-site Resident
Remediation of 1.0E-06 Unconsolidated Soils
***Ex Situ* Solidification/Stabilization**

Item	Units	Calculated Quantity	Design Quantity	Unit Price	Total Price	Calculated Quantity Remarks	Unit Price Source (1)
Soils Base					$ 344,721	See Soils Base Cost Estimate	See Soils Base Cost Estimate
On-site treatment mobilization	ls	1	1	$ 50,000	$ 50,000	Prepare site and obtain utilities	Millgard Environmental
Truck to on-site treatment	cy	24,153	24,160	$ 2.99	$ 72,248	See Soils Base Cost Estimate	Means 022-266-0020
Ex situ solidification/stabilization	cy	24,153	24,160	$ 50	$ 1,208,000	Solidification/stabilization on site	Millgard Environmental
Demobilization	ls	1	1	$ 10,000	$ 10,000	ERM estimate	ERM estimate
Fill placement	cy	24,153	24,160	$ 3.10	$ 74,954	See Soils Base Cost Estimate	Means 022-246-1050
Fill compaction	cy	24,153	24,160	$ 0.35	$ 8,388	See Soils Base Cost Estimate	Means 022-226-5000
Fill grading	sy	18,023	18,030	$ 1.97	$ 35,541	1E-04, 1E-05 and 1E-06 soils total surface area	Means 029-308-0200
Subtotal					$ 1,803,852		
Design engineering	%	15.00%			$ 270,578		
Construction management	%	25.00%			$ 450,963		
Insurance	%	2.50%			$ 45,096		
Permitting and legal fees	ls	1	1	$ 20,000	$ 20,000		ERM estimate
Confirmatory sampling	ls	1	1	$ 10,000	$ 10,000		ERM estimate
Predesign soil sampling	ls	1	1	$ 70,990	$ 70,990	See page 3 of Table C-2-1 in Attachment 2.	ERM estimate
S/S binder selection	ls	1	1	$ 70,180	$ 70,180	See page 3 of Table C-2-1 in Attachment 2.	ERM estimate
Subtotal					$ 2,741,660		
Contingency	%	30.00%			$ 822,498		
Total					$ 3,564,158		

Notes
1 ERM estimate includes overhead and profit. 1996 Means Site Work - 15th Edition, plus 12% overhead and profit.
1996 Means Mechanical Work - 19th Edition, plus 12% overhead and profit.

Table C-10b
Lenz Oil - Capital Cost Estimate - Future On-site Resident
Remediation of 1.0E-06 Unconsolidated Soils
On-Site Treatment - Low Temperature Thermal Desorption

Item	Units	Calculated Quantity	Design Quantity	Unit Price	Total Price	Calculated Quantity Remarks	Unit Price Source (1)
Soils Base					$ 344,721	See Soils Base Cost Estimate	See Soils Base Cost Estimate
On-site treatment mobilization	ls	1	1	$ 600,000	$ 600,000	Prepare site and obtain utilities - 40% of charges The rest is included with the LNAPL-cont. mater.	Soiltech ATP Systems
Truck to on-site treatment	cy	24,153	24,160	$ 2.99	$ 72,248	See Soils Base Cost Estimate	Means 022-266-0020
Thermal desorption with offgas treatment	cy	24,153	24,160	$ 270	$ 6,523,200	Indirect w/ offgas treat - 1,100 degrees F	Soiltech ATP Systems
Disposal of LTTD residual by incineration							
Residual storage	gal	12,195	12,198	$ 0.10	$ 1,220	Estimated 0.25 % of treated volume	Baker Tank
Transportation to incineration facility	gal	12,195	12,198	$ 0.66	$ 8,037	TSCA and Subtitle C Incineration (liquid)	Clean Harbors Envir. Serv. @ Deer Park, TX
Disposal at incineration facility	gal	12,195	12,198	$ 4.09	$ 49,952	TSCA and Subtitle C Incineration (liquid)	Clean Harbors Envir. Serv. @ Deer Park, TX
Residual volume	cy	60	60				
Disposal of spent carbon by incineration						Estimated 0.5 % of treated volume	
Disposal at incineration facility (includes trucking)	cy	121	121	$ 945	$ 114,156	TSCA and Subtitle C Incineration (soil)	Waste Management @ Port Arthur, TX
Demobilization	ls	1	1	$ 10,000	$ 10,000	ERM estimate	ERM estimate
Fill placement	cy	24,153	24,160	$ 3.10	$ 74,954	See Soils Base Cost Estimate	Means 022-246-1050
Fill compaction	cy	24,153	24,160	$ 0.35	$ 8,388	See Soils Base Cost Estimate	Means 022-226-5000
Fill grading	sy	18,023	18,030	$ 1.97	$ 35,541	1E-04, 1E-05 and 1E-06 soils total surface area	Means 029-308-0200
Subtotal					$ 7,842,417		
Design engineering					$ 200,000		
Construction management	%	15.00%			$ 1,176,363		
Insurance	%	2.50%			$ 196,060		
Permitting and legal fees	ls	1	1	$ 20,000	$ 20,000		ERM estimate
Confirmatory sampling	ls	1	1	$ 37,000	$ 37,000		ERM estimate
Predesign soil sampling	ls	1	1	$ 70,990	$ 70,990	See page 3 of Table C-2-1 in Attachment 2.	
LTTD off-site test	ls	1	1	$ 89,300	$ 89,300	See page 7 of Table C-2-1 in Attachment 2.	ERM estimate
Subtotal					$ 9,632,130		
Contingency	%	30.00%			$ 2,889,639		
Total					$ 12,521,769		

Notes
1 ERM estimate includes overhead and profit. 1996 Means Site Work - 15th Edition, plus 12% overhead and profit.
1996 Means Mechanical Work - 19th Edition, plus 12% overhead and profit.

TABLE C-31b
PRESENT VALUE ANALYSIS OF REMEDIAL ALTERNATIVES - FUTURE ON-SITE RESIDENT, 1E0-6 SOIL
5% DISCOUNT RATE
LEMONT, ILLINOIS

PROCESS OPTIONS	PRESENT VALUE CAPITAL COST + 30-YRS O&M COST - 5.0% DISCOUNT RATE Alternative Number										
	1	2	3	4	5	5a	6	6a	7	8	9
No Action	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Common Activities	$ -	$ 2,362,768	$ 2,362,768	$ 2,362,768	$ 2,362,768	$ 2,362,768	$ 2,362,768	$ 2,362,768	$ 2,362,768	$ 2,362,768	$ 2,362,768
Covers											
Multilayered Cap	$ -	$ 3,256,190	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Solid Waste Cap	$ -	$ -	$ 1,957,324	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Asphalt Cap	$ -	$ -	$ -	$ 2,324,434	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Concrete Cap	$ -	$ -	$ -	$ 2,367,670	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Remediation of 1.0E-04 Unconsolidated Soils											
Off-Site Disposal											
RCRA Subtitle D	$ -	$ -	$ -	$ -	$ 3,955,439	$ -	$ 3,955,439	$ -	$ -	$ -	$ -
On-Site Treatment											
Ex Situ Solidification/Stabilization (S/S)	$ -	$ -	$ -	$ -	$ -	$ 3,564,158	$ -	$ 3,564,158	$ 3,564,158	$ 3,564,158	$ 3,564,158
Low Temperature Thermal Desorption (LTTD)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 12,521,769	$ 12,521,769	$ 12,521,769
LNAPL											
LNAPL Recovery - Passive 4 trenches	$ -	$ 2,097,401	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
LNAPL Recovery - Active 2 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,086,148	$ -	$ -
LNAPL Recovery - Active 3 trenches	$ -	$ -	$ 2,660,201	$ 2,660,201	$ 2,660,201	$ 2,660,201	$ -	$ -	$ -	$ 2,660,201	$ -
LNAPL Recovery - Active 4 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,187,123	$ 3,187,123	$ -	$ -	$ -
Enhanced LNAPL Recovery - Surfactants 3 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,385,355	$ -
Enhanced LNAPL Recovery - Surfactants 4 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,879,323	$ 7,879,323	$ -	$ -	$ -
LNAPL Soil Excavation and LTTD Treatment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,578,525	$ 5,578,525	$ -
LNAPL Soil Excavation and *Ex Situ* S/S	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,161,739	$ 3,161,739	$ -
LNAPL Soil & Rock Excavation and LTTD Treatment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 8,089,469
LNAPL Soil & Rock Excavation and *Ex Situ* S/S	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,204,770
Ground Water Recovery Wells											
Active Recovery with 2 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 978,887	$ -	$ -
Active Recovery with 3 trenches	$ -	$ -	$ 967,858	$ 967,858	$ 967,858	$ 967,858	$ -	$ -	$ -	$ -	$ -
Enhanced Recovery with 3 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 969,434	$ -
Enhanced Recovery with 4 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ 969,434	$ 969,434	$ -	$ -	$ -
Ground Water Treatment System											
Active Recovery with 2 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,611,230	$ -	$ -
Active Recovery with 3 trenches	$ -	$ -	$ 8,010,628	$ 8,010,628	$ 8,010,628	$ 8,010,628	$ -	$ -	$ -	$ -	$ -
Enhanced Recovery with 3 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 9,981,372	$ -
Enhanced Recovery with 4 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ 11,261,350	$ 11,261,350	$ -	$ -	$ -
Total Present Value (minimum)	$ -	$ 7,716,359	$ 15,958,780	$ 16,325,890	$ 17,956,895	$ 17,565,613	$ 29,615,438	$ 29,224,157	$ 19,764,929	$ 27,085,027	$ 11,131,696
Total Present Value (maximum)	$ -	$ 7,716,359	$ 15,958,780	$ 16,369,126	$ 17,956,895	$ 17,565,613	$ 29,615,438	$ 29,224,157	$ 31,139,327	$ 38,459,425	$ 22,974,006

TABLE C-32b
PRESENT VALUE ANALYSIS OF REMEDIAL ALTERNATIVES - FUTURE ON-SITE RESIDENT, 1E0-6 SOIL
3% DISCOUNT RATE
LENZ OIL SITE
LEMONT, ILLINOIS

PROCESS OPTIONS	PRESENT VALUE CAPITAL COST + 30-YRS O&M COST - 3.0% DISCOUNT RATE Alternative Number										
	1	2	3	4	5	5a	6	6a	7	8	9
No Action											
Common Activities	$ -	$ 2,926,148	$ 2,926,148	$ 2,926,148	$ 2,926,148	$ 2,926,148	$ 2,926,148	$ 2,926,148	$ 2,926,148	$ 2,926,148	$ 2,926,148
Covers											
Multilayered Cap	$ -	$ 3,292,120	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Solid Waste Cap	$ -	$ -	$ 1,993,253	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Asphalt Cap	$ -	$ -	$ -	$ 2,418,270	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Concrete Cap	$ -	$ -	$ -	$ 2,445,566	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Remediation of 1.0E-04 Unconsolidated Soils											
Off-Site Disposal											
RCRA Subtitle D	$ -	$ -	$ -	$ -	$ 3,955,439	$ -	$ 3,955,439	$ -	$ -	$ -	$ -
On-Site Treatment											
Ex Situ Solidification/Stabilization (S/S)	$ -	$ -	$ -	$ -	$ -	$ 7,034,410	$ -	$ 7,034,410	$ 7,034,410	$ 7,034,410	$ 7,034,410
Low Temperature Thermal Desorption (LTTD)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 12,521,769	$ 12,521,769	$ 12,521,769
LNAPL											
LNAPL Recovery - Passive 4 trenches	$ -	$ 2,212,245	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
LNAPL Recovery - Active 2 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,193,356	$ -	$ -
LNAPL Recovery - Active 3 trenches	$ -	$ -	$ 2,804,121	$ 2,804,121	$ 2,804,121	$ 2,804,121	$ -	$ -	$ -	$ 2,804,121	$ -
LNAPL Recovery - Active 4 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,391,416	$ 3,391,416	$ -	$ -	$ -
Enhanced LNAPL Recovery - Surfactants 3 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,266,016	$ -
Enhanced LNAPL Recovery - Surfactants 4 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,696,601	$ 7,696,601	$ -	$ -	$ -
LNAPL Soil Excavation and LTTD Treatment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,578,525	$ 5,578,525	$ -
LNAPL Soil Excavation and *Ex Situ* S/S	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,161,739	$ 3,161,739	$ -
LNAPL Soil & Rock Excavation and LTTD Treatment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 8,089,469
LNAPL Soil & Rock Excavation and *Ex Situ* S/S	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,204,770
Ground Water Recovery Wells											
Active Recovery with 2 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,061,832	$ -	$ -
Active Recovery with 3 trenches	$ -	$ -	$ 1,047,770	$ 1,047,770	$ 1,047,770	$ 1,047,770	$ -	$ -	$ -	$ -	$ -
Enhanced Recovery with 3 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,049,778	$ -
Enhanced Recovery with 4 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,049,778	$ 1,049,778	$ -	$ -	$ -
Ground Water Treatment System											
Active Recovery with 2 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 8,971,690	$ -	$ -
Active Recovery with 3 trenches	$ -	$ -	$ 9,480,937	$ 9,480,937	$ 9,480,937	$ 9,480,937	$ -	$ -	$ -	$ -	$ -
Enhanced Recovery with 3 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 11,784,500	$ -
Enhanced Recovery with 4 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ 13,416,519	$ 13,416,519	$ -	$ -	$ -
Total Present Value (minimum)	$ -	$ 8,430,515	$ 18,252,232	$ 21,122,815	$ 20,214,419	$ 23,293,385	$ 32,435,907	$ 35,514,872	$ 37,870,951	$33,026,720	$15,165,337
Total Present Value (maximum)	$ -	$ 8,430,515	$ 18,252,232	$ 21,122,815	$ 20,214,419	$ 23,293,385	$ 32,435,907	$ 35,514,872	$ 40,287,737	$40,930,865	$23,537,395

TABLE C-33b
PRESENT VALUE ANALYSIS OF REMEDIAL ALTERNATIVES - FUTURE ON-SITE RESIDENT, 1E0-6 SOIL
10% DISCOUNT RATE
LENZ OIL SITE
LEMONT, ILLINOIS

PROCESS OPTIONS	PRESENT VALUE CAPITAL COST + 30-YRS O&M COST - 10.0% DISCOUNT RATE Alternative Number										
	1	2	3	4	5	5a	6	6a	7	8	9
No Action	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Common Activities	$ -	$ 1,570,525	$ 1,570,525	$ 1,570,525	$ 1,570,525	$ 1,570,525	$ 1,570,525	$ 1,570,525	$ 1,570,525	$ 1,570,525	$ 1,570,525
Covers											
Multilayered Cap	$ -	$ 3,199,432	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Solid Waste Cap	$ -	$ -	$ 1,900,565	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Asphalt Cap	$ -	$ -	$ -	$ 2,203,894	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Concrete Cap	$ -	$ -	$ -	$ 2,268,319	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Remediation of 1.0E-04 Unconsolidated Soils											
Off-Site Disposal											
RCRA Subtitle D	$ -	$ -	$ -	$ -	$ 3,955,439	$ -	$ 3,955,439	$ -	$ -	$ -	$ -
On-Site Treatment											
Ex Situ Solidification/Stabilization (S/S)	$ -	$ -	$ -	$ -	$ -	$ 7,034,410	$ -	$ 7,034,410	$ 7,034,410	$ 7,034,410	$ 7,034,410
Low Temperature Thermal Desorption (LTTD)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 12,521,769	$ 12,521,769	$ 12,521,769
LNAPL											
LNAPL Recovery - Passive 4 trenches	$ -	$ 1,935,904	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
LNAPL Recovery - Active 2 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,935,387	$ -	$ -
LNAPL Recovery - Active 3 trenches	$ -	$ -	$ 2,457,817	$ 2,457,817	$ 2,457,817	$ 2,457,817	$ -	$ -	$ -	$ 2,457,817	$ -
LNAPL Recovery - Active 4 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,899,841	$ 2,899,841	$ -	$ -	$ -
Enhanced LNAPL Recovery - Surfactants 3 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,738,766	$ -
Enhanced LNAPL Recovery - Surfactants 4 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,832,549	$ 4,832,549	$ -	$ -	$ -
LNAPL Soil Excavation and LTTD Treatment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,578,525	$ 5,578,525	$ -
LNAPL Soil Excavation and *Ex Situ* S/S	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,161,739	$ 3,161,739	$ -
LNAPL Soil & Rock Excavation and LTTD Treatment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 8,089,469
LNAPL Soil & Rock Excavation and *Ex Situ* S/S	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,204,770
Ground Water Recovery Wells											
Active Recovery with 2 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 862,248	$ -	$ -
Active Recovery with 3 trenches	$ -	$ -	$ 855,485	$ 855,485	$ 855,485	$ 855,485	$ -	$ -	$ -	$ -	$ -
Enhanced Recovery with 3 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 856,451	$ -
Enhanced Recovery with 4 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ 856,451	$ 856,451	$ -	$ -	$ -
Ground Water Treatment System											
Active Recovery with 2 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,698,107	$ -	$ -
Active Recovery with 3 trenches	$ -	$ -	$ 5,943,032	$ 5,943,032	$ 5,943,032	$ 5,943,032	$ -	$ -	$ -	$ -	$ -
Enhanced Recovery with 3 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,445,756	$ -
Enhanced Recovery with 4 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$8,230,683	$8,230,683	$ -	$ -	$ -
Total Present Value (minimum)	$ -	$ 6,705,861	$ 12,727,424	$ 13,030,753	$ 14,782,298	$ 17,861,269	$ 22,345,488	$ 25,424,460	$ 20,262,417	$ 25,265,465	$ 13,809,706
Total Present Value (maximum)	$ -	$ 6,705,861	$ 12,727,424	$ 13,095,178	$ 14,782,298	$ 17,861,269	$ 22,345,488	$ 25,424,460	$ 28,166,562	$ 33,169,610	$ 22,181,763

TABLE C-34b
PRESENT VALUE ANALYSIS OF REMEDIAL ALTERNATIVES - FUTURE ON-SITE RESIDENT, 1E0-6 SOIL
LENZ OIL SITE
LEMONT, ILLINOIS

PROCESS OPTIONS	CAPITAL COST	ANNUALIZED OPERATING & MAINTENANCE COSTS DISCOUNT RATES			PRESENT VALUE OF 30 YEARS OPERATING & MAINTENANCE COSTS DISCOUNT RATES			PRESENT VALUE CAPITAL COST + 30-YRS O&M COST DISCOUNT RATES		
		3.00%	5.00%	10.00%	3.00%	5.00%	10.00%	3.00%	5.00%	10.00%
No Action	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Common Activities	$ 314,389	$ 133,250	$ 133,250	$ 133,250	$ 2,611,759	$ 2,048,379	$ 1,256,136	$ 2,926,148	$ 2,362,768	$ 1,570,525
Covers										
Multilayered Cap	$ 3,014,381	$ 14,170	$ 15,730	$ 19,630	$ 277,738	$ 241,809	$ 185,050	$ 3,292,120	$ 3,256,190	$ 3,199,432
Solid Waste Cap	$ 1,715,515	$ 14,170	$ 15,730	$ 19,630	$ 277,738	$ 241,809	$ 185,050	$ 1,993,253	$ 1,957,324	$ 1,900,565
Asphalt Cap	$ 2,066,638	$ 17,940	$ 16,770	$ 14,560	$ 351,632	$ 257,796	$ 137,256	$ 2,418,270	$ 2,324,434	$ 2,203,894
Concrete Cap	$ 2,167,828	$ 14,170	$ 13,000	$ 10,660	$ 277,738	$ 199,842	$ 100,491	$ 2,445,566	$ 2,367,670	$ 2,268,319
Remediation of 1.0E-04 Unconsolidated Soils										
Off-Site Disposal										
RCRA Subtitle D	$ 3,955,439	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,955,439	$ 3,955,439	$ 3,955,439
On-Site Treatment										
Ex Situ Solidification/Stabilization (S/S)	$ 3,564,158	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,564,158	$ 3,564,158	$ 3,564,158
Low Temperature Thermal Desorption (LTTD)	$ 12,521,769	$ -	$ -	$ -	$ -	$ -	$ -	$ 12,521,769	$ 12,521,769	$ 12,521,769
LNAPL										
LNAPL Recovery - Passive 4 trenches	$ 1,679,842	$ 27,163	$ 27,163	$ 27,163	$ 532,404	$ 417,559	$ 256,062	$ 2,212,245	$ 2,097,401	$ 1,935,904
LNAPL Recovery - Active 2 trenches	$ 1,696,350	$ 25,357	$ 25,357	$ 25,357	$ 497,007	$ 389,798	$ 239,037	$ 2,193,356	$ 2,086,148	$ 1,935,387
LNAPL Recovery - Active 3 trenches	$ 2,136,928	$ 34,040	$ 34,040	$ 34,040	$ 667,192	$ 523,273	$ 320,889	$ 2,804,121	$ 2,660,201	$ 2,457,817
LNAPL Recovery - Active 4 trenches	$ 2,444,342	$ 48,319	$ 48,319	$ 48,319	$ 947,074	$ 742,782	$ 455,499	$ 3,391,416	$ 3,187,123	$ 2,899,841
Enhanced LNAPL Recovery - Surfactants 3 trenches	$ 1,323,598	$ 199,172	$ 199,172	$ 199,172	$ 3,903,853	$ 3,061,757	$ 1,877,575	$ 5,227,451	$ 4,385,355	$ 3,201,172
Enhanced LNAPL Recovery - Surfactants 4 trenches	$ 2,178,684	$ 370,835	$ 370,835	$ 370,835	$ 7,268,525	$ 5,700,639	$ 3,495,827	$ 9,447,209	$ 7,879,323	$ 5,674,512
LNAPL Soil Excavation and LTTD Treatment	$ 5,578,525	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,578,525	$ 5,578,525	$ 5,578,525
LNAPL Soil Excavation and *Ex Situ* S/S	$ 3,161,739	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,161,739	$ 3,161,739	$ 3,161,739
LNAPL Soil & Rock Excavation and LTTD Treatment	$ 8,089,469	$ -	$ -	$ -	$ -	$ -	$ -	$ 8,089,469	$ 8,089,469	$ 8,089,469
LNAPL Soil & Rock Excavation and *Ex Situ* S/S	$ 5,204,770	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,204,770	$ 5,204,770	$ 5,204,770
Ground Water Recovery Wells										
Active Recovery with 2 trenches	$ 677,311	$ 19,618	$ 19,618	$ 19,618	$ 384,521	$ 301,576	$ 184,937	$ 1,061,832	$ 978,887	$ 862,248
Active Recovery with 3 trenches	$ 677,311	$ 18,901	$ 18,901	$ 18,901	$ 370,458	$ 290,547	$ 178,174	$ 1,047,770	$ 967,858	$ 855,485
Enhanced Recovery with 3 trenches	$ 677,311	$ 19,003	$ 19,003	$ 19,003	$ 372,467	$ 292,123	$ 179,140	$ 1,049,778	$ 969,434	$ 856,451
Enhanced Recovery with 4 trenches	$ 677,311	$ 19,003	$ 19,003	$ 19,003	$ 372,467	$ 292,123	$ 179,140	$ 1,049,778	$ 969,434	$ 856,451
Ground Water Treatment System										
Active Recovery with 2 trenches	$ 2,664,765	$ 321,775	$ 321,775	$ 321,775	$ 6,306,924	$ 4,946,464	$ 3,033,342	$ 8,971,690	$ 7,611,230	$ 5,698,107
Active Recovery with 3 trenches	$ 2,664,765	$ 347,756	$ 347,756	$ 347,756	$ 6,816,172	$ 5,345,863	$ 3,278,267	$ 9,480,937	$ 8,010,628	$ 5,943,032
Enhanced Recovery with 3 trenches	$ 3,425,424	$ 426,474	$ 426,474	$ 426,474	$ 8,359,076	$ 6,555,949	$ 4,020,333	$ 11,784,500	$ 9,981,372	$ 7,445,756
Enhanced Recovery with 4 trenches	$ 3,425,424	$ 509,738	$ 509,738	$ 509,738	$ 9,991,095	$ 7,835,927	$ 4,805,259	$ 13,416,519	$ 11,261,350	$ 8,230,683
Total Present Value (minimum)										
Total Present Value (maximum)										

TABLE C-1c
CAPITAL COST ESTIMATE SUMMARY - CURRENT ADJACENT RESIDENT, 1E-05 RISK SOIL
LENZ OIL SITE
LEMONT, ILLINOIS

Process Option	Table Number	1	2	3	4	5	5a	6	6a	7	8	9
Common Activities	Table C-2	$ -	$ 314,389	$ 314,389	$ 314,389	$ 314,389	$ 314,389	$ 314,389	$ 314,389	$ 314,389	$ 314,389	$ 314,389
Covers												
Multilayered Cap	Table C-3	$ -	$ 3,014,381	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Solid Waste Cap	Table C-4	$ -	$ -	$ 1,715,515	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Asphalt Cap	Table C-5	$ -	$ -	$ -	$ 2,066,638	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Concrete Cap	Table C-6	$ -	$ -	$ -	$ 2,167,828	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Remediation of 1.0E-05 Unconsolidated Soils												
Off-Site Disposal												
RCRA Subtitle D	Table C-8	$ -	$ -	$ -	$ -	$ 233,202	$ -	$ 233,202	$ -	$ -	$ -	$ -
On-Site Treatment												
Ex Situ Solidification/Stabilization (S/S)	Table C-9	$ -	$ -	$ -	$ -	$ -	$ 433,640	$ -	$ 433,640	$ 433,640	$ 433,640	$ 433,640
Low Temperature Thermal Desorption (LTTD)	Table C-10	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,674,666	$ 1,674,666	$ 1,674,666
LNAPL												
LNAPL Recovery - Passive 4 trenches	Table C-11	$ -	$ 1,679,842	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
LNAPL Recovery - Active 2 trenches	Table C-12	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,696,350	$ -	$ -
LNAPL Recovery - Active 3 Trenches	Table C-13	$ -	$ -	$ 2,136,928	$ 2,136,928	$ 2,136,928	$ 2,136,928	$ -	$ -	$ -	$ 2,136,928	$ -
LNAPL Recovery - Active 4 Trenches	Table C-14	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,444,342	$ 2,444,342	$ -	$ -	$ -
Enhanced LNAPL Recovery - Surfactants 3 trenches	Table C-15	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,323,598	$ -
Enhanced LNAPL Recovery - Surfactants 4 trenches	Table C-16	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,178,684	$ 2,178,684	$ -	$ -	$ -
LNAPL Soil Excavation and LTTD Treatment	Table C-19	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,578,525	$ 5,578,525	$ -
LNAPL Soil Excavation and *Ex Situ* S/S	Table C-19a	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,161,739	$ 3,161,739	$ -
LNAPL Soil & Rock Excavation and LTTD Treatment	Table C-20	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 8,089,469
LNAPL Soil & Rock Excavation and *Ex Situ* S/S	Table C-20a	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,204,770
Ground Water												
Ground Water Recovery Wells - No surfactant	Table C-21	$ -	$ -	$ 677,311	$ 677,311	$ 677,311	$ 677,311	$ -	$ -	$ 677,311	$ -	$ -
Ground Water Recovery Wells - Surfactants	Table C-21	$ -	$ -	$ -	$ -	$ -	$ -	$ 677,311	$ 677,311	$ -	$ 677,311	$ -
Ground Water Treatment System												
Active Recovery with 2 trenches	Table C-22	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,664,765	$ -	$ -
Active Recovery with 3 trenches	Table C-22	$ -	$ -	$ 2,664,765	$ 2,664,765	$ 2,664,765	$ 2,664,765	$ -	$ -	$ -	$ -	$ -
Enhanced Recovery with 3 trenches	Table C-23	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,425,424	$ -
Enhanced Recovery with 4 trenches	Table C-23	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,425,424	$ 3,425,424	$ -	$ -	$ -
Total Cost (minimum)		$ -	$ 5,008,612	$ 7,508,909	$ 7,860,032	$ 6,026,595	$ 6,227,033	$ 9,273,351	$ 9,473,789	$ 8,948,194	$ 11,473,028	$ 5,952,799
Total Cost (maximum)		$ -	$ 5,008,612	$ 7,508,909	$ 7,961,222	$ 6,026,595	$ 6,227,033	$ 9,273,351	$ 9,473,789	$ 12,606,006	$ 15,130,841	$ 10,078,524

Table C-7c
Lenz Oil - Capital Cost Estimate - Current Adjacent Resident
Remediation of 1.0E-05 Unconsolidated Soils - Base Costs

Item	Units	Calculated Quantity	Design Quantity	Unit Price	Total Price	Calculated Quantity Remarks	Unit Price Source (1)
Mobilization	ls	1	1	$ 10,000	$ 10,000	ERM estimate	ERM estimate
Surveying	ls	1	1	$ 1,000	$ 1,000	ERM estimate	ERM estimate
Excavation of areas							
Area X material to be treated/disposed	cy	336	340	$ 13.04	$ 4,434	1E-05 soil area and 1:1 excavation slopes	Means 022-238-0500/0020/4250
Area Y material to be treated/disposed	cy	-	-	$ 13.04	$ -	No soils posing 1E-05 carcinogenic risks in this area.	Means 022-238-0500/0020/4250
Area Z material to be treated/disposed	cy	-	-	$ 13.04	$ -	No soils posing 1E-05 carcinogenic risks in this area.	Means 022-238-0500/0020/4250
Subtotal excavated	cy	336	340				
Subtotal treated/disposed	cy	336	340				
Excavation/treatment duration	wk	0.4	3			Excavation/treatment rate of 900 cy/wk (2)	
Air monitoring with an HNu	wk	0.4	3	$ 2,000	$ 6,000	Labor and materials	ERM estimate
H&S equipment	wk	0.4	3	$ 2,000	$ 6,000	ERM estimate	ERM estimate
Decontamination materials and labor	wk	0.4	3	$ 300	$ 900	ERM estimate	ERM estimate
Decon water storage	gal	112	900	$ 0.10	$ 90	300 gal per week	Baker Tank
Decon water disposal (includes trucking)	gal	112	900	$ 0.73	$ 661	RCRA Subtitle C Treatment	Rollins Envir., Inc. @ Deer Park, TX
Demobilization	ls	1	1	$ 5,000	$ 5,000	ERM estimate	ERM estimate
Subtotal (Soils base)					$ 34,084		

Notes
1 ERM estimate includes overhead and profit. 1996 Means Site Work - 15th Edition, plus 12% overhead and profit.
1996 Means Mechanical Work - 19th Edition, plus 12% overhead and profit.
2 Excavation and treatment rates are based on the following assumptions:
LTTD
Treatment rate of 10 tons or 7.4 cubic yards per hour.
System operating 24 hours a day - 7 days a week, at 75 percent utilization.
Average treatment rate 932 cy/wk (used 900 cy/wk)
SS
Treatment rate of 30 cubic yards per hour.
System operating 8 hours a day - 5 days a week, at 75 percent utilization.
Average treatment rate 900 cy/wk
Off-site Disposal
Loading two to three 15 cubic yard trucks a hour.
Excavating 6 hours a day - 5 days a week.
Minimum excavation rate 900 cy/wk (used 900 cy/wk)
Maximum excavation rate 1,350 cy/wk

Table C-8c
Lenz Oil - Capital Cost Estimate - Current Adjacent Resident
Remediation of 1.0E-05 Unconsolidated Soils
Off-Site Disposal - RCRA Subtitle D

Item	Units	Calculated Quantity	Design Quantity	Unit Price	Total Price	Calculated Quantity Remarks	Unit Price Source (1)
Soils Base					$ 34,084	See Soils Base Cost Estimate	See Soils Base Cost Estimate
Transportation to off-site facility	cy	336	340	$ 35.10	$ 11,934	RCRA Subtitle D Landfill	Peoria Disposal Company @ Clinton, IL
Disposal at off-site facility	cy	336	340	$ 24.30	$ 8,262	RCRA Subtitle D Landfill	Peoria Disposal Company @ Clinton, IL
Additional fill material	cy	336	340	$ 7.00	$ 2,380	See Soils Base Cost Estimate	S&K Excavation
Fill placement	cy	336	340	$ 3.10	$ 1,055	See Soils Base Cost Estimate	Means 022-246-1050
Fill compaction	cy	336	340	$ 0.35	$ 118	See Soils Base Cost Estimate	Means 022-226-5000
Fill grading	sy	347	350	$ 1.97	$ 690	Area X excavation surface area	Means 025-122-1050
Subtotal					$ 58,523		
Design engineering	%	15.00%			$ 8,778		
Construction management	%	25.00%			$ 14,631		
Insurance	%	2.50%			$ 1,463		
Permitting and legal fees	ls	1	1	$ 5,000	$ 5,000		ERM estimate
Predesign soil sampling	ls	1	1	$ 70,990	$ 70,990	See page 3 of Table C-2-1 in Attachment 2.	ERM estimate
Confirmatory sampling	ls	1	1	$ 20,000	$ 20,000		ERM estimate
Subtotal					$ 179,386		
Contingency	%	30.00%			$ 53,816		
Total					$ 233,202		

Notes
1 ERM estimate includes overhead and profit. 1996 Means Site Work - 15th Edition, plus 12% overhead and profit.
1996 Means Mechanical Work - 19th Edition, plus 12% overhead and profit.

Table C-9c
Lenz Oil - Capital Cost Estimate - Current Adjacent Resident
Remediation of 1.0E-05 Unconsolidated Soils
***Ex Situ* Solidification/Stabilization**

Item	Units	Calculated Quantity	Design Quantity	Unit Price	Total Price	Calculated Quantity Remarks	Unit Price Source (1)
Soils Base					$ 34,084	See Soils Base Cost Estimate	See Soils Base Cost Estimate
On-site treatment mobilization	ls	1	1	$ 50,000	$ 50,000	Prepare site and obtain utilities	Millgard Environmental
Truck to on-site treatment	cy	336	340	$ 2.99	$ 1,017	See Soils Base Cost Estimate	Means 022-266-0020
Ex situ solidification/stabilization	cy	336	340	$ 50	$ 17,000	Solidification/stabilization on site	Millgard Environmental
Demobilization	ls	1	1	$ 10,000	$ 10,000	ERM estimate	ERM estimate
Fill placement	cy	336	340	$ 3.10	$ 1,055	See Soils Base Cost Estimate	Means 022-246-1050
Fill compaction	cy	336	340	$ 0.35	$ 118	See Soils Base Cost Estimate	Means 022-226-5000
Fill grading	sy	347	350	$ 1.97	$ 690	Area X excavation surface area	Means 029-308-0200
Subtotal					$ 113,964		
Design engineering	%	15.00%			$ 17,095		
Construction management	%	25.00%			$ 28,491		
Insurance	%	2.50%			$ 2,849		
Permitting and legal fees	ls	1	1	$ 20,000	$ 20,000		ERM estimate
Confirmatory sampling	ls	1	1	$ 10,000	$ 10,000		ERM estimate
Predesign soil sampling	ls	1	1	$ 70,990	$ 70,990	See page 3 of Table C-2-1 in Attachment 2.	ERM estimate
S/S binder selection	ls	1	1	$ 70,180	$ 70,180	See page 3 of Table C-2-1 in Attachment 2.	ERM estimate
Subtotal					$ 333,569		
Contingency	%	30.00%			$ 100,071		
Total					$ 433,640		

Notes
1 ERM estimate includes overhead and profit. 1996 Means Site Work - 15th Edition, plus 12% overhead and profit.
1996 Means Mechanical Work - 19th Edition, plus 12% overhead and profit.

Table C-10c
Lenz Oil - Capital Cost Estimate - Current Adjacent Resident
Remediation of 1.0E-05 Unconsolidated Soils
On-Site Treatment - Low Temperature Thermal Desorption

Item	Units	Calculated Quantity	Design Quantity	Unit Price	Total Price	Calculated Quantity Remarks	Unit Price Source (1)
Soils Base					$ 34,084	See Soils Base Cost Estimate	See Soils Base Cost Estimate
On-site treatment mobilization	ls	1	1	$ 600,000	$ 600,000	Prepare site and obtain utilities - 40% of charges The rest is included with the LNAPL-cont. mater.	Soiltech ATP Systems
Truck to on-site treatment	cy	336	340	$ 2.99	$ 1,017	See Soils Base Cost Estimate	Means 022-266-0020
Thermal desorption with offgas treatment	cy	336	340	$ 270	$ 91,800	Indirect w/ offgas treat - 1,100 degrees F	Soiltech ATP Systems
Disposal of LTTD residual by incineration							
Residual storage	gal	170	172	$ 0.10	$ 17	Estimated 0.25 % of treated volume	Baker Tank
Transportation to incineration facility	gal	170	172	$ 0.66	$ 113	TSCA and Subtitle C Incineration (liquid)	Clean Harbors Envir. Serv. @ Deer Park, TX
Disposal at incineration facility	gal	170	172	$ 4.09	$ 703	TSCA and Subtitle C Incineration (liquid)	Clean Harbors Envir. Serv. @ Deer Park, TX
Residual volume	cy	1	1				
Disposal of spent carbon by incineration						Estimated 0.5 % of treated volume	
Disposal at incineration facility (includes trucking)	cy	2	2	$ 945	$ 1,607	TSCA and Subtitle C Incineration (soil)	Waste Management @ Port Arthur, TX
Demobilization	ls	1	1	$ 10,000	$ 10,000	ERM estimate	ERM estimate
Fill placement	cy	336	340	$ 3.10	$ 1,055	See Soils Base Cost Estimate	Means 022-246-1050
Fill compaction	cy	336	340	$ 0.35	$ 118	See Soils Base Cost Estimate	Means 022-226-5000
Fill grading	sy	347	350	$ 1.97	$ 690	Area X excavation surface area	Means 029-308-0200
Subtotal					$ 741,204		
Design engineering					$ 200,000		
Construction management	%	15.00%			$ 111,181		
Insurance	%	2.50%			$ 18,530		
Permitting and legal fees	ls	1	1	$ 20,000	$ 20,000		ERM estimate
Confirmatory sampling	ls	1	1	$ 37,000	$ 37,000		ERM estimate
Predesign soil sampling	ls	1	1	$ 70,990	$ 70,990	See page 3 of Table C-2-1 in Attachment 2.	
LTTD off-site test	ls	1	1	$ 89,300	$ 89,300	See page 7 of Table C-2-1 in Attachment 2.	ERM estimate
Subtotal					$ 1,288,205		
Contingency	%	30.00%			$ 386,461		
Total					$ 1,674,666		

Notes
1 ERM estimate includes overhead and profit. 1996 Means Site Work - 15th Edition, plus 12% overhead and profit.
1996 Means Mechanical Work - 19th Edition, plus 12% overhead and profit.

TABLE C-31c
PRESENT VALUE ANALYSIS OF REMEDIAL ALTERNATIVES, CURRENT ADJACENT RESIDENT - 1E-05 SOIL
5% DISCOUNT RATE
LENZ OIL SITE
LEMONT, ILLINOIS

PROCESS OPTIONS	PRESENT VALUE CAPITAL COST + 30-YRS O&M COST - 5.0% DISCOUNT RATE Alternative Number										
	1	2	3	4	5	5a	6	6a	7	8	9
No Action	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Common Activities	$ -	$ 2,362,768	$ 2,362,768	$ 2,362,768	$ 2,362,768	$ 2,362,768	$ 2,362,768	$ 2,362,768	$ 2,362,768	$ 2,362,768	$ 2,362,768
Covers											
Multilayered Cap	$ -	$ 3,256,190	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Solid Waste Cap	$ -	$ -	$ 1,957,324	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Asphalt Cap	$ -	$ -	$ -	$ 2,324,434	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Concrete Cap	$ -	$ -	$ -	$ 2,367,670	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Remediation of 1.0E-04 Unconsolidated Soils											
Off-Site Disposal											
RCRA Subtitle D	$ -	$ -	$ -	$ -	$ 233,202	$ -	$ 233,202	$ -	$ -	$ -	$ -
On-Site Treatment											
Ex Situ Solidification/Stabilization (S/S)	$ -	$ -	$ -	$ -	$ -	$ 433,640	$ -	$ 433,640	$ 433,640	$ 433,640	$ 433,640
Low Temperature Thermal Desorption (LTTD)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,674,666	$ 1,674,666	$ 1,674,666
LNAPL											
LNAPL Recovery - Passive 4 trenches	$ -	$ 2,097,401	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
LNAPL Recovery - Active 2 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,086,148	$ -	$ -
LNAPL Recovery - Active 3 trenches	$ -	$ -	$ 2,660,201	$ 2,660,201	$ 2,660,201	$ 2,660,201	$ -	$ -	$ -	$ 2,660,201	$ -
LNAPL Recovery - Active 4 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,187,123	$ 3,187,123	$ -	$ -	$ -
Enhanced LNAPL Recovery - Surfactants 3 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,385,355	$ -
Enhanced LNAPL Recovery - Surfactants 4 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,879,323	$ 7,879,323	$ -	$ -	$ -
LNAPL Soil Excavation and LTTD Treatment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,578,525	$ 5,578,525	$ -
LNAPL Soil Excavation and *Ex Situ* S/S	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,161,739	$ 3,161,739	$ -
LNAPL Soil & Rock Excavation and LTTD Treatment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 8,089,469
LNAPL Soil & Rock Excavation and *Ex Situ* S/S	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,204,770
Ground Water Recovery Wells											
Active Recovery with 2 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 978,887	$ -	$ -
Active Recovery with 3 trenches	$ -	$ -	$ 967,858	$ 967,858	$ 967,858	$ 967,858	$ -	$ -	$ -	$ -	$ -
Enhanced Recovery with 3 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 969,434	$ -
Enhanced Recovery with 4 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ 969,434	$ 969,434	$ -	$ -	$ -
Ground Water Treatment System											
Active Recovery with 2 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,611,230	$ -	$ -
Active Recovery with 3 trenches	$ -	$ -	$ 8,010,628	$ 8,010,628	$ 8,010,628	$ 8,010,628	$ -	$ -	$ -	$ -	$ -
Enhanced Recovery with 3 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 9,981,372	$ -
Enhanced Recovery with 4 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ 11,261,350	$ 11,261,350	$ -	$ -	$ -
Total Present Value (minimum)	$ -	$ 7,716,359	$ 15,958,780	$ 16,325,890	$ 14,234,657	$ 14,435,096	$ 25,893,201	$ 26,093,639	$ 16,634,411	$ 23,954,509	$ 8,001,178
Total Present Value (maximum)	$ -	$ 7,716,359	$ 15,958,780	$ 16,369,126	$ 14,234,657	$ 14,435,096	$ 25,893,201	$ 26,093,639	$ 20,292,224	$ 27,612,322	$ 12,126,903

TABLE C-32c
PRESENT VALUE ANALYSIS OF REMEDIAL ALTERNATIVES, CURRENT ADJACENT RESIDENT - 1E-05 SOIL
3% DISCOUNT RATE
LENZ OIL SITE
LEMONT, ILLINOIS

PROCESS OPTIONS	PRESENT VALUE CAPITAL COST + 30-YRS O&M COST - 3.0% DISCOUNT RATE Alternative Number										
	1	2	3	4	5	5a	6	6a	7	8	9
No Action											
Common Activities	$ -	$ 2,926,148	$ 2,926,148	$ 2,926,148	$ 2,926,148	$ 2,926,148	$ 2,926,148	$ 2,926,148	$ 2,926,148	$ 2,926,148	$ 2,926,148
Covers											
Multilayered Cap	$ -	$ 3,292,120	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Solid Waste Cap	$ -	$ -	$ 1,993,253	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Asphalt Cap	$ -	$ -	$ -	$ 2,418,270	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Concrete Cap	$ -	$ -	$ -	$ 2,445,566	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Remediation of 1.0E-04 Unconsolidated Soils											
Off-Site Disposal											
RCRA Subtitle D	$ -	$ -	$ -	$ -	$ 233,202	$ -	$ 233,202	$ -	$ -	$ -	$ -
On-Site Treatment											
Ex Situ Solidification/Stabilization (S/S)	$ -	$ -	$ -	$ -	$ -	$ 415,428	$ -	$ 415,428	$ 415,428	$ 415,428	$ 415,428
Low Temperature Thermal Desorption (LTTD)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,674,666	$ 1,674,666	$ 1,674,666
LNAPL											
LNAPL Recovery - Passive 4 trenches	$ -	$ 2,212,245	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
LNAPL Recovery - Active 2 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,193,356	$ -	$ -
LNAPL Recovery - Active 3 trenches	$ -	$ -	$ 2,804,121	$ 2,804,121	$ 2,804,121	$ 2,804,121	$ -	$ -	$ -	$ 2,804,121	$ -
LNAPL Recovery - Active 4 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,391,416	$ 3,391,416	$ -	$ -	$ -
Enhanced LNAPL Recovery - Surfactants 3 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,266,016	$ -
Enhanced LNAPL Recovery - Surfactants 4 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,696,601	$ 7,696,601	$ -	$ -	$ -
LNAPL Soil Excavation and LTTD Treatment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,578,525	$ 5,578,525	$ -
LNAPL Soil Excavation and *Ex Situ* S/S	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,161,739	$ 3,161,739	$ -
LNAPL Soil & Rock Excavation and LTTD Treatment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 8,089,469
LNAPL Soil & Rock Excavation and *Ex Situ* S/S	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,204,770
Ground Water Recovery Wells											
Active Recovery with 2 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,061,832	$ -	$ -
Active Recovery with 3 trenches	$ -	$ -	$ 1,047,770	$ 1,047,770	$ 1,047,770	$ 1,047,770	$ -	$ -	$ -	$ -	$ -
Enhanced Recovery with 3 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,049,778	$ -
Enhanced Recovery with 4 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,049,778	$ 1,049,778	$ -	$ -	$ -
Ground Water Treatment System											
Active Recovery with 2 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 8,971,690	$ -	$ -
Active Recovery with 3 trenches	$ -	$ -	$ 9,480,937	$ 9,480,937	$ 9,480,937	$ 9,480,937	$ -	$ -	$ -	$ -	$ -
Enhanced Recovery with 3 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 11,784,500	$ -
Enhanced Recovery with 4 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ 13,416,519	$ 13,416,519	$ -	$ -	$ -
Total Present Value (minimum)	$ -	$ 8,430,515	$ 18,252,232	$ 21,122,815	$ 16,492,182	$ 16,674,403	$ 28,713,669	$ 28,895,889	$ 20,404,865	$26,407,737	$8,546,355
Total Present Value (maximum)	$ -	$ 8,430,515	$ 18,252,232	$ 21,122,815	$ 16,492,182	$ 16,674,403	$ 28,713,669	$ 28,895,889	$ 22,821,652	$30,083,762	$12,690,292

TABLE C-33c
PRESENT VALUE ANALYSIS OF REMEDIAL ALTERNATIVES, CURRENT ADJACENT RESIDENT - 1E-05 SOIL
10% DISCOUNT RATE
LENZ OIL SITE
LEMONT, ILLINOIS

PROCESS OPTIONS	PRESENT VALUE CAPITAL COST + 30-YRS O&M COST - 10.0% DISCOUNT RATE Alternative Number										
	1	2	3	4	5	5a	6	6a	7	8	9
No Action	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Common Activities	$ -	$ 1,570,525	$ 1,570,525	$ 1,570,525	$ 1,570,525	$ 1,570,525	$ 1,570,525	$ 1,570,525	$ 1,570,525	$ 1,570,525	$ 1,570,525
Covers											
Multilayered Cap	$ -	$ 3,199,432	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Solid Waste Cap	$ -	$ -	$ 1,900,565	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Asphalt Cap	$ -	$ -	$ -	$ 2,203,894	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Concrete Cap	$ -	$ -	$ -	$ 2,268,319	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Remediation of 1.0E-04 Unconsolidated Soils											
Off-Site Disposal											
RCRA Subtitle D	$ -	$ -	$ -	$ -	$ 233,202	$ -	$ 233,202	$ -	$ -	$ -	$ -
On-Site Treatment											
Ex Situ Solidification/Stabilization (S/S)	$ -	$ -	$ -	$ -	$ -	$ 415,428	$ -	$ 415,428	$ 415,428	$ 415,428	$ 415,428
Low Temperature Thermal Desorption (LTTD)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,674,666	$ 1,674,666	$ 1,674,666
LNAPL											
LNAPL Recovery - Passive 4 trenches	$ -	$ 1,935,904	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
LNAPL Recovery - Active 2 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,935,387	$ -	$ -
LNAPL Recovery - Active 3 trenches	$ -	$ -	$ 2,457,817	$ 2,457,817	$ 2,457,817	$ 2,457,817	$ -	$ -	$ -	$ 2,457,817	$ -
LNAPL Recovery - Active 4 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,899,841	$ 2,899,841	$ -	$ -	$ -
Enhanced LNAPL Recovery - Surfactants 3 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,738,766	$ -
Enhanced LNAPL Recovery - Surfactants 4 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,832,549	$ 4,832,549	$ -	$ -	$ -
LNAPL Soil Excavation and LTTD Treatment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,578,525	$ 5,578,525	$ -
LNAPL Soil Excavation and *Ex Situ* S/S	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,161,739	$ 3,161,739	$ -
LNAPL Soil & Rock Excavation and LTTD Treatment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 8,089,469
LNAPL Soil & Rock Excavation and *Ex Situ* S/S	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,204,770
Ground Water Recovery Wells											
Active Recovery with 2 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 862,248	$ -	$ -
Active Recovery with 3 trenches	$ -	$ -	$ 855,485	$ 855,485	$ 855,485	$ 855,485	$ -	$ -	$ -	$ -	$ -
Enhanced Recovery with 3 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 856,451	$ -
Enhanced Recovery with 4 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ 856,451	$ 856,451	$ -	$ -	$ -
Ground Water Treatment System											
Active Recovery with 2 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,698,107	$ -	$ -
Active Recovery with 3 trenches	$ -	$ -	$ 5,943,032	$ 5,943,032	$ 5,943,032	$ 5,943,032	$ -	$ -	$ -	$ -	$ -
Enhanced Recovery with 3 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,445,756	$ -
Enhanced Recovery with 4 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$8,230,683	$8,230,683	$ -	$ -	$ -
Total Present Value (minimum)	$ -	$ 6,705,861	$ 12,727,424	$ 13,030,753	$ 11,060,061	$ 11,242,287	$ 18,623,251	$ 18,805,477	$ 13,643,434	$ 18,646,483	$ 7,190,723
Total Present Value (maximum)	$ -	$ 6,705,861	$ 12,727,424	$ 13,095,178	$ 11,060,061	$ 11,242,287	$ 18,623,251	$ 18,805,477	$ 17,319,459	$ 22,322,507	$ 11,334,660

TABLE C-34c
PRESENT VALUE ANALYSIS OF PROCESS OPTIONS, 1E-05 CURRENT ADJACENT RESIDENT
LENZ OIL SITE
LEMONT, ILLINOIS

PROCESS OPTIONS	CAPITAL COST	ANNUALIZED OPERATING & MAINTENANCE COSTS DISCOUNT RATES 3.00%	5.00%	10.00%	PRESENT VALUE OF 30 YEARS OPERATING & MAINTENANCE COSTS DISCOUNT RATES 3.00%	5.00%	10.00%	PRESENT VALUE CAPITAL COST + 30-YRS O&M COST DISCOUNT RATES 3.00%	5.00%	10.00%
No Action	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Common Activities	$ 314,389	$ 133,250	$ 133,250	$ 133,250	$ 2,611,759	$ 2,048,379	$ 1,256,136	$ 2,926,148	$ 2,362,768	$ 1,570,525
Covers										
Multilayered Cap	$ 3,014,381	$ 14,170	$ 15,730	$ 19,630	$ 277,738	$ 241,809	$ 185,050	$ 3,292,120	$ 3,256,190	$ 3,199,432
Solid Waste Cap	$ 1,715,515	$ 14,170	$ 15,730	$ 19,630	$ 277,738	$ 241,809	$ 185,050	$ 1,993,253	$ 1,957,324	$ 1,900,565
Asphalt Cap	$ 2,066,638	$ 17,940	$ 16,770	$ 14,560	$ 351,632	$ 257,796	$ 137,256	$ 2,418,270	$ 2,324,434	$ 2,203,894
Concrete Cap	$ 2,167,828	$ 14,170	$ 13,000	$ 10,660	$ 277,738	$ 199,842	$ 100,491	$ 2,445,566	$ 2,367,670	$ 2,268,319
Remediation of 1.0E-04 Unconsolidated Soils										
Off-Site Disposal										
RCRA Subtitle D	$ 233,202	$ -	$ -	$ -	$ -	$ -	$ -	$ 233,202	$ 233,202	$ 233,202
On-Site Treatment										
Ex Situ Solidification/Stabilization (S/S)	$ 433,640	$ -	$ -	$ -	$ -	$ -	$ -	$ 433,640	$ 433,640	$ 433,640
Low Temperature Thermal Desorption (LTTD)	$ 1,674,666	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,674,666	$ 1,674,666	$ 1,674,666
LNAPL										
LNAPL Recovery - Passive 4 trenches	$ 1,679,842	$ 27,163	$ 27,163	$ 27,163	$ 532,404	$ 417,559	$ 256,062	$ 2,212,245	$ 2,097,401	$ 1,935,904
LNAPL Recovery - Active 2 trenches	$ 1,696,350	$ 25,357	$ 25,357	$ 25,357	$ 497,007	$ 389,798	$ 239,037	$ 2,193,356	$ 2,086,148	$ 1,935,387
LNAPL Recovery - Active 3 trenches	$ 2,136,928	$ 34,040	$ 34,040	$ 34,040	$ 667,192	$ 523,273	$ 320,889	$ 2,804,121	$ 2,660,201	$ 2,457,817
LNAPL Recovery - Active 4 trenches	$ 2,444,342	$ 48,319	$ 48,319	$ 48,319	$ 947,074	$ 742,782	$ 455,499	$ 3,391,416	$ 3,187,123	$ 2,899,841
Enhanced LNAPL Recovery - Surfactants 3 trenches	$ 1,323,598	$ 199,172	$ 199,172	$ 199,172	$ 3,903,853	$ 3,061,757	$ 1,877,575	$ 5,227,451	$ 4,385,355	$ 3,201,172
Enhanced LNAPL Recovery - Surfactants 4 trenches	$ 2,178,684	$ 370,835	$ 370,835	$ 370,835	$ 7,268,525	$ 5,700,639	$ 3,495,827	$ 9,447,209	$ 7,879,323	$ 5,674,512
LNAPL Soil Excavation and LTTD Treatment	$ 5,578,525	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,578,525	$ 5,578,525	$ 5,578,525
LNAPL Soil Excavation and *Ex Situ* S/S	$ 3,161,739	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,161,739	$ 3,161,739	$ 3,161,739
LNAPL Soil & Rock Excavation and LTTD Treatment	$ 8,089,469	$ -	$ -	$ -	$ -	$ -	$ -	$ 8,089,469	$ 8,089,469	$ 8,089,469
LNAPL Soil & Rock Excavation and *Ex Situ* S/S	$ 5,204,770	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,204,770	$ 5,204,770	$ 5,204,770
Ground Water Recovery Wells										
Active Recovery with 2 trenches	$ 677,311	$ 19,618	$ 19,618	$ 19,618	$ 384,521	$ 301,576	$ 184,937	$ 1,061,832	$ 978,887	$ 862,248
Active Recovery with 3 trenches	$ 677,311	$ 18,901	$ 18,901	$ 18,901	$ 370,458	$ 290,547	$ 178,174	$ 1,047,770	$ 967,858	$ 855,485
Enhanced Recovery with 3 trenches	$ 677,311	$ 19,003	$ 19,003	$ 19,003	$ 372,467	$ 292,123	$ 179,140	$ 1,049,778	$ 969,434	$ 856,451
Enhanced Recovery with 4 trenches	$ 677,311	$ 19,003	$ 19,003	$ 19,003	$ 372,467	$ 292,123	$ 179,140	$ 1,049,778	$ 969,434	$ 856,451
Ground Water Treatment System										
Active Recovery with 2 trenches	$ 2,664,765	$ 321,775	$ 321,775	$ 321,775	$ 6,306,924	$ 4,946,464	$ 3,033,342	$ 8,971,690	$ 7,611,230	$ 5,698,107
Active Recovery with 3 trenches	$ 2,664,765	$ 347,756	$ 347,756	$ 347,756	$ 6,816,172	$ 5,345,863	$ 3,278,267	$ 9,480,937	$ 8,010,628	$ 5,943,032
Enhanced Recovery with 3 trenches	$ 3,425,424	$ 426,474	$ 426,474	$ 426,474	$ 8,359,076	$ 6,555,949	$ 4,020,333	$ 11,784,500	$ 9,981,372	$ 7,445,756
Enhanced Recovery with 4 trenches	$ 3,425,424	$ 509,738	$ 509,738	$ 509,738	$ 9,991,095	$ 7,835,927	$ 4,805,259	$ 13,416,519	$ 11,261,350	$ 8,230,683
Total Present Value (minimum)										
Total Present Value (maximum)										

TABLE C-1d
CAPITAL COST ESTIMATE SUMMARY - CURRENT ADJACENT RESIDENT, 1E-06 SOIL
LENZ OIL SITE
LEMONT, ILLINOIS

Process Option	Table Number	1	2	3	4	5	5a	6	6a	7	8	9
Common Activities	Table C-2	$ -	$ 314,389	$ 314,389	$ 314,389	$ 314,389	$ 314,389	$ 314,389	$ 314,389	$ 314,389	$ 314,389	$ 314,389
Covers												
Multilayered Cap	Table C-3	$ -	$ 3,014,381	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Solid Waste Cap	Table C-4	$ -	$ -	$ 1,715,515	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Asphalt Cap	Table C-5	$ -	$ -	$ -	$ 2,066,638	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Concrete Cap	Table C-6	$ -	$ -	$ -	$ 2,167,828	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Remediation of 1.0E-04 Unconsolidated Soils												
Off-Site Disposal												
RCRA Subtitle D	Table C-8	$ -	$ -	$ -	$ -	$ 1,278,414	$ -	$ 1,278,414	$ -	$ -	$ -	$ -
On-Site Treatment												
Ex Situ Solidification/Stabilization (S/S)	Table C-9	$ -	$ -	$ -	$ -	$ -	$ 1,312,540	$ -	$ 1,312,540	$ 1,312,540	$ 1,312,540	$ 1,312,540
Low Temperature Thermal Desorption (LTTD)	Table C-10	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,722,611	$ 4,722,611	$ 4,722,611
LNAPL												
LNAPL Recovery - Passive 4 trenches	Table C-11	$ -	$ 1,679,842	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
LNAPL Recovery - Active 2 trenches	Table C-12	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,696,350	$ -	$ -
LNAPL Recovery - Active 3 Trenches	Table C-13	$ -	$ -	$ 2,136,928	$ 2,136,928	$ 2,136,928	$ 2,136,928	$ -	$ -	$ -	$ 2,136,928	$ -
LNAPL Recovery - Active 4 Trenches	Table C-14	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,444,342	$ 2,444,342	$ -	$ -	$ -
Enhanced LNAPL Recovery - Surfactants 3 trenches	Table C-15	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,323,598	$ -
Enhanced LNAPL Recovery - Surfactants 4 trenches	Table C-16	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,178,684	$ 2,178,684	$ -	$ -	$ -
LNAPL Soil Excavation and LTTD Treatment	Table C-19	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,578,525	$ 5,578,525	$ -
LNAPL Soil Excavation and *Ex Situ* S/S	Table C-19a	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,161,739	$ 3,161,739	$ -
LNAPL Soil & Rock Excavation and LTTD Treatment	Table C-20	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 8,089,469
LNAPL Soil & Rock Excavation and *Ex Situ* S/S	Table C-20a	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,204,770
Ground Water												
Ground Water Recovery Wells - No surfactant	Table C-21	$ -	$ -	$ 677,311	$ 677,311	$ 677,311	$ 677,311	$ -	$ -	$ 677,311	$ -	$ -
Ground Water Recovery Wells - Surfactants	Table C-21	$ -	$ -	$ -	$ -	$ -	$ -	$ 677,311	$ 677,311	$ -	$ 677,311	$ -
Ground Water Treatment System												
Active Recovery with 2 trenches	Table C-22	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,664,765	$ -	$ -
Active Recovery with 3 trenches	Table C-22	$ -	$ -	$ 2,664,765	$ 2,664,765	$ 2,664,765	$ 2,664,765	$ -	$ -	$ -	$ -	$ -
Enhanced Recovery with 3 trenches	Table C-23	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,425,424	$ -
Enhanced Recovery with 4 trenches	Table C-23	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,425,424	$ 3,425,424	$ -	$ -	$ -
Total Cost (minimum)		$ -	$ 5,008,612	$ 7,508,909	$ 7,860,032	$ 7,071,808	$ 7,105,933	$ 10,318,564	$ 10,352,689	$ 9,827,094	$ 12,351,928	$ 6,831,699
Total Cost (maximum)		$ -	$ 5,008,612	$ 7,508,909	$ 7,961,222	$ 7,071,808	$ 7,105,933	$ 10,318,564	$ 10,352,689	$ 15,653,951	$ 18,178,786	$ 13,126,469

Table C-7d
Lenz Oil - Capital Cost Estimate - Current Adjacent Resident
Remediation of 1.0E-06 Unconsolidated Soils - Base Costs

Item	Units	Calculated Quantity	Design Quantity	Unit Price	Total Price	Calculated Quantity Remarks	Unit Price Source (1)
Mobilization	ls	1	1	$ 10,000	$ 10,000	ERM estimate	ERM estimate
Surveying	ls	1	1	$ 1,000	$ 1,000	ERM estimate	ERM estimate
Excavation of areas							
Area X material to be treated/disposed	cy	1,956	1,960	$ 13.04	$ 25,560	1E-05 and 1E-06 soil areas and 1:1 excavation slopes	Means 022-238-0500/0020/4250
Area Y material to be treated/disposed	cy	5,072	5,075	$ 13.04	$ 66,183	See Figure 2-1a	Means 022-238-0500/0020/4250
Area Z material to be treated/disposed	cy	-	-	$ 13.04	$ -	Included in Area Y	Means 022-238-0500/0020/4250
Subtotal excavated	cy	7,028	7,035				
Subtotal treated/disposed	cy	7,028	7,035				
Excavation/treatment duration	wk	7.8	3			Excavation/treatment rate of 900 cy/wk (2)	
Air monitoring with an HNu	wk	7.8	3	$ 2,000	$ 6,000	Labor and materials	ERM estimate
H&S equipment	wk	7.8	3	$ 2,000	$ 6,000	ERM estimate	ERM estimate
Decontamination materials and labor	wk	7.8	3	$ 300	$ 900	ERM estimate	ERM estimate
Decon water storage	gal	2,343	900	$ 0.10	$ 90	300 gal per week	Baker Tank
Decon water disposal (includes trucking)	gal	2,343	900	$ 0.73	$ 661	RCRA Subtitle C Treatment	Rollins Envir., Inc. @ Deer Park, TX
Demobilization	ls	1	1	$ 5,000	$ 5,000	ERM estimate	ERM estimate
Subtotal (Soils base)					$ 121,394		

Notes
1 ERM estimate includes overhead and profit. 1996 Means Site Work - 15th Edition, plus 12% overhead and profit.
1996 Means Mechanical Work - 19th Edition, plus 12% overhead and profit.
2 Excavation and treatment rates are based on the following assumptions:
LTTD
Treatment rate of 10 tons or 7.4 cubic yards per hour.
System operating 24 hours a day - 7 days a week, at 75 percent utilization.
Average treatment rate 932 cy/wk (used 900 cy/wk)
SS
Treatment rate of 30 cubic yards per hour.
System operating 8 hours a day - 5 days a week, at 75 percent utilization.
Average treatment rate 900 cy/wk
Off-site Disposal
Loading two to three 15 cubic yard trucks a hour.
Excavating 6 hours a day - 5 days a week.
Minimum excavation rate 900 cy/wk (used 900 cy/wk)
Maximum excavation rate 1,350 cy/wk

Table C-8d
Lenz Oil - Capital Cost Estimate - Current Adjacent Resident
Remediation of 1.0E-06 Unconsolidated Soils
Off-Site Disposal - RCRA Subtitle D

Item	Units	Calculated Quantity	Design Quantity	Unit Price	Total Price	Calculated Quantity Remarks	Unit Price Source (1)
Soils Base					$ 121,394	See Soils Base Cost Estimate	See Soils Base Cost Estimate
Transportation to off-site facility	cy	7,028	7,035	$ 35.10	$ 246,929	RCRA Subtitle D Landfill	Peoria Disposal Company @ Clinton, IL
Disposal at off-site facility	cy	7,028	7,035	$ 24.30	$ 170,951	RCRA Subtitle D Landfill	Peoria Disposal Company @ Clinton, IL
Additional fill material	cy	7,028	7,035	$ 7.00	$ 49,245	See Soils Base Cost Estimate	S&K Excavation
Fill placement	cy	7,028	7,035	$ 3.10	$ 21,825	See Soils Base Cost Estimate	Means 022-246-1050
Fill compaction	cy	7,028	7,035	$ 0.35	$ 2,443	See Soils Base Cost Estimate	Means 022-226-5000
Fill grading	sy	5,049	5,050	$ 1.97	$ 9,955	Areas X, and Y total surface area	Means 025-122-1050
Subtotal					$ 622,740		
Design engineering	%	15.00%			$ 93,411		
Construction management	%	25.00%			$ 155,685		
Insurance	%	2.50%			$ 15,569		
Permitting and legal fees	ls	1	1	$ 5,000	$ 5,000		ERM estimate
Predesign soil sampling	ls	1	1	$ 70,990	$ 70,990	See page 3 of Table C-2-1 in Attachment 2.	ERM estimate
Confirmatory sampling	ls	1	1	$ 20,000	$ 20,000		ERM estimate
Subtotal					$ 983,395		
Contingency	%	30.00%			$ 295,019		
Total					$ 1,278,414		

Notes
1 ERM estimate includes overhead and profit. 1996 Means Site Work - 15th Edition, plus 12% overhead and profit.
1996 Means Mechanical Work - 19th Edition, plus 12% overhead and profit.

Table C-9d
Lenz Oil - Capital Cost Estimate - Current Adjacent Resident
Remediation of 1.0E-06 Unconsolidated Soils
***Ex Situ* Solidification/Stabilization**

Item	Units	Calculated Quantity	Design Quantity	Unit Price	Total Price	Calculated Quantity Remarks	Unit Price Source (1)
Soils Base					$ 121,394	See Soils Base Cost Estimate	See Soils Base Cost Estimate
On-site treatment mobilization	ls	1	1	$ 50,000	$ 50,000	Prepare site and obtain utilities	Millgard Environmental
Truck to on-site treatment	cy	7,028	7,035	$ 2.99	$ 21,037	See Soils Base Cost Estimate	Means 022-266-0020
Ex situ solidification/stabilization	cy	7,028	7,035	$ 50	$ 351,750	Solidification/stabilization on site	Millgard Environmental
Demobilization	ls	1	1	$ 10,000	$ 10,000	ERM estimate	ERM estimate
Fill placement	cy	7,028	7,035	$ 3.10	$ 21,825	See Soils Base Cost Estimate	Means 022-246-1050
Fill compaction	cy	7,028	7,035	$ 0.35	$ 2,443	See Soils Base Cost Estimate	Means 022-226-5000
Fill grading	sy	5,049	5,050	$ 1.97	$ 9,955	Areas X, and Y total surface area	Means 029-308-0200
Subtotal					$ 588,404		
Design engineering	%	15.00%			$ 88,261		
Construction management	%	25.00%			$ 147,101		
Insurance	%	2.50%			$ 14,710		
Permitting and legal fees	ls	1	1	$ 20,000	$ 20,000		ERM estimate
Confirmatory sampling	ls	1	1	$ 10,000	$ 10,000		ERM estimate
Predesign soil sampling	ls	1	1	$ 70,990	$ 70,990	See page 3 of Table C-2-1 in Attachment 2.	ERM estimate
S/S binder selection	ls	1	1	$ 70,180	$ 70,180	See page 3 of Table C-2-1 in Attachment 2.	ERM estimate
Subtotal					$ 1,009,646		
Contingency	%	30.00%			$ 302,894		
Total					$ 1,312,540		

Notes
1 ERM estimate includes overhead and profit. 1996 Means Site Work - 15th Edition, plus 12% overhead and profit.
1996 Means Mechanical Work - 19th Edition, plus 12% overhead and profit.

Table C-10d
Lenz Oil - Capital Cost Estimate - Current Adjacent Resident
Remediation of 1.0E-06 Unconsolidated Soils
On-Site Treatment - Low Temperature Thermal Desorption

Item	Units	Calculated Quantity	Design Quantity	Unit Price	Total Price	Calculated Quantity Remarks	Unit Price Source (1)
Soils Base					$ 121,394	See Soils Base Cost Estimate	See Soils Base Cost Estimate
On-site treatment mobilization	ls	1	1	$ 600,000	$ 600,000	Prepare site and obtain utilities - 40% of charges The rest is included with the LNAPL-cont. mater.	Soiltech ATP Systems
Truck to on-site treatment	cy	7,028	7,035	$ 2.99	$ 21,037	See Soils Base Cost Estimate	Means 022-266-0020
Thermal desorption with offgas treatment	cy	7,028	7,035	$ 270	$ 1,899,450	Indirect w/ offgas treat - 1,100 degrees F	Soiltech ATP Systems
Disposal of LTTD residual by incineration							
Residual storage	gal	3,548	3,552	$ 0.10	$ 355	Estimated 0.25 % of treated volume	Baker Tank
Transportation to incineration facility	gal	3,548	3,552	$ 0.66	$ 2,340	TSCA and Subtitle C Incineration (liquid)	Clean Harbors Envir. Serv. @ Deer Park, TX
Disposal at incineration facility	gal	3,548	3,552	$ 4.09	$ 14,545	TSCA and Subtitle C Incineration (liquid)	Clean Harbors Envir. Serv. @ Deer Park, TX
Residual volume	cy	18	18				
Disposal of spent carbon by incineration						Estimated 0.5 % of treated volume	
Disposal at incineration facility (includes trucking)	cy	35	35	$ 945	$ 33,240	TSCA and Subtitle C Incineration (soil)	Waste Management @ Port Arthur, TX
Demobilization	ls	1	1	$ 10,000	$ 10,000	ERM estimate	ERM estimate
Fill placement	cy	7,028	7,035	$ 3.10	$ 21,825	See Soils Base Cost Estimate	Means 022-246-1050
Fill compaction	cy	7,028	7,035	$ 0.35	$ 2,443	See Soils Base Cost Estimate	Means 022-226-5000
Fill grading	sy	5,049	5,050	$ 1.97	$ 9,955	Areas X, and Y total surface area	Means 029-308-0200
Subtotal					$ 2,736,585		
Design engineering					$ 200,000		
Construction management	%	15.00%			$ 410,488		
Insurance	%	2.50%			$ 68,415		
Permitting and legal fees	ls	1	1	$ 20,000	$ 20,000		ERM estimate
Confirmatory sampling	ls	1	1	$ 37,000	$ 37,000		ERM estimate
Predesign soil sampling	ls	1	1	$ 70,990	$ 70,990	See page 3 of Table C-2-1 in Attachment 2.	
LTTD off-site test	ls	1	1	$ 89,300	$ 89,300	See page 7 of Table C-2-1 in Attachment 2.	ERM estimate
Subtotal					$ 3,632,778		
Contingency	%	30.00%			$ 1,089,833		
Total					$ 4,722,611		

Notes
1 ERM estimate includes overhead and profit. 1996 Means Site Work - 15th Edition, plus 12% overhead and profit.
1996 Means Mechanical Work - 19th Edition, plus 12% overhead and profit.

TABLE C-31d
PRESENT VALUE ANALYSIS OF REMEDIAL ALTERNATIVES, CURRENT ADJACENT RESIDENT - 1E-06 SOIL
5% DISCOUNT RATE
LENZ OIL SITE
LEMONT, ILLINOIS

PROCESS OPTIONS	PRESENT VALUE CAPITAL COST + 30-YRS O&M COST - 5.0% DISCOUNT RATE Alternative Number										
	1	2	3	4	5	5a	6	6a	7	8	9
No Action	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Common Activities	$ -	$ 2,362,768	$ 2,362,768	$ 2,362,768	$ 2,362,768	$ 2,362,768	$ 2,362,768	$ 2,362,768	$ 2,362,768	$ 2,362,768	$ 2,362,768
Covers											
Multilayered Cap	$ -	$ 3,256,190	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Solid Waste Cap	$ -	$ -	$ 1,957,324	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Asphalt Cap	$ -	$ -	$ -	$ 2,324,434	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Concrete Cap	$ -	$ -	$ -	$ 2,367,670	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Remediation of 1.0E-04 Unconsolidated Soils											
Off-Site Disposal											
RCRA Subtitle D	$ -	$ -	$ -	$ -	$ 1,278,414	$ -	$ 1,278,414	$ -	$ -	$ -	$ -
On-Site Treatment											
Ex Situ Solidification/Stabilization (S/S)	$ -	$ -	$ -	$ -	$ -	$ 1,312,540	$ -	$ 1,312,540	$ 1,312,540	$ 1,312,540	$ 1,312,540
Low Temperature Thermal Desorption (LTTD)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,722,611	$ 4,722,611	$ 4,722,611
LNAPL											
LNAPL Recovery - Passive 4 trenches	$ -	$ 2,097,401	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
LNAPL Recovery - Active 2 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,086,148	$ -	$ -
LNAPL Recovery - Active 3 trenches	$ -	$ -	$ 2,660,201	$ 2,660,201	$ 2,660,201	$ 2,660,201	$ -	$ -	$ -	$ 2,660,201	$ -
LNAPL Recovery - Active 4 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,187,123	$ 3,187,123	$ -	$ -	$ -
Enhanced LNAPL Recovery - Surfactants 3 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,385,355	$ -
Enhanced LNAPL Recovery - Surfactants 4 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,879,323	$ 7,879,323	$ -	$ -	$ -
LNAPL Soil Excavation and LTTD Treatment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,578,525	$ 5,578,525	$ -
LNAPL Soil Excavation and *Ex Situ* S/S	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,161,739	$ 3,161,739	$ -
LNAPL Soil & Rock Excavation and LTTD Treatment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 8,089,469
LNAPL Soil & Rock Excavation and *Ex Situ* S/S	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,204,770
Ground Water Recovery Wells											
Active Recovery with 2 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 978,887	$ -	$ -
Active Recovery with 3 trenches	$ -	$ -	$ 967,858	$ 967,858	$ 967,858	$ 967,858	$ -	$ -	$ -	$ -	$ -
Enhanced Recovery with 3 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 969,434	$ -
Enhanced Recovery with 4 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ 969,434	$ 969,434	$ -	$ -	$ -
Ground Water Treatment System											
Active Recovery with 2 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,611,230	$ -	$ -
Active Recovery with 3 trenches	$ -	$ -	$ 8,010,628	$ 8,010,628	$ 8,010,628	$ 8,010,628	$ -	$ -	$ -	$ -	$ -
Enhanced Recovery with 3 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 9,981,372	$ -
Enhanced Recovery with 4 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ 11,261,350	$ 11,261,350	$ -	$ -	$ -
Total Present Value (minimum)	$ -	$ 7,716,359	$ 15,958,780	$ 16,325,890	$ 15,279,870	$ 15,313,995	$ 26,938,413	$ 26,972,539	$ 17,513,311	$ 24,833,409	$ 8,880,078
Total Present Value (maximum)	$ -	$ 7,716,359	$ 15,958,780	$ 16,369,126	$ 15,279,870	$ 15,313,995	$ 26,938,413	$ 26,972,539	$ 23,340,169	$ 30,660,267	$ 15,174,848

TABLE C-32d
PRESENT VALUE ANALYSIS OF REMEDIAL ALTERNATIVES, CURRENT ADJACENT RESIDENT - 1E-06 SOIL
3% DISCOUNT RATE
LENZ OIL SITE
LEMONT, ILLINOIS

PROCESS OPTIONS	PRESENT VALUE CAPITAL COST + 30-YRS O&M COST - 3.0% DISCOUNT RATE Alternative Number										
	1	2	3	4	5	5a	6	6a	7	8	9
No Action											
Common Activities	$ -	$ 2,926,148	$ 2,926,148	$ 2,926,148	$ 2,926,148	$ 2,926,148	$ 2,926,148	$ 2,926,148	$ 2,926,148	$ 2,926,148	$ 2,926,148
Covers											
Multilayered Cap	$ -	$ 3,292,120	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Solid Waste Cap	$ -	$ -	$ 1,993,253	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Asphalt Cap	$ -	$ -	$ -	$ 2,418,270	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Concrete Cap	$ -	$ -	$ -	$ 2,445,566	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Remediation of 1.0E-04 Unconsolidated Soils											
Off-Site Disposal											
RCRA Subtitle D	$ -	$ -	$ -	$ -	$ 1,278,414	$ -	$ 1,278,414	$ -	$ -	$ -	$ -
On-Site Treatment											
Ex Situ Solidification/Stabilization (S/S)	$ -	$ -	$ -	$ -	$ -	$ 2,275,801	$ -	$ 2,275,801	$ 2,275,801	$ 2,275,801	$ 2,275,801
Low Temperature Thermal Desorption (LTTD)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,722,611	$ 4,722,611	$ 4,722,611
LNAPL											
LNAPL Recovery - Passive 4 trenches	$ -	$ 2,212,245	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
LNAPL Recovery - Active 2 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,193,356	$ -	$ -
LNAPL Recovery - Active 3 trenches	$ -	$ -	$ 2,804,121	$ 2,804,121	$ 2,804,121	$ 2,804,121	$ -	$ -	$ -	$ 2,804,121	$ -
LNAPL Recovery - Active 4 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,391,416	$ 3,391,416	$ -	$ -	$ -
Enhanced LNAPL Recovery - Surfactants 3 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,266,016	$ -
Enhanced LNAPL Recovery - Surfactants 4 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,696,601	$ 7,696,601	$ -	$ -	$ -
LNAPL Soil Excavation and LTTD Treatment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,578,525	$ 5,578,525	$ -
LNAPL Soil Excavation and *Ex Situ* S/S	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,161,739	$ 3,161,739	$ -
LNAPL Soil & Rock Excavation and LTTD Treatment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 8,089,469
LNAPL Soil & Rock Excavation and *Ex Situ* S/S	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,204,770
Ground Water Recovery Wells											
Active Recovery with 2 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,061,832	$ -	$ -
Active Recovery with 3 trenches	$ -	$ -	$ 1,047,770	$ 1,047,770	$ 1,047,770	$ 1,047,770	$ -	$ -	$ -	$ -	$ -
Enhanced Recovery with 3 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,049,778	$ -
Enhanced Recovery with 4 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,049,778	$ 1,049,778	$ -	$ -	$ -
Ground Water Treatment System											
Active Recovery with 2 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 8,971,690	$ -	$ -
Active Recovery with 3 trenches	$ -	$ -	$ 9,480,937	$ 9,480,937	$ 9,480,937	$ 9,480,937	$ -	$ -	$ -	$ -	$ -
Enhanced Recovery with 3 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 11,784,500	$ -
Enhanced Recovery with 4 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ 13,416,519	$ 13,416,519	$ -	$ -	$ -
Total Present Value (minimum)	$ -	$ 8,430,515	$ 18,252,232	$ 21,122,815	$ 17,537,394	$ 18,534,776	$ 29,758,882	$ 30,756,263	$ 25,313,183	$28,268,111	$10,406,728
Total Present Value (maximum)	$ -	$ 8,430,515	$ 18,252,232	$ 21,122,815	$ 17,537,394	$ 18,534,776	$ 29,758,882	$ 30,756,263	$ 27,729,969	$33,131,707	$15,738,237

TABLE C-33d
PRESENT VALUE ANALYSIS OF REMEDIAL ALTERNATIVES, CURRENT ADJACENT RESIDENT - 1E-06 SOIL
10% DISCOUNT RATE
LENZ OIL SITE
LEMONT, ILLINOIS

PROCESS OPTIONS	PRESENT VALUE CAPITAL COST + 30-YRS O&M COST - 10.0% DISCOUNT RATE Alternative Number										
	1	2	3	4	5	5a	6	6a	7	8	9
No Action	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Common Activities	$ -	$ 1,570,525	$ 1,570,525	$ 1,570,525	$ 1,570,525	$ 1,570,525	$ 1,570,525	$ 1,570,525	$ 1,570,525	$ 1,570,525	$ 1,570,525
Covers											
Multilayered Cap	$ -	$ 3,199,432	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Solid Waste Cap	$ -	$ -	$ 1,900,565	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Asphalt Cap	$ -	$ -	$ -	$ 2,203,894	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Concrete Cap	$ -	$ -	$ -	$ 2,268,319	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Remediation of 1.0E-04 Unconsolidated Soils											
Off-Site Disposal											
RCRA Subtitle D	$ -	$ -	$ -	$ -	$ 1,278,414	$ -	$ 1,278,414	$ -	$ -	$ -	$ -
On-Site Treatment											
Ex Situ Solidification/Stabilization (S/S)	$ -	$ -	$ -	$ -	$ -	$ 2,275,801	$ -	$ 2,275,801	$ 2,275,801	$ 2,275,801	$ 2,275,801
Low Temperature Thermal Desorption (LTTD)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,722,611	$ 4,722,611	$ 4,722,611
LNAPL											
LNAPL Recovery - Passive 4 trenches	$ -	$ 1,935,904	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
LNAPL Recovery - Active 2 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,935,387	$ -	$ -
LNAPL Recovery - Active 3 trenches	$ -	$ -	$ 2,457,817	$ 2,457,817	$ 2,457,817	$ 2,457,817	$ -	$ -	$ -	$ 2,457,817	$ -
LNAPL Recovery - Active 4 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,899,841	$ 2,899,841	$ -	$ -	$ -
Enhanced LNAPL Recovery - Surfactants 3 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,738,766	$ -
Enhanced LNAPL Recovery - Surfactants 4 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,832,549	$ 4,832,549	$ -	$ -	$ -
LNAPL Soil Excavation and LTTD Treatment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,578,525	$ 5,578,525	$ -
LNAPL Soil Excavation and *Ex Situ* S/S	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,161,739	$ 3,161,739	$ -
LNAPL Soil & Rock Excavation and LTTD Treatment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 8,089,469
LNAPL Soil & Rock Excavation and *Ex Situ* S/S	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,204,770
Ground Water Recovery Wells											
Active Recovery with 2 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 862,248	$ -	$ -
Active Recovery with 3 trenches	$ -	$ -	$ 855,485	$ 855,485	$ 855,485	$ 855,485	$ -	$ -	$ -	$ -	$ -
Enhanced Recovery with 3 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 856,451	$ -
Enhanced Recovery with 4 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ 856,451	$ 856,451	$ -	$ -	$ -
Ground Water Treatment System											
Active Recovery with 2 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,698,107	$ -	$ -
Active Recovery with 3 trenches	$ -	$ -	$ 5,943,032	$ 5,943,032	$ 5,943,032	$ 5,943,032	$ -	$ -	$ -	$ -	$ -
Enhanced Recovery with 3 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,445,756	$ -
Enhanced Recovery with 4 trenches	$ -	$ -	$ -	$ -	$ -	$ -	$8,230,683	$8,230,683	$ -	$ -	$ -
Total Present Value (minimum)	$ -	$ 6,705,861	$ 12,727,424	$ 13,030,753	$ 12,105,273	$ 13,102,660	$ 19,668,463	$ 20,665,850	$ 15,503,807	$ 20,506,856	$ 9,051,097
Total Present Value (maximum)	$ -	$ 6,705,861	$ 12,727,424	$ 13,095,178	$ 12,105,273	$ 13,102,660	$ 19,668,463	$ 20,665,850	$ 20,367,403	$ 25,370,452	$ 14,382,605

TABLE C-34d
PRESENT VALUE ANALYSIS OF PROCESS OPTIONS, CURRENT ADJACENT RESIDENT - 1E-06 SOIL
LENZ OIL SITE
LEMONT, ILLINOIS

PROCESS OPTIONS	CAPITAL COST	ANNUALIZED OPERATING & MAINTENANCE COSTS DISCOUNT RATES			PRESENT VALUE OF 30 YEARS OPERATING & MAINTENANCE COSTS DISCOUNT RATES			PRESENT VALUE CAPITAL COST + 30-YRS O&M COST DISCOUNT RATES		
		3.00%	5.00%	10.00%	3.00%	5.00%	10.00%	3.00%	5.00%	10.00%
No Action	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Common Activities	$ 314,389	$ 133,250	$133,250	$ 133,250	$ 2,611,759	$ 2,048,379	$ 1,256,136	$ 2,926,148	$ 2,362,768	$ 1,570,525
Covers										
Multilayered Cap	$ 3,014,381	$14,170	$15,730	$19,630	$ 277,738	$ 241,809	$ 185,050	$ 3,292,120	$ 3,256,190	$ 3,199,432
Solid Waste Cap	$ 1,715,515	$14,170	$15,730	$19,630	$ 277,738	$ 241,809	$ 185,050	$ 1,993,253	$ 1,957,324	$ 1,900,565
Asphalt Cap	$ 2,066,638	$17,940	$16,770	$14,560	$ 351,632	$ 257,796	$ 137,256	$ 2,418,270	$ 2,324,434	$ 2,203,894
Concrete Cap	$ 2,167,828	$14,170	$13,000	$10,660	$ 277,738	$ 199,842	$ 100,491	$ 2,445,566	$ 2,367,670	$ 2,268,319
Remediation of 1.0E-04 Unconsolidated Soils										
Off-Site Disposal										
RCRA Subtitle D	$ 1,278,414	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,278,414	$ 1,278,414	$ 1,278,414
On-Site Treatment										
Ex Situ Solidification/Stabilization (S/S)	$ 1,312,540	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,312,540	$ 1,312,540	$ 1,312,540
Low Temperature Thermal Desorption (LTTD)	$ 4,722,611	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,722,611	$ 4,722,611	$ 4,722,611
LNAPL										
LNAPL Recovery - Passive 4 trenches	$ 1,679,842	$ 27,163	$ 27,163	$ 27,163	$ 532,404	$ 417,559	$ 256,062	$ 2,212,245	$ 2,097,401	$ 1,935,904
LNAPL Recovery - Active 2 trenches	$ 1,696,350	$ 25,357	$ 25,357	$ 25,357	$ 497,007	$ 389,798	$ 239,037	$ 2,193,356	$ 2,086,148	$ 1,935,387
LNAPL Recovery - Active 3 trenches	$ 2,136,928	$ 34,040	$ 34,040	$ 34,040	$ 667,192	$ 523,273	$ 320,889	$ 2,804,121	$ 2,660,201	$ 2,457,817
LNAPL Recovery - Active 4 trenches	$ 2,444,342	$ 48,319	$ 48,319	$ 48,319	$ 947,074	$ 742,782	$ 455,499	$ 3,391,416	$ 3,187,123	$ 2,899,841
Enhanced LNAPL Recovery - Surfactants 3 trenches	$ 1,323,598	$ 199,172	$ 199,172	$ 199,172	$ 3,903,853	$ 3,061,757	$ 1,877,575	$ 5,227,451	$ 4,385,355	$ 3,201,172
Enhanced LNAPL Recovery - Surfactants 4 trenches	$ 2,178,684	$ 370,835	$ 370,835	$ 370,835	$ 7,268,525	$ 5,700,639	$ 3,495,827	$ 9,447,209	$ 7,879,323	$ 5,674,512
LNAPL Soil Excavation and LTTD Treatment	$ 5,578,525	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,578,525	$ 5,578,525	$ 5,578,525
LNAPL Soil Excavation and *Ex Situ* S/S	$ 3,161,739	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,161,739	$ 3,161,739	$ 3,161,739
LNAPL Soil & Rock Excavation and LTTD Treatment	$ 8,089,469	$ -	$ -	$ -	$ -	$ -	$ -	$ 8,089,469	$ 8,089,469	$ 8,089,469
LNAPL Soil & Rock Excavation and *Ex Situ* S/S	$ 5,204,770	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,204,770	$ 5,204,770	$ 5,204,770
Ground Water Recovery Wells										
Active Recovery with 2 trenches	$ 677,311	$ 19,618	$ 19,618	$ 19,618	$ 384,521	$ 301,576	$ 184,937	$ 1,061,832	$ 978,887	$ 862,248
Active Recovery with 3 trenches	$ 677,311	$ 18,901	$ 18,901	$ 18,901	$ 370,458	$ 290,547	$ 178,174	$ 1,047,770	$ 967,858	$ 855,485
Enhanced Recovery with 3 trenches	$ 677,311	$ 19,003	$ 19,003	$ 19,003	$ 372,467	$ 292,123	$ 179,140	$ 1,049,778	$ 969,434	$ 856,451
Enhanced Recovery with 4 trenches	$ 677,311	$ 19,003	$ 19,003	$ 19,003	$ 372,467	$ 292,123	$ 179,140	$ 1,049,778	$ 969,434	$ 856,451
Ground Water Treatment System										
Active Recovery with 2 trenches	$ 2,664,765	$ 321,775	$ 321,775	$ 321,775	$ 6,306,924	$ 4,946,464	$ 3,033,342	$ 8,971,690	$ 7,611,230	$ 5,698,107
Active Recovery with 3 trenches	$ 2,664,765	$ 347,756	$ 347,756	$ 347,756	$ 6,816,172	$ 5,345,863	$ 3,278,267	$ 9,480,937	$ 8,010,628	$ 5,943,032
Enhanced Recovery with 3 trenches	$ 3,425,424	$ 426,474	$ 426,474	$ 426,474	$ 8,359,076	$ 6,555,949	$ 4,020,333	$ 11,784,500	$ 9,981,372	$ 7,445,756
Enhanced Recovery with 4 trenches	$ 3,425,424	$ 509,738	$ 509,738	$ 509,738	$ 9,991,095	$ 7,835,927	$ 4,805,259	$ 13,416,519	$ 11,261,350	$ 8,230,683
Total Present Value (minimum)										
Total Present Value (maximum)										

APPENDIX D

CALCULATION OF RISKS DURING EXCAVATION AND EX SITU SOLIDIFICATION/STABILIZATION

APPENDIX D CALCULATION OF RISKS DURING EXCAVATION AND EX SITU SOLIDIFICATION/STABILIZATION

1.0 INTRODUCTION

This appendix to the feasibility study for the Lenz Oil site in Lemont, Illinois, presents the procedures used for the calculation of the organic compound and particulate emissions, as well as the risks posed as a result of emissions during the remediation of the: (1) soil that poses a carcinogenic risk greater than 1×10^{-4}, and (2) light nonaqueous phase liquid- (LNAPL-) contaminated unconsolidated soil and bedrock.

The next sections describe the procedures that were followed to calculate the soil concentrations, air concentrations, and risks for the following cases:

- Excavation of
  - Soils exceeding a carcinogenic risk of 1×10^{-4};
  - LNAPL Areas 1a, 2, and 1b;
  - LNAPL Areas 1a and 2;
  - LNAPL Areas 1b;
  - Three and 4 trenches (the fourth trench is in an uncontaminated area); and
  - Two trenches.
- Excavation and *ex situ* solidification/stabilization (S/S) of:
  - Soils exceeding a carcinogenic risk of 1×10^{-4};
  - LNAPL Areas 1a, 2, and 1b;
  - LNAPL Areas 1a and 2; and
  - LNAPL Area 1b.

2.0 SOIL CONCENTRATIONS

Soil concentrations were calculated for the aforementioned types of soil, i.e., soil that poses a carcinogenic risk greater than 1×10^{-4} and LNAPL-contaminated unconsolidated soil, unconsolidated gravels, and bedrock.

2.1 SOIL POSING CARCINOGENIC RISKS GREATER THAN 1×10^{-4}

The weighted average soil concentrations (shown in Table D-1) were calculated by using: (1) the maximum detected analytical results of the samples collected in the areas that exhibit carcinogenic risks greater than 1×10^{-4} (i.e., Areas X, Y, and Z), which were obtained from Appendices M and N of the Remedial Investigation Report (RI); and (2) their respective excavation soil volumes. Because the RI appendices do not show all of the detection limits, one-half of the lowest available detection limits was used for each parameter not detected in one of the Areas. The weighted average soil concentrations shown in Table D-1 were then used to calculate the air concentrations resulting from the volatilization of organics and the emission of particulates as detailed in Sections 3.1 and 3.2, respectively. As a worst case scenario, it is assumed that the risks resulting from the *in situ* solidification/stabilization of these soils would be equal to the risks resulting from volatilization of organics and emission of particulates during excavation. As shown in Section 4.0, this assumption is valid, because most of the risks are the result of the volatilization of organics.

2.2 LNAPL-CONTAMINATED MATERIAL

The concentrations of parameters in the LNAPL were obtained from Table 5-2 of Technical Memorandum No. 4 (see Table D-2). The average LNAPL contaminant concentrations were determined by calculating the arithmetic average of the analytical results for each sample using one-half of the detection limit for nondetected parameters. If the calculated arithmetic average was higher than the maximum detected concentration (i.e., because of high detection limits), the maximum detected concentration was used as the average. After the average analyte concentrations in the LNAPL were calculated, the respective concentrations in the LNAPL-contaminated materials were estimated as described in the following subsections.

2.2.1 *Equation*

The analyte concentrations in the LNAPL-contaminated materials shown in Table D-2 were determined by: (1) assuming that all of these LNAPL-

contaminated materials (i.e., from the area of the two and three trenches, and excavation Areas 1a, 2, and 1b) would have the same concentrations upon excavation and that the LNAPL occupies all of the soil pore spaces; and (2) using the following equation:

$$C_s = (C_{LNAPL})(E_t)(\rho_{LNAPL}/\rho_{soil})$$

Where:

C_s = Analyte's concentration in the soil, mg/kg

C_{LNAPL} = Average analyte's concentration in the LNAPL, mg/kg

E_t = Total porosity, dimensionless, 0.368

ρ_{LNAPL} = LNAPL density = 860 kg/m^3

ρ_{soil} = Soil density = 1,590 kg/m^3

This formula estimates the concentration of contaminants due to LNAPL being entrapped within the pore spaces of the soil. Since the bedrock porosity to density ratio is lower than the porosity to density ratio of unconsolidated soil and gravel, worse-case LNAPL-contaminated materials analyte concentrations are generated by considering only the soil geotechnical data. The unconsolidated soil and gravel density is the arithmetic average of the sample densities listed on Table 1-2 of this FS. The LNAPL density was calculated as the LNAPL specific gravity, as reported in Technical Memorandum No. 4 (ERM-North Central, 1995a) multiplied by the density of water (i.e., 1,000 kg/m^3). The equation would tend to overestimate the risks because the LNAPL would not saturate all of the excavated materials.

As shown in Table 5-2 of Technical Memorandum No. 4, volatile organic concentrations in the LNAPL were presented in units of µg/L. These results were converted to µg/kg by using the following formula:

$$C_{LNAPL} = (C_{LNAPL,1})(CF_1)(\rho_{LNAPL})$$

Where:

$C_{LNAPL,1}$ = Average analyte's concentration in the LNAPL, µg/L

CF_1 = Conversion factor = 1 mg · L/µg/m^3

The parameters C_{LNAPL} and ρ_{LNAPL}, are as previously defined.

2.2.2 *Sample Calculation*

The following is a sample calculation estimating the concentration of benzene in the LNAPL-contaminated unconsolidated materials:

$C_{LNAPL,1}$ = 192,000 μg/L

C_{LNAPL} = (192,000 μg/L)(1 mg · L/μg/m^3)/(860 kg/m^3)

C_{LNAPL} = 223 mg/kg

Thus,

C_s = (223 mg/kg)(0.368)(860 kg/m^3)/(1,590 kg/m^3)

C_s = 44.4 mg/kg

3.0 AIR CONCENTRATIONS CALCULATION

This section presents the determination of the air concentrations used in the risk calculations, which are obtained after calculating emission rates from volatilization and particulate emissions.

The volatilization equation accounts for emissions during excavation, soil dumping into trucks and transport of soil, and from the open excavation. The particulate emission equation estimates the emissions during soil handling operations such as adding to or removing from piles, conveyor belts, or truck dumping. Particulate emission during transport of the soils or wind erosion of a soil pile was not calculated because the trucks would not be driving over the contaminated areas and soil piles would either: (1) not be used for the soil that exceeds that 1×10^{-4} cancer risk, or (2) be composed of wet LNAPL-contaminated materials with minimal emissions.

3.1 VOLATILIZATION EMISSION RATES DURING EXCAVATION

Volatilization emission rates during excavation were derived by using the following equations obtained from the United States Environmental Protection Agency's (USEPA's) *Air/Superfund National Technical Guidance Study Series: Estimation of Air Impacts for the Excavation of Contaminated Soil* (1992c). Section 3.1.1 describes the equations, site data, and assumptions used to calculate the volatilization emission rates, and Section 3.1.2 presents a sample calculation.

3.1.1 *Equations*

The emission rate for each specific compound was calculated by using the following formula:

$$ER = ER_{PS} + ER_{DIFF}$$

Where:

ER	=	Emission rate, g/s
ER_{PS}	=	Pore space emission rate, g/s
ER_{DIFF}	=	Emission rate from diffusion, g/s

Pore Space Emission Rate:

$$ER_{PS} = \frac{(P_i)(MW_i)(CF_2)(E_a)(Q)(E \cdot C)}{(R)(T)}$$

Where:

P_i	=	Compound's vapor pressure, mmHg
MW_i	=	Compound's molecular weight, g/gmole
CF_2	=	Conversion factor = 10^6 cm^3/m^3
E_a	=	Air filled porosity, dimensionless = 0.35 (default value)
Q	=	Soil excavation rate, m^3/s
E•C	=	Soil gas to atmosphere exchange constant, dimensionless = 0.33 (default value)
R	=	Universal gas constant = $\frac{62{,}361\ mmHg \cdot cm^3}{gmole \cdot K}$
T	=	Soil temperature = 288 K (15°C from the Baseline Risk Assessment document)

According to the aforementioned USEPA document, this equation may overpredict the pore space emission rate. Therefore, the result given by this equation must be checked against one-third of the total mass of each contaminant in the soil to be excavated, divided by the time of excavation. The smaller of these two figures should be used as the short-term pore space emission rate.

Emission Rate from Diffusion:

$$ER_{DIFF} = \frac{(C_i)(CF_3)(SA)}{\left(\frac{E_a}{(K_{eq})(k_g)}\right) + \left(\frac{\pi t}{(D_e)(K_{eq})}\right)^{1/2}}$$

Where:

C_i	=	Compound's concentration in soil, µg/kg
CF_3	=	Conversion factor = 10^4 cm^2/m^2
SA	=	Emitting surface area, m^2
K_{eq}	=	Equilibrium coefficient, dimensionless
k_g	=	Gas-phase mass transfer coefficient = 0.15 cm/s (default value)
π	=	Pi, dimensionless = 3.1416
t	=	Time of excavation =

(a) 1,451,500 s (24 hr/d, 16.8 d) for soils with carcinogenic risks greater than 1×10^{-4}

(b) 2,694,700 s (24 hr/d, 31.2 d) for excavation of LNAPL Area 1a, Area 2, and Area 1b

(c) 1,753,900 s (24 hr/d, 20.3 d) for excavation of LNAPL Area 1a and Area 2

(d) 940,800 s (24 hr/d, 10.9 d) for excavation of LNAPL Area 1b
(e) 154,600 s (24 hr/d, 1.8 d) for excavation of two trenches in the LNAPL Area 1
(f) 205,000 s (24 hr/d, 2.4 d) for excavation of three and four trenches in the LNAPL Area 1 (i.e., the fourth trench is located in an area where there is no LNAPL)

D_e = Compound's effective diffusivity in air, cm^2/s

Effective Diffusivity:

$$D_e = \frac{(Da_i)(E_a)^{3.33}}{(E_t)^2}$$

Where:

Da_i = Compound's diffusivity in air, cm^2/s

The parameters E_a and E_t are as previously defined.

Equilibrium Coefficient:

$$K_{eq} = \frac{H_i}{(R_1)(T)}$$

Where:

H_i = Compound's Henry's Law constant, $atm \cdot m^3/gmole$
R_1 = Gas Law constant = $8.205 \times 10^{-5} \frac{atm \cdot m^3}{gmole \cdot K}$

The parameter T is as previously defined.

Table D-3 summarizes the molecular weight, vapor pressure, diffusivity in air, and Henry's Law constant of the compounds detected in the soils exhibiting carcinogenic risks greater than 1×10^{-4} and LNAPL-contaminated materials at the site. Table D-4 presents the volatilized organics emission rates for all the excavation scenarios.

3.1.2 *Sample Calculation*

The following are the emission rate calculations for benzene in the LNAPL-contaminated materials excavation Areas 1a, 2, and 1b:

C_i	=	44,400 µg/kg
Excavation Area	=	4,140 m^2 (4,950 sq. yd.)
Soil Volume	=	3,070 m^3 (4,010 cu. yd.)
T	=	288 K (15°C)

$P = 95.2\ mmHg$
$MW = 78.1\ g/gmole$
$D_a = 0.09234\ cm^2/s$

$$Q = \frac{3{,}070\ m^3}{(31.2\ d)(24\ hr/d)(3{,}600\ s/hr)} = 0.001139\ m^3/s$$

$$ER_{PS} = \frac{(95.2\ mmHg)(78.1\ g/gmole)(0.35)(0.001139\ m^3/s)(0.33)(10^6\ cm^3/m^3)}{62{,}361\ \frac{mmHg \cdot cm^3}{gmole \cdot K}\ (288\ K)}$$

$ER_{PS} = 0.0545\ g/s$

As required in USEPA, 1992c, this figure is then compared to the maximum ER_{PS} (i.e., $ER_{PS,MAX}$), or one third the total contaminant mass divided by the excavation time.

$$ER_{PS,MAX} = (1/3)(C_i)(\rho_{SOIL})(Q)(CF_4)$$

Where:

ρ_{SOIL} = Soil bulk density = $1.59\ g/cm^3$ (assumed value)

CF_4 = Conversion factor = $1 \times 10^{-3}\ cm^3 \cdot kg/m^3/\mu g$

The parameters C_i and Q are as previously defined.

$$ER_{PS,MAX} = (0.33)(44{,}400\ \mu g/kg)(1.59\ g/cm^3)(0.001139\ m^3/s)(1 \times 10^{-3}\ cm^3 \cdot kg/m^3/\mu g)$$

$ER_{PS,MAX} = 0.0268\ g/s$

The value of the pore space emission rate is the lesser of the two pore space emission rates, (i.e., ER_{PS} and $ER_{PS,MAX}$). Therefore, the emission rate of benzene for the LNAPL-contaminated materials is 0.0268 g/s, as shown in Table D-4.

The value of ER_{DIFF} is determined by using the following values:

$C_i = 44{,}400\ \mu g/kg$
$SA = 4{,}140\ m^2$
$H_i = 5.59 \times 10^{-3}\ \frac{atm \cdot m^3}{gmole}$
$t = 2{,}694{,}700\ s\ (24\ h/d,\ 31.2\ d)$

$$K_{eq} = \frac{(5.59 \times 10^{-3}\ \frac{atm \cdot m^3}{gmole})}{(8.205 \times 10^{-5}\ \frac{atm \cdot m^3}{gmole \cdot K})(288K)} = 0.237$$

The effective diffusivity of benzene is:

$$D_e = \frac{(0.09234\ cm^2/s)(0.35)^{3.33}}{(0.368)^2} = 0.0206\ cm^2/s$$

The diffusion emission rate is:

$$ER_{DIFF} = \frac{(44{,}400\ \mu g/kg)(10^{-9}\ kg/\mu g)(1.59\ g/cm^3)(10^4 cm^2/m^2)(4{,}140\ m^2)}{\left(\frac{0.35}{(2.37 \times 10^{-1})(0.15)}\right) + \left(\frac{(3.1416)(2{,}694{,}700)}{(0.0206\ cm^2/s)(2.37 \times 10^{-1})}\right)^{1/2}}$$

$$ER_{DIFF} = 0.0702\ g/s$$

Therefore, the emission rate for benzene in the LNAPL-contaminated materials excavation is:

ER = 0.0268 + 0.0702 g/s
ER = 0.0970 g/s

3.2 *PARTICULATE EMISSION RATES DURING EXCAVATION*

The emission rates of particulate matter less than 10 microns in size during excavation were determined using an equation obtained from USEPA's *Air/Superfund National Technical Guidance Study Series: Estimation of Air Impacts from Area Sources of Particulate Matter Emissions at Superfund Sites*, EPA-451/R-93-004 (USEPA, 1993b). The equations and site data used are outlined in the following section. Particulate emissions from wind erosion of the open excavation were not considered because (1) wind erosion emissions from the open excavations were deemed negligible when compared to particulate emissions during excavation and materials handling, and (2) the material will be handled in an on-site treatment system immediately or shortly after excavation.

3.2.1 *Equation*

The particulate emission rates during excavation and materials handling were calculated by using the following equation obtained from the aforementioned document:

$$E = \frac{(k)(0.0016)(M)(\frac{U}{2.2})^{1.3}}{(\frac{X_{H2O}}{2})^{1.4}}$$

Where:

E	=	Total particulate matter emissions, g
k	=	Particulate size multiplier = 0.35 for PM10
0.0016	=	Empirical constant, g/kg

M	=	Mass of soil handled =
		(a) $2.63 \times 10^{+6}$ kg for soils posing risks greater than 1×10^{-4} carcinogenic risk
		(b) $4.88 \times 10^{+6}$ kg for LNAPL-contaminated materials from Areas 1a, 2, and 1b
		(c) $3.17 \times 10^{+6}$ kg for LNAPL-contaminated materials from Areas 1a and 2
		(d) $1.70 \times 10^{+6}$ kg for LNAPL-contaminated materials from Area 1b
		(e) $2.80 \times 10^{+5}$ kg for LNAPL-contaminated materials from two trenches
		(f) $3.71 \times 10^{+5}$ kg for LNAPL-contaminated materials from three and four trenches
U	=	Mean wind speed = 4.6 m/s
2.2	=	Empirical constant, m/s
X_{H20}	=	Percent moisture content = 19.4%

The percent moisture content was obtained by taking the arithmetic average of the percent moisture results presented in Table J-1 of Appendix J of the RI. The mean wind speed value was obtained from Appendix F of the Baseline Risk Assessment document. Table D-5 presents the emission rates and total emissions for the excavation of soils exhibiting risks greater than 1×10^{-4} and the different excavation areas of LNAPL-contaminated materials.

3.2.2 *Sample Calculation*

The particulate emission rate during excavation and materials handling of the LNAPL-contaminated material in Areas 1a, 2, and 1b is calculated as follows:

$$E = \frac{(0.35)(0.0016\ g/kg)(4.88 \times 10^{+6}\ kg)(\frac{4.6}{2.2})^{1.3}}{(\frac{19.4}{2})^{1.4}}$$

$$E = 296\ g$$

The duration of the Areas 1a, 2, and 1b LNAPL-contaminated materials excavation is 24 hrs/d for 28.3 days. Therefore, the emission rate is the total particulate matter emission rate divided by the excavation duration:

$$ER = 296\ g/(2{,}694{,}700\ s) = 1.10 \times 10^{-4}\ g/s$$

3.3 *VOLATILIZATION EMISSION RATES DURING EX SITU SOLIDIFICATION/STABILIZATION*

Volatilization emission rates during *ex situ* solidification/stabilization (S/S) were determined by using the following equation obtained from the

USEPA's *Air/Superfund National Technical Guidance Study Series: Emission Factors for Superfund Remediation Technologies* (1991c). Section 3.3.1 describes the equations, site-specific variables, and assumptions used to calculate the volatilization emission rates, while Section 3.3.2 provides a sample calculation.

3.3.1 *Equations*

The emission rate for each compound was calculated by using the following equation:

$$ER_i = (C_i)(M)\left(\frac{\%V_i}{100}\right)(CF)$$

Where:

ER_i	=	Emission rate for contaminant i, g/s
C_i	=	Soil concentration of contaminant i, mg/kg
M	=	Mass rate of soil treated, 1.81 kg/s (900 cy/week)
$\%V_i$	=	Percentage of contaminant i volatilized, 50% (assumed value from USEPA, 1991c)
CF	=	Conversion factor, 10^{-3} g/mg

As indicated in USEPA, 1991c, 40% to 80% of volatile organic compounds (VOCs) in the treated waste volatilize. Since a portion of the volatiles are emitted during materials excavation, it was assumed that 50% of the VOCs mass is emitted during *ex situ* S/S. In addition, USEPA, 1991c indicates that the particulates emissions for S/S are similar to those of materials handling. Therefore, the particulate emission rates calculated in Section 3.4.2 were used to determine the air concentrations due to particulates. Table D-5 presents the estimated emission rates during S/S.

3.3.2 *Sample Calculation*

The volatile emissions rate for benzene during the *ex situ* S/S of the LNAPL-contaminated materials is calculated as follows:

$$ER = (44.4\ mg/kg)(1.81\ kg/s)(0.50)(10^{-3}\ g/mg)$$

$$ER = 4.01 \times 10^{-2}\ g/s$$

3.4 *AIR CONCENTRATIONS*

The air concentrations of the volatilized organics and particulates were determined by using the calculated emission rates and the USEPA's SCREEN model dispersion factor (i.e., for the nearest receptor, 60 feet away from the unexcavated area) that was estimated in the Baseline Risk Assessment document. Although the value of this coefficient was not specifically provided in the Baseline Risk Assessment document or its appendices, the coefficient was calculated from the data shown in Tables E-1 and E-2 of Appendix E of that document by: (1) dividing the dispersed air concentration of each compound by its emission rate, and (2) calculating an arithmetic average of all of the determined dispersion coefficients. The resulting value is 8,861.7 mg • s/g/m.

3.4.1 *Volatilized Organics Air Concentration Equation*

The volatilized organics air concentrations were determined by using the following formula:

$$C_{ai} = (ER_i)(DF) / SA$$

Where:

C_{ai} = Compound's air concentration, mg/m^3
ER_i = Compound's emission rate, g/s
DF = Dispersion factor, mg · s/g/m = 8,861.7 mg · s/g/m

The parameter SA is as defined in Section 3.1.1.

The air concentration of specific compounds were then used to calculate the risks posed by such compounds at the receptor location. The volatilized organics concentrations of compounds in the soil exhibiting risks greater than 1×10^{-4} and the LNAPL-contaminated materials are presented in Tables D-1 and D-2, respectively. A sample calculation of the air concentration for benzene is provided in Section 4.1.2 of this appendix.

3.4.2 *Particulate Emissions Air Concentrations Equation*

The air concentration of particulate matter was determined by using the USEPA's SCREEN model dispersion factor determined for the volatilization of organics. This assumption was made because particulates of 10 microns or less behave as diffusing compounds. Thus, the compound's concentration in particulate matter at the nearest receptor is calculated as follows:

$$C_{PMi} = (C_{is})(ER)(DF)(CF_5) / SA$$

Where:

C_{PMi} = Compound's concentration in particulate matter, mg/m^3

C_{is}	=	Compound's soil concentration, mg/kg
ER	=	Particulate emission rate, g/s
DF	=	Dispersion factor, mg · s/g/m
CF_5	=	Conversion factor, 10^{-6} kg/mg

The parameter SA is as defined in Section 3.1.1.

The concentrations in particulate matter emitted during the excavation of soils that exhibit carcinogenic risks greater than 1×10^{-4} and LNAPL-contaminated materials are summarized in Tables D-1 and D-2, respectively. A sample calculation of the benzene particulate matter concentration is included in Section 4.1.2 of this appendix.

4.0 *RISK CALCULATIONS*

Risks were calculated for a short-term exposure of the nearby adult residents (i.e., the nearest receptors). The methodology used to calculate the lifetime cumulative carcinogenic risk and hazard indices is detailed in the following sections. The inhalation carcinogenic risks and hazard indices posed by the excavation of soils that exhibit carcinogenic risks greater than 1×10^{-4} and different LNAPL-contaminated materials areas are presented in Tables D-7 and D-8, respectively. The corresponding risks during excavation and *ex situ* S/S are shown in Tables D-9 and D-10.

4.1 *CARCINOGENIC RISKS*

Carcinogenic risks were calculated for the inhalation of volatilized organics and particulates emitted from the soils. The carcinogenic risk equation and the assumptions made during the calculation of risks are outlined in the following sections.

4.1.1 *Equation*

The carcinogenic risk for a specific analyte is given by the following equation:

$$CR = \frac{(C_{ia})(IR)(EF)(ED)(SF)}{(BW)(AT)}$$

Where:

C_{ia} = Analyte's average air concentration, mg/m^3 (either C_{ai} or C_{PMi})

IR = Inhalation rate = $20\ m^3/d$

EF = Exposure frequency, d/yr =
- (a) 16.8 d/yr for soils posing carcinogenic risks are greater than 1×10^{-4}
- (b) 31.2 d/yr for LNAPL-contaminated materials
- (c) 20.3 d/yr for LNAPL-contaminated materials from Areas 1a and 2
- (d) 10.9 d/yr for LNAPL-contaminated materials from Area 1b
- (e) 1.8 d/yr for LNAPL-contaminated materials from two trenches
- (f) 2.4 d/yr for LNAPL-contaminated materials from three and four trenches

ED = Exposure duration = 1 yr

SF = Analyte's inhalation slope factor, $\frac{kg \cdot d}{mg}$

BW = Body weight = 70 kg
AT = Averaging time = 25,550 d (70 yr)

The inhalation slope factors used to calculate the carcinogenic risks were obtained from Table 4-4 of the Baseline Risk Assessment document.

4.1.2 *Sample Excavation Carcinogenic Risk Calculation*

The carcinogenic risk posed by benzene in the LNAPL-contaminated materials excavated from Areas 1a, 2, and 1b is calculated by using the compound's volatilized and particulate matter concentrations at the nearest receptor location. Benzene's inhalation slope factor is 0.029 kg • d/mg and, therefore, the carcinogenic risk posed by benzene is calculated by using the calculated volatilized and particulate concentrations shown in Table D-2. These concentrations were calculated as follows:

$$C_{ai} = (0.097\ g/s)(8{,}861.7\ mg \cdot s/g/m)/(4{,}140\ m^2)$$

$$C_{ai} = 0.208\ mg/m^3$$

$$C_{PMi} = (44.4\ mg/kg)(1.10 \times 10^{-4}\ g/s)(8{,}861.7\ mg \cdot s/g/m)(10^{-6}\ kg/mg)/(4{,}065\ m^2)$$

$$C_{PMi} = 1.04 \times 10^{-8}\ mg/m^3$$

Volatilized Organics Inhalation Risk:

$$CR = \frac{(0.208\ mg/m^3)(20\ m^3/d)(31.2\ d/yr)(1\ yr)(0.029\ kg \cdot d/mg)}{(70\ kg)(25{,}550\ d)}$$

$$CR = 2.1 \times 10^{-6}$$

Particulate Inhalation Risk:

$$CR = \frac{(1.04 \times 10^{-8}\ mg/m^3)(20\ m^3/d)(31.2\ d/yr)(1\ yr)(0.029\ kg \cdot d/mg)}{(70\ kg)(25{,}550\ d)}$$

$$CR = 1.05 \times 10^{-13}$$

The total carcinogenic risk posed by benzene at the nearest receptor location is:

$$CR = 2.1 \times 10^{-6} + 1.05 \times 10^{-13}$$
$$CR = 2.1 \times 10^{-6}$$

4.1.3 *Sample Excavation and Ex Situ Solidification/Stabilization Carcinogenic Risk Calculation*

The carcinogenic risk posed by benzene during the excavation and *ex situ* S/S of LNAPL-contaminated materials in Areas 1a, 2 and 1b is calculated by adding the excavation carcinogenic risk to the risk posed by *ex situ* S/S emissions. As calculated in Section 4.1.2, the excavation carcinogenic risk posed by benzene during the excavation of these areas is 2.1×10^{-6}. The calculated volatilized and particulate concentrations during *ex situ* S/S are shown in Table D-2 and are as follows:

$C_i = 8.59 \times 10^{-2}\ mg/m^3$
$C_{PM} = 1.04 \times 10^{-8}\ mg/m^3$

Volatilized Organics Inhalation Risk:

$$CR = \frac{\left(8.59 \times 10^{-2}\ mg/m^3\right)\left(20\ m^3/d\right)(31.2\ d/yr)((1\ yr)(0.029\ kg \cdot d/mg)}{(70\ kg)(25{,}550\ d)}$$

$$CR = 8.7 \times 10^{-7}$$

Particulate Inhalation Risk:

$$CR = \frac{\left(1.04 \times 10^{-8}\ mg/m^3\right)\left(20\ m^3/d\right)(31.2\ d/yr)(1\ yr)(0.029\ kg \cdot d/mg)}{(70\ kg)(25{,}550\ d)}$$

$$CR = 1.05 \times 10^{-13}$$

The total carcinogenic risk posed by benzene emitted from the excavation and *ex situ* S/S of LNAPL-contaminated materials in Areas 1a, 2, and 1b is:

$CR = 2.1 \times 10^{-6} + 8.7 \times 10^{-7} + 1.05 \times 10^{-13}$
$CR = 3.0 \times 10^{-6}$

4.2 *HAZARD INDICES*

Hazard indices were calculated for the inhalation of volatilized organics and particulate emissions from the contaminated soils. The hazard index equation and the assumptions made during the hazard indices calculation are described in the following sections.

4.2.1 *Hazard Index Equation*

The calculation of hazard indices was performed by using the following equation:

$$HI = \frac{(C_i)(IR)(EF)(ED)}{(BW)(AT)(RfD)}$$

Where:

AT = Averaging time = 365 d
RfD = Compound's inhalation reference dose, mg/kg · d

All other parameters are as defined in Section 4.1.1.

The subchronic reference doses used to calculate the hazard indices were obtained from Table 4-2 of the Baseline Risk Assessment document.

4.2.2 *Sample Excavation Hazard Index Calculations*

Since a reference dose has not been established for benzene, the sample calculations will be conducted for toluene in Areas 1a, 2, and 1b. Toluene has a subchronic inhalation reference dose of 2 mg/kg/d. The HI posed by the inhalation of toluene emissions is calculated by using the calculated volatilized and particulate concentrations shown in Table D-2, which are:

C_{ai} = 1.98 mg/m^3
C_{PMi} = 1.37×10^{-7} mg/m^3

Volatilized Organics Inhalation Risk:

$$HI = \frac{(1.98\ mg/m^3)(20\ m^3/d)(31.2\ d/yr)(1\ yr)}{(70\ kg)(365\ d)(2\ mg/kg \cdot d)}$$

$$HI = 0.024$$

Particulate Inhalation Risk:

$$HI = \frac{(1.37 \times 10^{-7}\ mg/m^3)(20\ m^3/d)(31.2\ d/yr)(1\ yr)}{(70\ kg)(365\ d)(2\ mg/kg \cdot d)}$$

$$HI = 1.67 \times 10^{-9}$$

Therefore, the hazard index posed by toluene at the nearest receptor location is:

$$HI = 0.024 + 1.67 \times 10^{-9}$$
$$HI = 0.024$$

4.2.3 *Sample Excavation and Ex Situ Solidification/Stabilization Hazard Index Calculations*

The hazard index posed by toluene during the excavation and *ex situ* S/S of LNAPL-contaminated materials in Areas 1a, 2 and 1b is calculated by adding the excavation hazard index to the hazard indices posed by *ex situ* S/S emissions. As calculated in Section 4.2.2, the excavation hazard index posed by toluene during the excavation of these areas is 0.024. The calculated, volatilized and particulate concentrations during *ex situ* S/S are summarized in Table D-2 and are as follows:

$$C_i = 1.13\ mg/m^3$$
$$C_{PM} = 1.37 \times 10^{-7}\ mg/m^3$$

Volatilized Organics Inhalation Risk:

$$HI = \frac{(1.13\ mg/m^3)(20\ m^3/d)(31.2\ d/yr)(1\ yr)}{(70\ kg)(365\ d)(2\ mg/kg \cdot d)}$$

$$HI = 0.014$$

Particulate Inhalation Risk:

$$HI = \frac{(1.37 \times 10^{-7}\ mg/m^3)(20\ m^3/d)(31.2\ d/yr)(1\ yr)}{(70\ kg)(365\ d)(2\ mg/kg \cdot d)}$$

$$HI = 1.67 \times 10^{-9}$$

The total hazard index posed by toluene during the excavation and *ex situ* S/S of LNAPL-contaminated materials in Areas 1a, 2 and 1b is:

$$HI = 0.024 + 0.014 + 1.67 \times 10^{-9}$$
$$HI = 0.038$$

TABLES

TABLE D-1
AVERAGE VOLATILE ORGANICS AND PARTICULATES AIR CONCENTRATIONS
DURING THE SOLIDIFICATION/STABILIZATION OF SOILS
EXCEEDING 1E-04 CARCINOGENIC RISK LEVELS
LENZ OIL SITE
LEMONT, ILLINOIS

Compound	Weighted Average Soil Concentration (mg/kg)	Excavation		Excavation and Solidification/Stabilization	
		Average Volatilization Concentration (1) (mg/m3)	Average Particulates Air Concentration (mg/m3)	Average Volatilization Concentration (2) (mg/m3)	Average Particulates Air Concentration (mg/m3)
1,1,1-Trichloroethane	0.0065	7.31E-05	5.14E-12	4.24E-05	5.14E-12
Trichloroethene	0.0031	3.10E-05	2.48E-12	2.05E-05	2.48E-12
Benzene	0.0030	2.72E-05	2.40E-12	1.97E-05	2.40E-12
Tetrachloroethene	0.006	8.00E-05	4.77E-12	3.93E-05	4.77E-12
Toluene	0.0033	2.96E-05	2.63E-12	2.17E-05	2.63E-12
Ethyl benzene	0.005	4.43E-05	4.09E-12	3.37E-05	4.09E-12
Xylenes (total)	0.010	8.50E-05	7.54E-12	6.21E-05	7.54E-12
Naphthalene	0.300	1.84E-03	2.37E-10	NA	2.37E-10
2-Methylnaphthalene	0.185	0.00E+00	1.46E-10	NA	1.46E-10
Acenaphthene	0.317	2.08E-04	2.50E-10	NA	2.50E-10
Dibenzofuran	0.307	0.00E+00	2.43E-10	NA	2.43E-10
Fluorene	0.329	1.42E-04	2.59E-10	NA	2.59E-10
Phenanthrene	0.704	4.36E-04	5.55E-10	NA	5.55E-10
Anthracene	0.366	6.66E-04	2.89E-10	NA	2.89E-10
di-n-Butylphthalate	0.211	4.90E-06	1.66E-10	NA	1.66E-10
Fluoranthene	1.329	8.22E-03	1.05E-09	NA	1.05E-09
Pyrene	1.235	1.91E-04	9.75E-10	NA	9.75E-10
Benzo(a)anthracene	0.808	3.08E-05	6.37E-10	NA	6.37E-10
Chrysene	0.908	7.63E-11	7.16E-10	NA	7.16E-10
bis(2-Ethylhexyl)phthalate	0.387	9.51E-06	3.05E-10	NA	3.05E-10
Benzo(b)fluoranthene	0.957	1.55E-04	7.55E-10	NA	7.55E-10
Benzo(k)fluoranthene	0.647	9.78E-04	5.11E-10	NA	5.11E-10
Benzo(a)pyrene	0.761	5.47E-05	6.01E-10	NA	6.01E-10
Indeno(1,2,3-cd)pyrene	0.573	1.47E-12	4.52E-10	NA	4.52E-10
Benzo(g,h,i)perylene	0.509	8.33E-06	4.02E-10	NA	4.02E-10
Aroclor-1242	10.3	1.13E-02	8.13E-09	NA	8.13E-09
Aroclor-1254	8.000	1.83E-02	6.31E-09	NA	6.31E-09
Aroclor-1260	0.589	2.11E-03	4.65E-10	NA	4.65E-10
beta-BHC	0.075	1.57E-06	5.89E-11	NA	5.89E-11
Aluminum	22,664	NA	1.79E-05	NA	1.79E-05
Barium	1,137	NA	8.97E-07	NA	8.97E-07
Cadmium	1.47	NA	1.16E-09	NA	1.16E-09
Calcium	81,809	NA	6.45E-05	NA	6.45E-05
Chromium	84.1	NA	6.63E-08	NA	6.63E-08
Cobalt	17.2	NA	1.36E-08	NA	1.36E-08
Copper	579.2	NA	4.57E-07	NA	4.57E-07
Iron	35,613	NA	2.81E-05	NA	2.81E-05
Lead	621.1	NA	4.90E-07	NA	4.90E-07
Magnesium	40,407	NA	3.19E-05	NA	3.19E-05
Mercury	0.084	NA	6.61E-11	NA	6.61E-11
Nickel	41.3	NA	3.25E-08	NA	3.25E-08
Potassium	4,499	NA	3.55E-06	NA	3.55E-06
Silver	0.089	NA	7.01E-11	NA	7.01E-11
Sodium	3,076	NA	2.43E-06	NA	2.43E-06
Vanadium	60.3	NA	4.75E-08	NA	4.75E-08
Zinc	568.9	NA	4.49E-07	NA	4.49E-07
Cyanide	5.54	NA	4.37E-09	NA	4.37E-09

Note:

(1) The volatilization concentration of inorganic analytes is shown as not applicable because inorganic analytes do not volatilize.

(2) The volatilization concentration of organics other than volatile organic compounds and inorganic analytes is shown as not applicable because inorganic analytes do not volatilize.

Key:

NA = Not applicable

TABLE D-2

AVERAGE VOLATILE ORGANICS AND PARTICULATES AIR CONCENTRATIONS

DURING THE SOLIDIFICATION/STABILIZATION OF

LNAPL-CONTAMINATED MATERIALS

LENZ OIL SITE

LEMONT, ILLINOIS

Compound	Average LNAPL Concentration (ug/l)	Average LNAPL Concentration (ug/kg)	Average Soil Concentration (mg/kg)	Soil Excavation: Areas 1a & 2, and Area 1b: Average Volatilization Concentration (1) (mg/m3)	Areas 1a & 2, and Area 1b: Average Particulates Air Concentration (mg/m3)	Areas 1a & 2: Average Volatilization Concentration (1) (mg/m3)	Areas 1a & 2: Average Particulates Air Concentration (mg/m3)	Area 1b: Average Volatilization Concentration (1) (mg/m3)	Area 1b: Average Particulates Air Concentration (mg/m3)	Three and Four Trenches: Average Volatilization Concentration (1) (mg/m3)	Three and Four Trenches: Average Particulates Air Concentration (mg/m3)	Two Trenches: Average Volatilization Concentration (1) (mg/m3)	Two Trenches: Average Particulates Air Concentration (mg/m3)
Acetone	86,000	100,000	19.9	3.00E-02	4.68E-09	4.95E-02	8.04E-09	6.87E-02	1.12E-08	5.05E-01	8.91E-08	7.66E-01	1.36E-07
1,1-Dichloroethene	780	907	0.181	1.41E-03	4.24E-11	1.87E-03	7.29E-11	2.56E-03	1.01E-10	8.72E-03	8.08E-10	1.17E-02	1.24E-09
1,1-Dichloroethane	3,600	4,186	0.833	3.53E-03	1.96E-10	4.90E-03	3.37E-10	6.73E-03	4.68E-10	2.94E-02	3.73E-09	4.16E-02	5.70E-09
1,2-Dichloroethene (total)	213,000	247,674	49.3	1.44E+00	1.16E-08	1.82E+00	1.99E-08	2.49E+00	2.77E-08	6.22E+00	2.21E-07	7.62E+00	3.37E-07
1,1,1-Trichloroethane	229,333	266,667	53.1	3.36E-01	1.25E-08	4.50E-01	2.14E-08	6.17E-01	2.98E-08	2.28E+00	2.38E-07	3.11E+00	3.63E-07
Trichloroethene	86,000	100,000	19.9	1.06E-01	4.68E-09	1.44E-01	8.04E-09	1.98E-01	1.12E-08	7.81E-01	8.91E-08	1.08E+00	1.36E-07
Benzene	191,733	222,946	44.4	2.08E-01	1.04E-08	2.85E-01	1.79E-08	3.91E-01	2.49E-08	1.64E+00	1.99E-07	2.30E+00	3.04E-07
Tetrachloroethene	65,000	75,581	15.0	1.18E-01	3.54E-09	1.55E-01	6.08E-09	2.13E-01	8.46E-09	7.26E-01	6.73E-08	9.76E-01	1.03E-07
Toluene	2,516,333	2,925,969	582	1.98E+00	1.37E-07	2.48E+00	2.35E-07	3.38E+00	3.27E-07	7.86E+00	2.61E-06	9.36E+00	3.99E-06
Ethyl benzene	1,114,333	1,295,736	258	8.13E-01	6.06E-08	1.02E+00	1.04E-07	1.39E+00	1.45E-07	3.20E+00	1.15E-06	3.81E+00	1.77E-06
Xylenes (total)	4,976,667	5,786,822	1,152	3.87E+00	2.71E-07	4.81E+00	4.65E-07	6.56E+00	6.48E-07	1.43E+01	5.16E-06	1.66E+01	7.89E-06
Naphthalene	786,667	786,667	157	2.06E-01	3.68E-08	2.55E-01	6.33E-08	3.48E-01	8.80E-08	7.52E-01	7.01E-07	8.69E-01	1.07E-06
2-Methylnaphthalene	2,700,000	2,700,000	537	0.00E+00	1.26E-07	0.00E+00	2.17E-07	0.00E+00	3.02E-07	0.00E+00	2.41E-06	0.00E+00	3.68E-06
Acenaphthene	216,667	216,667	43.1	1.95E-02	1.01E-08	2.41E-02	1.74E-08	3.29E-02	2.42E-08	7.05E-02	1.93E-07	8.11E-02	2.95E-07
Fluorene	223,333	223,333	44.5	1.35E-02	1.05E-08	1.68E-02	1.80E-08	2.29E-02	2.50E-08	4.88E-02	1.99E-07	5.62E-02	3.04E-07
Phenanthrene	560,000	560,000	111	5.00E-02	2.62E-08	6.19E-02	4.50E-08	8.45E-02	6.27E-08	1.81E-01	4.99E-07	2.08E-01	7.63E-07
bis(2-Ethylhexyl)phthalate	463,333	463,333	92.2	1.67E-03	2.17E-08	2.07E-03	3.73E-08	2.80E-03	5.18E-08	5.77E-03	4.13E-07	6.58E-03	6.31E-07
Aroclor-1242	158,333	158,333	31.5	2.53E-02	7.41E-09	3.14E-02	1.27E-08	4.28E-02	1.77E-08	9.17E-02	1.41E-07	1.06E-01	2.16E-07
Aroclor-1260	39,333	39,333	7.83	2.05E-02	1.84E-09	2.55E-02	3.16E-09	3.48E-02	4.40E-09	7.44E-02	3.50E-08	8.57E-02	5.36E-08
Aluminum	17.7	17,733	3.5	NA	8.30E-10	NA	1.43E-09	NA	1.98E-09	NA	1.58E-08	NA	2.42E-08
Arsenic	3.7	3,733	0.743	NA	1.75E-10	NA	3.00E-10	NA	4.18E-10	NA	3.33E-09	NA	5.09E-09
Barium	151	151,333	30.1	NA	7.08E-09	NA	1.22E-08	NA	1.69E-08	NA	1.35E-07	NA	2.06E-07
Cadmium	307	307,000	61.1	NA	1.44E-08	NA	2.47E-08	NA	3.44E-08	NA	2.74E-07	NA	4.18E-07
Chromium	6.3	6,300	1.3	NA	2.95E-10	NA	5.07E-10	NA	7.05E-10	NA	5.61E-09	NA	8.58E-09
Copper	2.3	2,300	0.458	NA	1.08E-10	NA	1.85E-10	NA	2.57E-10	NA	2.05E-09	NA	3.13E-09
Iron	56.9	56,933	11.3	NA	2.66E-09	NA	4.58E-09	NA	6.37E-09	NA	5.07E-08	NA	7.76E-08
Lead	126	125,667	25.0	NA	5.88E-09	NA	1.01E-08	NA	1.41E-08	NA	1.12E-07	NA	1.71E-07
Manganese	1.3	1,333	0.265	NA	6.24E-11	NA	1.07E-10	NA	1.49E-10	NA	1.19E-09	NA	1.82E-09
Selenium	0.22	220	0.044	NA	1.03E-11	NA	1.77E-11	NA	2.46E-11	NA	1.96E-10	NA	3.00E-10
Vanadium	3.2	3,167	0.630	NA	1.48E-10	NA	2.55E-10	NA	3.54E-10	NA	2.82E-09	NA	4.31E-09
Zinc	4.6	4,567	0.909	NA	2.14E-10	NA	3.67E-10	NA	5.11E-10	NA	4.07E-09	NA	6.22E-09

Note:

(1) The volatilization concentration of inorganic analytes is shown as not applicable because inorganic analytes do not volatilize.

Key:

LNAPL = Light nonaquaeous phase liquid.

NA = Not applicable.

TABLE D-2
AVERAGE VOLATILE ORGANICS AND PARTICULATES AIR CONCENTRATIONS
DURING THE SOLIDIFICATION/STABILIZATION OF
LNAPL-CONTAMINATED MATERIALS
LENZ OIL SITE
LEMONT, ILLINOIS

Compound	Average LNAPL Concentration (ug/l)	Average LNAPL Concentration (ug/kg)	Average Soil Concentration (mg/kg)	Soil Solidification/Stabilization: Areas 1a & 2, and Area 1b: Average Volatilization Concentration (1) (mg/m3)	Areas 1a & 2, and Area 1b: Average Particulates Air Concentration (mg/m3)	Areas 1a & 2: Average Volatilization Concentration (1) (mg/m3)	Areas 1a & 2: Average Particulates Air Concentration (mg/m3)	Area 1b: Average Volatilization Concentration (1) (mg/m3)	Area 1b: Average Particulates Air Concentration (mg/m3)
Acetone	86,000	100,000	19.9	3.86E-02	4.68E-09	6.63E-02	8.04E-09	9.22E-02	1.12E-08
1,1-Dichloroethene	780	907	0.181	3.50E-04	4.24E-11	6.01E-04	7.29E-11	8.36E-04	1.01E-10
1,1-Dichloroethane	3,600	4,186	0.833	1.61E-03	1.96E-10	2.77E-03	3.37E-10	3.86E-03	4.68E-10
1,2-Dichloroethene (total)	213,000	247,674	49.3	9.55E-02	1.16E-08	1.64E-01	1.99E-08	2.28E-01	2.77E-08
1,1,1-Trichloroethane	229,333	266,667	53.1	1.03E-01	1.25E-08	1.77E-01	2.14E-08	2.46E-01	2.98E-08
Trichloroethene	86,000	100,000	19.9	3.86E-02	4.68E-09	6.63E-02	8.04E-09	9.22E-02	1.12E-08
Benzene	191,733	222,946	44.4	8.59E-02	1.04E-08	1.48E-01	1.79E-08	2.06E-01	2.49E-08
Tetrachloroethene	65,000	75,581	15.0	2.91E-02	3.54E-09	5.01E-02	6.08E-09	6.97E-02	8.46E-09
Toluene	2,516,333	2,925,969	582	1.13E+00	1.37E-07	1.94E+00	2.35E-07	2.70E+00	3.27E-07
Ethyl benzene	1,114,333	1,295,736	258	5.00E-01	6.06E-08	8.59E-01	1.04E-07	1.19E+00	1.45E-07
Xylenes (total)	4,976,667	5,786,822	1,152	2.23E+00	2.71E-07	3.83E+00	4.65E-07	5.33E+00	6.48E-07
Naphthalene	786,667	786,667	157	NA	3.68E-08	NA	6.33E-08	NA	8.80E-08
2-Methylnaphthalene	2,700,000	2,700,000	537	NA	1.26E-07	NA	2.17E-07	NA	3.02E-07
Acenaphthene	216,667	216,667	43.1	NA	1.01E-08	NA	1.74E-08	NA	2.42E-08
Fluorene	223,333	223,333	44.5	NA	1.05E-08	NA	1.80E-08	NA	2.50E-08
Phenanthrene	560,000	560,000	111	NA	2.62E-08	NA	4.50E-08	NA	6.27E-08
bis(2-Ethylhexyl)phthalate	463,333	463,333	92.2	NA	2.17E-08	NA	3.73E-08	NA	5.18E-08
Aroclor-1242	158,333	158,333	31.5	NA	7.41E-09	NA	1.27E-08	NA	1.77E-08
Aroclor-1260	39,333	39,333	7.83	NA	1.84E-09	NA	3.16E-09	NA	4.40E-09
Aluminum	17.7	17,733	3.5	NA	8.30E-10	NA	1.43E-09	NA	1.98E-09
Arsenic	3.7	3,733	0.743	NA	1.75E-10	NA	3.00E-10	NA	4.18E-10
Barium	151	151,333	30.1	NA	7.08E-09	NA	1.22E-08	NA	1.69E-08
Cadmium	307	307,000	61.1	NA	1.44E-08	NA	2.47E-08	NA	3.44E-08
Chromium	6.3	6,300	1.3	NA	2.95E-10	NA	5.07E-10	NA	7.05E-10
Copper	2.3	2,300	0.458	NA	1.08E-10	NA	1.85E-10	NA	2.57E-10
Iron	56.9	56,933	11.3	NA	2.66E-09	NA	4.58E-09	NA	6.37E-09
Lead	126	125,667	25.0	NA	5.88E-09	NA	1.01E-08	NA	1.41E-08
Manganese	1.3	1,333	0.265	NA	6.24E-11	NA	1.07E-10	NA	1.49E-10
Selenium	0.22	220	0.044	NA	1.03E-11	NA	1.77E-11	NA	2.46E-11
Vanadium	3.2	3,167	0.630	NA	1.48E-10	NA	2.55E-10	NA	3.54E-10
Zinc	4.6	4,567	0.909	NA	2.14E-10	NA	3.67E-10	NA	5.11E-10

Note:

(1) The volatilization concentration of organics other than volatile organic compounds and inorganic analytes is shown as not applicable because inorganic analytes do not volatileize.

Key:

LNAPL = Light nonaquaeous phase liquid.

NA = Not applicable.

TABLE D-3
COMPOUND PROPERTIES USED IN THE DETERMINATION OF THE VOLATILE EMISSION RATES (1)
LENZ OIL SITE
LEMONT, ILLINOIS

Compound	Molecular Weight [g/mol]	Vapor Pressure [mmHg]	Diffusivity in Air [cm2/s]	Henry's Law Constant [atm*m3/mol]
Acetone	58.08	266	0.1031	0.0000206
1,1-Dichloroethane	98.96	234	0.091	0.00431
1,1-Dichloroethene	96.94	591	0.0919	0.021
1,2-Dichloroethene (total)	96.94	265	0.0919	0.384
1,1,1-Trichloroethane	133.41	123	0.0797	0.0144
Trichloroethene	131.40	75	0.0812	0.0091
Benzene	78.12	95.2	0.09234	0.00559
Tetrachloroethene	165.83	19	0.0741	0.0259
Toluene	92.14	30	0.0783	0.00637
Ethyl benzene	106.16	10	0.0667	0.00643
Xylenes (total)	106.20	10	0.0717	0.00704
Naphthalene	128.16	0.23	0.067304	0.00115
2-Methylnaphthalene (2)	142.20	No Data	0.0639	No Data
Acenaphthene	154.21	0.00155	0.06136	0.00015
Dibenzofuran (2)	168.20	No Data	0.058748	No Data
Fluorene	166.22	0.00071	0.06514	0.0000642
Phenanthrene	178.22	0.00068	0.057074	0.000159
Anthracene	178.24	0.000195	0.057074	0.0014
di-n-Butylphthalate	278.00	0.00001	0.0467	0.000000282
Fluoranthene	202.26	0.01	0.053576	0.0169
Pyrene	202.26	0.000000685	0.053576	0.0000109
Benzo(a)anthracene	228.30	0.000000005	0.056058	0.00000066
Chrysene	228.30	6.3E-09	0.056058	7.26E-20
bis(2-Ethylhexyl)phthalate	390.54	0.0000002	0.042807	0.000000361
Benzo(b)fluoranthene	252.32	0.0000005	0.053322	0.000012
Benzo(k)fluoranthene	252.32	9.59E-11	0.053322	0.00104
Benzo(a)pyrene	252.32	5.49E-09	0.053322	0.0000024
Indeno(1,2,3-cd)pyrene	276.34	1E-10	0.050951	2.96E-20
Benzo(g,h,i)perylene	276.34	1.01E-10	0.050951	0.00000014
Aroclor-1242	261.00	0.001	0.0519	0.00056
Aroclor-1254	327.00	0.00006	0.047025	0.0027
Aroclor-1260	370.00	0.0000405	0.043653	0.0071
beta-BHC	290.83	0.00000028	0.04962	0.00000023

Notes:

(1) Data obtained from the Baseline Risk Assessment document and from Montgomery, J.H. and L.M. Welkom, *Groundwater Chemicals Desk Reference.* Chelsea, Michigan: Lewis Publishers, Inc., 1989.

(2) No vapor pressure or Henry's Law constant data were available for these compounds.

TABLE D-4
EMISSION RATES OF VOLATILIZED ORGANICS DURING EXCAVATION
LENZ OIL SITE
LEMONT, ILLINOIS

	Soil Concentration [ug/kg]	Soil Concentration [g/cm3]	Total Mass of Contaminant [g]	1/3 of Total Mass in Soil [g]	Maximum Pore Space Emission Rate [g/s]	Calculated Pore Space Emission Rate [g/s]	Pore Space Emission Rate [g/s]	Emission Rate from Diffusion [g/s]	Total Estimated Emission Rate [g/s]
Soil Exhibiting Carcinogenic Risks Greater than 1E-04									
Compound									
1,1,1-Trichloroethane	6.5	1.04E-08	1.71E+01	5.71E+00	3.93E-06	1.21E-01	3.93E-06	6.24E-06	1.02E-05
Trichloroethene	3.1	5.01E-09	8.27E+00	2.76E+00	1.90E-06	7.28E-02	1.90E-06	2.42E-06	4.32E-06
Benzene	3.0	4.83E-09	7.98E+00	2.66E+00	1.83E-06	5.49E-02	1.83E-06	1.95E-06	3.78E-06
Tetrachloroethene	6.1	9.62E-09	1.59E+01	5.30E+00	3.65E-06	2.33E-02	3.65E-06	7.49E-06	1.11E-05
Toluene	3.3	5.30E-09	8.75E+00	2.92E+00	2.01E-06	2.04E-02	2.01E-06	2.10E-06	4.11E-06
Ethyl benzene	5.2	8.24E-09	1.36E+01	4.54E+00	3.13E-06	7.84E-03	3.13E-06	3.03E-06	6.16E-06
Xylenes (total)	9.6	1.52E-08	2.51E+01	8.36E+00	5.76E-06	7.85E-03	5.76E-06	6.06E-06	1.18E-05
Naphthalene	300	4.77E-07	7.88E+02	2.63E+02	1.81E-04	2.18E-04	1.81E-04	7.46E-05	2.56E-04
2-Methylnaphthalene	185	2.94E-07	4.86E+02	1.62E+02	1.12E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Acenaphthene	317	5.05E-07	8.34E+02	2.78E+02	1.91E-04	1.77E-06	1.77E-06	2.72E-05	2.89E-05
Dibenzofuran	307	4.89E-07	8.07E+02	2.69E+02	1.85E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fluorene	329	5.22E-07	8.63E+02	2.88E+02	1.98E-04	8.72E-07	8.72E-07	1.89E-05	1.98E-05
Phenanthrene	704	1.12E-06	1.85E+03	6.16E+02	4.24E-04	8.95E-07	8.95E-07	5.98E-05	6.07E-05
Anthracene	366	5.82E-07	9.62E+02	3.21E+02	2.21E-04	2.57E-07	2.57E-07	9.25E-05	9.27E-05
di-n-Butylphthalate	211	3.35E-07	5.53E+02	1.84E+02	1.27E-04	2.05E-08	2.05E-08	6.62E-07	6.83E-07
Fluoranthene	1,329	2.11E-06	3.49E+03	1.16E+03	8.01E-04	1.49E-05	1.49E-05	1.13E-03	1.14E-03
Pyrene	1,235	1.96E-06	3.24E+03	1.08E+03	7.45E-04	1.02E-09	1.02E-09	2.65E-05	2.65E-05
Benzo(a)anthracene	808	1.28E-06	2.12E+03	7.07E+02	4.87E-04	8.43E-12	8.43E-12	4.29E-06	4.29E-06
Chrysene	908	1.44E-06	2.38E+03	7.94E+02	5.47E-04	1.06E-11	1.06E-11	2.34E-17	1.06E-11
bis(2-Ethylhexyl)phthalate	387	6.15E-07	1.02E+03	3.39E+02	2.33E-04	5.77E-10	5.77E-10	1.32E-06	1.32E-06
Benzo(b)fluoranthene	957	1.52E-06	2.51E+03	8.37E+02	5.77E-04	9.32E-10	9.32E-10	2.15E-05	2.15E-05
Benzo(k)fluoranthene	647	1.03E-06	1.70E+03	5.67E+02	3.90E-04	1.79E-13	1.79E-13	1.36E-04	1.36E-04
Benzo(a)pyrene	761	1.21E-06	2.00E+03	6.66E+02	4.59E-04	1.02E-11	1.02E-11	7.61E-06	7.61E-06
Indeno(1,2,3-c,d)pyrene	573	9.11E-07	1.50E+03	5.01E+02	3.45E-04	2.04E-13	2.04E-13	6.03E-18	2.04E-13
Benzo(g,h,i)perylene	509	8.09E-07	1.34E+03	4.46E+02	3.07E-04	2.06E-13	2.06E-13	1.16E-06	1.16E-06
Aroclor-1242	10,302	1.64E-05	2.71E+04	9.02E+03	6.21E-03	1.93E-06	1.93E-06	1.57E-03	1.57E-03
Aroclor-1254	8,000	1.27E-05	2.10E+04	7.00E+03	4.82E-03	1.45E-07	1.45E-07	2.55E-03	2.55E-03
Aroclor-1260	589	9.37E-07	1.55E+03	5.16E+02	3.55E-04	1.11E-07	1.11E-07	2.93E-04	2.93E-04
beta-BHC	74.7	1.19E-07	1.96E+02	6.54E+01	4.50E-05	6.02E-10	6.02E-10	2.17E-07	2.18E-07

TABLE D-4
EMISSION RATES OF VOLATILIZED ORGANICS DURING EXCAVATION
LENZ OIL SITE
LEMONT, ILLINOIS

	Soil Concentration [ug/kg]	[g/cm3]	Total Mass of Contaminant [g]	1/3 of Total Mass in Soil [g]	Maximum Pore Space Emission Rate [g/s]	Calculated Pore Space Emission Rate [g/s]	Pore Space Emission Rate [g/s]	Emission Rate from Diffusion [g/s]	Total Estimated Emission Rate [g/s]
LNAPL-Contaminated Materials, Areas 1a & 2, and Area 1b									
Compound									
Acetone	19,904	3.16E-05	9.70E+04	3.23E+04	1.20E-02	1.14E-01	1.20E-02	2.01E-03	1.40E-02
1,1-Dichloroethene	181	2.87E-07	8.80E+02	2.93E+02	1.09E-04	4.23E-01	1.09E-04	5.52E-04	6.61E-04
1,1-Dichloroethane	833	1.32E-06	4.06E+03	1.35E+03	5.02E-04	1.71E-01	5.02E-04	1.15E-03	1.65E-03
1,2-Dichloroethene (total)	49,298	7.84E-05	2.40E+05	8.01E+04	2.97E-02	1.90E-01	2.97E-02	6.45E-01	6.74E-01
1,1,1-Trichloroethane	53,078	8.44E-05	2.59E+05	8.63E+04	3.20E-02	1.21E-01	3.20E-02	1.25E-01	1.57E-01
Trichloroethene	19,904	3.16E-05	9.70E+04	3.23E+04	1.20E-02	7.28E-02	1.20E-02	3.77E-02	4.97E-02
Benzene	44,376	7.06E-05	2.16E+05	7.21E+04	2.68E-02	5.49E-02	2.68E-02	7.02E-02	9.69E-02
Tetrachloroethene	15,044	2.39E-05	7.33E+04	2.44E+04	9.07E-03	2.33E-02	9.07E-03	4.59E-02	5.49E-02
Toluene	582,397	9.26E-04	2.84E+06	9.46E+05	3.51E-01	2.04E-02	2.04E-02	9.05E-01	9.25E-01
Ethylbenzene	257,909	4.10E-04	1.26E+06	4.19E+05	1.56E-01	7.84E-03	7.84E-03	3.72E-01	3.80E-01
Xylene	1,151,832	1.83E-03	5.62E+06	1.87E+06	6.95E-01	7.85E-03	7.85E-03	1.80E+00	1.81E+00
Naphthalene	156,581	2.49E-04	7.63E+05	2.54E+05	9.44E-02	2.18E-04	2.18E-04	9.58E-02	9.61E-02
2-Methylnaphthalene	537,419	8.54E-04	2.62E+06	8.73E+05	3.24E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Acenaphthene	43,126	6.86E-05	2.10E+05	7.01E+04	2.60E-02	1.77E-06	1.77E-06	9.10E-03	9.10E-03
Fluorene	44,453	7.07E-05	2.17E+05	7.22E+04	2.68E-02	8.72E-07	8.72E-07	6.32E-03	6.32E-03
Phenanthrene	111,465	1.77E-04	5.43E+05	1.81E+05	6.72E-02	8.95E-07	8.95E-07	2.33E-02	2.33E-02
bis(2-Ethylhexyl)phthalate	92,224	1.47E-04	4.50E+05	1.50E+05	5.56E-02	5.77E-10	5.77E-10	7.82E-04	7.82E-04
Aroclor-1242	31,515	5.01E-05	1.54E+05	5.12E+04	1.90E-02	1.93E-06	1.93E-06	1.18E-02	1.18E-02
Aroclor-1260	7,829	1.24E-05	3.82E+04	1.27E+04	4.72E-03	1.11E-07	1.11E-07	9.59E-03	9.59E-03

TABLE D-4
EMISSION RATES OF VOLATILIZED ORGANICS DURING EXCAVATION
LENZ OIL SITE
LEMONT, ILLINOIS

	Soil Concentration [ug/kg]	Soil Concentration [g/cm3]	Total Mass of Contaminant [g]	1/3 of Total Mass in Soil [g]	Maximum Pore Space Emission Rate [g/s]	Calculated Pore Space Emission Rate [g/s]	Pore Space Emission Rate [g/s]	Emission Rate from Diffusion [g/s]	Total Estimated Emission Rate [g/s]
LNAPL-Contaminated Materials, Areas 1a & 2									
Compound									
Acetone	19,904	3.16E-05	6.32E+04	2.11E+04	1.20E-02	1.14E-01	1.20E-02	1.45E-03	1.35E-02
1,1-Dichloroethene	181	2.87E-07	5.73E+02	1.91E+02	1.09E-04	4.23E-01	1.09E-04	3.98E-04	5.07E-04
1,1-Dichloroethane	833	1.32E-06	2.64E+03	8.81E+02	5.02E-04	1.71E-01	5.02E-04	8.28E-04	1.33E-03
1,2-Dichloroethene (total)	49,298	7.84E-05	1.56E+05	5.21E+04	2.97E-02	1.90E-01	2.97E-02	4.65E-01	4.95E-01
1,1,1-Trichloroethane	53,078	8.44E-05	1.68E+05	5.61E+04	3.20E-02	1.21E-01	3.20E-02	9.02E-02	1.22E-01
Trichloroethene	19,904	3.16E-05	6.32E+04	2.11E+04	1.20E-02	7.28E-02	1.20E-02	2.72E-02	3.92E-02
Benzene	44,376	7.06E-05	1.41E+05	4.69E+04	2.68E-02	5.49E-02	2.68E-02	5.06E-02	7.74E-02
Tetrachloroethene	15,044	2.39E-05	4.77E+04	1.59E+04	9.07E-03	2.33E-02	9.07E-03	3.31E-02	4.21E-02
Toluene	582,397	9.26E-04	1.85E+06	6.16E+05	3.51E-01	2.04E-02	2.04E-02	6.53E-01	6.73E-01
Ethylbenzene	257,909	4.10E-04	8.18E+05	2.73E+05	1.56E-01	7.84E-03	7.84E-03	2.68E-01	2.76E-01
Xylene	1,151,832	1.83E-03	3.65E+06	1.22E+06	6.95E-01	7.85E-03	7.85E-03	1.30E+00	1.31E+00
Naphthalene	156,581	2.49E-04	4.97E+05	1.66E+05	9.44E-02	2.18E-04	2.18E-04	6.91E-02	6.93E-02
2-Methylnaphthalene	537,419	8.54E-04	1.71E+06	5.68E+05	3.24E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Acenaphthene	43,126	6.86E-05	1.37E+05	4.56E+04	2.60E-02	1.77E-06	1.77E-06	6.56E-03	6.56E-03
Fluorene	44,453	7.07E-05	1.41E+05	4.70E+04	2.68E-02	8.72E-07	8.72E-07	4.55E-03	4.55E-03
Phenanthrene	111,465	1.77E-04	3.54E+05	1.18E+05	6.72E-02	8.95E-07	8.95E-07	1.68E-02	1.68E-02
bis(2-Ethylhexyl)phthalate	92,224	1.47E-04	2.93E+05	9.75E+04	5.56E-02	5.77E-10	5.77E-10	5.61E-04	5.61E-04
Aroclor-1242	31,515	5.01E-05	1.00E+05	3.33E+04	1.90E-02	1.93E-06	1.93E-06	8.52E-03	8.52E-03
Aroclor-1260	7,829	1.24E-05	2.48E+04	8.28E+03	4.72E-03	1.11E-07	1.11E-07	6.92E-03	6.92E-03

TABLE D-4
EMISSION RATES OF VOLATILIZED ORGANICS DURING EXCAVATION
LENZ OIL SITE
LEMONT, ILLINOIS

	Soil Concentration [ug/kg]	[g/cm3]	Total Mass of Contaminant [g]	1/3 of Total Mass in Soil [g]	Maximum Pore Space Emission Rate [g/s]	Calculated Pore Space Emission Rate [g/s]	Pore Space Emission Rate [g/s]	Emission Rate from Diffusion [g/s]	Total Estimated Emission Rate [g/s]
LNAPL-Contaminated Materials, Area 1b									
Compound									
Acetone	19,904	3.16E-05	3.39E+04	1.13E+04	1.20E-02	1.14E-01	1.20E-02	1.42E-03	1.34E-02
1,1-Dichloroethene	181	2.87E-07	3.07E+02	1.02E+02	1.09E-04	4.23E-01	1.09E-04	3.91E-04	4.99E-04
1,1-Dichloroethane	833	1.32E-06	1.42E+03	4.73E+02	5.02E-04	1.71E-01	5.02E-04	8.12E-04	1.31E-03
1,2-Dichloroethene (total)	49,298	7.84E-05	8.39E+04	2.80E+04	2.97E-02	1.90E-01	2.97E-02	4.56E-01	4.86E-01
1,1,1-Trichloroethane	53,078	8.44E-05	9.03E+04	3.01E+04	3.20E-02	1.21E-01	3.20E-02	8.86E-02	1.21E-01
Trichloroethene	19,904	3.16E-05	3.39E+04	1.13E+04	1.20E-02	7.28E-02	1.20E-02	2.66E-02	3.86E-02
Benzene	44,376	7.06E-05	7.55E+04	2.52E+04	2.68E-02	5.49E-02	2.68E-02	4.96E-02	7.64E-02
Tetrachloroethene	15,044	2.39E-05	2.56E+04	8.53E+03	9.07E-03	2.33E-02	9.07E-03	3.25E-02	4.15E-02
Toluene	582,397	9.26E-04	9.91E+05	3.30E+05	3.51E-01	2.04E-02	2.04E-02	6.40E-01	6.61E-01
Ethylbenzene	257,909	4.10E-04	4.39E+05	1.46E+05	1.56E-01	7.84E-03	7.84E-03	2.63E-01	2.71E-01
Xylene	1,151,832	1.83E-03	1.96E+06	6.53E+05	6.95E-01	7.85E-03	7.85E-03	1.27E+00	1.28E+00
Naphthalene	156,581	2.49E-04	2.67E+05	8.88E+04	9.44E-02	2.18E-04	2.18E-04	6.78E-02	6.80E-02
2-Methylnaphthalene	537,419	8.54E-04	9.15E+05	3.05E+05	3.24E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Acenaphthene	43,126	6.86E-05	7.34E+04	2.45E+04	2.60E-02	1.77E-06	1.77E-06	6.43E-03	6.43E-03
Fluorene	44,453	7.07E-05	7.57E+04	2.52E+04	2.68E-02	8.72E-07	8.72E-07	4.46E-03	4.46E-03
Phenanthrene	111,465	1.77E-04	1.90E+05	6.32E+04	6.72E-02	8.95E-07	8.95E-07	1.65E-02	1.65E-02
bis(2-Ethylhexyl)phthalate	92,224	1.47E-04	1.57E+05	5.23E+04	5.56E-02	5.77E-10	5.77E-10	5.46E-04	5.46E-04
Aroclor-1242	31,515	5.01E-05	5.36E+04	1.79E+04	1.90E-02	1.93E-06	1.93E-06	8.36E-03	8.36E-03
Aroclor-1260	7,829	1.24E-05	1.33E+04	4.44E+03	4.72E-03	1.11E-07	1.11E-07	6.79E-03	6.79E-03

TABLE D-4
EMISSION RATES OF VOLATILIZED ORGANICS DURING EXCAVATION
LENZ OIL SITE
LEMONT, ILLINOIS

	Soil Concentration [ug/kg]	[g/cm3]	Total Mass of Contaminant [g]	1/3 of Total Mass in Soil [g]	Maximum Pore Space Emission Rate [g/s]	Calculated Pore Space Emission Rate [g/s]	Pore Space Emission Rate [g/s]	Emission Rate from Diffusion [g/s]	Total Estimated Emission Rate [g/s]
LNAPL-Contaminated Materials, Three and Four Trenches									
Compound									
Acetone	19,904	3.16E-05	7.38E+03	2.46E+03	1.20E-02	1.14E-01	1.20E-02	3.79E-04	1.24E-02
1,1-Dichloroethene	181	2.87E-07	6.69E+01	2.23E+01	1.09E-04	4.23E-01	1.09E-04	1.05E-04	2.14E-04
1,1-Dichloroethane	833	1.32E-06	3.09E+02	1.03E+02	5.02E-04	1.71E-01	5.02E-04	2.19E-04	7.21E-04
1,2-Dichloroethene (total)	49,298	7.84E-05	1.83E+04	6.09E+03	2.97E-02	1.90E-01	2.97E-02	1.23E-01	1.52E-01
1,1,1-Trichloroethane	53,078	8.44E-05	1.97E+04	6.56E+03	3.20E-02	1.21E-01	3.20E-02	2.38E-02	5.58E-02
Trichloroethene	19,904	3.16E-05	7.38E+03	2.46E+03	1.20E-02	7.28E-02	1.20E-02	7.17E-03	1.92E-02
Benzene	44,376	7.06E-05	1.65E+04	5.48E+03	2.68E-02	5.49E-02	2.68E-02	1.34E-02	4.01E-02
Tetrachloroethene	15,044	2.39E-05	5.58E+03	1.86E+03	9.07E-03	2.33E-02	9.07E-03	8.73E-03	1.78E-02
Toluene	582,397	9.26E-04	2.16E+05	7.20E+04	3.51E-01	2.04E-02	2.04E-02	1.72E-01	1.93E-01
Ethylbenzene	257,909	4.10E-04	9.56E+04	3.19E+04	1.56E-01	7.84E-03	7.84E-03	7.08E-02	7.86E-02
Xylene	1,151,832	1.83E-03	4.27E+05	1.42E+05	6.95E-01	7.85E-03	7.85E-03	3.43E-01	3.51E-01
Naphthalene	156,581	2.49E-04	5.81E+04	1.94E+04	9.44E-02	2.18E-04	2.18E-04	1.82E-02	1.84E-02
2-Methylnaphthalene	537,419	8.54E-04	1.99E+05	6.64E+04	3.24E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Acenaphthene	43,126	6.86E-05	1.60E+04	5.33E+03	2.60E-02	1.77E-06	1.77E-06	1.73E-03	1.73E-03
Fluorene	44,453	7.07E-05	1.65E+04	5.49E+03	2.68E-02	8.72E-07	8.72E-07	1.20E-03	1.20E-03
Phenanthrene	111,465	1.77E-04	4.13E+04	1.38E+04	6.72E-02	8.95E-07	8.95E-07	4.43E-03	4.43E-03
bis(2-Ethylhexyl)phthalate	92,224	1.47E-04	3.42E+04	1.14E+04	5.56E-02	5.77E-10	5.77E-10	1.42E-04	1.42E-04
Aroclor-1242	31,515	5.01E-05	1.17E+04	3.90E+03	1.90E-02	1.93E-06	1.93E-06	2.25E-03	2.25E-03
Aroclor-1260	7,829	1.24E-05	2.90E+03	9.68E+02	4.72E-03	1.11E-07	1.11E-07	1.83E-03	1.83E-03

TABLE D-4
EMISSION RATES OF VOLATILIZED ORGANICS DURING EXCAVATION
LENZ OIL SITE
LEMONT, ILLINOIS

	Soil Concentration [ug/kg]	Soil Concentration [g/cm3]	Total Mass of Contaminant [g]	1/3 of Total Mass in Soil [g]	Maximum Pore Space Emission Rate [g/s]	Calculated Pore Space Emission Rate [g/s]	Pore Space Emission Rate [g/s]	Emission Rate from Diffusion [g/s]	Total Estimated Emission Rate [g/s]
LNAPL-Contaminated Materials, Two Trenches									
Compound									
Acetone	19,904	3.16E-05	5.57E+03	1.86E+03	1.20E-02	1.14E-01	1.20E-02	2.85E-04	1.23E-02
1,1-Dichloroethene	181	2.87E-07	5.05E+01	1.68E+01	1.09E-04	4.23E-01	1.09E-04	7.91E-05	1.88E-04
1,1-Dichloroethane	833	1.32E-06	2.33E+02	7.77E+01	5.02E-04	1.71E-01	5.02E-04	1.65E-04	6.67E-04
1,2-Dichloroethene (total)	49,298	7.84E-05	1.38E+04	4.59E+03	2.97E-02	1.90E-01	2.97E-02	9.24E-02	1.22E-01
1,1,1-Trichloroethane	53,078	8.44E-05	1.48E+04	4.95E+03	3.20E-02	1.21E-01	3.20E-02	1.79E-02	4.99E-02
Trichloroethene	19,904	3.16E-05	5.57E+03	1.86E+03	1.20E-02	7.28E-02	1.20E-02	5.40E-03	1.74E-02
Benzene	44,376	7.06E-05	1.24E+04	4.14E+03	2.68E-02	5.49E-02	2.68E-02	1.01E-02	3.68E-02
Tetrachloroethene	15,044	2.39E-05	4.21E+03	1.40E+03	9.07E-03	2.33E-02	9.07E-03	6.58E-03	1.56E-02
Toluene	582,397	9.26E-04	1.63E+05	5.43E+04	3.51E-01	2.04E-02	2.04E-02	1.30E-01	1.50E-01
Ethylbenzene	257,909	4.10E-04	7.21E+04	2.40E+04	1.56E-01	7.84E-03	7.84E-03	5.33E-02	6.11E-02
Xylene	1,151,832	1.83E-03	3.22E+05	1.07E+05	6.95E-01	7.85E-03	7.85E-03	2.58E-01	2.66E-01
Naphthalene	156,581	2.49E-04	4.38E+04	1.46E+04	9.44E-02	2.18E-04	2.18E-04	1.37E-02	1.39E-02
2-Methylnaphthalene	537,419	8.54E-04	1.50E+05	5.01E+04	3.24E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Acenaphthene	43,126	6.86E-05	1.21E+04	4.02E+03	2.60E-02	1.77E-06	1.77E-06	1.30E-03	1.30E-03
Fluorene	44,453	7.07E-05	1.24E+04	4.14E+03	2.68E-02	8.72E-07	8.72E-07	9.00E-04	9.01E-04
Phenanthrene	111,465	1.77E-04	3.12E+04	1.04E+04	6.72E-02	8.95E-07	8.95E-07	3.34E-03	3.34E-03
bis(2-Ethylhexyl)phthalate	92,224	1.47E-04	2.58E+04	8.60E+03	5.56E-02	5.77E-10	5.77E-10	1.06E-04	1.06E-04
Aroclor-1242	31,515	5.01E-05	8.81E+03	2.94E+03	1.90E-02	1.93E-06	1.93E-06	1.69E-03	1.69E-03
Aroclor-1260	7,829	1.24E-05	2.19E+03	7.30E+02	4.72E-03	1.11E-07	1.11E-07	1.37E-03	1.37E-03

TABLE D-5
EMISSION RATES OF VOLATILIZED ORGANICS DURING SOLIDIFICATION/STABILIZATION
LENZ OIL SITE
LEMONT, ILLINOIS

	Soil Concentration [ug/kg]	Solidification Stabilization Emission Rate [g/s]
Soil Exhibiting Carcinogenic Risks Greater than 1E-04		
Compound		
1,1,1-Trichloroethane	6.5	5.90E-06
Trichloroethene	3.1	2.85E-06
Benzene	3.0	2.75E-06
Tetrachloroethene	6.1	5.47E-06
Toluene	3.3	3.02E-06
Ethyl benzene	5.2	4.69E-06
Xylenes (total)	9.6	8.64E-06
Naphthalene	300	NA
2-Methylnaphthalene	185	NA
Acenaphthene	317	NA
Dibenzofuran	307	NA
Fluorene	329	NA
Phenanthrene	704	NA
Anthracene	366	NA
di-n-Butylphthalate	211	NA
Fluoranthene	1,329	NA
Pyrene	1,235	NA
Benzo(a)anthracene	808	NA
Chrysene	908	NA
bis(2-Ethylhexyl)phthalate	387	NA
Benzo(b)fluoranthene	957	NA
Benzo(k)fluoranthene	647	NA
Benzo(a)pyrene	761	NA
Indeno(1,2,3-c,d)pyrene	573	NA
Benzo(g,h,i)perylene	509	NA
Aroclor-1242	10,302	NA
Aroclor-1254	8,000	NA
Aroclor-1260	589	NA
beta-BHC	74.7	NA

TABLE D-5
EMISSION RATES OF VOLATILIZED ORGANICS DURING
SOLIDIFICATION/STABILIZATION
LENZ OIL SITE
LEMONT, ILLINOIS

	Soil Concentration [ug/kg]	Solidification Stabilization Emission Rate [g/s]
LNAPL-Contaminated Materials		
Compound		
Acetone	19,904	1.80E-02
1,1-Dichloroethene	181	1.63E-04
1,1-Dichloroethane	833	7.54E-04
1,2-Dichloroethene (total)	49,298	4.46E-02
1,1,1-Trichloroethane	53,078	4.80E-02
Trichloroethene	19,904	1.80E-02
Benzene	44,376	4.01E-02
Tetrachloroethene	15,044	1.36E-02
Toluene	582,397	5.27E-01
Ethylbenzene	257,909	2.33E-01
Xylene	1,151,832	1.04E+00
Naphthalene	156,581	NA
2-Methylnaphthalene	537,419	NA
Acenaphthene	43,126	NA
Fluorene	44,453	NA
Phenanthrene	111,465	NA
bis(2-Ethylhexyl)phthalate	92,224	NA
Aroclor-1242	31,515	NA
Aroclor-1260	7,829	NA

Key:

NA = Not applicable

TABLE D-6
PARTICULATE EMISSION RATES
LENZ OIL SITE
LEMONT, ILLINOIS

Excavated Material	Total Particulate Emissions (g)	Particulate Emission Rate (g/s)
1E-04 Soils	159	1.10E-04
LNAPL-Contaminated Materials:		
Areas 1a & 2 and Area 1b	296	1.10E-04
Three and Four Trenches	23	1.10E-04
Two Trenches	17	1.10E-04
Areas 1a & 2	193	1.10E-04
Area 1b	103	1.10E-04

TABLE D-7
RISKS RESULTING FROM EMISSIONS OF
VOLATILIZED ORGANICS AND PARTICULATES DURING THE EXCAVATION
OF SOILS EXCEEDING 1E-04 CARCINOGENIC RISK LEVELS (1,2)
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (3)	Soil Concentration (mg/kg)	Air Concentration (4) (mg/m3)	Inhalation Carcinogenic Risk	Inhalation Hazard Index (4)
1,1,1-Trichloroethane	0.0065	7.31E-05	--	--
Trichloroethene	0.0031	3.10E-05	9.9E-11	--
Benzene	0.0030	2.72E-05	1.5E-10	--
Tetrachloroethene	0.0061	8.00E-05	2.7E-11	--
Toluene	0.0033	2.96E-05	--	0.000
Ethyl benzene	0.0052	4.43E-05	--	0.000
Xylenes (total)	0.010	8.50E-05	--	--
Naphthalene	0.300	1.84E-03	--	--
2-Methylnaphthalene	0.185	0.00E+00	--	--
Acenaphthene	0.317	2.08E-04	--	--
Dibenzofuran	0.307	0.00E+00	--	--
Fluorene	0.329	1.42E-04	--	--
Phenanthrene	0.704	4.36E-04	--	--
Anthracene	0.366	6.66E-04	--	--
di-n-Butylphthalate	0.211	4.90E-06	--	--
Fluoranthene	1.3	8.22E-03	--	--
Pyrene	1.2	1.91E-04	--	--
Benzo(a)anthracene	0.808	3.08E-05	5.1E-09	--
Chrysene	0.908	7.63E-11	4.0E-15	--
bis(2-Ethylhexyl)phthalate	0.387	9.51E-06	--	--
Benzo(b)fluoranthene	0.957	1.55E-04	2.5E-08	--
Benzo(k)fluoranthene	0.647	9.78E-04	7.4E-08	--
Benzo(a)pyrene	0.761	5.47E-05	6.3E-08	--
Indeno(1,2,3-cd)pyrene	0.573	1.47E-12	1.2E-13	--
Benzo(g,h,i)perylene	0.509	8.33E-06	2.0E-10	--
Aroclor-1242	10.3	1.13E-02	--	--
Aroclor-1254	8.000	1.83E-02	--	--
Aroclor-1260	0.589	2.11E-03	--	--
beta-BHC	0.075	1.57E-06	--	--
Aluminum	22,664	NA	--	--
Barium	1,137	NA	--	--
Cadmium	1.5	NA	1.3E-12	--
Calcium	81,809	NA	--	--
Chromium	84.1	NA	--	--
Cobalt	17.2	NA	--	--
Copper	579.2	NA	--	--
Iron	35,613	NA	--	--
Lead	621	NA	--	--
Magnesium	40,407	NA	--	--
Mercury	0.084	NA	--	0.000
Nickel	41.3	NA	--	--
Potassium	4,499	NA	--	--
Silver	0.089	NA	--	--
Sodium	3,076	NA	--	--
Vanadium	60.3	NA	--	--
Zinc	569	NA	--	--
Cyanide	5.5	NA	--	--
Total:			2E-07	0.000

Notes:

(1) Inhalation risks were calculated by using the air concentrations generated by volatile and particulates emissions.
(2) Inorganic analytes inhalation risks were calculated by using only the air concentrations generated by particulates emissions.
(3) Only detected parameters are shown.
(4) Zero values indicate that the hazard indices are less than 5E-04.

Key:

NA = Not applicable

TABLE D-8
RISKS RESULTING FROM EMISSIONS OF VOLATILIZED
ORGANICS AND PARTICULATES DURING THE EXCAVATION OF
LNAPL-CONTAMINATED MATERIALS (1,2)
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (3)	Soil Concentration (mg/kg)	Air Concentration (4) (mg/m3)	Inhalation Carcinogenic Risk	Inhalation Hazard Index (4)
Areas 1a & 2, and Area 1b				
Acetone	19.9	3.00E-02	--	--
1,1-Dichloroethene	0.181	1.41E-03	5.9E-07	--
1,1-Dichloroethane	0.833	3.53E-03	--	--
1,2-Dichloroethene (total)	49.3	1.44E+00	--	--
1,1,1-Trichloroethane	53.1	3.36E-01	--	--
Trichloroethene	19.9	1.06E-01	6.3E-07	--
Benzene	44.4	2.08E-01	2.1E-06	--
Tetrachloroethene	15.0	1.18E-01	7.4E-08	--
Toluene	582	1.98E+00	--	0.024
Ethyl benzene	258	8.13E-01	--	0.020
Xylenes (total)	1,152	3.87E+00	--	--
Naphthalene	157	2.06E-01	--	--
2-Methylnaphthalene	537	0.00E+00	--	--
Acenaphthene	43.1	1.95E-02	--	--
Fluorene	44.5	1.35E-02	--	--
Phenanthrene	111	5.00E-02	--	--
bis(2-Ethylhexyl)phthalate	92.2	1.67E-03	--	--
Aroclor-1242	31.5	2.53E-02	--	--
Aroclor-1260	7.8	2.05E-02	--	--
Aluminum	3.5	NA	--	--
Arsenic	0.743	NA	3.0E-12	--
Barium	30.1	NA	--	--
Cadmium	61.1	NA	3.1E-11	--
Chromium	1.3	NA	--	--
Copper	0.458	NA	--	--
Iron	11.3	NA	--	--
Lead	25.0	NA	--	--
Manganese	0.27	NA	--	0.000
Selenium	0.044	NA	--	--
Vanadium	0.63	NA	--	--
Zinc	0.91	NA	--	--
Total:			3E-06	0.044

TABLE D-8
RISKS RESULTING FROM EMISSIONS OF VOLATILIZED
ORGANICS AND PARTICULATES DURING THE EXCAVATION OF
LNAPL-CONTAMINATED MATERIALS (1,2)
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (3)	Soil Concentration (mg/kg)	Air Concentration (4) (mg/m3)	Inhalation Carcinogenic Risk	Inhalation Hazard Index (4)
Areas 1a & 2				
Acetone	19.9	4.95E-02	--	--
1,1-Dichloroethene	0.181	1.87E-03	5.1E-07	--
1,1-Dichloroethane	0.833	4.90E-03	--	--
1,2-Dichloroethene (total)	49.3	1.82E+00	--	--
1,1,1-Trichloroethane	53.1	4.50E-01	--	--
Trichloroethene	19.9	1.44E-01	5.6E-07	--
Benzene	44.4	2.85E-01	1.9E-06	--
Tetrachloroethene	15.0	1.55E-01	6.3E-08	--
Toluene	582	2.48E+00	--	0.020
Ethyl benzene	258	1.02E+00	--	0.016
Xylenes (total)	1,152	4.81E+00	--	--
Naphthalene	157	2.55E-01	--	--
2-Methylnaphthalene	537	0.00E+00	--	--
Acenaphthene	43.1	2.41E-02	--	--
Fluorene	44.5	1.68E-02	--	--
Phenanthrene	111	6.19E-02	--	--
bis(2-Ethylhexyl)phthalate	92.2	2.07E-03	--	--
Aroclor-1242	31.5	3.14E-02	--	--
Aroclor-1260	7.8	2.55E-02	--	--
Aluminum	3.5	NA	--	--
Arsenic	0.743	NA	3.4E-12	--
Barium	30.1	NA	--	--
Cadmium	61.1	NA	3.4E-11	--
Chromium	1.3	NA	--	--
Copper	0.458	NA	--	--
Iron	11.3	NA	--	--
Lead	25.0	NA	--	--
Manganese	0.27	NA	--	0.000
Selenium	0.044	NA	--	--
Vanadium	0.63	NA	--	--
Zinc	0.91	NA	--	--
Total:			3E-06	0.036

TABLE D-8
RISKS RESULTING FROM EMISSIONS OF VOLATILIZED
ORGANICS AND PARTICULATES DURING THE EXCAVATION OF
LNAPL-CONTAMINATED MATERIALS (1,2)
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (3)	Soil Concentration (mg/kg)	Air Concentration (4) (mg/m3)	Inhalation Carcinogenic Risk	Inhalation Hazard Index (4)
Area 1b				
Acetone	19.9	6.87E-02	--	--
1,1-Dichloroethene	0.181	2.56E-03	3.7E-07	--
1,1-Dichloroethane	0.833	6.73E-03	--	--
1,2-Dichloroethene (total)	49.3	2.49E+00	--	--
1,1,1-Trichloroethane	53.1	6.17E-01	--	--
Trichloroethene	19.9	1.98E-01	4.1E-07	--
Benzene	44.4	3.91E-01	1.4E-06	--
Tetrachloroethene	15.0	2.13E-01	4.7E-08	--
Toluene	582	3.38E+00	--	0.014
Ethyl benzene	258	1.39E+00	--	0.012
Xylenes (total)	1,152	6.56E+00	--	--
Naphthalene	157	3.48E-01	--	--
2-Methylnaphthalene	537	0.00E+00	--	--
Acenaphthene	43.1	3.29E-02	--	--
Fluorene	44.5	2.29E-02	--	--
Phenanthrene	111	8.45E-02	--	--
bis(2-Ethylhexyl)phthalate	92.2	2.80E-03	--	--
Aroclor-1242	31.5	4.28E-02	--	--
Aroclor-1260	7.8	3.48E-02	--	--
Aluminum	3.5	NA	--	--
Arsenic	0.743	NA	2.5E-12	--
Barium	30.1	NA	--	--
Cadmium	61.1	NA	2.6E-11	--
Chromium	1.3	NA	--	--
Copper	0.458	NA	--	--
Iron	11.3	NA	--	--
Lead	25.0	NA	--	--
Manganese	0.27	NA	--	0.000
Selenium	0.044	NA	--	--
Vanadium	0.63	NA	--	--
Zinc	0.91	NA	--	--
Total:			2E-06	0.026

TABLE D-8
RISKS RESULTING FROM EMISSIONS OF VOLATILIZED
ORGANICS AND PARTICULATES DURING THE EXCAVATION OF
LNAPL-CONTAMINATED MATERIALS (1,2)
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (3)	Soil Concentration (mg/kg)	Air Concentration (4) (mg/m3)	Inhalation Carcinogenic Risk	Inhalation Hazard Index (4)
Three and Four Trenches				
Acetone	19.9	5.05E-01	--	--
1,1-Dichloroethene	0.181	8.72E-03	2.8E-07	--
1,1-Dichloroethane	0.833	2.94E-02	--	--
1,2-Dichloroethene (total)	49.3	6.22E+00	--	--
1,1,1-Trichloroethane	53.1	2.28E+00	--	--
Trichloroethene	19.9	7.81E-01	3.5E-07	--
Benzene	44.4	1.64E+00	1.3E-06	--
Tetrachloroethene	15.0	7.26E-01	3.5E-08	--
Toluene	582	7.86E+00	--	0.007
Ethyl benzene	258	3.20E+00	--	0.006
Xylenes (total)	1,152	1.43E+01	--	--
Naphthalene	157	7.52E-01	--	--
2-Methylnaphthalene	537	0.00E+00	--	--
Acenaphthene	43.1	7.05E-02	--	--
Fluorene	44.5	4.88E-02	--	--
Phenanthrene	111	1.81E-01	--	--
bis(2-Ethylhexyl)phthalate	92.2	5.77E-03	--	--
Aroclor-1242	31.5	9.17E-02	--	--
Aroclor-1260	7.8	7.44E-02	--	--
Aluminum	3.5	NA	--	--
Arsenic	0.743	NA	4.4E-12	--
Barium	30.1	NA	--	--
Cadmium	61.1	NA	4.4E-11	--
Chromium	1.3	NA	--	--
Copper	0.458	NA	--	--
Iron	11.3	NA	--	--
Lead	25.0	NA	--	--
Manganese	0.27	NA	--	0.000
Selenium	0.044	NA	--	--
Vanadium	0.63	NA	--	--
Zinc	0.91	NA	--	--
Total:			2E-06	0.013

TABLE D-8
RISKS RESULTING FROM EMISSIONS OF VOLATILIZED
ORGANICS AND PARTICULATES DURING THE EXCAVATION OF
LNAPL-CONTAMINATED MATERIALS (1,2)
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (3)	Soil Concentration (mg/kg)	Air Concentration (4) (mg/m3)	Inhalation Carcinogenic Risk	Inhalation Hazard Index (4)
Two Trenches				
Acetone	19.9	7.66E-01	--	--
1,1-Dichloroethene	0.181	1.17E-02	2.8E-07	--
1,1-Dichloroethane	0.833	4.16E-02	--	--
1,2-Dichloroethene (total)	49.3	7.62E+00	--	--
1,1,1-Trichloroethane	53.1	3.11E+00	--	--
Trichloroethene	19.9	1.08E+00	3.7E-07	--
Benzene	44.4	2.30E+00	1.3E-06	--
Tetrachloroethene	15.0	9.76E-01	3.5E-08	--
Toluene	582	9.36E+00	--	0.007
Ethyl benzene	258	3.81E+00	--	0.005
Xylenes (total)	1,152	1.66E+01	--	--
Naphthalene	157	8.69E-01	--	--
2-Methylnaphthalene	537	0.00E+00	--	--
Acenaphthene	43.1	8.11E-02	--	--
Fluorene	44.5	5.62E-02	--	--
Phenanthrene	111	2.08E-01	--	--
bis(2-Ethylhexyl)phthalate	92.2	6.58E-03	--	--
Aroclor-1242	31.5	1.06E-01	--	--
Aroclor-1260	7.8	8.57E-02	--	--
Aluminum	3.5	NA	--	--
Arsenic	0.743	NA	5.1E-12	--
Barium	30.1	NA	--	--
Cadmium	61.1	NA	5.1E-11	--
Chromium	1.3	NA	--	--
Copper	0.458	NA	--	--
Iron	11.3	NA	--	--
Lead	25.0	NA	--	--
Manganese	0.27	NA	--	0.000
Selenium	0.044	NA	--	--
Vanadium	0.63	NA	--	--
Zinc	0.91	NA	--	--
Total:			2E-06	0.012

Notes:

(1) Inhalation risks were calculated by using the air concentrations generated by the dispersion and particulates emission models.
(2) Inorganic analytes inhalation risks were calculated by using only the air concentrations generated by the particulates emission model.
(3) Only detected parameters are shown.
(4) Zero values indicate that the hazard indices are less than 5E-04.

Key:

NA = Not applicable

TABLE D-9
RISKS RESULTING FROM EMISSIONS OF VOLATILIZED ORGANICS AND PARTICULATES
DURING EXCAVATION AND EX SITU SOLIDIFICATION/STABILIZATION
OF SOILS EXCEEDING 1E-04 CARCINOGENIC RISK LEVELS (1)
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (2)	Soil Concentration (mg/kg)	S/S Air Concentration (mg/m3)	Inhalation Carcinogenic Risk (3)	Inhalation Hazard Index (3,4)
1,1,1-Trichloroethane	0.0065	4.24E-05	--	--
Trichloroethene	0.0031	2.05E-05	1.6E-10	--
Benzene	0.0030	1.97E-05	2.6E-10	--
Tetrachloroethene	0.0061	3.93E-05	4.0E-11	--
Toluene	0.0033	2.17E-05	--	0.000
Ethyl benzene	0.0052	3.37E-05	--	0.000
Xylenes (total)	0.010	6.21E-05	--	--
Naphthalene	0.300	NA	--	--
2-Methylnaphthalene	0.185	NA	--	--
Acenaphthene	0.317	NA	--	--
Dibenzofuran	0.307	NA	--	--
Fluorene	0.329	NA	--	--
Phenanthrene	0.704	NA	--	--
Anthracene	0.366	NA	--	--
di-n-Butylphthalate	0.211	NA	--	--
Fluoranthene	1.3	NA	--	--
Pyrene	1.2	NA	--	--
Benzo(a)anthracene	0.808	NA	5.1E-09	--
Chrysene	0.908	NA	7.7E-15	--
bis(2-Ethylhexyl)phthalate	0.387	NA	--	--
Benzo(b)fluoranthene	0.957	NA	2.5E-08	--
Benzo(k)fluoranthene	0.647	NA	7.4E-08	--
Benzo(a)pyrene	0.761	NA	6.3E-08	--
Indeno(1,2,3-cd)pyrene	0.573	NA	2.4E-13	--
Benzo(g,h,i)perylene	0.509	NA	2.0E-10	--
Aroclor-1242	10.3	NA	--	--
Aroclor-1254	8.000	NA	--	--
Aroclor-1260	0.589	NA	--	--
beta-BHC	0.075	NA	--	--
Aluminum	22,664	NA	--	--
Barium	1,137	NA	--	--
Cadmium	1.5	NA	2.7E-12	--
Calcium	81,809	NA	--	--
Chromium	84.1	NA	--	--
Cobalt	17.2	NA	--	--
Copper	579.2	NA	--	--
Iron	35,613	NA	--	--
Lead	621	NA	--	--
Magnesium	40,407	NA	--	--
Mercury	0.084	NA	--	0.000
Nickel	41.3	NA	--	--
Potassium	4,499	NA	--	--
Silver	0.089	NA	--	--
Sodium	3,076	NA	--	--
Vanadium	60.3	NA	--	--
Zinc	569	NA	--	--
Cyanide	5.5	NA	--	--
Total:			2E-07	0.000

Notes:

(1) Organic analytes other than volatile organic compounds and inorganic analytes inhalation risks were calculated by using only the air concentrations generated by particulates emissions.
(2) Only detected parameters are shown.
(3) Risks include the risks posed by the emissions generated during soils excavation.
(4) Zero values indicate that the hazard indices are less than 5E-04.

Key:

NA = Not applicable
S/S = Solidification/Stabilization

TABLE D-10
RISKS RESULTING FROM EMISSIONS OF VOLATILIZED ORGANICS AND PARTICULATES
DURING EXCAVATION AND EX SITU SOLIDIFICATION/STABILIZATION
OF LNAPL-CONTAMINATED MATERIALS (1)
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (2)	Soil Concentration (mg/kg)	S/S Air Concentration (mg/m3)	Inhalation Carcinogenic Risk (3)	Inhalation Hazard Index (3,4)
Areas 1a & 2, and Area 1b				
Acetone	19.9	3.86E-02	--	--
1,1-Dichloroethene	0.181	3.50E-04	7.4E-07	--
1,1-Dichloroethane	0.833	1.61E-03	--	--
1,2-Dichloroethene (total)	49.3	9.55E-02	--	--
1,1,1-Trichloroethane	53.1	1.03E-01	--	--
Trichloroethene	19.9	3.86E-02	8.6E-07	--
Benzene	44.4	8.59E-02	3.0E-06	--
Tetrachloroethene	15.0	2.91E-02	9.2E-08	--
Toluene	582	1.13E+00	--	0.038
Ethyl benzene	258	5.00E-01	--	0.032
Xylenes (total)	1,152	2.23E+00	--	--
Naphthalene	157	NA	--	--
2-Methylnaphthalene	537	NA	--	--
Acenaphthene	43.1	NA	--	--
Fluorene	44.5	NA	--	--
Phenanthrene	111	NA	--	--
bis(2-Ethylhexyl)phthalate	92.2	NA	--	--
Aroclor-1242	31.5	NA	--	--
Aroclor-1260	7.8	NA	--	--
Aluminum	3.5	NA	--	--
Arsenic	0.743	NA	6.1E-12	--
Barium	30.1	NA	--	--
Cadmium	61.1	NA	6.1E-11	--
Chromium	1.3	NA	--	--
Copper	0.458	NA	--	--
Iron	11.3	NA	--	--
Lead	25.0	NA	--	--
Manganese	0.27	NA	--	0.000
Selenium	0.044	NA	--	--
Vanadium	0.63	NA	--	--
Zinc	0.91	NA	--	--
Total:			5E-06	0.070

TABLE D-10
RISKS RESULTING FROM EMISSIONS OF VOLATILIZED ORGANICS AND PARTICULATES
DURING EXCAVATION AND EX SITU SOLIDIFICATION/STABILIZATION
OF LNAPL-CONTAMINATED MATERIALS (1)
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (2)	Soil Concentration (mg/kg)	S/S Air Concentration (mg/m3)	Inhalation Carcinogenic Risk (3)	Inhalation Hazard Index (3,4)
Areas 1a & 2				
Acetone	19.9	6.63E-02	--	--
1,1-Dichloroethene	0.181	6.01E-04	6.7E-07	--
1,1-Dichloroethane	0.833	2.77E-03	--	--
1,2-Dichloroethene (total)	49.3	1.64E-01	--	--
1,1,1-Trichloroethane	53.1	1.77E-01	--	--
Trichloroethene	19.9	6.63E-02	8.1E-07	--
Benzene	44.4	1.48E-01	2.8E-06	--
Tetrachloroethene	15.0	5.01E-02	8.4E-08	--
Toluene	582	1.94E+00	--	0.035
Ethyl benzene	258	8.59E-01	--	0.030
Xylenes (total)	1,152	3.83E+00	--	--
Naphthalene	157	NA	--	--
2-Methylnaphthalene	537	NA	--	--
Acenaphthene	43.1	NA	--	--
Fluorene	44.5	NA	--	--
Phenanthrene	111	NA	--	--
bis(2-Ethylhexyl)phthalate	92.2	NA	--	--
Aroclor-1242	31.5	NA	--	--
Aroclor-1260	7.8	NA	--	--
Aluminum	3.5	NA	--	--
Arsenic	0.743	NA	6.8E-12	--
Barium	30.1	NA	--	--
Cadmium	61.1	NA	6.8E-11	--
Chromium	1.3	NA	--	--
Copper	0.458	NA	--	--
Iron	11.3	NA	--	--
Lead	25.0	NA	--	--
Manganese	0.27	NA	--	0.000
Selenium	0.044	NA	--	--
Vanadium	0.63	NA	--	--
Zinc	0.91	NA	--	--
Total:			4E-06	0.065

TABLE D-10
RISKS RESULTING FROM EMISSIONS OF VOLATILIZED ORGANICS AND PARTICULATES
DURING EXCAVATION AND EX SITU SOLIDIFICATION/STABILIZATION
OF LNAPL-CONTAMINATED MATERIALS (1)
LENZ OIL SITE
LEMONT, ILLINOIS

Compound (2)	Soil Concentration (mg/kg)	S/S Air Concentration (mg/m3)	Inhalation Carcinogenic Risk (3)	Inhalation Hazard Index (3,4)
Area 1b				
Acetone	19.9	9.22E-02	--	--
1,1-Dichloroethene	0.181	8.36E-04	5.0E-07	--
1,1-Dichloroethane	0.833	3.86E-03	--	--
1,2-Dichloroethene (total)	49.3	2.28E-01	--	--
1,1,1-Trichloroethane	53.1	2.46E-01	--	--
Trichloroethene	19.9	9.22E-02	6.0E-07	--
Benzene	44.4	2.06E-01	2.1E-06	--
Tetrachloroethene	15.0	6.97E-02	6.2E-08	--
Toluene	582	2.70E+00	--	0.026
Ethyl benzene	258	1.19E+00	--	0.022
Xylenes (total)	1,152	5.33E+00	--	--
Naphthalene	157	NA	--	--
2-Methylnaphthalene	537	NA	--	--
Acenaphthene	43.1	NA	--	--
Fluorene	44.5	NA	--	--
Phenanthrene	111	NA	--	--
bis(2-Ethylhexyl)phthalate	92.2	NA	--	--
Aroclor-1242	31.5	NA	--	--
Aroclor-1260	7.8	NA	--	--
Aluminum	3.5	NA	--	--
Arsenic	0.743	NA	5.1E-12	--
Barium	30.1	NA	--	--
Cadmium	61.1	NA	5.1E-11	--
Chromium	1.3	NA	--	--
Copper	0.458	NA	--	--
Iron	11.3	NA	--	--
Lead	25.0	NA	--	--
Manganese	0.27	NA	--	0.000
Selenium	0.044	NA	--	--
Vanadium	0.63	NA	--	--
Zinc	0.91	NA	--	--
Total:			3E-06	0.048

Notes:

(1) Organic analytes other than volatile organic compounds and inorganic analytes inhalation risks were calculated by using only the air concentrations generated by particulates emissions.
(2) Only detected parameters are shown.
(3) Risks include the risks posed by the emissions generated during soils excavation.
(4) Zero values indicate that the hazard indices are less than 5E-04.

Key:

NA = Not applicable
S/S = Solidification/Stabilization

APPENDIX E

WASTEWATER TREATMENT SYSTEM SELECTION

APPENDIX E WASTEWATER TREATMENT SYSTEM SELECTION

1.0 INTRODUCTION

This appendix describes the selection of an on-site ground water pretreatment system for the alternatives involving active recovery and *ex situ* treatment of ground water.

The ground water pretreatment system has been designed to remove the following parameters prior to discharge to the local publicly owned treatment works (POTW): light nonaqueous phase liquid (LNAPL) and polychlorinated biphenyls (PCBs) associated with the LNAPL, lead and mercury present in the suspended solids, and total toxic organics (TTOs). As indicated in Section 3.2.3.1 and shown on Figure 3-13, the selected ground water treatment system would include:

- Oil/water separation for removal of the LNAPL and associated PCBs,
- A combination of precipitation and filtration for removal of suspended solids and associated lead and mercury, and
- Air stripping and/or carbon adsorption to remove TTOs.

This appendix discusses the rationale for the selection of the different components of the ground water pretreatment system and documents the calculations used to evaluate the options.

2.0 *INFLUENT CHARACTERISTICS*

2.1 *INFLUENT COMPOSITION*

The expected influent characteristics were determined based on ground water information collected during the Remedial Investigation (RI). Table E-1 shows a comparison of the maximum and average concentrations in all the monitoring wells of all detected parameters to the POTW pretreatment standards. Table E-1 also shows a comparison of the maximum and average concentrations detected at wells G106L and MW-5S, and at all wells except G106L and MW-5S.

The monitoring wells G106L and MW-5S are located in the LNAPL Area 1. The analytical results from these wells were selected to represent the highest zone of ground water contamination at the site, and the average concentrations of organic compounds detected at wells G106L and MW-5S were used to estimate the concentration of the wastewater influent.

If a constituent was not detected at either G106L or MW-5S, the average concentration at all wells except G106L and MW-5S was used for that parameter (see Table E-1). Several volatile and semivolatile tentatively identified compound (TICs) were identified in the ground water samples, and these TICs were also included in the evaluation of the treatment system.

The wastewater pretreatment standards for TTO, lead, mercury, and cyanide were exceeded in at least one sample (see Table E-1). However, only TTO, lead, and mercury exceed the pretreatment standard when considering the influent constituent concentration (i.e., the average concentrations from wells G106L and MW-5S or the average at all wells except G106L and MW-5S). For this reason, only TTO, lead, and mercury are expected to require treatment prior to discharge to the POTW. As shown on Table 1-12 of this Feasibility Study report, mercury was detected in the unfiltered samples from only 3 wells, and neither lead nor mercury was detected in the unfiltered samples.

The estimated influent TTO averages approximately 7.00 mg/L as compared to a discharge limit of 2.13 mg/L (Table E-1). Approximately 35% of the influent TTO is attributed to volatile organic compounds (VOCs), and the remaining 65% is attributed to semivolatile organic compounds (SVOCs) and PCBs. The SVOCs and PCBs detected in the

ground water samples are believed to be present primarily in LNAPL droplets and not as dissolved parameters. Similarly, the only inorganic constituents in the influent ground water to exceed the applicable threshold were lead and mercury which were not detected in the filtered ground water samples.

Table E-2 provides a summary of the detected filtered and unfiltered inorganic compounds at monitoring wells MW-3S and MW-6S, the two shallow wells located nearest to the Des Plaines River. The average filtered, unfiltered, and suspended solids at wells MW-3S and MW-6S shown in Table E-2 were used for estimating actual sludge generation from the wastewater treatment system.

2.2 *INFLUENT FLOW RATE*

As described in Section 2.6.3.1, the proposed remedial action would include extraction trenches in the LNAPL Area 1 and extraction wells near the Des Plaines River. As shown in Table E-3, the flow rate from the trenches and wells varies between 11 and 35.5 gpm for the trenches and between 6 and 15.5 gpm for the extraction wells. The average expected operating flow of 28.2 gpm for the active recovery of LNAPL with three trenches was used for the cost comparison between air stripping and carbon adsorption for the removal of TTOs.

3.0 *TREATMENT REQUIREMENTS*

Block flow diagrams of the proposed ground water treatment systems are included as Figures 3-13 and 3-25 of this Feasibility Study Report. Because the ground water has been in contact with the LNAPL and may potentially contain free-phase LNAPL droplets, oil/water separation would be included as the first step of ground water treatment. The oil/water separation step would consist of a gravity oil/water separator followed by a porous, oil/water filter. For the alternatives involving surfactant-enhanced LNAPL recovery, a dissolved air flotation (DAF) unit would be added after the separator and filter in the oil/water separation step.

Tables E-1 and E-2 show the estimated average suspended solids concentrations for the trenches and wells. The average of the suspended solids results for wells G106L and MW-5S was used to simulate the water quality in the ground water extracted from the trenches. The average of the suspended solids results for wells MW-3S and MW-6S was used to simulate the ground water quality extracted from the wells.

Because the suspended solids concentrations are relatively high, i.e., 800 mg/L for the trenches, and 234 mg/L for the wells, the suspended solids would be removed in two steps: gravity solids separation and pressure filtration through porous filter media. A portion of the suspended solids in the ground water extracted from the trenches would settle in the gravity oil/water separator. The ground water extracted from the wells would be treated in a gravity solids plate separator. For purposes of the detailed evaluation of Alternatives in Section 3.2 and the cost estimates presented in Appendix C for each alternative, the effluent from the gravity solids separation step is assumed to contain 50 mg/L of suspended solids.

The filtered inorganic analytical results shown in Table E-1 meet the POTW pretreatment requirements for all of the inorganic analytes. Therefore, treatment of the effluent from the gravity separation step to remove the remaining suspended solids should effectively remove the lead and mercury. The remaining suspended solids would be removed by using two pressure filters in series, a coarse primary and a fine polishing filter, that would remove suspended solids to 5 mg/L and essentially 0 mg/L, respectively. The sludge generated in the gravity separation step would be concentrated in a settling tank to an estimated 20% suspended solids . The solids removed in the pressure filters would be disposed of with the filter media once the media are clogged. Two options are being

considered for the organics removal: air stripping and activated carbon adsorption. The suspended solids pressure filtration system would be located after the air stripper or before the activated carbon unit. In this second case, the spent filter media would likely be considered a listed hazardous waste under the Resource Conservation and Recovery Act (RCRA) because listed constituents would be present at concentrations that pose a carcinogenic risk over 1×10^{-6}. If filtration is conducted after organics removal, as in the case of the air stripper, the spent filter media would be nonhazardous.

An 80% removal efficiency for SVOCs in the oil/water separation step was assumed based on the assumption that most of the SVOCs in the extracted ground water are present in free-phase LNAPL droplets. Using this assumption, the calculated contaminant concentrations in the effluent from the oil/water separation step are shown on Table E-4. Additional treatment by either air stripping or carbon adsorption will be required to remove VOCs and the remaining SVOCs to concentrations below the pretreatment standards. Because both processes can achieve the POTW pretreatment requirements (as indicated in Tables E-4 and E-5), the comparison between the two will focus on cost and operations considerations. An evaluation of the effectiveness and cost of each process is presented in the next section.

4.0 *COST ESTIMATES*

The evaluation of air stripping and carbon absorption operations involves determining the number of units needed for air stripping and the rate of granular activated carbon (GAC) usage.

The number of air stripper units was calculated using a vendor-supplied model that uses equipment-specific removal parameters. The model was run at the expected average flow rate of 28.2 gpm. The model output is included as Attachment E-1 and Table E-4 summarizes the expected effluent concentrations. The output of the model in Attachment E-1 identifies the size of the air stripper required. One unit is required to meet the POTW pretreatment regulations, but two units would be purchased to achieve a design flow capacity of 50 gpm and also provide a back-up unit.

The air emissions from the air stripping would potentially be subject to the Air Emission Standards for Process Vents (Code of Federal Regulations Part 40, Section 264.1032), and may require control measures. Based on the removals predicted by the model for a ground water flow rate of 28.2 gpm, the rate of VOC emissions would be 0.13 pounds per hour (lb/hr), and 0.55 ton per year (tpy). This is below the regulatory limits of 3 lb/hr and 3.1 tpy VOCs specified in 40 CFR 264.1032. Therefore, removal of the VOCs from the air stripper of gas prior to emission into the atmosphere is not required.

The GAC usage was calculated by a vendor using software from an activated carbon supplier and the oil/water separator effluent contaminant concentrations (see Attachment E-2 and Table E-5). At a design flow rate of 50 gpm, 120 lb/day of GAC are required to achieve the POTW pretreatment standards. At an average flow rate of 28.2 gpm, approximately 67.6 pounds of GAC would be required per day.

For the GAC option, carbon disposal requires additional consideration. The spent activated carbon would be regenerated by the vendors and fresh carbon delivered simultaneously to the treatment unit for additional use. Because it is expected that the spent GAC from the Lenz Oil site would be a listed hazardous waste, the cost estimate assumes that the carbon would be regenerated at a RCRA Subtitle C–permitted facility. The spent carbon is expected to be a listed hazardous waste because the influent ground water is estimated to have concentrations of listed constituents at levels that would exceed a carcinogenic risk of 1×10^{-6}.

The air stripper option involves higher initial capital costs (i.e., costs to purchase the air stripping units) but low operation and maintenance (O&M) costs (i.e., the power to run the blower units). The initial capital cost for the GAC units would be relatively low; however, the O&M costs would be high due to the need to replace the GAC media as it is consumed. Because the other units in the ground water treatment system (i.e., the oil/water and suspended solids separation equipment) would remain the same, the cost analysis is based only on those items that would be required for one of these options but not the other. A summary of the incremental capital and O&M costs for both options is presented in Tables E-6 and E-7. Because one option has higher capital costs while the other has higher O&M costs, a present worth analysis at 5% was performed to compare the options assuming 30 years operation. The results are presented in Table E-8.

Based on the analysis above, air stripping is the selected alternative for the removal of the dissolved organics from the ground water because its present value cost of $258,422 is less than that for GAC.

If the SVOCs are not removed in the oil/water separation step, the air stripper by itself would not be able to remove the TTOs to levels below the POTW pretreatment standards. In this case, either activated carbon adsorption or a biological treatment process that can remove relatively low levels of organics in the order of 127 mg/L (such as a fixed-media system) would be required. On the other hand, if adsorption of organics in the aquifer occur during pumping of ground water, it is possible that pretreatment for removal of organics would not be required.

TABLES

TABLE E-1

COMPARISON OF MAXIMUM AND AVERAGE ANALYTE CONCENTRATIONS IN THE UPPER AQUIFER WITH POTW TREATMENT STANDARDS
LENZ OIL SITE
LEMONT, ILLINOIS

Parameter	POTW Pretreatment Standards (ug/L)	All Wells				Wells G106L and MW-5S				All Wells Except G106L and MW-5S				Estimated Influent Concentration (ug/L)
		Maximum		Average		Maximum		Average		Maximum		Average		
		Total (ug/L)	Dissolved[1] (ug/L)	Total (ug/L)	Dissolved[1] (ug/L)	Total (ug/L)	Dissolved[1] (ug/L)	Total (ug/L)	Dissolved[1] (ug/L)	Total (ug/L)	Dissolved[1] (ug/L)	Total (ug/L)	Dissolved[1] (ug/L)	
Organic Compounds:														
Vinyl chloride		15		6.2		ND		ND		15		6.5		6
Chloroethane		100		12		100		53		5.0		4.9		53
Acetone		150		18		150		87		ND		ND		87
1,1-Dichloroethene		5.0		2.9		5.0		3.8		5.0		2.8		4
1,1-Dichloroethane		70		14		28		16		70		14		16
1,2-Dichloroethene(total)		21		4.9		ND		ND		21		5.4		5
Chloroform		14		3.4		14		8.3		ND		ND		8
1,2-Dichloroethane		31		4.7		31		17		ND		ND		17
1,1,1-Trichloroethane		120		18		ND		ND		120		21		21
Trichloroethene		6.0		2.8		ND		ND		6.0		2.8		3
Benzene		340		28		340		171		ND		ND		171
Tetrachloroethene		3.0		2.5		ND		ND		3.0		2.5		3
Toluene		360		30		360		181		ND		ND		181
Ethyl benzene		440		64		440		405		ND		ND		405
Xylenes (total)		2,400		258		2,400		1,660		ND		ND		1,660
Naphthalene		800		101		800		630		ND		ND		630
2-Methylnaphthalene		4,000		450		4,000		2,900		ND		ND		2,900
Acenaphthene		72		10		72		39		ND		ND		39
Dibenzofuran		76		10		76		41		ND		ND		41
Fluorene		420		46		420		270		ND		ND		270
Phenanthrene		1,000		107		1,000		670		5.0		4.6		670
Di-n-butyl phthalate		5.0		4.4		ND		ND		5.0		4.3		4
Aroclor-1242		160		17		160		108		ND		ND		108
Aroclor-1260		97		12		97		74		ND		ND		74
Total Toxic Organics[2]:	2,130[3]	**10,190**		916		**10,070**		**6,996**		120		ND		**6,996**
Inorganics:														
Aluminum		68,700	171	19,730	58	47,000	ND	25,160	ND	68,700	171	18,524	63	25,160
Arsenic		92	52	27	10	44.8	52	34	27	92	31.2	26	6.5	34
Barium		1,410	230	295	81	1,410	230	939	206	481	100	152	53	939
Beryllium		2.2	ND	0.83	ND	2.2	ND	1.4	ND	ND	ND	ND	ND	1.4
Cadmium	260	1.6	ND	0.65	ND	1.6	ND	1.1	ND	1.1	ND	0.57	ND	1.1
Calcium		1,020,000	220,000	441,636	115,262	955,000	123,000	560,500	114,500	1,020,000	220,000	415,222	115,400	560,500
Chromium	1,710	117	ND	50	ND	82.2	ND	54	ND	117	ND	49	ND	54
Cobalt		91.8	3.7	25	1.6	55	ND	28	ND	91.8	3.7	25	1.6	28
Copper	2,070	212	ND	67	ND	76.7	ND	45	ND	212	ND	72	ND	45
Iron		192,000	12,800	59,318	1,913	127,000	12,800	67,215	6,584	192,000	1,840	57,563	875	67,215
Lead	430	**564**	ND	146	ND	**564**	ND	**548**	ND	173	ND	57	ND	**548**
Magnesium		597,000	224,000	261,627	72,383	544,000	60,700	315,050	56,300	597,000	224,000	249,756	75,600	315,050
Manganese		4,650	382	1,403	157	3,920	382	2,044	212	4,650	363	1,261	146	2,044
Mercury[4]	0.5	**0.57**	ND	0.18	ND	**0.57**	ND	**0.57**	ND	0.31	ND	0.14	ND	**0.57**
Nickel	2,380	164	18.9	57	6.4	85.8	ND	53	ND	164	18.9	58	7.0	53
Potassium		54,100	49,900	16,718	9,092	27,600	25,600	26,300	14,010	54,100	49,900	14,589	8,197	26,300
Silver	240	30.6	7.0	4.4	3.0	30.6	ND	18	ND	ND	7.0	ND	3.1	18
Sodium		803,000	861,000	238,036	229,350	249,000	264,000	209,500	217,000	803,000	861,000	244,378	231,820	209,500
Vanadium		130	5.3	40	1.7	79.8	ND	46	ND	130	5.3	38	1.7	46
Zinc	1,480	386	ND	145	ND	168	ND	97	ND	386	ND	155	ND	97
Cyanide	25	**44.9**	NA	8.9	NA	ND	NA	ND	NA	**44.9**	NA	10	NA	10
Total Solids (ug/l):				1,039				1,208				1,002		
Total Dissolved Solids (ug/l):					428				409				432	
Total Suspended Solids (ug/l):				611				799				570		

Footnotes:

[1] Dissolved column applies only to inorganic analytes.
[2] The totals shown are the sum of all concentrations of the toxic organic compounds greater than 100 ug/L.
[3] The sum of the concentrations of the toxic organic compounds greater than 100 ug/l must be less than 2,130 ug/L.
[4] The mercury Phase II result in monitoring well G106L was rejected during the Quality Assurance Review, and all of the Phase I inorganic data were also rejected. Therefore, the average shown for mercury under the "Wells G106L and MW-5S Average" is equal to the only detected value, i. e., 0.57 ug/L at MW-5S.

Key:

ND = Not detected
NA = Not analyzed
POTW = Publicly Owned Treatment Works
= Values indicate concentrations above the pretreatment standards

TABLE E-2

DETECTED INORGANIC COMPOUNDS
IN SHALLOW MONITORING WELLS NEAR THE DES PLAINES RIVER
LENZ OIL SITE
LEMONT, ILLINOIS

Parameter	Monitoring Well Number		
	MW-3S	MW-6S	Average
Inorganics (unfiltered) (ug/L)			
Aluminum	15,100	7,050	
Arsenic	43	7.7	
Barium	92	44	
Cadmium	ND	1.1	
Calcium	252,000	150,000	
Chromium	32	32	
Cobalt	20	3.7	
Copper	34	102	
Iron	48,000	19,300	
Lead	36	26	
Magnesium	142,000	75,400	
Manganese	686	386	
Mercury	0.24	ND	
Nickel	58	25	
Potassium	6,670	7,110	
Sodium	22,500	24,900	
Vanadium	24	15	
Zinc	108	45	
Inorganics (filtered) (ug/L)			
Arsenic	3.3	2.4	
Barium	15	15	
Calcium	94,000	74,400	
Iron	ND	39	
Magnesium	45,900	30,500	
Manganese	16	35	
Potassium	2,200	5,370	
Sodium	26,400	24,800	
Total solids (ug/L):	487,404	284,447	385,925
Total dissolved solids (ug/L):	168,534	135,162	151,848
Total suspended solids (ug/L):	318,870	149,286	234,078

Key:
ND = Not detected.

TABLE E-3

SELECTED OPTIMAL COMBINATIONS OF PUMPING RATES[1]
LENZ OIL SITE
LEMONT, ILLINOIS

ALTERNATIVE	REMEDIAL OPTION	EXTRACTION TRENCHES TOTAL FLOW RATE	EXTRACTION WELLS PUMPING RATES						CUMULATIVE DISCHARGE RATE
			EW-1	EW-2	EW-3	EW-4	EW-5	TOTAL FLOW	
3,4,5, and 5a	1B - Active, 3 trenches								
	Minimum	11	2	0.75	0.75	0.75	2	6.3	17.3
	Maximum	25.66	2	2	2	2	3	11	36.7
	Design average[2]	19.5	2	1.4	1.4	1.4	2.5	8.7	28.2
7	2 - Active, 2 trenches								
	Minimum	8.82	1	1	1	1	2	6	14.8
	Maximum	19.95	3	3	3	3	3.5	15.5	35.5
	Design average[2]	15	2	2	2	2	2.8	10.8	25.8
6 and 6a	3 - Enhanced, 4 trenches								
	Minimum	20.04	1	1	1	1	2	6	26.0
	Maximum	35.45	2	2	2	2	4	12	47.5
	Design average[2]	28	1.5	1.5	1.5	1.5	3	9	37.0
8	4 - Enhanced, 3 trenches								
	Minimum	13.53	2	0.75	0.75	0.75	3	7.3	20.8
	Maximum	27.48	2	0.75	0.75	3	4	10.5	38.0
	Design average[2]	21	2	0.8	0.8	1.9	3.5	9	30.0

NOTE:

(1) Pumping and flow rates are in units of gallons per minute (gpm).

(2) Flow rate to be used for the design of the alternatives in Section 3.0. The values shown were calculated as the average of the minimum and maximum flow rates and were rounded as appropiate.

TABLE E-4

EFFLUENT CONCENTRATIONS AFTER OIL/WATER SEPARATION AND AIR STRIPPING
AVERAGE CONCENTRATION INFLUENT, 28.2 GPM FLOW
LENZ OIL SITE
LEMONT, ILLINOIS

Parameter	Influent [1] (mg/L)	% Removal in Oil/Water Separator [2]	Oil/Water Separation Effluent (mg/L)	% Removal in Air Stripper [3]	Effluent from Air Stripper (mg/L)
Volatile Organic Compounds					
Vinyl chloride	0.0065		0.0065	99.9998	1.29091E-08
Chloroethane	0.053		0.053	95	0.002625
Acetone	0.087		0.087	15.1946	0.073780698
1,1-Dichloroethene	0.0038		0.0038	99.964	1.35E-06
1,1-Dichloroethane	0.016		0.016	99.936	9.92E-06
1,2-Dichloroethene(total)	0.0054		0.0054	99.9587	2.21518E-06
Chloroform	0.0083		0.0083	99.8562	1.18635E-05
1,2-Dichloroethane	0.017		0.017	93.317	0.001119403
1,1,1-Trichloroethane	0.021		0.021	99.8846	2.3657E-05
Trichloroethene	0.0028		0.0028	99.98	5.63636E-07
Benzene	0.171		0.171	99.6973	0.000518374
Tetrachloroethene	0.0025		0.0025	99.9921	2.01091E-07
Toluene	0.181		0.181	99.5838	0.000754363
Ethyl benzene	0.405		0.405	99.7682	0.00093879
Xylenes (total)	1.660		1.660	99.718	0.0046812
Semivolatile Organic Compounds					
Naphthalene	0.630	80	0.126	70.9219	0.036638406
2-Methylnaphthalene	2.900	80	0.580		0.58
Acenaphthene	0.039	80	0.0077		0.0077
Dibenzofuran	0.041	80	0.0081		0.0081
Fluorene	0.270	80	0.054		0.054
Phenanthrene	0.670	80	0.134		0.134
Di-n-butyl phthalate	0.0043	80	0.00085		0.000854545
PCBs					
Aroclor-1242	0.108	80	0.022		0.0216
Aroclor-1260	0.074	80	0.015		0.0148
TTO Parameters:	7.374		3.586		0.942
TTO > 0.1 mg/L [4]:	6.996		3.258		0.714
Tentatively Identified Compounds					
Volatile Organic Compounds					
Unknown (no. of peaks)	5.169		5.169	70.9219	1.503046989
Unknown amide	0.0030		0.0030	70.9219	0.000872343
Unknown oxygenated compound	0.0028		0.0028	70.9219	0.00080524
3-Methylhexane	0.056		0.056	70.9219	0.016283736
Unknown alkane	0.465		0.465	70.9219	0.135213165
Substituted benzene	0.0030		0.0030	70.9219	0.000872343
Cycloalkanes	0.213		0.213	70.9219	0.061936353
C6H12 isomer	0.073		0.073	70.9219	0.021227013
C7H16 isomer	0.071		0.071	70.9219	0.020645451
Ethylmethylbenzene	0.356		0.356	70.9219	0.103518036
Semivolatile Organic Compounds					
Unknown (no. of peaks)	0.026	80	0.005		0.0052
Unknown phthalate esthers	0.0049	80	0.0010		0.000983333
Unknown alkane (no. of peaks)	74.000	80	14.800		14.8
Dimethylnaphthalene isomers	13.250	80	2.650		2.65
Unknown aromatic	6.350	80	1.270		1.27
Aliphatic hydrocarbons	0.0050	80	0.0010		0.001
2-Butanone, 3,3-dimethyl	0.0050	80	0.0010		0.001
Alcohols	0.0050	80	0.0010		0.001
Oxygenated hydrocarbon	0.0048	80	0.0010		0.00095
Hexanoic acid 2-ethyl	0.0050	80	0.0010		0.001
Sulfur, MOL (S8)	0.0050	80	0.0010		0.001
Unknown phenol	0.0049	80	0.0010		0.000983333
Cyclohexane isomers	2.003	80	0.401		0.4006
Trimethylnaphthalene isomers	10.400	80	2.080		2.08
Biphenyl compounds	6.955	80	1.391		1.391
Unknown acids	0.0048	80	0.0010		0.00095
Total TICs:	119.44		29.02		24.47
Total Organics:	126.81		32.60		25.41

Notes:

[1] Based on the average concentration in the ground water samples collected from wells MW-5S and G106L during the Remedial Investigation. If the compound was not detected in wells G106L and MW-5S, the average of all wells except G106L and MW-5S was used as the influent concentration.

[2] Assumes that the semivolatile organics are associated with the light nonaqueous phase liquid and will be removed in the oil/water separation system.

[3] From the results of the ShallowTray Modeler software. This software models air stripping based on specific equipment mass transfer rates. Compounds not available for modeling in ShallowTray were assumed to have removal efficiencies equal to naphthalene.

[4] Calculated as the sum of the concentrations of the organic compounds greater than 0.100 mg/L. The sum of the concentrations of the organic compounds greater than 0.100 mg/L must be less than the POTW Pretreatment Standard of 2.130 mg/L.

Key:

TTO = Total toxic organics
TIC = Tenatively identified compound
PCB = Polychlorinated biphenyl

TABLE E-5

ESTIMATION OF GRANULAR ACTIVATED CARBON USAGE
AVERAGE CONCENTRATION, 28.2 GPM FLOW
LENZ OIL SITE
LEMONT, ILLINOIS

Parameter	Influent [1] (mg/L)	% Removal in Oil/Water Separator [2]	Oil/Water Separation Effluent (mg/L)	Target Effluent (mg/L)	Estimated GAC Usage [3] (lb/day)
Volatile Organic Compounds					
Vinyl chloride	0.0065		0.0065	<0.1	0.00
Chloroethane	0.053		0.053	<0.1	0.00
Acetone	0.087		0.087	<0.1	0.00
1,1-Dichloroethene	0.0038		0.0038	<0.1	1.27
1,1-Dichloroethane	0.016		0.016	<0.1	0.00
1,2-Dichloroethene(total)	0.0054		0.0054	<0.1	0.00
Chloroform	0.0083		0.0083	<0.1	5.20
1,2-Dichloroethane	0.017		0.017	<0.1	0.00
1,1,1-Trichloroethane	0.021		0.021	<0.1	5.12
Trichloroethene	0.0028		0.0028	<0.1	0.59
Benzene	0.171		0.171	<0.1	4.64
Tetrachloroethene	0.0025		0.0025	<0.1	0.11
Toluene	0.181		0.181	<0.1	1.88
Ethyl benzene	0.405		0.405	<0.1	2.94
Xylenes (total)	1.660		1.660	<0.1	4.34
Semivolatile Organic Compounds					
Naphthalene	0.630	80	0.126	<0.1	0.35
2-Methylnaphthalene	2.900	80	0.580	<0.1	1.62
Acenaphthene	0.039	80	0.0077	<0.1	0.00
Dibenzofuran	0.041	80	0.0081	<0.1	0.00
Fluorene	0.270	80	0.054	<0.1	0.00
Phenanthrene	0.670	80	0.134	<0.1	0.71
Di-n-butyl phthalate	0.0043	80	0.00085	<0.1	0.00
PCBs					
Aroclor-1242	0.108	80	0.022	<0.1	0.15
Aroclor-1260	0.074	80	0.015	<0.1	0.10
TTO Parameters:	7.374		3.586		
TTO > 0.1 mg/L[4]:	6.996		3.258	0	
Tentatively Identified Compounds					
Volatile Organic Compounds					
Unknown (no. of peaks)	5.169		5.169		
Unknown amide	0.0030		0.0030		
3-Methylhexane	0.056		0.056		
Unknown alkane	0.465		0.465		
Substituted benzene	0.0030		0.0030		
Cycloalkanes	0.213		0.213		
C6H12 isomer	0.073		0.073		
C7H16 isomer	0.071		0.071		
Ethylmethylbenzene	0.356		0.356		
Semivolatile Organic Compounds					
Unknown (no. of peaks)	0.026	80	0.0052		
Unknown phthalate esthers	0.0049	80	0.0010		
Unknown alkane (no. of peaks)	74.000	80	14.800		
Dimethylnaphthalene isomers	13.250	80	2.650		
Unknown aromatic	6.350	80	1.270		
Aliphatic hydrocarbons	0.0050	80	0.0010		
2-Butanone, 3,3-dimethyl	0.0050	80	0.0010		
Alcohols	0.0050	80	0.0010		
Oxygenated hydrocarbon	0.0048	80	0.0010		
Hexanoic acid 2-ethyl	0.0050	80	0.0010		
Sulfur, MOL (S8)	0.0050	80	0.0010		
Unknown phenol	0.0049	80	0.0010		
Cyclohexane isomers	2.003	80	0.401		
Trimethylnaphthalene isomers	10.400	80	2.080		
Biphenyl compounds	6.955	80	1.391		
Unknown acids	0.0048	80	0.0010		
Total TICs:	119.44		29.02	70.00	
Total Organics:	126.81		32.60	70.00	

Notes:

[1] Based on the average concentration in the ground water samples collected from wells MW-5S and G106L during the Remedial Investigation. If the compound was not detected in wells G106L and MW-5S, the average of all wells except G106L and MW-[illegible] was used as the influent concentration.

[2] Assumes that the semivolatile organics are associated with the light nonaqueous phase liquid and will be removed in the oil/water separation unit.

[3] Carbon usage rates were calculated by vendor using "Carbtrol Corporation Carbon Usage Calculation" software.

[4] Calculated as the sum of the concentrations of the organic compounds greater than 0.100 mg/L. The sum of the concentration of the organic compounds greater than 0.100 mg/L must be less than the POTW Pretreatment Standard of 2.130 mg/L.

Key:

GAC = Granular activated carbon
TTO = Total toxic Organics
TIC = Tenatively identified compound
PCB = Polychlorinated biphenyl

TABLE E-6

INCREMENTAL CAPITAL COSTS FOR AIR STRIPPING VS. GAC ADSORPTION
LENZ OIL SITE
LEMONT, ILLINOIS

Item	Quantity	Units	Unit Price[1,2]	Total Cost
Air Stripping				
Air stripper, with blower	2	ea.	$23,318	$ 46,637
Pump station	2	ea.	$6,720	$ 13,440
Total:				$ 60,077
GAC				
GAC - water phase	4	ea.	$5,835	$ 23,341
Total:				$ 23,341

Key:
GAC = Granular activated carbon.

Note:
(1) Unit costs estimated from *1996 ECHOS Environmental Restoration Unit Cost Book*, published by R. S. Means Co., Inc. and Delta Technologies Group, Inc., 1996.

(2) Cost estimates include 12% markup for overhead and profit.

TABLE E-7

INCREMENTAL OPERATION & MAINTENANCE COSTS
FOR AIR STRIPPING VS. GAC ADSORPTION
LENZ OIL SITE
LEMONT, ILLINOIS

Item	Quantity	Units	Unit Price (cost per unit)	Annual Cost (1)
Air Stripping				
Electrical power	11.3	kw hr	$ 0.10	$ 9,899
Operation & maintenance			5% of capital cost	$ 3,004
Total:				$ 12,903
GAC				
GAC media disposal & replacement	25,012	lb carbon	$ 2.75	$ 68,783
Operation & maintenance			5% of capital cost	$ 1,167
Total:				$ 69,950

Key:
GAC = Granular activated carbon.

Note:
(1) Cost estimates include 12% markup for overhead and profit.

TABLE E-8

INCREMENTAL PRESENT VALUE COSTS
FOR AIR STRIPPING VS. GAC ADSORPTION
LENZ OIL SITE
LEMONT, ILLINOIS

	Capital	Annual O&M	Total Present Value Cost (1,2)
Air Stripping	$ 60,077	$ 12,903	$ 258,422
GAC	$ 23,341	$ 69,950	$ 1,098,644

Key:
GAC = Granular activated carbon.

Note:
(1) The present value calculation is based on 30 years of system operation and a 5% discount rate.

(2) Cost estimates include 12% markup for overhead and profit.

ATTACHMENT E-1

AIR STRIPPER CALCULATIONS

ShallowTray™
low profile air strippers

System Performance Estimate

Client and Proposal Information:

lenz oil

Model Chosen:	2300
Water Flow Rate:	28.2 gpm
Air Flow Rate:	300 cfm
Water Temp:	50.0 F
Air Temp:	50.0 F
A/W Ratio:	79.6
Safety Factor:	None

Contaminant	Untreated Influent Effluent Target	Model 2311 Effluent Water Air(lbs/hr) % removal	Model 2321 Effluent Water Air(lbs/hr) % removal	Model 2331 Effluent Water Air(lbs/hr) % removal	Model 2341 Effluent Water Air(lbs/hr) % removal
Acetone	**87 ppb** 86 ppb	**85 ppb** 0.000028 2.9730%	**82 ppb** 0.000071 5.8576%	**80 ppb** 0.000099 8.6565%	**78 ppb** 0.000127 11.3722%
Due to its miscibility with water, acetone removal is difficult to predict. Call your NEEP representative for more information.					
1,1-Dichloroethylene	**4 ppb** 0 ppb	**1 ppb** 0.000039 93.0104%	**<1 ppb** 0.000053 99.5115%	**<1 ppb** 0.000054 99.9659%	**<1 ppb** 0.000054 99.9976%
1,1-Dichloroethane	**16 ppb** 2 ppb	**3 ppb** 0.000183 85.1358%	**1 ppb** 0.000212 97.7906%	**<1 ppb** 0.000225 99.6716%	**<1 ppb** 0.000226 99.9512%
t-1,2-Dichloroethylene	**5 ppb** 1 ppb	**1 ppb** 0.000062 86.7305%	**<1 ppb** 0.000075 98.2392%	**<1 ppb** 0.000076 99.7663%	**<1 ppb** 0.000076 99.9690%
Chloroform	**8 ppb** 1 ppb	**2 ppb** 0.000089 81.6551%	**1 ppb** 0.000103 96.6347%	**<1 ppb** 0.000116 99.3826%	**<1 ppb** 0.000117 99.8867%
1,1,1-Trichloroethane	**21 ppb** 2 ppb	**2 ppb** 0.000268 91.8694%	**<1 ppb** 0.000294 99.3389%	**<1 ppb** 0.000296 99.9463%	**<1 ppb** 0.000296 99.9956%
Trichloroethylene	**3 ppb** 0 ppb	**1 ppb** 0.000025 89.0044%	**<1 ppb** 0.000039 98.7910%	**<1 ppb** 0.000039 99.8671%	**<1 ppb** 0.000039 99.9854%
Benzene	**171 ppb** 17 ppb	**30 ppb** 0.001989 82.6033%	**6 ppb** 0.002328 96.9735%	**1 ppb** 0.002398 99.4735%	**<1 ppb** 0.002410 99.9084%
Tetrachloroethylene	**2 ppb** 0 ppb	**<1 ppb** 0.000032 91.3679%	**<1 ppb** 0.000035 99.2549%	**<1 ppb** 0.000035 99.9357%	**<1 ppb** 0.000035 99.9944%

Contaminant	Influent Effluent Target	Model 2611 Effluent Water Air(lbs/hr) % removal	Model 2621 Effluent Water Air(lbs/hr) % removal	Model 2631 Effluent Water Air(lbs/hr) % removal	Model 2641 Effluent Water Air(lbs/hr) % removal
Toluene	**181 ppb** 18 ppb	**12 ppb** 0.002384 93.5489%	**1 ppb** 0.002539 99.5838%	**<1 ppb** 0.002553 99.9732%	**<1 ppb** 0.002553 99.9983%
Ethyl Benzene	**405 ppb** 40 ppb	**20 ppb** 0.005431 95.1855%	**1 ppb** 0.005699 99.7682%	**<1 ppb** 0.005712 99.9888%	**<1 ppb** 0.005713 99.9995%
Naphthalene	**126 ppb** 38 ppb	**68 ppb** 0.000818 46.0758%	**37 ppb** 0.001255 70.9219%	**20 ppb** 0.001495 84.3199%	**11 ppb** 0.001622 91.5446%
Vinyl Chloride	**6 ppb** 1 ppb	**<1 ppb** 0.000092 99.8621%	**<1 ppb** 0.000092 99.9998%	**<1 ppb** 0.000092 100.0000%	**<1 ppb** 0.000092 100.0000%
1,2-Dichloroethane	**17 ppb** 2 ppb	**5 ppb** 0.000169 74.1486%	**2 ppb** 0.000212 93.3170%	**1 ppb** 0.000226 98.2724%	**<1 ppb** 0.000239 99.5534%
p-Xylene	**1660 ppb** 166 ppb	**89 ppb** 0.022161 94.6898%	**5 ppb** 0.023346 99.7180%	**<1 ppb** 0.023413 99.9850%	**<1 ppb** 0.023416 99.9992%
o-Xylene	**1660 ppb** 166 ppb	**88 ppb** 0.022175 94.7132%	**5 ppb** 0.023346 99.7205%	**<1 ppb** 0.023413 99.9852%	**<1 ppb** 0.023416 99.9992%

This report has been generated by ShallowTray Modeler software version 2.0.2. This software is designed to assist a skilled operator in predicting the performance of a ShallowTray air stripping system. North East Environmental Products, Inc. is not responsible for incidental or consequential damages resulting from the improper operation of either the software or the air stripping equipment.
Report generated: 11/6/1996

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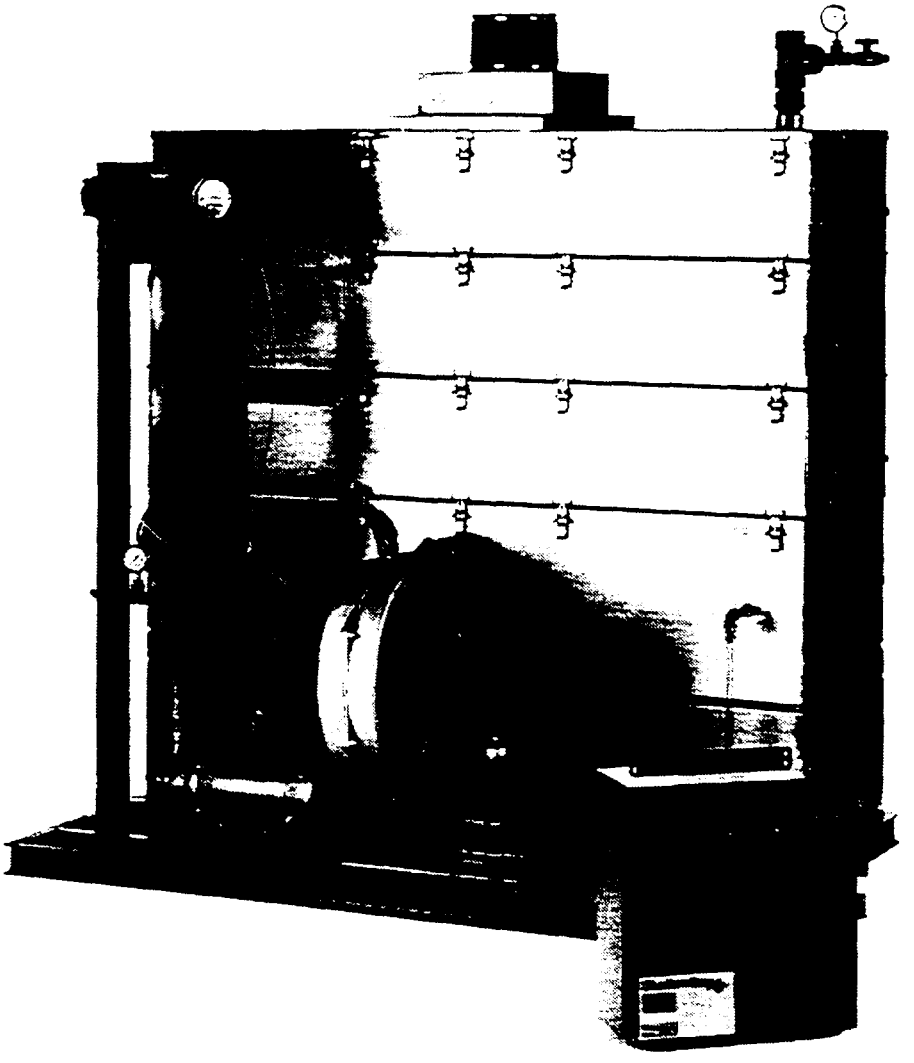
Voice: 603-298-7061 FAX: 603-298-7063 * All Rights Reserved.

2600 Series

Model Pictured: 2631

Options chosen for system pictured:

- Discharge pump
- EXP pump and blower motors
- NEMA 3R control panel with level controls for pump, alarm interlocks, motor starters, relays, 100 db alarm horn
- Control panel intrinsically safe components for remote mounted NEMA 3R panel
- Low pressure alarm switch
- High level alarm switch
- Discharge pump level switch
- Water pressure gauges
- Line sampling ports



Models	flow rate	# trays	width	length	height	min. cfm	approx. lbs.
2611	1-90gpm	1	4'0"	6'2"	5'0"	600	935
2621	1-90gpm	2	4'0"	6'2"	5'9"	600	1050
2631	1-90gpm	3	4'0"	6'2"	6'6"	600	1165
2641	1-90gpm	4	4'0"	6'2"	7'3"	600	1280

ATTACHMENT E-2

GAC USAGE CALCULATION

CARBTROL®

ENGINEERED SYSTEMS FOR ENVIRONMENTAL CONTROL

51 RIVERSIDE AVENUE
WESTPORT, CT 06880

(203) 226-5642
(800) 242-1150
FAX: (203) 226-5322

TO:	Tom Frew	FAX NUMBER:	847 940 9280
COMPANY:	ERM	DATE: 10/24/96	STATE: IL
REF:	Carbon Application - 50/60 gpm	TOTAL PAGES:	3
		TEL. NUMBER:	7200

MESSAGE:

Tom:

Resulting carbon usage rates at 50 and 60 gpm attached. Had to include a number of compounds below 100 ppb because their adsorbtion capacities on carbon are simply too high to be left out. The only compounds we feel are weak enough to be washed off by the stronger ones at equilibrium are vinyl chloride, chlorethane, acetone, 1,1-dichloroethane and 1,2 dichloroethane. I am unable to predict the exact hierarchy of adsorbtion capacities but the ones listed on the sheet will certainly be adsorbed in preference to the others in the mix.

Whenever you have an oleo of compounds like we have here, adsorption capacities start competing with each other and its real difficult to be precise in predicting carbon usage. What's provided in the attachments is our best judgment. The only sure way to predict outcome is a pilot test with an L-1 canister cutting the flow rate to about 3 gpm and monitoring the effluent for breakthrough of each contaminant. The data obtained can be extrapolated to what will happen at a flow of 50 gpm.

Please call if any questions.

Charlie O'Rourke
3021

FROM: C.E. O'Rourke

CARBTROL

Oct. 24. 1996 3:36PM CARBTROL CORPORATION No. 6652 P. 2/3

PROJECT:

FLOW IN GPM: 50.00
FLOW IN GPD: 72000.00

PERFORMANCE:

CONTAMINANT	CONC(ppb)	#CONT /DAY	# CARBON /DAY	# CONT /1000 gal	# CARBON /1000 gal
1,1-Dichloroethane	4	0.00	2.26	0.00	0.14
Chloroform	8	0.00	9.22	0.00	0.13
1,1,1-Trichloroethane	120	0.07	9.08	0.00	0.13
Trichloroethylene	6	0.00	1.05	0.00	0.01
Benzene	171	0.10	8.23	0.00	0.11
Tetrachloroethylene	3	0.00	0.19	0.00	0.00
Toluene	181	0.11	3.33	0.00	0.05
Ethylbenzene	405	0.24	5.22	0.00	0.07
Xylene	1660	1.00	7.70	0.01	0.11
Naphthalene	706	0.42	3.49	0.01	0.05
Phenanthrene	205	0.12	1.26	0.00	0.02
PCB (as 1232)	36	0.02	0.44	0.00	0.01
TOTALS	3505	2.10	51.47	0.03	0.82

Total TICs (as Naphthalene) ~~119,440~~ 70

Carbon usage rate @ 50 gpm – 51.5 #/op day

121.5 lb/d

per C. O'Rourke phone conv. 10/25 TJF

PROJECT:

FLOW IN GPM: 60.00
FLOW IN GPD: 86400.00

PERFORMANCE:

CONTAMINANT	CONC(ppb)	#CONT /DAY	# CARBON /DAY	# CONT /1000 gal	# CARBON /1000 gal
1,1-Dichloroethane	4	0.00	5.9	0.00	0.14
Chloroform	8	0.01	11.06	0.00	0.13
1,1,1-Trichloroethane	120	0.09	10.89	0.00	0.13
Trichloroethylene	6	0.00	1.26	0.00	0.01
Benzene	171	0.12	9.87	0.00	0.11
Tetrachloroethylene	3	0.00	0.23	0.00	0.00
Toluene	181	0.13	3.99	0.00	0.05
Ethylbenzene	405	0.29	6.26	0.00	0.07
Xylene	1660	1.20	9.24	0.01	0.11
Naphthalene	706	0.51	4.19	0.01	0.05
Phenanthrene	205	0.15	1.51	0.00	0.02
PCB (as 1232)	36	0.03	0.53	0.00	0.01
TOTALS	3505	2.53	64.93	0.03	0.82
Total TICs			84		

Carbon usage rate @ 70 gpm — 65 #/bp day

148.93

APPENDIX F

GROUND WATER AND LIGHT NONAQUEOUS PHASE LIQUID MODELING

CONTENTS

1.0	*INTRODUCTION*		*F-1*
2.0	*MODEL SELECTION*		*F-3*
	2.1	*GROUND WATER MODEL*	*F-3*
	2.2	*LNAPL MODEL*	*F-3*
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APPENDIX F GROUND WATER AND LIGHT NONAQUEOUS PHASE LIQUID MODELING

1.0 INTRODUCTION

The ground water flow system at the Lenz Oil Service, Inc. site (Site) was modeled as part of the Feasibility Study (FS) to: (1) generate quantitative predictions of the ground water flow system resulting from the pumping of ground water from extraction wells and trenches with or without surfactant infiltration to enhance the recovery of light nonaqueous phase liquids (LNAPL), and (2) predict LNAPL recovery and movement resulting from the installation of extraction trenches or wells.

Specific requirements governing the ground water modeling efforts for the Site include the following:

- Capture the ground water contaminant plume upgradient from the Des Plaines river,
- Optimize drawdown in the LNAPL recovery area while effectively capturing the shallow contaminated ground water.

The desired ground water capture zone was assumed to extend from the Des Plaines River northwestward (upgradient) to the Site's northwestern fence including the full width of the Site (see Figure F-1). Optimization of drawdown within the capture zone focused on maximizing the effectiveness of the LNAPL recovery systems concurrent with minimizing the effect beyond the limits of the LNAPL Area 1 at the Site. Drawdown outside the area of contamination is minimized to prevent influencing the ground water flow on adjacent properties and to minimize the extraction/treatment of clean ground water.

Specific requirements governing the LNAPL modeling efforts for the Site include determining:

- The total cumulative LNAPL removed by the trenches over time, and
- The amount of residual LNAPL remaining in the saturated and unsaturated zones.

The extent of the LNAPL at the Site consists of the area shown on Figure F-2.

The following sections of this appendix provide: a description of the ground water and LNAPL models and input parameters used for this project, a brief description of the site hydrogeology, the rationale for selecting the models and the various input parameters, and a discussion of the results of the model with respect to the goals outlined above.

2.0 *MODEL SELECTION*

Two separate models were used in support of the FS, one for the ground water and one for the LNAPL. The reasoning for the selection is presented in the following sections.

2.1 *GROUND WATER MODEL*

Selection of a ground water flow model depends primarily on the complexity of the geological and hydrogeological boundaries that define the modeled domain. In many cases, a simple, straightforward model is adequate for obtaining a generalized answer to a specified problem. The U.S. Geological Survey's Modular Three-Dimensional Finite Difference Ground Water Flow Model (MODFLOW) (McDonald and Harbaugh, 1988) was selected for this project because it is widely used and it is capable of representing a wide array of geological and boundary conditions. MODELCAD[386], a preprocessor distributed by Geraghty & Miller, Inc. (1993), was used for the construction of MODFLOW input files. In addition, MODELCAD[386] was used to create input data sets for use with MODPATH (Pollock, 1989) and for determining calibration statistics after execution of MODFLOW. Finally, drawdown contours were displayed using Golden Software's SURFER Program (Golden Software, 1994).

MODPATH is capable of tracking particles within the modeled domain by using head potential and cell-by-cell flow values generated by MODFLOW, thereby allowing for an assessment of the impact of active pumping on ground water flow. Although MODFLOW and MODPATH are not capable of simulating contaminant transport, the conservative particle tracking movement and travel times based on the ground water model-generated velocity field allows for assessment of the capture zone of one or multiple pumping wells.

2.2 *LNAPL MODEL*

There are a limited number of commercially available models capable of analyzing LNAPL behavior in a setting such as that found at the Lenz Oil site. Complex models available are limited to one layer, unconsolidated aquifer systems. The LNAPL at the site is found in two different systems: the unconsolidated soils northwest of Jeans Road and the bedrock southeast of Jeans Road. However, because the bedrock is extensively fractured in the upper sections where the LNAPL is located, the bedrock unit can be approximated by a permeable, unconsolidated unit. The professional version of Areal Multiphase Organic Simulator (ARMOS)

version 5.11 was selected to be applied to the site, as it is the only comprehensive LNAPL model available on the market that would satisfy the specific requirements for the LNAPL modeling conducted in support of the Lenz Oil site FS. ARMOS was developed by Environmental Systems & Technologies, Inc. of Blacksburg, Virginia (ES&T, 1994). ARMOS can simulate multiple recovery trenches/wells with passive skimming or active ground water and oil pumping. Cumulative recovery and volume of the LNAPL (and therefore the residual LNAPL present after recovery) can also be estimated using this computer model.

2.3 *MODEL ALTERNATIVES*

In the models, four extraction trenches were simulated. The location of each extraction trench is identified with a letter designating its position in the LNAPL area. The three active ground water recovery trenches modeled are designated N, M, and S. A fourth trench primarily intended for passive LNAPL recovery and for capturing surfactant (when used) is located southeast of trench S and is designated trench P.

The following four remedial scenarios were modeled for the ground water extraction model:

1. Active recovery of ground water with three northeast-southwest trending trenches (N, M, and S), in the LNAPL area with or without extraction wells located near the Des Plaines River;

2. Excavation and removal of LNAPL in the area where the LNAPL lies within the unconsolidated soils and gravels, and active recovery of ground water with two trenches (M and S) and five extraction wells;

3. Active recovery of ground water with 4 trenches (N, M, S, and P) and 5 extraction wells as well as surfactant infiltration at 10 gallons per minute (gpm) in the LNAPL area; and

4. Excavation and removal of LNAPL in the area where the LNAPL lies within the unconsolidated soils and gravels, and active recovery with 3 trenches (M, S, and P) and 5 extraction wells, as well as surfactant infiltration at 5 gpm in the LNAPL area.

Figures F-3 through F-6 show the conceptual design of each remedial alternative including the approximate locations of the remedial system components. A similar group of remedial scenarios were evaluated with the LNAPL model, with the addition of a passive recovery scenario using trenches N, M, S, and P where only LNAPL is removed.

3.0 CONCEPTUAL MODELS

The following subsections discuss the various remediation scenarios, the conceptual design of the models, and the input parameters.

3.1 HYDROSTRATIGRAPHIC UNITS

Data from the Remedial Investigation [(RI), (ERM-North Central, Inc., 1992) show that the surficial aquifer at the site is composed of fractured Silurian dolomite overlain by a variable thickness (0- to 26.5-foot) of unconsolidated alluvium (Figure F-7). These units have differing hydrogeological characteristics, but are hydraulically connected and generally act as a single unconfined aquifer. Although the aquifer was observed to be under semi-confined conditions over a narrow zone along the topographic slope immediately southeast of Jeans Road, this condition is considered to have minimal affect on the results of the modeling because the area under confinement is relatively small in comparison to the modeled domain.

In the area that encompasses Jeans Road and the site to the northwest, the LNAPL occurs within the unconsolidated materials (i.e., the silty soils and gravels). Southeast of Jeans Road, the LNAPL occurs within bedrock. Since ARMOS is limited to simulating a one-layer system, the LNAPL was modeled as occurring within a single layer whose physical hydrogeological properties were variable. In other words, the transition from unconsolidated deposits to fractured bedrock was modeled as a transition in physical and hydrogeologic properties from northwest to southeast.

3.1.1 *Fractured Silurian Dolomite*

The fractured Silurian dolomite consists of yellowish-gray, finely crystalline, fractured dolomite with some intraclasts and pelloids. Most of the fractures are horizontal (bedding plane), but high angle fractures are also present. Major continuous horizontal fracture zones occur at 553 and 587 feet above mean sea level (AMSL). These fracture zones appear to be regional in extent and have been identified at other locations in the area (Nicholas and Healy, 1988).

The base of the fractured Silurian dolomite portion of the surficial aquifer was selected as 550 feet AMSL for the models because: (1) a regional joint set by which ground water flows is present at 550 feet AMSL (Nicholas and Healy, 1988); (2) the site data show fractures to a depth of 553 feet AMSL; and (3) the weathered zone and fractures at the top of the dolomite are the major conduits for ground water flow in the bedrock (Nicholas

and Healy, 1988 and Ziezel and others, 1962). The elevation of the top of the Silurian dolomite ranges from 574 to 591 feet AMSL. For the most part, the Silurian dolomite is completely saturated except adjacent to the Des Plaines River, where the upper few feet may be in the vadose zone. In the LNAPL model, the dolomite unit comprises the southeastern portion of the modeled domain.

3.1.2 *Unconsolidated Portion of the Surficial Aquifer*

The unconsolidated portion of the surficial aquifer is composed of silty clay, silty gravel, and excavation backfill (primarily incinerator ash). In general, the silty gravel is saturated and the silty clay and excavation backfill are partially saturated. The excavation backfill is hydraulically isolated from the rest of the aquifer by a 10-mil, pond grade, visqueen liner.

The unconsolidated portion of the aquifer is thickest near MW-05S (approximately 20 feet) and thins considerably southeast of Jeans Road to less than 1 foot at the Des Plaines River. At the Lenz Oil site, the water table occurs in the unconsolidated deposits with a reported saturated thickness of 16 feet at Jeans Road and 10 feet at the northwesternmost boundary of the site. At the river, the unconsolidated deposits occur as a thin veneer over the bedrock and the water table is in the underlying dolomite. This unconsolidated unit was used in the ARMOS model to represent the northwestern portion of the modeled domain (Figure F-8).

The bedrock portion of the aquifer consists of a highly fractured and weathered dolomite near the top of the unit, but with less weathering at depth. However, fractures and regional joint sets occur throughout the bedrock such that on a large scale, the bedrock may behave as an unconsolidated aquifer.

The focus of the ground water modeling is to simulate extraction trench and extraction well recovery in the areas containing LNAPL and dissolved constituents. The LNAPL is located in the area shown in Figure F-2. The unconsolidated deposits in this area, although present, are typically unsaturated during the dry portions of the year, and contain ground water within the lower portions during the extreme wet periods. As a result, the LNAPL is primarily located within the upper portions of the fractured bedrock southeast of Jeans Road, where the saturated, unconsolidated deposits are thin or nonexistent.

Because portions of the fractured bedrock will likely require some excavation in order to install the extraction trenches and because the major portions of the LNAPL are situated within the bedrock southeast of Jeans Road, the ground water model focuses on simulations of ground water extraction within the bedrock. The properties of the fractured

bedrock (i.e., hydraulic conductivity, saturated thickness, etc.) are, therefore, incorporated into the single-layer ground water model for the simulated alternatives.

3.2 *SURFACE WATER*

Discharge of the Des Plaines River is measured at several gaging stations in Northern Illinois. The closest, active gaging station maintained by the Illinois Geologic Survey (IGS) is at Riverside, Illinois, located several miles upstream of the Site. Historically, a gaging station was located in Lemont, but it was abandoned in 1944.

Daily discharge measurements at Riverside, Illinois span the time interval between October 1, 1987 and September 30, 1993. The maximum, minimum, and mean discharge for this time period is 5,490 cubic feet per second (cfs), 138 cfs, and 719 cfs, respectively. Attachment 1 presents the daily discharge data for the Des Plaines River for this period of time and a plot of discharge data for 1991 is presented in Figure F-9.

The United States Geological Survey (USGS) typically determines the base flow of a river by plotting the frequency of discharge on probability paper. In studies prepared by the USGS, the 55th and 60th percentile of annual flow duration (amount of time that flow in an average year is equaled or exceeded) has been considered a representative value for average annual ground water runoff (Holmstrom, 1978; Gillespie and Dumouchelle, 1988). For this study, the 60th percentile of average annual flow duration was used to estimate the base flow of the Des Plaines River. Using all of the historical data from the Riverside, Illinois gaging station, the base flow (60 percent duration) is approximately 627 cfs.

The base flow value of the river is significant because it estimates the amount of ground water flow into the river without the influence of surface runoff due to precipitation or other inputs. Base flow predictions of rivers in urban areas do not take into account industrial discharges (cooling water, etc.). The base flow of the river can be used to determine when inputs to river discharge are mostly due to ground water flow.

The dates when the calculated base flow of the Des Plaines River occurred were compared to the dates on which water level measurements were collected at the site to determine if any of the water level measurements were collected on a day where the Des Plaines River was at the base flow. The closest match was found for the May 9, 1991 water level measurement at the Site, which corresponds to a river discharge of 689 cfs. By comparison, the Des Plaines River discharge on September 27, 1991 was 167 cfs, representing drought conditions. Therefore, the September 27, 1991 water level measurements were used to determine the depth of the

trenches to be used for collection of the LNAPL and the minimum ground water pumping requirements, and the May 9, 1991 water level measurements were used to determine the maximum ground water pumping requirements. The average ground water pumping requirement is calculated as the average of the May 9, 1991 and September 27, 1991 pumping requirements.

3.3 *GROUND WATER LEVELS*

A correlation exists between precipitation or snow melt events and ground water elevations. Thus, during the spring when snow melt occurs and precipitation is frequent, ground water levels are expected to be higher. Conversely, during dry periods such as occur in late summer, ground water levels are lower.

Water level measurements in all of the monitoring wells at the Lenz Oil site were collected monthly between January 1991 and March 1992. The additional measurements collected during 1994 as part of the LNAPL investigation could not be used for the MODFLOW calibration because data were obtained from only shallow wells. Monthly total precipitation versus water level elevations for selected wells are plotted in Figure F-10.

Ground water flow occurs as a result of influences such as seasonal variations of precipitation, river stage, and nearby pumping wells. Extended precipitation, snowmelt or other influences can cause the ground water levels to increase. Typically, precipitation is common during spring months, which contributes to ground water levels directly due to percolation through soils and indirectly due to higher streamflow which can cause surface water to flow from the stream into the aquifer. Conversely, the lack of these influences on the ground water regime causes the ground water levels to decline and ground water flow rates to decrease. These conditions were met at the Site during the spring and late summer of 1991. In April and May, spring runoff was at its peak, causing high discharge rates in the Des Plaines River. In addition, ground water levels were high due to the increased ground water recharge due to precipitation and contributions to ground water levels from the River. Therefore, the May 9, 1991 water levels represent near-maximum ground water conditions at the Site.

Low ground water level conditions were observed in September, 1991. In September, the Des Plaines River Discharge was at a record low. In addition, the cumulative precipitation during the four previous months (June through September) totaled less than 8-inches of which approximately 1-inch are estimated to have contributed to aquifer recharge based on Cartwright, 1992. Therefore, the September 27, 1991

water levels represented drought conditions due to little or no significant recharge to the ground water.

Therefore, the May 9, 1991 and September 27, 1991 rounds of water levels represent the extremes of ground water conditions expected at the Site. The water table elevation contours for September 27 and May 9, 1991 (illustrated on Figures F-11 and F-12, respectively) show a general gradual southeasterly slope towards the Des Plaines River. As reported in the RI, the average gradient in the unconfined aquifer is to the southeast at approximately 0.004 ft/ft.

3.4 *HYDRAULIC CONDUCTIVITY*

Hydraulic conductivity values measured during the RI for the unconsolidated portion of the aquifer range from 23.8 to 548 ft/day with a geometric mean of 81 ft/day. This variation is typical of and reflects the heterogeneous nature of the unconsolidated deposits.

Aquifer heterogeneity was also noted in the hydraulic conductivity values calculated from tests performed in wells whose screened intervals are within the bedrock unit. Slug tests and pressure tests for bedrock monitoring wells installed during the RI show that the hydraulic conductivity of the Silurian dolomite ranges from 1.76 to 109 ft/day with a geometric mean of 13.48 ft/day. The hydraulic conductivity within the bedrock at the site is assumed homogeneous because of: (1) the relative abundance of vertical and horizontal fractures; (2) the high degree of fracturing of the shallow weathered bedrock as shown in the RI and LNAPL investigation; (3) the presence of other secondary porosity in the upper part of the dolomite (Ziezel and others, 1962); and (4) the analysis of hydraulic conductivity data in surrounding areas (Nicholas and Healy, 1988). In the ground water model, the geometric mean of the hydraulic conductivity values (i.e., 13.48 ft/day) was used, while in the LNAPL model the same value was used for the bedrock portions of the aquifer.

3.5 *BOUNDARY CONDITIONS*

Hydrologic boundaries influence the local aquifer conditions. A constant head boundary supplies a constant water level. An example of a constant head boundary is a perennial lake or river, whose head does not appreciably change during the length of time that ground water conditions are to be simulated. A constant flux boundary is one in which a continuous flow of water is supplied to the aquifer, regardless of the head conditions. An example of a constant flux boundary is a pumping well. In this case, a constant volume of water over time is added or

removed from the aquifer, and heads are adjusted in the model to account for the change in water volume.

At the Lenz Oil site, a constant head boundary occurs at the Des Plaines River. The head in the Des Plaines River is typically lower than the head in the aquifer. Therefore, ground water has a tendency to flow toward the river.

The water level measurements collected at the site indicate that, with only slight variations in flow direction, ground water flows from northwest to southeast toward the Des Plaines River. Small variations in the hydraulic gradient occur due to seasonal changes in precipitation and river stage, but the flow direction remains relatively unchanged. Therefore, a constant head boundary can be assigned at some distance to the northwest of the site. However, the exact location of this boundary is not apparent based on the local hydrology. As a result of the lack of control at great distances northwest of the site, the ground water model constant head boundary was specified at the northwesternmost edge of the Des Plaines River valley located approximately 650 feet northwest of Jeans Road.

Because of the uniformity of the ground water flow direction over time, a no-flow boundary condition was assigned to the northeastern and southwestern edges of the modeled domain.

4.0 MODEL SIMULATION

4.1 SPECIFICATION OF PARAMETERS

4.1.1 Ground Water Model

The MODFLOW model consisted of a grid of 101 rows by 101 columns. Grid lines were placed parallel to the Site grid. The model grid was offset from the site grid 208 feet in the x-direction and 162 feet in the y-direction to center the Site in the modeled domain. The grid spacing varies between 3 feet and 25 feet. A grid spacing of 3 feet was selected near potential extraction well and extraction trench locations to increase the resolution of the model at those locations. A spacing of 25 feet was used in areas where the expected changes in head were more gradual from cell to cell. The spacing between individual grid lines is included in Attachment 2.

A contour map of the ground surface was imported into MODELCAD to represent the top of the vadose zone. The vadose zone is defined as the unsaturated soils between the land surface and the water table. In MODFLOW, the thickness of the vadose zone is arbitrary except for situations where the evapotranspiration (ET) package is used, and for situations where significant mounding may occur. In the ground water flow model for the Lenz Oil site, the ET package was not used.

The bottom of the ground water flow model was set at a constant elevation of 550 feet. This elevation was used for the reasons discussed in Section 3.1.1.

Figure F-13 shows the locations where hydraulic conductivity testing was performed in the bedrock wells. As discussed in Section 3.4, the geometric mean of all of the measured bedrock hydraulic conductivities (i.e., 13.48 ft/day) was used in the model. The simulation of the bedrock unit is justified because (1) the bulk of the aquifer is within the bedrock units, (2) the LNAPL occurring southeast of Jeans Road is located within the bedrock, and (3) any extraction wells southeast of Jeans Road would likely be completed in bedrock.

A constant head boundary that roughly parallels the topography was simulated upgradient of the Site (Section 3.5). This boundary is located approximately 650 feet northwest of Jeans Road. The downgradient constant head boundary simulated water level conditions in the Des Plaines River. The northwestern boundary head was extrapolated as 591.5 feet AMSL from the September 27, 1991 specified head condition at wells located near the northwestern portion of the site. The southeastern

boundary head was 588.2 feet, i.e., the water surface elevation of the Des Plaines River on September 27, 1991.

Model simulations were also performed using water levels that reflected the May 9, 1991 conditions. The May 9, 1991 water levels were approximately 5 feet higher than in September 1991. This fluctuation in water levels is a reflection of seasonal climatic conditions (precipitation, snow melt, and dry periods). The May 9, 1991 simulated boundary heads were 597.31 feet for the northwestern boundary and 590.34 feet for the southeastern boundary. The May 1991 and September 1991 ground water conditions represent the range of water level fluctuations that will likely be encountered by the ground water extraction and treatment system (see Section 3.3 of this appendix). Therefore, simulation of alternatives include head conditions that represent these two hydrologic extremes.

Precipitation in the Chicagoland area averages 35.4 inches per year based on monthly climatological data summaries obtained for the duration of the RI Field activities (i.e. January 1991 through March 1992). According to Cartwright (1992), only one-tenth of the total annual precipitation infiltrates to recharge the aquifer with the remainder lost to evaporation or runoff in the Chicagoland area. Therefore, a recharge value of 3.5 inches was added to the model.

The extraction trenches in the MODFLOW model were simulated using MODFLOW's drain package. The drain package was designed to simulate the removal of water from the aquifer at a rate proportional to the difference between the head in the aquifer and some fixed head or elevation. Therefore, any ground water that enters the drain is assumed to be immediately removed from the model. In actuality, the water removed by an actual drain such as the proposed extraction trenches is governed by a pumping system, where ground water enters the drain and flows through a horizontal pipe to the pump. The pump therefore is capable of maintaining a constant head in the trench.

The locations of the four extraction trenches are shown in Figures F-3 through F-6. As mentioned earlier, the model grid spacing was adjusted at the drains in order to obtain better resolution of simulated head changes. The dimensions of each trench in the model is 3 feet of width and a length that varies between 245 and 270 feet, depending on the estimated width of the LNAPL area.

An initial elevation of 588.0 feet was used for the trenches. At this elevation, the trenches are approximately 2 feet below the September 27, 1991 ground water elevations. This elevation allows a maximum 2-feet drawdown to occur within the trenches based on the September 27, 1991 water levels. For model simulations using the May 9, 1991 water levels for

initial conditions, the trench elevations were adjusted to 589.5 feet, resulting in a maximum possible drawdown of 5.5 feet.

An extraction trench elevation of 589.5 feet AMSL was selected for subsequent model runs because it is approximately 0.5 feet below the September 27, 1991 initial heads in the area of the extraction trenches. This extraction trench elevation ensures that: (1) if a low water level condition exists due to seasonal fluctuations, the extraction trenches would be capable of continued removal of ground water and LNAPL and (2) the amount of bedrock that needs to be removed is minimized for extraction trench installation.

The discharge rate of a drain in MODFLOW is dependent upon the head in the drain, the head in the cell outside the drain, and the conductance of the drain. The drain conductance is a factor of proportionality that reflects the material properties of the drain and the backfill material outside the drain.

As required in MODFLOW, the extraction wells are screened across the entire saturated layer thickness in which they are located. In a single-layer model, the wells are screened across the entire saturated thickness of the aquifer. In addition, the wells are assumed to be 100% efficient, and the well rates specified represent the actual volume per time that water is removed from the modeled aquifer. Finally, the water removed occurs uniformly across the screened interval (which is equal to the entire saturated thickness of the modeled layer).

4.1.2 *LNAPL Model*

The ARMOS model consisted of a grid of 50 rows by 50 columns as shown in Figure F-14. Grid lines were placed parallel to the Site grid and encompassed the rectangular area on the Site grid from N200, E100 to N600, E500. A grid spacing of 4 feet was selected for all grid nodes within the modeled domain.

The input parameters for ARMOS are subdivided into either those which pertain to the soil matrix or those that pertain to the fluid (LNAPL). Soil input parameters required by ARMOS consist of:

K_{sw} = Saturated hydraulic conductivity, average of anisotropic components [feet/day],

R = Ratio of maximum and minimum hydraulic conductivity components [unitless],

ω = Angle of principal component of conductivity from north [unitless],

$\propto$ = van Genuchten mean pore size parameter [1/foot],

n = van Genuchten pore size distribution exponent [unitless],

S_m = Water saturation at field capacity [unitless],

ϕ = Total porosity [unitless],

S_{or} = Maximum saturated zone residual oil saturation [unitless], and

S_{og} = Maximum unsaturated zone residual oil saturation [unitless].

Fluid input parameters consist of:

ρ_{ro} = Ratio of oil to water density [unitless],

η_{ro} = Ratio of oil to water viscosity [unitless],

β_{ao} = Ratio of water surface tension to oil surface tension [unitless], and

β_{ow} = Ratio of water surface tension to oil-water interfacial tension [unitless].

Of the required soil parameters, only K_{sw} and ϕ were measured during the RI for the unconsolidated materials and bedrock. The $\propto$, n, and S_m parameters were estimated by ARMOS using grain size data. For the unconsolidated materials, default ARMOS values of R, ω, S_{or}, and S_{og} for sand were applied. The bedrock soil parameters were estimated in ARMOS by using a grain size equivalent to that of a fine gravel (2-4 millimeters in diameter).

Input soil parameters for the areas where the LNAPL is present in unconsolidated soils consisted of the following values:

K_{sw} = 81.0 feet/day,

R = 1.0,

ω = 1.756 degrees,

$\propto$ = 4.45/foot,

n = 2.7,

S_m = 0.130,

ϕ = 0.36,

S_{or} = varies with simulation model run, and

S_{og} = 0.015.

Input parameters for the areas where the LNAPL is present in bedrock consisted of the following values:

K_{sw} = 13.48 feet/day,

R = 1.0,

ω = 1.756 degrees,

$\propto$ = 3.616/foot,

n = 1.761,

S_m = 0.2,

ϕ = 0.36,

S_{or} = varies with simulation model run, and

S_{og} = 0.015.

Two of the four specific LNAPL parameters required for the ARMOS input were collected during the RI and LNAPL investigation. The ρ_{ro} was measured as 0.87 in the LNAPL samples from piezometer P21 and MW5S, 0.86 in the samples from piezometers P19 and P20, and 0.87 from G106L. The viscosity of the LNAPL collected from P19 through P21 was measured at 50, 100, and 150 degrees Fahrenheit (°F) and η_{ro} was calculated to be 26.19, 14.3, and 11.6 based on the measured viscosities at those temperatures, respectively. Although the viscosity data results from MW05 and GL06L were similar to those collected during the LNAPL investigation, they were not used because the sample collection method used (i.e., bailing) may have emulsified the LNAPL with the ground water thereby potentially skewing the results. β_{ao} and β_{ow} were estimated at 2.8 and 1.4 using the ARMOS default parameters for a heavy fuel oil based on its physical similarity to the LNAPL at the Site.

The top of the model layer was assumed to be the ground surface at the Site. As previously indicated, the base of the Silurian dolomite portion of the aquifer was selected to be 550 feet AMSL. A recharge of 3.5 inches per year was added to the model to simulate the amount of precipitation that infiltrates through the soil to the water table.

4.2 *CALIBRATION*

Calibration is the process of adjusting the parameters in the model, within reasonable ranges, so that the model adequately simulates the actual ground water system under study. Calibration of a model is usually conducted by trial and error or by linear programming to optimize input parameters and to achieve an accurate representation of site observations. Calibration is accomplished by first adjusting those parameters believed to have the lowest level of accuracy and then fine-tuning the simulation by adjusting other parameters.

4.2.1 *Ground Water Model*

The Lenz Oil ground water flow model was calibrated to the September 27, 1991 water level measurement data. This was accomplished by first plotting the northwestern model coordinate for each well versus the measured head, as shown in Figure F-15. A regression line was constructed, and the resulting regression equation was used to extrapolate the estimated head value required for the northwestern constant head boundary. The southeastern constant head boundary value was selected as the measured head for the Des Plaines River staff gage. The degree to which calibration was possible was determined by mathematically estimating the predicted head value at each well using the regression equation. The difference between the observed head and the predicted head is defined as the residual. The sum of the squares of residuals, as well as the average of the absolute value of the residuals provides information regarding the goodness of fit between the model and the observed head values.

Calibration statistics can be generated after each model run to compare the model head values to the target values (observed head at specified points). The model was calibrated by adjusting boundary heads until the calibration residual sum of squares and average of the residual absolute values were minimized.

Table F-1 presents the target and model-generated heads and the statistics calculated for the September 27, 1991 calibrated Lenz Oil model. The model for the site was considered calibrated when the residual sum of squares between the actual versus the model-predicted hydraulic heads for each layer was less than 10 and the modeled hydraulic heads were

generally within 1.0 foot of the target head. (Average of the absolute value of the residuals plus one standard deviation.) As shown on Table F-1, the model achieved the residual sum of squares requirement but could not be completely calibrated to within 1.0 foot of the target heads at all locations. Variations due to the presence of LNAPL in some monitoring wells, and possibly transient conditions locally prevent an exact calibration of the model to the observed water levels.

After simulations were performed using the September 27, 1991 head conditions, the model was recalibrated to the May 9, 1991 initial conditions using the procedure described for the September 1991 head calibration. A plot of the site y-coordinate versus measured head well locations for May 9, 1991 is presented in Figure F-16 and the respective calibration statistics are shown in Table F-2.

4.2.2 *LNAPL Model*

The ground water head results from the steady-state MODFLOW modeling were used as the starting ground water elevations for ARMOS. This was done because the modeled domain for the ARMOS modeling was a smaller subset of the MODFLOW domain that does not include the extraction wells. The northwestern and southeastern boundaries of the LNAPL model were constant head cells set to the MODFLOW steady-state results. No flow boundary cells were used on the southwestern and northeastern sides of the model grid so that the ground water would flow in a southeasterly direction.

ARMOS used the measured ground water and LNAPL elevation values to calculate the areal extent of the LNAPL and the LNAPL volume. Because the LNAPL depresses the piezometric surface, ARMOS calculates the elevation of the true air-water interface based on the measured LNAPL thickness and density. Both the modeled piezometric surface and the flow direction were evaluated to verify that they were a reasonable representation of the measured site conditions (Figures F-2 and F-8). ARMOS was also used to krig the thicknesses of the LNAPL by using an average of all the site measurements data. The areal limits of the LNAPL was based upon the extent determined by the LNAPL investigation and presented in Technical Memorandum 4 (ERM-North Central, Inc., 1995). The extent and thickness of the LNAPL is shown in Figure F-17.

4.3 *SENSITIVITY ANALYSIS*

4.3.1 *Ground Water Model*

Sensitivity analysis is performed by incrementally changing model values to determine those input parameters which produce the greatest or least

amount of change to model output. The sensitivity analysis also aids in determining the confidence in the selected model input parameters for the calibrated model.

The parameters changed during the sensitivity analysis are (1) hydraulic conductivity, (2) drain elevation, (3) drain conductance, (4) aquifer bottom elevation, and (5) recharge. Table F-3 presents the results of the ground water flow model sensitivity analysis. The sensitivity analysis was performed using the configuration described for Alternative 2. After each sensitivity run, the MODFLOW output was examined and the model budget parameters were compared to the base case. The base case consisted of an aquifer hydraulic conductivity of 13.48 feet per day, drain elevations of 588 feet, drain conductance of 100, aquifer bottom elevation of 550 feet, and a recharge of 3.5 inches per year. In all cases, the discrepancy between flow volumes in and flow volumes out was less than or equal to 0.1 percent.

Plots of the sensitivity parameters are presented in Figures F-18 through F-22. By increasing hydraulic conductivity, flow in from, and out to, constant head boundaries increased, and the discharge to the drains increased. This relationship was expected because as hydraulic conductivity is increased, the ability for water to flow through the porous medium is greater. By changing the hydraulic conductivity to four times the geometric mean, the discharge rate from the trenches increased by a factor of 2.4 (from 8.8 gpm to 21.5 gpm).

The drain elevations were changed from 588 ft to 589 and then to 589.5 ft above MSL. By increasing the drain elevation, a lower hydraulic head exists above the drain, and therefore a lower discharge to the drains occurs. Thus, by raising the drain elevation by 1.5 feet, the discharge rate drops from 8.8 gpm to 3.3 gpm. Flow into the model from the constant head boundaries decreases, and flow out of the model through constant head boundaries increases slightly.

The sensitivity of drain conductance was investigated in the model. A large increase in drain conductance (i.e., from 100 to 750) did not cause significant changes in the overall model water budget. Values less than 100 were found to be sensitive. At values lower than 100, significant changes in the water budget occurred due to the higher degree of head loss across the drain material (i.e., a lower permeability of the drain material caused less discharge of water to the drain, thereby allowing more water to flow out of the model through the constant head boundary).

Changing the aquifer bottom elevation over a range of 15 feet did not significantly change the overall model budget. Volumetric flow rates changed on the order of approximately 2 to 4.5 gpm for constant head

boundaries, and by approximately 2.5 gpm for the discharge to drains. By decreasing the saturated thickness of the aquifer, extraction well drawdown is expected to increase although not significantly because the well rates are low (1 to 3 gpm on average).

Changes in the amount of recharge to the model affected the water budget to a small degree. An increase in recharge reduced the amount of water entering the model through constant head boundaries, and slightly increased the amount of water leaving the model through constant head boundaries.

Because the ground water flow model simulates steady-state conditions, small fluctuations of head values due to heterogeneity were not investigated. However, hydraulic conductivity values were changed during the simulation of alternatives to determine the expected possible range of extraction rates necessary to capture the contaminant plume as specified in the particle tracking analysis. No other sensitivity analysis was performed in the ground water flow model.

4.3.2 *LNAPL Model*

The two main variables that affect the results of the modeling include the maximum residual oil saturation in the saturated zone (S_{or}) and the ratio of oil to water viscosity (η_{ro}).

The LNAPL can be divided into two groups: free oil and residual oil (Testa and Winegardener, 1991). Free oil is defined as the portion of the LNAPL that remains flowable and therefore recoverable by an extraction system. Residual oil is defined as the portion of the LNAPL which is not free to move and cannot be recovered by an extraction system. In the unsaturated zone, residual oil occurs as pendular rings of LNAPL at particle contacts or as thin film coatings on soil particles. Under saturated conditions, discrete zones of residual oil are hydraulically discontinuous masses and are trapped within the water phase. Any LNAPL that is retained within the unsaturated zone typically cannot be recovered by conventional means.

The soil property parameter (S_{or}) in ARMOS specifically determines the percentage of LNAPL that remains trapped in the saturated zone as residual oil. Typical retention for higher viscosity oils was reported in Testa and Winegardener, (1991) to be of 35 to 50% for fine grained sandy soils with porosities of 30%. The only verifiable determination as to the true percentage of residual oil at a site is to compare the LNAPL's total estimated volume to the actual site extraction systems recovered volume over time (Parker, et al., 1994). This variable cannot be easily defined as to its exact value until active LNAPL extraction at the site has progressed for a period of several years. Therefore, each of the remedial scenarios were

run at three different S_{or} values to analyze a range of performance for the Lenz Oil LNAPL extraction system. Specifically, the three different S_{or} values used for the model reflect the range that may be expected for the site soil heterogeneity.

The selection of which S_{or} values to use was based upon a series of runs in which the total cumulative LNAPL volume recovered over a 20 year period was plotted with differing S_{or} values. The simulation used for the run was a series of four passive trenches that intercepted the LNAPL. Figure F-23 shows the results of the S_{or} sensitivity analysis. As is noted on the figure, S_{or} values above 0.05 produce eratic results with the model grid, which are insensitive to S_{or} changes. Therefore, S_{or} values used for the modeling were within the 0.0 to 0.05 range where the model behaves properly. Specifically, the S_{or} values used were 0.001 for ARMOS model runs 1, 4, 7, 10, and 13; 0.03 for the ARMOS model runs 2, 5, 8, 11, and 14; and 0.05 for the ARMOS model runs 3, 6, 9, 12, and 15. This range of S_{or} values covers the potential range of possible LNAPL residual recoveries in the saturated zone based upon the variations in the geologic soils at the site.

The effect of adding surfactant to the LNAPL was simulated in the model by varying the LNAPL fluid parameter for the ratio of oil to water viscosity (η_{ro}) value. A sensitivity analysis was conducted on the passive trench model to determine the total cumulative LNAPL recovered after a 20 year period when the η_{ro} value is changed. As noted on Figure F-24, the low η_{ro} values of between 0 and 10 show a linear decrease in the total amount of LNAPL recovered by the passive trenches. Between the values of 10 and 30, the recovery stabilizes and actually increases slightly. From η_{ro} values of 30 to 50, the LNAPL recovery linearly decreases once again. Although the η_{ro} value after the addition of surfactant is unknown, a value of 4.3 was selected for η_{ro} because (1) it represents the equivalent η_{ro} value for the LNAPL having been heated to 200°F (which is probably equivalent to the mobilization of the LNAPL achieved with surfactants), and (2) it falls within the portion of the graph where the LNAPL recovery is not static (i.e., between η_{ro} values of 10 and 30).

5.0 DISCUSSION OF OUTPUT AND RESULTS

5.1 GROUND WATER MODEL

The ground water flow model was used to simulate extraction wells, surfactant infiltration and extraction trench design to remediate the LNAPL and ground water at the site. The alternatives were described in Section 2.3 of this appendix.

Three sets of model simulations were performed for each alternative, corresponding to: (1) simulation of extraction trenches at an elevation of 588 feet above MSL and operating under head conditions representative of the September 27, 1991 water levels at the site; (2) simulation of extraction trenches at an elevation of 589.5 feet and operating under head conditions representative of the September 27, 1991 water levels; and (3) simulation of extraction trenches at an elevation of 589.5 feet but operating under head conditions representative of the May 9, 1991 water levels. These modeling simulations represent the likely expected range of conditions over which both extraction wells and extraction trenches may operate.

The base case simulations using the September 27, 1991 water levels and the trench elevations at 588 feet were performed until the extraction trench and well configuration indicated that (1) the extraction trench capture zone exceeded the LNAPL extent, and (2) the ground water extraction wells adequately captured all of the ground water likely to contain dissolved contaminants, preventing the migration of these contaminants to the river. Using the same extraction well discharge rates for subsequent models simulating elevated ground water levels and then adjusting the well rates to once again capture the ground water allows an expected range of pumping rates, and total extraction system flow rate to be estimated. Predicted hydraulic heads for the September 27, 1991 and the May 9, 1991 initial conditions are presented in Figures F-25 and F-26, respectively. Subsequent plots depicting the results of the simulated alternatives present drawdown contours based on these predicted heads. Tables F-4 through F-7 and Figures F-27 through F-45 present the results of the ground water model simulations for these alternatives.

5.1.1 *Initial Conditions*

After initial construction of the model, simulations were performed to determine the consistency of model output and site-collected ground water elevations. Extraction wells, trenches, and artificial recharge (i.e., surfactant infiltration) were not included during the initial model runs.

The initial conditions model was run to provide a basis against which to compare the modeled alternative remedies. Starting positions for particle tracking analysis were set upgradient of the Site, along the northernmost boundary of the model, at the approximate extent of the LNAPL area, and along the southeastern boundary of the model between the extraction wells and the river. These initial particle locations provide a qualitative assessment of the model alternative's effectiveness in capturing the required ground water plume areas. As shown in Figure F-25, the movement of the particles (i.e., ground water flow direction) generally match the expected flow directions based on the September 27, 1991 ground water piezometric surface (Figure F-11).

5.1.2 *Alternative 1A Simulations*

Alternative 1A consists of three extraction trenches (N, M, S) at the locations specified in Figure F-3. Surfactant infiltration is not implemented, and extraction wells near the Des Plaines River are not used.

September 27, 1991 Initial Head Conditions

Alternative 1A was modeled using the September 27, 1991 initial head conditions, simulating a uniform ground water flow gradient at its lowest recorded levels. The extraction trenches were modeled at an elevation of 588.0 feet which is approximately two feet below the static head levels for the model. Therefore, a maximum possible drawdown of 2 feet is available in the model. The model simulated steady-state conditions for this alternative (and for subsequent alternative runs).

Figure F-27 shows the particle traces generated from model simulation of alternative 1A. The particles beginning at the northwest portion of the site as well as the particles that began at approximately the outer extent of the LNAPL area are all captured by the trenches. Therefore, the trenches appear to be adequate in capturing surficial contamination emanating at the site or within the LNAPL area. However, the particles that begin near the Des Plaines River are captured by the river due to the tendency for ground water in this area to flow towards the southeast. The total trench discharge rate for this alternative is approximately 12.2 gallons per minute with a maximum drawdown of 1.76 feet.

The trenches are capable of capturing shallow contaminants only (free product, and dissolved constituents at elevations higher than the trenches and within the radius of capture for the trenches). Therefore, the use of ground water extraction wells was evaluated in subsequent simulations to determine the amount of pumping that would be required to (1) capture the dissolved plume not captured by the trenches, and (2) reverse the

overall ground water gradient between the site and the river to prevent contaminants from impacting the river.

Adjusted Trench Elevations

A second set of simulations for Alternative 1A investigated the expected trench discharge rate that would ensue due to a smaller saturated thickness above the trenches. The trenches were simulated at an elevation of 589.5 feet, corresponding to an elevation approximately 6 inches below static, September 27, 1991 ground water conditions. The results of this simulation are presented in Table F-5 and the drawdown contours and particle traces are shown in Figure F-28.

As expected, because a smaller ground water head is available above the trench elevations, a lower ground water yield (2.8 gpm) and a lower drawdown (0.45 ft) occurs. Although some of the northwestern and LNAPL particles are captured by the trenches, most of the particles escape capture by the trenches and migrate to the Des Plaines river.

Adjusted Trench Elevations and Modeled May 1991 Head Conditions

A third set of simulations for Alternative 1A was studied to determine the effect that increased head conditions have on the entire model. The May 1991 head conditions represented wet conditions typical of springtime in Northern Illinois. These conditions were simulated in the model by first adjusting the boundary heads to correspond to the May conditions. A uniform flow field was created to simulate initial head conditions prior to allowing discharge from the trenches.

The trench elevations were kept at the 589.5 ft MSL elevations. The maximum trench discharge rate for this alternative and these conditions was 28.4 gpm, with a maximum drawdown within the trenches of 3.8 feet. Because the trench elevations were not adjusted, they produced a greater "sink," causing a higher volume of flow to occur, as shown in Figure F-29. However, the particles near the river are still not captured by the extraction trench system.

5.1.3 *Alternative 1B Simulations*

Alternative 1B is identical to Alternative 1A except that extraction wells were added at the locations shown in Figure F-3. The addition of extraction wells addresses the issue of dissolved contaminant plume migration to the Des Plaines River. The use of extraction wells could potentially affect the migration of particles towards the extraction trenches. Therefore, the pumping rates for the extraction wells were balanced to ensure interception of particles migrating towards the river, while minimizing affects on the LNAPL area.

September 27, 1991 Initial Head Conditions

Results of simulations using the September 27, 1991 initial head conditions are shown in Table F-4 and on Figure F-30. These simulations indicate that the northwestern particles and the LNAPL particles are all captured by the extraction trenches with the exception of one particle that begins at the northwestern portion of the site, and is captured by EW-3 (Figure F-30). Because this particle likely corresponds to a dissolved plume contaminant (no LNAPL is present in that area of the Site), its capture by an extraction well is acceptable in this situation. The extraction well rates used in this alternative are 1 gpm for EW-1, 0.75 gpm each for EW-2 through EW-4 and 2 gpm for EW-5. The increased discharge for EW-5 was necessary to ensure capture of all particles whose origins were between the extraction wells and the river. The total trench discharge rate for this alternative is 11 gpm with a maximum drawdown of about 1.8 feet.

Adjusted Trench Elevations

A second set of simulations for Alternative 1B investigated the expected trench discharge rate that would result from a smaller saturated thickness above the trenches. The trenches were simulated at an elevation of 589.5 feet, corresponding to an elevation approximately 6 inches below the static, September 27, 1991 ground water conditions. Well extraction rates remained at 1 gpm each for EW-1 through EW-4 and 2 gpm for EW-5. The results of this simulation are presented in Table F-5 and shown on Figure F-31.

As expected, because a smaller ground water head is available above the trench elevations, a lower ground water yield (1.8 gpm) and a lower drawdown (0.65 ft) occurs. Although some of the northwestern and LNAPL particles are captured by the trenches, a larger portion are captured by the wells, and other particles escape capture by the trenches and wells and migrate to the Des Plaines river. An increase in extraction well discharge rate would force capture of all particles, but exacerbation of the LNAPL plume could result.

Adjusted Trench Elevations and Modeled May 1991 Head Conditions

A third set of simulations for Alternative 1B was investigated to evaluate the effect of increased head conditions. As in the simulations for Alternative 1A, the May 1991 head conditions were used for this simulation and initial conditions were developed as explained in Section 1.3 of this appendix. Results for this simulation are presented in Table F-6 and shown on Figure F-32.

The trench elevations were kept at the 589.5 ft AMSL. The maximum trench discharge rate for this alternative and these conditions was 27.1 gpm, with a maximum drawdown within the trenches of 3.8 feet. The extraction well discharge rates remained as before. Because the trench elevations were not adjusted, they produced a greater "sink," causing a higher volume of flow to occur. Because of this, a steep hydraulic gradient was formed which caused the migration of nearly all particles toward the trenches. Several of the southeasternmost river particles migrated to the river.

The extraction well pumping rates were increased in order to ensure capture of all particles as shown in Figure F-33. Effective capture was achieved with well extraction rates of 2 gpm each for EW-1 through EW-4 and 3 gpm for EW-5. Increased pumping from the extraction wells lowered the available head above the drains. Therefore, the discharge rate from the drains decreased to 25.7 gpm. A summary of the discharge rates for extraction trenches and adjusted flow rates for extraction wells is presented in Table F-7.

5.1.4 *Alternative 2 Simulations*

Alternative 2 simulates the use of two trenches (M and S, shown in Figure F-4) with no surfactant infiltration but with 5 extraction wells near the Des Plaines River. This alternative simulates the required trench configuration that would ensue if LNAPL were excavated northwest of trench M. Therefore, a smaller area of LNAPL would require capture by the extraction trenches, and trench N would not be necessary.

September 27, 1991 Initial Head Conditions

Results of simulations using the September 27, 1991 initial head conditions are shown in Table F-4 and on Figure F-34. These simulations indicate that the northwestern particles and the LNAPL particles are all captured by the extraction trenches with the exception of three particles that begin at the northwesternmost portion of the site, and are captured by EW-3 and EW-4. Because these particles likely correspond to a dissolved plume contaminants, their capture by the extraction wells is acceptable. The extraction well rates used in this alternative are 1 gpm each for EW-1 through EW-4 and 2 gpm for EW-5. The increased discharge for EW-5 was necessary to ensure capture of all particles whose origins were between the extraction wells and the river. The total trench discharge rate for this alternative is 8.8 gpm with a maximum drawdown of about 1.6 feet.

Adjusted Trench Elevations

Results of a second set of simulations for Alternative 2 are presented in Table F-5 and shown in Figure F-35. This simulation investigated the expected trench discharge rate that would result from a smaller saturated thickness above the trenches. The trenches were simulated at an elevation of 589.5 feet, corresponding to an elevation approximately 6 inches below the static, September 27, 1991 ground water conditions. Well extraction rates remained at 1 gpm each for EW-1 through EW-4 and 2 gpm for EW-5.

As expected, because a smaller ground water head is available above the trench elevations, a lower ground water yield (0.8 gpm) and a lower drawdown (0.66 ft) occurs. Although some of the northwestern and LNAPL particles are captured by the trenches, a larger portion are captured by the wells, and other particles escape capture by the trenches and wells and migrate to the Des Plaines river. All of the particles that begin between the extraction wells and the river are lost to the river. An increase in extraction well discharge rate would force capture of all particles, but exacerbation of the LNAPL plume could result.

Adjusted Trench Elevations and Modeled May 1991 Head Conditions

Simulations for Alternative 2 were investigated to evaluate the effect of increased head conditions. Results of these simulations are shown in Table F-6 and in Figure F-36. As in the simulations for Alternatives 1A and 1B, the May 1991 head conditions were used for this simulation and initial conditions were developed as explained in Section 1.3.

The trench elevations were kept at 589.5 ft AMSL. The maximum trench discharge rate for this alternative and these conditions was 22.2 gpm, with a maximum drawdown within the trenches of 3.4 feet. The extraction well discharge rates remained as before. Because the trench elevations were not adjusted, they produced a greater "sink," causing a higher volume of flow to occur. Because of this, a steep hydraulic gradient was formed which caused the migration of all LNAPL and northwestern particles toward the trenches.

The extraction wells were not successful in capturing most of the particles which were placed between the extraction wells and the river (only two particles were captured by the extraction wells). Therefore, increasing the extraction well rates was necessary in order to capture all of these particles under this scenario.

Capture of all particles by the extraction trenches and/or extraction wells was achieved by increasing the extraction well discharge rate as shown in Table F-7. Effective capture was achieved with well extraction rates of

3 gpm each for EW-1 though EW-4 and 3.5 gpm for EW-5. As with alternative 1B, the increased extraction rate from the wells slightly lowered the water table over the extraction trenches, thereby decreasing the amount of ground water recovered by the extraction trenches by approximately 2 gpm. The drawdown contours and pathlines generated under the increased extraction rates are shown in Figure F-37.

5.1.5 *Alternative 3 Simulations*

Alternative 3 simulates the active recovery of ground water using four trenches (N, M, S, and P) and 5 extraction wells near the Des Plaines River. In addition, surfactant infiltration was simulated at a rate of 10 gpm within the boundaries of the trenches.

September 27, 1991 Initial Head Conditions

Alternative 3 model simulations (Table F-4 and Figure F-38) using the September 27, 1991 initial head conditions indicate that the northwestern particles and the LNAPL particles are all captured by the extraction trenches with the exception of one particle that begins at the northwesternmost portion of the site. This particle is captured by EW-3. Because this particle likely corresponds to a dissolved plume contaminant, its capture by the extraction well is acceptable. The extraction well rates used in this alternative are 1 gpm each for EW-1 through EW-4 and 2 gpm for EW-5. The increased discharge for EW-5 was necessary to ensure capture of all particles whose origins were between the extraction wells and the river. The total trench discharge rate for this alternative is 20 gpm with a maximum drawdown of about 1.6 feet in the model. The increased discharge rate in the trenches reflects the added surfactant infiltration. Capture of all particles in the LNAPL area verifies that infiltrated surfactant is collected by the trenches.

Adjusted Trench Elevations

Simulations for Alternative 3 included an investigation of the expected trench discharge rate that would result from a smaller saturated thickness above the trenches. The trenches were simulated at an elevation of 589.5 feet, corresponding to an elevation approximately 6 inches below the static, September 27, 1991 ground water conditions. Well extraction rates remained at 1 gpm each for EW-1 through EW-4 and 2 gpm for EW-5. Results of this simulation are presented in Table F-5 and in Figure F-39.

As expected, because a smaller ground water head is available above the trench elevations, a lower ground water yield (9.5 gpm) and a lower drawdown (0.61 ft) occurs. The 9.5 gpm trench discharge rate indicates that 0.5 gpm of surfactant may escape capture by the trenches, possibly migrating vertically downward below the elevation of the trenches.

Although some of the northwestern and LNAPL particles are captured by the trenches, other particles are captured by the wells, while the remaining particles escape capture by the trenches and wells and migrate to the Des Plaines river. All of the particles that begin between the extraction wells and the river are lost to the river. An increase in extraction well discharge rate would force capture of all particles, but exacerbation of the LNAPL plume could result.

Adjusted Trench Elevations and Modeled May 1991 Head Conditions

Alternative 3 simulations also investigated the effect of increased head conditions. As in the alternative simulations described above, the May 1991 head conditions were used for this simulation and initial conditions were developed as explained in Section 1.3. The trench elevations were kept at 589.5 ft AMSL.

Results of this simulation are presented in Table F-6 and on Figure F-40. The maximum trench discharge rate for this alternative and these conditions was 37.1 gpm, with a maximum drawdown within the trenches of 3.7 feet. The extraction well discharge rates remained as before. Because the trench elevations were not adjusted, they produced a greater "sink," causing a higher volume of flow to occur. Because of this, a steep hydraulic gradient was formed which caused the migration of all particles toward the trenches. The extraction wells were effective in capturing most of the particles between the wells and the river, although some of the particles migrated to the river.

The extraction well rates were adjusted in order to capture the particles that were lost to the river. The required pumping rate for the extraction wells was 2 gpm each for EW-1 through EW-4 and 4 gpm for EW-5. The extraction rates are summarized in Table F-7. Figure F-41 depicts the drawdown contours and pathlines generated by using the adjusted well rates.

5.1.6 *Alternative 4 Simulations*

Alternative 4 simulates the active recovery of ground water using three trenches (M, S, and P as shown in Figure F-5) and 5 extraction wells near the Des Plaines River. In addition, surfactant infiltration was simulated at a rate of 5 gpm within the boundaries of the three trenches. Summaries of simulations for Alternative 4 are presented in Tables F-4 through F-7 and in Figures F-42 to F-45.

September 27, 1991 Initial Head Conditions

Alternative 4 model simulations using the September 27, 1991 initial head conditions indicate that the northwestern particles and the LNAPL

particles are all captured by the extraction trenches with the exception of three particles that begin at the northwesternmost portion of the site as shown in Figure F-42. These particles are captured by EW-3 and EW-4. Because these particles likely correspond to dissolved plume contaminants, their capture by the extraction wells is acceptable. The extraction well rates used in this alternative are 2 gpm for EW-1, 0.75 gpm for EW-2 through EW-4 and 3 gpm for EW-5. These extraction well rates were necessary to ensure capture of all particles whose origins were between the extraction wells and the river and to avoid causing particles associated with the LNAPL to migrate toward the wells thereby causing the LNAPL plume to spread. The total trench discharge rate for this alternative is 13.5 gpm with a maximum drawdown of about 1.65 feet. The increased discharge rate in the trenches (compared to Alternatives 1A through Alternative 2) reflects the added surfactant infiltration. Capture of all particles in the LNAPL area verifies that infiltrated surfactant is collected by the trenches.

Adjusted Trench Elevations

Simulations for Alternative 4 included an investigation of the expected trench discharge rate that would result from a smaller saturated thickness above the trenches. The trenches were simulated at an elevation of 589.5 feet, corresponding to an elevation approximately 6 inches below the static, September 27, 1991 ground water conditions. Well extraction rates remained the same as those listed above.

As expected, because a smaller ground water head is available above the trench elevations, a lower ground water yield (4.1 gpm) and a lower drawdown (0.84 ft) occurs (Table F-5). The 4.1 gpm trench discharge rate indicates that 0.9 gpm of surfactant may escape capture by the trenches, possibly migrating vertically downward below the elevation of the trenches. Although some of the northwestern and LNAPL particles are captured by the trenches as shown in Figure F-43, other particles are captured by the wells, while the remaining particles escape capture by the trenches and wells and migrate to the Des Plaines river. All of the particles that begin between the extraction wells and the river are lost to the river. An increase in extraction well discharge rate would force capture of all particles, but exacerbation of the LNAPL plume could result.

Adjusted Trench Elevations and Modeled May 1991 Head Conditions

Alternative 4 simulations also investigated the effect of increased head conditions. As in the alternative simulations described above, the May 1991 head conditions were used for this simulation and initial conditions were developed as explained in Section 1.3 of this appendix.

The trench elevations were kept at 589.5 ft AMSL. The maximum trench discharge rate for this alternative and these conditions was 28.2 gpm, with a maximum drawdown within the trenches of 3.4 feet (Table F-6). The extraction well discharge rates remained as before. Because the trench elevations were not adjusted, they produced a greater "sink," causing a higher volume of flow to occur (Figure F-44). Because of this, a steep hydraulic gradient was formed which caused the migration of all LNAPL and northwestern particles toward the trenches. The extraction wells were effective in capturing most of the particles between the wells and the river, although some of the particles migrated to the river.

An increase in the discharge rate of extraction wells produced complete capture of all particles between the extraction wells and the river (Figure F-45). The adjusted extraction well rates are 2 gpm for EW-1, 0.75 gpm for EW-2 and EW-3, 3 gpm for EW-4 and 4 gpm for EW-5.

5.2 *LNAPL MODEL*

The primary objectives of the ARMOS simulation were to estimate the volume of total recoverable LNAPL and to estimate the time required to remove that volume. The pumping rates for extraction trenches in the LNAPL area derived during the ground water modeling (discussed above) were used as input to the ARMOS model. The LNAPL model extent was limited to that portion of the MODFLOW domain that corresponded to the area of the LNAPL. Table F-8 presents a summary of ARMOS simulations.

5.2.1 *Initial Conditions*

After initial construction of the model, simulations were performed to determine the consistency of the ARMOS model output with the MODFLOW steady-state results for the extraction well system.

The initial conditions model was run to provide a basis against which to compare the modeled extraction trenches. Predicted hydraulic heads and the predicted LNAPL for the initial conditions are shown on Figures F-25 and F-17, respectively. The estimated volume of the LNAPL in Area 1 was calculated by ARMOS to contain approximately 478 cubic feet (approximately 3,578 gallons) based on using the average thickness detected at each well or piezometer. The estimated volume of the LNAPL in Area 1 after the LNAPL in the unconsolidated soils was removed dropped to 319 cubic feet (approximately 2,388 gallons).

5.2.2 *Passive Recovery Trenches Simulations*

As shown on Table F-8, ARMOS Runs 1, 2, and 3 simulate the scenario in which the viscosity of the LNAPL is allowed to remain at natural conditions and the four extraction trenches are used to passively skim the LNAPL as it enters the trench. The variation between the model runs 1, 2, and 3 is to provide for a range of possible residual oil percentages that may be encountered in the site's soils. Table F-9 and Figures F-46 through F-48 show the results of the simulation over time.

The range of recovery of the free LNAPL for the passive trench simulation over a 20-year period varied from approximately 380 gallons for soils that have a high residual oil capacity (run 3) to 3,000 gallons for soils with little to no residual oil capacity (run 1). The scenario with soil that contains a moderate residual capacity (run 2) recovered approximately 1,000 gallons of LNAPL after 20 years. Residual LNAPL remaining trapped by the soils after 20 years for run 1 was approximately 41% of the 600 gallons remaining, 96% of the 2,600 gallons remaining in run 2, and 96% of the 3,200 gallons remaining in run 3.

5.2.3 *Active Recovery Trenches Simulations*

ARMOS Runs 4, 5, and 6 simulate the scenario in which the N, M, and S trenches are extracting ground water at a total rate of 11 gpm to increase the gradient and promote LNAPL movement toward the trenches. This corresponds to the Alternative 1B MODFLOW simulation described in Section 5.1.3. The variation between the model runs 4, 5, and 6 is to provide for a range of possible residual oil percentages that may be encountered in the site's soils. Table F-9 and Figures F-49 through F-51 show the results of the simulation over time.

The range of recovery of the free LNAPL for the active trench simulation over a 20-year period varied from approximately 820 gallons for soils that have a high residual oil capacity (run 3) to 2,800 gallons for soils with little to no residual oil capacity (run 1). The scenario with soil that contains a moderate residual capacity (run 2) recovered approximately 1,300 gallons of LNAPL after 20 years. Residual LNAPL remaining trapped by the soils after 20 years for run 4 was approximately 73% of the 815 gallons remaining, 97% of the 2,300 gallons remaining in run 5, and 97% of the 3,200 gallons remaining in run 6.

5.2.4 *Active Recovery Trenches With Surfactant Infiltration Simulations*

ARMOS Runs 7, 8, and 9 simulate the scenario in which surfactant is added to the LNAPL area between the four trenches (N, M, S, and P) through infiltration. To model the effect of the surfactant on the LNAPL movement, the viscosity variable in the model was lowered to 4.3. The

combined ground water discharge of the trenches was set to 22.2 gpm to increase the gradient and promote LNAPL movement toward the trenches. This corresponds to the Alternative 3 MODFLOW simulation described in Section 5.1.5. The variation between the model runs 7, 8, and 9 is to provide for a range of possible residual oil percentages that may be encountered in the site's soils. Table F-9 and Figures F-52 through F-54 show the results of the simulation over time.

The range of recovery of the free LNAPL for the active trench with added surfactant simulation over a 20-year period varied from approximately 820 gallons for soils that have a high residual oil capacity (run 7) to 2,800 gallons for soils with little to no residual oil capacity (run 9). The scenario with soil that contains a moderate residual capacity (run 8) recovered approximately 2,300 gallons of LNAPL after 20 years. Residual LNAPL remaining trapped by the soils after 20 years for run 7 was approximately 94% of the 820 gallons remaining, 91% of the 2,300 gallons remaining in run 8, and 98% of the 2,800 gallons remaining in run 9.

5.2.5 *LNAPL Excavation and Active Recovery Trenches Simulations*

ARMOS Runs 10, 11, and 12 simulate the scenario in which the northern portion of the LNAPL which resides in the unconsolidated soils has been removed. The remaining LNAPL lies only within the bedrock unit to the south, therefore, only the M and S trenches are necessary. These trenches are actively pumped at a total rate of 8.8 gpm to increase the gradient and promote LNAPL movement toward the trenches. This corresponds to the Alternative 2 MODFLOW simulation described in Section 5.1.4. The variation between the model runs 10, 11, and 12 is to provide for a range of possible residual oil percentages that may be encountered in the site's soils. Table F-9 and Figures F-55 through F-57 show the results of the simulation over time.

The range of recovery of the free LNAPL for the active trenches over a 20-year period varied from approximately 520 gallons for soils that have a high residual oil capacity (run 12) to 1,800 gallons for soils with little to no residual oil capacity (run 10). The scenario with soil that contains a moderate residual capacity (run 11) recovered approximately 840 gallons of LNAPL after 20 years. Residual LNAPL remaining trapped by the soils after 20 years for run 10 was approximately 80% of the 530 gallons remaining, 98% of the 1,600 gallons remaining in run 11, and 99% of the 1,900 gallons remaining in run 12.

5.2.5 *LNAPL Excavation, Active Recovery Trenches and Surfactant Infiltration Simulations*

ARMOS Runs 13, 14, and 15 simulate the same scenario as runs 10, 11, and 12, except that surfactant is infiltrated and an additional trench has been

added to the downgradient edge of the LNAPL. Trenches M, S, and P are actively pumped at a total of 13.5 gpm and surfactant is infiltrated between the trenches at a rate of 5 gpm to increase the gradient and promote LNAPL movement toward the trenches. This corresponds to the Alternative 4 MODFLOW simulation described in Section 5.1.6. The variation between the model runs 13, 14, and 15 is to provide for a range of possible residual oil percentages that may be encountered in the site's soils. Table F-9 and Figures F-58 through F-60 show the results of the simulation over time.

The range of recovery of the free LNAPL for the active trenches with added surfactant over a 20-year period varied from approximately 260 gallons for soils that have a high residual oil capacity (run 13) to 1,800 gallons for soils with little to no residual oil capacity (run 15). The scenario with soil that contains a moderate residual capacity (run 14) recovered approximately 850 gallons of LNAPL after 20 years. Residual LNAPL remaining trapped by the soils after 20 years for run 13 was approximately 95% of the 610 gallons remaining, 97% of the 1,500 gallons remaining in run 11, and 90% of the 2,100 gallons remaining in run 12.

6.0 *SUMMARY*

The ground water flow modeling effort has demonstrated that an extraction system consisting of a combination of extraction trenches situated in the LNAPL area and extraction wells located southeast of the site near the Des Plaines River adequately captures the required ground water area shown in Figure F-1. Simulations that include surfactant infiltration indicate that drawdown is reduced compared to no surfactant infiltration, and extraction rates are increased. Extraction wells located near the Des Plaines River ensure that any contaminated ground water migrating from the site is prevented from impacting the river.

A degree of uncertainty in modeled aquifer parameters indicates that the sum of the extraction rates from trenches and wells will likely not exceed 100 gpm.

The LNAPL modeling effort using ARMOS indicated that the total amount of LNAPL present at the Site is 3,578 gallons (478 cubic feet) of which a portion will remain in the soil as residual, unrecoverable oil. The total amount of LNAPL present in the bedrock after the LNAPL has been removed from the unconsolidated portion of the soils is 2,387 gallons (319 cubic feet).

As shown by the cumulative oil recovery for each of the scenarios in ARMOS runs 1 through 9 and 13 through 15, the runs with the lower S_{or} values recovered more LNAPL initially. In the runs 10 through 12, the first five years of run 11 (S_{or} value of 0.03) showed a slight decrease in the total oil recovered when compared with run 12 (S_{or} value of 0.05). After 6 years, however, run 11's total oil recovered exceeds run 12.

As can be seen on Table F-10, for the scenarios in which there is no LNAPL excavation (runs 1 through 9), the maximum estimated recoverable volume of LNAPL for the low residual soil capacity scenario (runs 1, 4, and 7) is 820 gallons. The point at which each the passive, active, and active with surfactant infiltration scenarios reach 90% of that level is 13, 14, and 3 years, respectively. The maximum estimated recoverable volume of LNAPL for the moderate residual soil capacity scenario (runs 2, 5, and 8) is 2,300 gallons. The point at which each the passive, active, and active with surfactant infiltration scenarios reach 90% of that level is greater than 20 years, 12 years, and 7 years, respectively. The maximum estimated recoverable volume of LNAPL for the high residual soil capacity scenario (runs 3, 6, and 9) is 2,750 gallons. The point at which each the passive, active, and active with surfactant infiltration scenarios reach 90% of that level is greater than 20 years, 11 years, and 3 years, respectively.

For the scenarios in which the LNAPL has been excavated from the unconsolidated soils (runs 10 through 15), the maximum estimated recoverable volume of LNAPL for the low residual soil capacity scenario (runs 10 and 13) is 570 gallons. The point at which each the active and active with surfactant infiltration scenarios reach 90% of that level is 12 and 3 years, respectively. The maximum estimated recoverable volume of LNAPL for the moderate residual soil capacity scenario (runs 11 and 14) is 1,570 gallons. The point at which each the active and active with surfactant infiltration scenarios reach 90% of that level is greater than 11 years and 3 years, respectively. The maximum estimated recoverable volume of LNAPL for the high residual soil capacity scenario (runs 12 and 15) is 1,910 gallons. The point at which each the passive, active, and active with surfactant infiltration reach 90% of that level is 6 years and 9 years, respectively.

In general, the time to recover the free LNAPL for any given soil residual capacity takes less time when additional enhancement techniques are included (e.g., surfactants or active pumping). The use of active pumping over a passive series of trenches generally improves the time required to reach 90% of the maximum estimated recoverable volume of LNAPL. Likewise, the addition of surfactant shortens the time to recover the free LNAPL with respect to the time required for either the passive or active trenches alone. Figures F-61 through F-63 document the increase in LNAPL recovery with enhancements.

The uncertainty of the model is primarily a result of how the heterogeneity in the site's soils will affect the amount of residual hydrocarbon present in the soils. In all of the scenarios discussed above, there always is a portion of the LNAPL which remains unrecoverable in the system. ARMOS calculates the instantaneous residual oil remaining in the system during each time interval during the model run. Because the system is constantly in flux, with conditions changing between each time interval, the total residual oil volume may also change. For instance, if pumping lowers the water table, the LNAPL that was trapped in the saturated zone as residual oil may become untrapped and flowable thereby lowering the total residual oil volume. Lowering of the water table will also result in LNAPL smearing across previously clean soil particles. This smearing will cause a portion of LNAPL to be retained as residual oil trapped on the soil particles. Therefore, even using the most optimistic scenario (LNAPL excavation, active pumping from the trenches, and the addition of surfactant), approximately 17% of the initial amount of hydrocarbon will remain in the system after a 20 year period. Typical total recovery reported in literature suggests that the recoverable volumes have ranged from 20% to 60% for low viscosity hydrocarbons (Testa and Winegardener, 1991). As is shown by the ARMOS modeling, if surfactant is not added to the system, the expected recoverable volume is

much less that the reported literature because the LNAPL at the site has a higher viscosity than the low viscosity hydrocarbons measured in the literature.

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REFERENCES

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TABLES

TABLE F-1

GROUND WATER FLOW MODEL
CALIBRATION STATISTICS FOR SEPTEMBER 27, 1991 INITIAL HEADS
LENZ OIL SITE, LEMONT, ILLINOIS

Well Name	Target Head	Model Head	Residual
G-101L	591.86	591.02	0.84
G-101M	591.89	591.02	0.87
G-102L	589.36	589.91	-0.55
G-104D	591.5	590.23	1.27
G-106DR	589.45	590.16	-0.71
MW-01S	591.68	590.66	1.02
MW-01D	589.93	590.69	-0.76
MW-02S	591.08	590.28	0.8
MW-02D	589.69	589.92	-0.23
MW-03D	589.14	588.66	0.48
MW-04D	589.55	590.51	-0.96
MW-05D	589.46	590.17	-0.71
MW-06S	589.18	588.76	0.42
MW-06D	588.95	588.83	0.12
MW-07S	589.04	589.73	-0.69
MW-07D	589.26	589.79	-0.53

---- Summary Statistics For Entire Model ----

Residual Mean =	0.041655
Residual Standard Dev. =	0.74062
Residual Sum of Squares =	8.804061
Absolute Residual Mean =	0.685728
Minimum Residual =	-0.964648
Maximum Residual =	1.268311
Observed Range in Head =	2.94
Res. Std. Dev./Range =	0.251912

CALIBRATED MODEL FILES:
MODFLOW BCF File Name....: flush.bcf
MODFLOW BAS File Name....: flush.bas
Target Information in....: flush.trg
Model-Computed Heads in..: flush.hds

TABLE F-2

GROUND WATER FLOW MODEL
CALIBRATION STATISTICS FOR MAY 9, 1991 INITIAL HEADS
LENZ OIL SITE, LEMONT, ILLINOIS

Well Name	Target Head	Model Head	Residual
G-101L	595.79	596.1	-0.31
G-101M	595.84	596.1	-0.26
G-102L	592.94	593.67	-0.73
G-104D	595.26	594.34	0.92
G-106S (OIL)	594.16	594.13	0.03
G-106DR	592.42	594.19	-1.77
MW-01S	595.71	595.27	0.44
MW-01D	593.27	595.35	-2.08
MW-02S	595.28	594.45	0.83
MW-02D	592.9	593.7	-0.8
MW-03D	592.04	591.21	0.83
MW-04D	592.64	594.95	-2.31
MW-05D	592.54	594.21	-1.67
MW-06S	592.41	591.4	1.01
MW-06D	591.69	591.53	0.16
MW-07S	591.95	593.3	-1.35
MW-07D	592.18	593.43	-1.25

—— Summary Statistics For Entire Model ——

Residual Mean =	-0.488293
Residual Standard Dev. =	1.076438
Residual Sum of Squares =	23.751527
Absolute Residual Mean =	0.985193
Minimum Residual =	-2.309707
Maximum Residual =	1.009426
Observed Range in Head =	4.15
Res. Std. Dev./Range =	0.259383

CALIBRATED MODEL FILE NAMES:
MODFLOW BCF File Name....: flush.bcf
MODFLOW BAS File Name....: flush.bas
Target Information in....: flush.trg

TABLE F-3

SUMMARY OF GROUND WATER FLOW MODEL SENSITIVITY ANALYSIS LENZ OIL SITE LEMONT, ILLINOIS

MODEL RUN	MODEL PARAMETER CHANGED	VALUE	VOLUME IN			VOLUME OUT				IN - OUT	PERCENT DISCREPANCY
			CONSTANT HEAD	RECHARGE	TOTAL IN	CONSTANT HEAD	WELLS	DRAINS	TOTAL OUT		
SENS6	Hydraulic Conducitivity	13.48	2102.7	1336.6	3439.3	588.19	1155	1698.1	3441.4	-2.1000	
SENS1	Hydraulic Conducitivity	27	4407.3	1336.6	5743.9	1807.4	1155	2783.3	5745.8	-1.8892	-0.03
SENS2	Hydraulic Conducitivity	54	8706.8	1336.6	10043	4751.7	1155	4139.5	10046	-2.8262	-0.03
SENS3	Hydraulic Conducitivity	7	1064.3	1336.6	2400.9	239.81	1155	1008.2	2403	-2.1306	-0.09
SENS4	Hydraulic Conducitivity	3.5	502.52	1336.6	1839.1	115.73	1155	570.15	1840.9	-1.8053	-0.1
SENS5	Drain Elevation	588.5	1882.3	1336.6	3218.9	896.01	1155	1170.2	3221.3	-2.3474	-0.07
SENS6	Drain Elevation	588	2102.7	1336.6	3439.3	588.19	1155	1698.1	3441.4	-2.0667	-0.06
SENS7	Drain Elevation	589	1670.9	1336.6	3007.5	1217	1155	637.99	3010	-2.5234	-0.08
SENS6	Drain Conductance	100	2102.7	1336.6	3439.3	588.19	1155	1698.1	3441.4	-2.0667	-0.06
SENS8	Drain Conductance	500	2319.5	1336.6	3656.1	458.75	1155	2044.6	3658.3	-2.2114	-0.06
SENS9	Drain Conductance	750	2347.4	1336.6	3684	446.05	1155	2085.1	3686.2	-2.2000	-0.06
SENS10	Drain Conductance	50	1975.5	1336.6	3312.1	746.2	1155	1413.2	3314.5	-2.3682	-0.07
SENS6	Aquifer Bottom El.	550	2102.7	1336.6	3439.3	588.19	1155	1698.1	3441.4	-2.0667	-0.06
SENS11	Aquifer Bottom El.	540	2686.1	1336.6	4022.7	862.94	1155	2006.4	4024.4	-1.7317	-0.04
SENS12	Aquifer Bottom El.	555	1826	1336.6	3162.6	477.92	1155	1531.7	3164.7	-2.1069	-0.07
SENS6	Recharge (in/yr)	3.5	2102.7	1336.6	3439.3	588.19	1155	1698.1	3441.4	-2.0667	-0.06
SENS13	Recharge (in/yr)	4.4	1955.9	1672.6	3628.5	700.2	1155	1776	3631.3	-2.7114	-0.07
SENS14	Recharge (in/yr)	2.2	2346.7	836.3	3183	447.83	1155	1582.9	3185.7	-2.7500	-0.09

TABLE F-4

SUMMARY OF GROUND WATER RECOVERY ALTERNATIVES
MODFLOW MODEL RESULTS (1)
LENZ OIL SITE
LEMONT, ILLINOIS

ALTERNATIVE	NUMBER OF EXTRACTION TRENCHES	EXTRACTION TRENCH LOCATION (2)	SURFACTANT INFILTRATION RATE (3) GPM	EXTRACTION WELL RATES (4) GPM	EXTRACTION TRENCH DISCHARGE RATE, GPM	MAXIMUM DRAWDOWN FT	LNAPL PARTICLES CAPTURED ?	NORTH PARTICLES CAPTURED ?	RIVER PARTICLES CAPTURED ?
1A	3	N, M, S	0	0, 0, 0, 0, 0	12.24	1.76	YES	YES	NO (5)
1B	3	N, M, S	0	2, .75, .75, .75, 2	11.00	1.77	YES	YES	YES
2	2	M, S	0	1, 1, 1, 1, 2	8.82	1.58	YES	YES	YES
3	4	N, M, S, P	10	1, 1, 1, 1, 2	20.04	1.65	YES	YES	YES (6)
4	3	M, S, P	5	2, .75, .75, .75, 3	13.53	1.51	YES	YES	YES (6)

NOTES:

(1) Extraction trench elevations set to 588.0 ft msl. Simulation of September 1991 initial head conditions.
(2) Location of trenches are shown in Figures F-3 through F-6.
(3) Surfactant infiltration occurs within the bounds of the extraction trenches that are actively recovering LNAPL and ground water during the simulation.
(4) Individual well rates are shown in order from west to east across the site.
(5) Extraction wells are required in order to capture ground water between the site and the Des Plaines River.
(6) Easternmost particle(s) from north captured by wells.

Key:

gpm = gallons per minute
N = northernmost extraction trench; M = middle extraction trench; S = southern extraction trench; P = passive extraction trench.

TABLE F-5

SUMMARY OF GROUND WATER RECOVERY ALTERNATIVES
MODFLOW MODEL RESULTS (1)
LENZ OIL SITE
LEMONT, ILLINOIS

ALTERNATIVE	NUMBER OF EXTRACTION TRENCHES	EXTRACTION TRENCH LOCATION (2)	SURFACTANT INFILTRATION RATE (3) GPM	EXTRACTION WELL RATES (4) GPM	EXTRACTION TRENCH DISCHARGE RATE, GPM	MAXIMUM DRAWDOWN FT	LNAPL PARTICLES CAPTURED ?	NORTH PARTICLES CAPTURED ?	RIVER PARTICLES CAPTURED ?
1A	3	N, M, S	0	0, 0, 0, 0, 0	2.83	0.45	NO (5)	NO (5)	NO (6)
1B	3	N, M, S	0	2, .75, .75, .75, 2	1.82	0.65	NO (5)	NO (5)	NO (6)
2	2	M, S	0	1, 1, 1, 1, 2	0.83	0.66	NO (5)	NO (5)	NO (6)
3	4	N, M, S, P	10	1, 1, 1, 1, 2	9.51	0.61	NO (5)	NO (5)	NO (6)
4	3	M, S, P	5	2, .75, .75, .75, 3	4.09	0.84	NO (5)	NO (5)	NO (6)

NOTES:

(1) Drain elevations adjusted to 589.5 ft msl and simulations performed using the September 27, 1991 initial head conditions.
(2) Location of trenches are shown in Figure __.
(3) Surfactant infiltration occurs within the bounds of the extraction trenches that are actively recovering LNAPL and ground water during the simulation.
(4) Individual well rates are shown in order from west to east across the site.
(5) Some particles from the north and some LNAPL particles are captured by the extraction trenches, but most particles migrate to the Des Plaines river.
(6) Insufficient drawdown is produced by the extraction trenches or the extraction wells in order to reverse the ground water gradient necessayr to capture the particles that begin between the extraction wells and the river.

Key:

gpm = gallons per minute
N = northernmost extraction trench; M = middle extraction trench; S = southern extraction trench; P = passive extraction trench.

TABLE F-6

SUMMARY OF GROUND WATER RECOVERY ALTERNATIVES
MODFLOW MODEL RESULTS (1)
LENZ OIL SITE
LEMONT, ILLINOIS

ALTERNATIVE	NUMBER OF EXTRACTION TRENCHES	EXTRACTION TRENCH LOCATION (2)	SURFACTANT INFILTRATION RATE (3) GPM	EXTRACTION WELL RATES (4) GPM	EXTRACTION TRENCH DISCHARGE RATE, GPM	MAXIMUM DRAWDOWN FT	LNAPL PARTICLES CAPTURED ?	NORTH PARTICLES CAPTURED ?	RIVER PARTICLES CAPTURED ?
1A	3	N, M, S	0	0, 0, 0, 0, 0	28.35	3.79	YES	YES	NO (5)
1B	3	N, M, S	0	2, .75, .75, .75, 2	27.12	3.80	YES	YES	NO (6)
2	2	M, S	0	1, 1, 1, 1, 2	22.16	3.37	YES	YES	NO (7)
3	4	N, M, S, P	10	1, 1, 1, 1, 2	37.11	3.70	YES	YES	NO (8)
4	3	M, S, P	5	2, .75, .75, .75, 3	28.24	3.36	YES	YES	NO (8,9)

NOTES:

(1) Drain elevation adjusted to 589.5 ft msl, simulation of May, 1991 initial head conditions.
(2) Location of trenches are shown in Figure __.
(3) Surfactant infiltration occurs within the bounds of the extraction trenches that are actively recovering LNAPL and ground water during the simulation.
(4) Individual well rates are shown in order from west to east across the site.
(5) Extraction wells are required in order to capture ground water between the site and the Des Plaines River.
(6) Four easternmost river particles not captured by wells.
(7) Only two river particles are captured by wells.
(8) Only two river particles are captured by wells.
(7) All but easternmost three river particles are captured by wells.
(8) Easternmost river particles from north are captured by wells.

Key:

gpm = gallons per minute
N = northernmost extraction trench; M = middle extraction trench; S = southern extraction trench; P = passive extraction trench.

TABLE F-7

SUMMARY OF GROUND WATER RECOVERY ALTERNATIVES
MODFLOW MODEL RESULTS (1)
LENZ OIL SITE
LEMONT, ILLINOIS

ALTERNATIVE	NUMBER OF EXTRACTION TRENCHES	EXTRACTION TRENCH LOCATION (2)	SURFACTANT INFILTRATION RATE (3) GPM	EXTRACTION WELL RATES (4) GPM	EXTRACTION TRENCH DISCHARGE RATE, GPM	MAXIMUM DRAWDOWN FT	LNAPL PARTICLES CAPTURED ?	NORTH PARTICLES CAPTURED ?	RIVER PARTICLES CAPTURED ?
1A	3	N, M, S	0	0, 0, 0, 0, 0	28.35	3.79	YES	YES	NO (5)
1B	3	N, M, S	0	2, 2, 2, 2, 3	25.66	3.83	YES	YES	YES
2	2	M, S	0	3, 3, 3, 3, 3.5	19.95	3.42	YES	YES	YES
3	4	N, M, S, P	10	2, 2, 2, 2, 4	35.45	3.70	YES	YES	YES
4	3	M, S, P	5	2, .75, .75, 3, 4	27.48	3.37	YES	YES	YES

NOTES:

(1) Extraction trench elevations adjusted to 589.5 ft msl, May 1991 initial head conditions, extraction well rates adjusted to achieve capture of river particles.
(2) Location of trenches are shown in Figure __.
(3) Surfactant infiltration occurs within the bounds of the extraction trenches that are actively recovering LNAPL and ground water during the simulation.
(4) Individual well rates are shown in order from west to east across the site.
(5) Extraction wells are required in order to capture ground water between the site and the Des Plaines River.

Key:

gpm = gallons per minute
N = northernmost extraction trench; M = middle extraction trench; S = southern extraction trench; P = passive extraction trench.

TABLE F-8

MATRIX OF ARMOS MODELING SCENARIOS
LENZ OIL SITE
LEMONT, ILLINOIS

Soil Residual LNAPL Percentage of the Total Initial LNAPL Volume Estimate	Four Passive Extraction Trenches	Three Trenches Actively Pumping at a Combined Rate of 11 gpm	Four Trenches Actively Pumping at a Combined Rate of 20 gpm and Surfactant Infiltrated at 10 gpm	Two Trenches Actively Pumping at a Combined Rate of 8.8 gpm and the LNAPL within the Unconsolidated Soils has been Excavated	Three Trenches Actively Pumping at a Combined Rate of 13.5 gpm and the LNAPL within the Unconsolidated Soils has been Excavated
Low Residual (7% - 24%)	ARMOS RUN 1	ARMOS RUN 4	ARMOS RUN 7	ARMOS RUN 10	ARMOS RUN 13
Moderate Residual (58% - 68%)	ARMOS RUN 2	ARMOS RUN 5	ARMOS RUN 8	ARMOS RUN 11	ARMOS RUN 14
High Residual (70% - 85%)	ARMOS RUN 3	ARMOS RUN 6	ARMOS RUN 9	ARMOS RUN 12	ARMOS RUN 15

Key:

ARMOS = Areal Multiphase Organic Simulator, version 5.11, by ES&T, Blacksburg, Virginia.
LNAPL = Light nonaqueous phase liquid
gpm = Gallons per minute

TABLE F-9

SUMMARY OF ARMOS MODELING RESULTS
LENZ OIL SITE
LEMONT, ILLINOIS

ARMOS Model Run	Total starting LNAPL volume [1] (gallons)	Cumulative LNAPL Recovery (gallons)											Total LNAPL that is Nonrecoverable After 20 Years (gallons)	Total LNAPL Remaining After 20 Years (gallons)
		1 Year	2 Years	4 Years	6 Years	8 Years	10 Years	12 Years	14 Years	16 Years	18 Years	20 Years		
Run 1	3,578	582	834	1276	1663	1996	2282	2495	2663	2792	2897	2973	246	604
Run 2	3,578	223	317	475	617	748	847	919	968	1000	1016	1025	2466	2553
Run 3	3,578	168	207	254	285	308	326	337	346	357	370	382	3065	3196
Run 4	3,578	575	826	1311	1687	1989	2229	2409	2542	2635	2709	2758	600	819
Run 5	3,578	264	410	639	828	985	1093	1166	1212	1236	1252	1262	2242	2315
Run 6	3,578	145	265	415	544	646	717	764	800	821	821	821	2855	2757
Run 7	3,578	1222	2179	2667	2730	2739	2743	2745	2748	2751	2753	2756	777	822
Run 8	3,578	503	968	1105	1143	1172	1183	1188	1192	1224	1264	1296	2087	2281
Run 9	3,578	303	641	763	812	813	814	815	816	817	818	819	2731	2759
Run 10	2,388	224	331	641	966	1253	1457	1604	1707	1781	1829	1861	419	527
Run 11	2,388	136	175	318	489	633	734	798	828	839	840	840	1525	1548
Run 12	2,388	227	282	344	422	479	509	518	519	519	519	519	1848	1869
Run 13	2,388	737	1385	1737	1762	1764	1766	1768	1770	1772	1774	1776	582	612
Run 14	2,388	437	750	845	846	846	847	848	848	849	849	850	1497	1538
Run 15	2,388	269	389	406	422	426	433	434	435	435	435	435	1784	1953

Key:

LNAPL = Light nonaqueous phase liquid.

ARMOS = "Areal Multiphase Organic Simulator", version 5.11, by ES&T of Blacksburg, Virginia.

Note:

[1] The LNAPL contained in the unconsolidated soils and gravels has been removed through excavation for Runs 10 through 15.

TABLE F-10

SUMMARY OF THE EFFICIENCY OF THE VARIOUS ARMOS SCENARIOS
LENZ OIL SITE
LEMONT, ILLINOIS

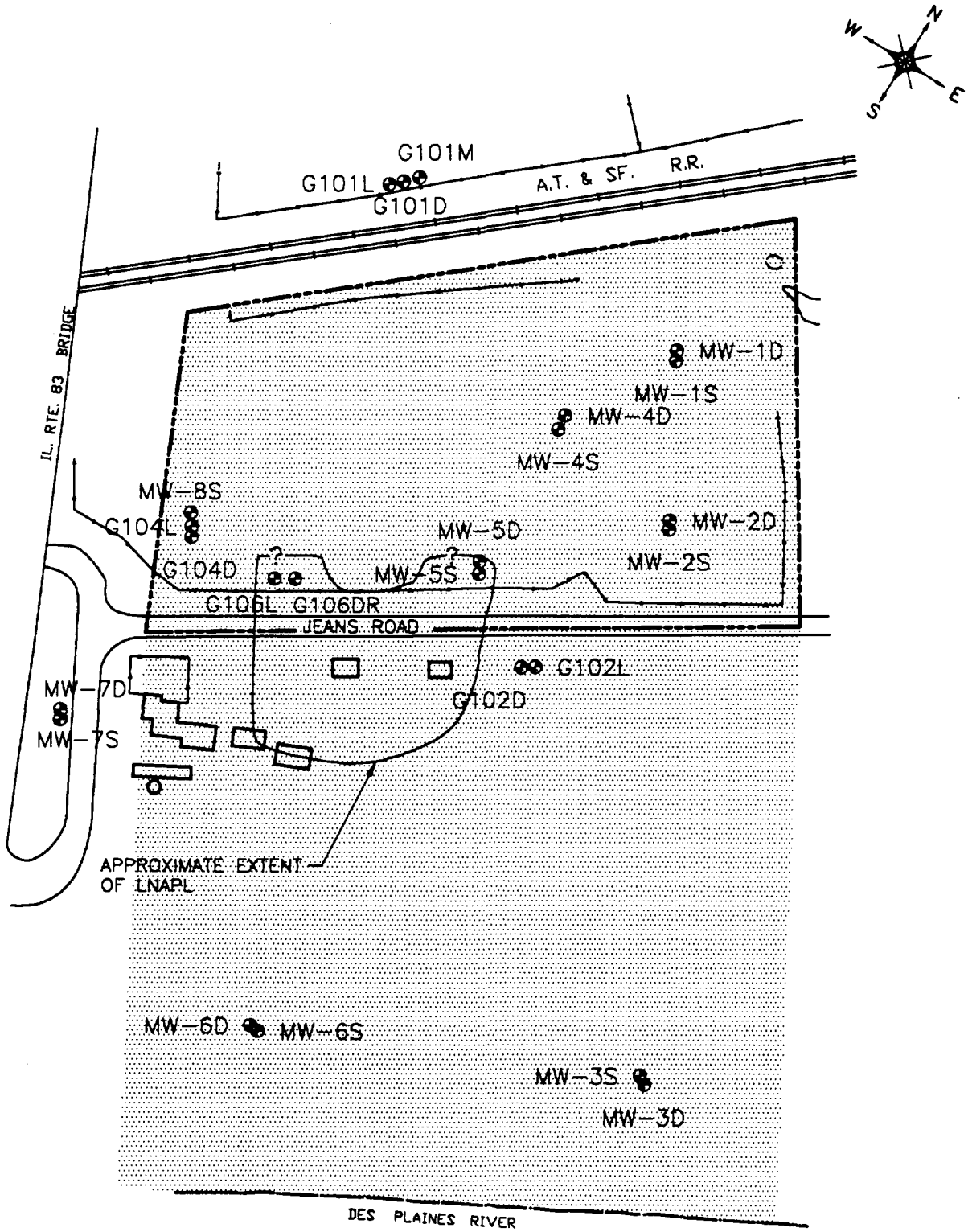
ARMOS Model Run	Soil Residual Capacity	Maximum Estimated Recoverable Volume of LNAPL (gallons)	Volume at 90% of Maximum Estimated Recoverable Volume of LNAPL (gallons)	Approximate Number of Years Required to Reach the 90% Removal (years)
Volume of starting LNAPL 3,578 gallons				
Run 1	Low	820	738	13
Run 4	Low	820	738	14
Run 7	Low	820	738	3
Run 2	Moderate	2,300	2,070	>20
Run 5	Moderate	2,300	2,070	12
Run 8	Moderate	2,300	2,070	7
Run 3	High	2,750	2,475	>20
Run 6	High	2,750	2,475	11
Run 9	High	2,750	2,475	3
Volume of starting LNAPL 2,388 gallons				
Run 10	Low	570	513	12
Run 13	Low	570	513	3
Run 11	Moderate	1,550	1,395	11
Run 14	Moderate	1,550	1,395	3
Run 12	High	1,910	1,719	6
Run 15	High	1,910	1,719	9

Key:

LNAPL = Light nonaqueous phase liquid.

ARMOS = "Areal Multiphase Organic Simulator", version 5.11, by ES&T of Blacksburg, Virginia.

FIGURES



APPROX. SCALE (ft.)
0 150

SYMBOL LEGEND

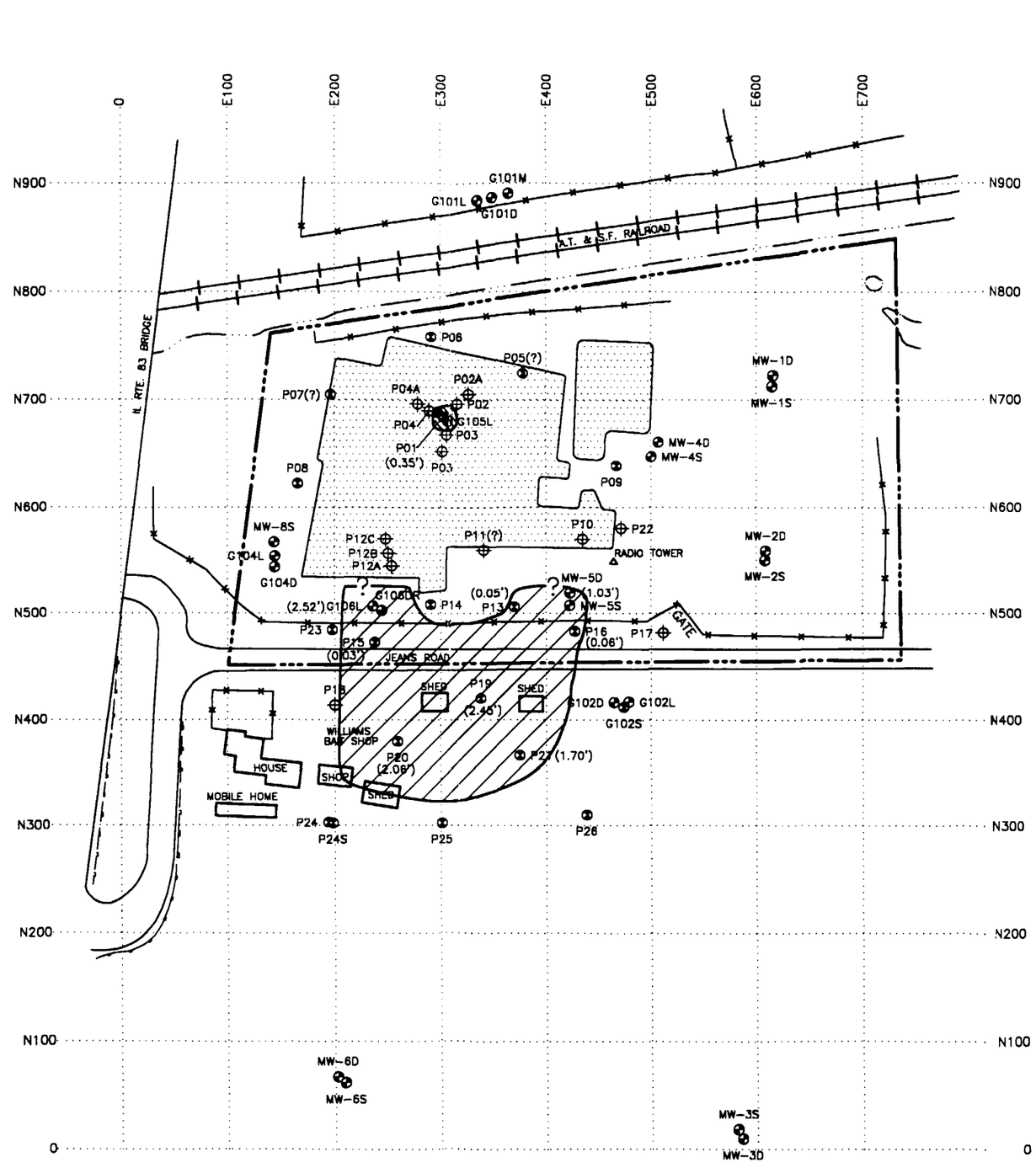
- ASSUMED CAPTURE ZONE
- PROPERTY LINE
- FENCE LINE
- RAILROAD
- MONITORING WELL
- BUILDING

FIGURE F-1

ASSUMED CAPTURE ZONE
LENZ OIL SITE
LEMONT, ILLINOIS

ERM

FILE: S:\CPFILES\ERM\S&A\94017\ACAD\FS\FIGD-1.DWG OCT 30, 1998 10:33 AM
DRAWN: MO-
DATE: 10/30/96



APPROX. SCALE (ft.)

0 120

SYMBOL LEGEND

	LNAPL AREA 1
	LNAPL AREA 2
	AREA OF EXCAVATION
	DRAINAGE DITCH
	PROPERTY LINE
	FENCE LINE
	RAILROAD
	BORING IN WHICH NO PIEZOMETER WAS INSTALLED
	PIEZOMETER LOCATION NOT DRAWN TO SCALE
	MONITORING WELL LOCATION
(1.21')	MAXIMUM APPARENT PRODUCT THICKNESS (FEET)
P05(?)	SEE NOTE 2

NOTES:

1. THE MAXIMUM APPARENT PRODUCT THICKNESS AT MW-5S WAS 1.21' DURING THE REMEDIAL INVESTIGATION.
2. THE EXCAVATION BOUNDARIES ARE BASED ON SKETCHES PROVIDED BY THE ILLINOIS ENVIRONMENTAL PROTECTION AGENCY FOR THE REMEDIAL INVESTIGATION REPORT PREPARED BY ERM-NORTH CENTRAL, INC. ACCORDING TO FIELD OBSERVATIONS, PIEZOMETERS P05 AND P07 ARE OUTSIDE THE AREA OF THE MAIN EXCAVATION, AND PIEZOMETER P11 IS INSIDE THE AREA OF THE MAIN EXCAVATION.

FIGURE F-2

EXTENT OF LIGHT NONAQUEOUS LIQUID
LENZ OIL SITE
LEMONT, ILLINOIS

ERM

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FIGURE F-3

ALTERNATIVE 1
LOCATIONS OF EXTRACTION TRENCHES AND WELLS
LENZ OIL SITE, LEMONT, ILLINOIS

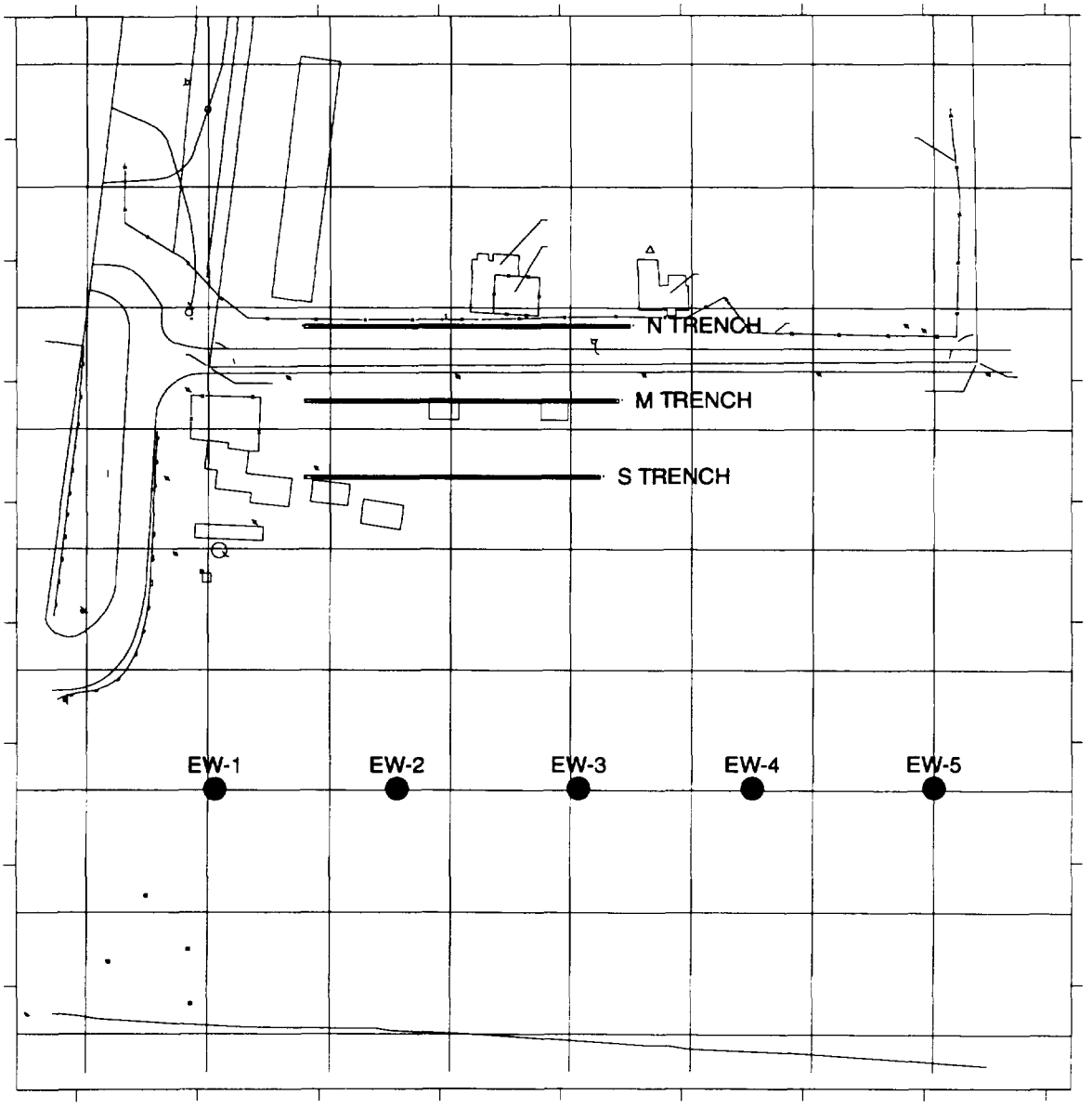


FIGURE F-4

ALTERNATIVE 2
LOCATIONS OF EXTRACTION TRENCHES AND WELLS
LENZ OIL SITE, LEMONT, ILLINOIS

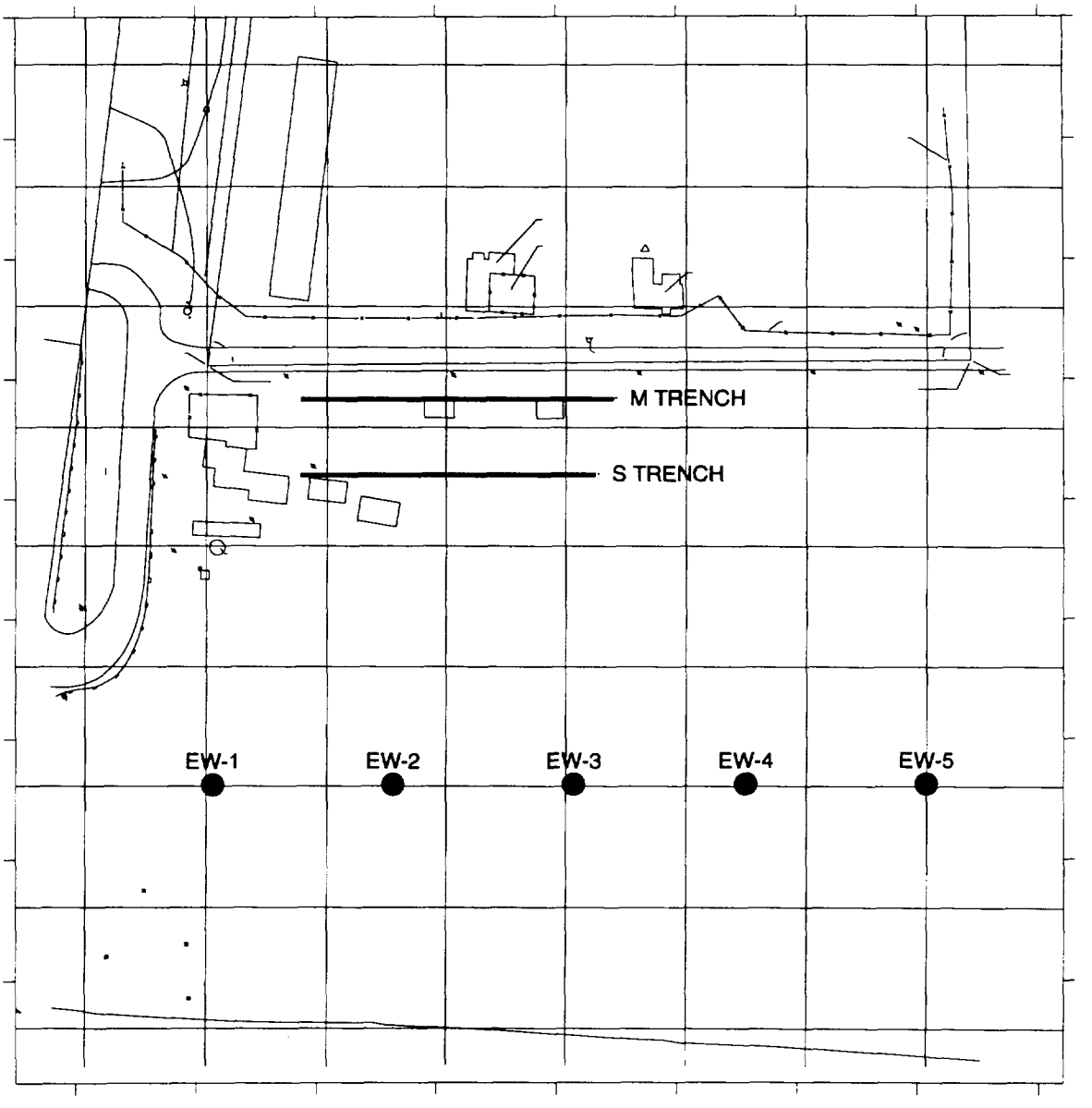


FIGURE F-5

ALTERNATIVE 3
LOCATIONS OF EXTRACTION TRENCHES AND WELLS
LENZ OIL SITE, LEMONT, ILLINOIS

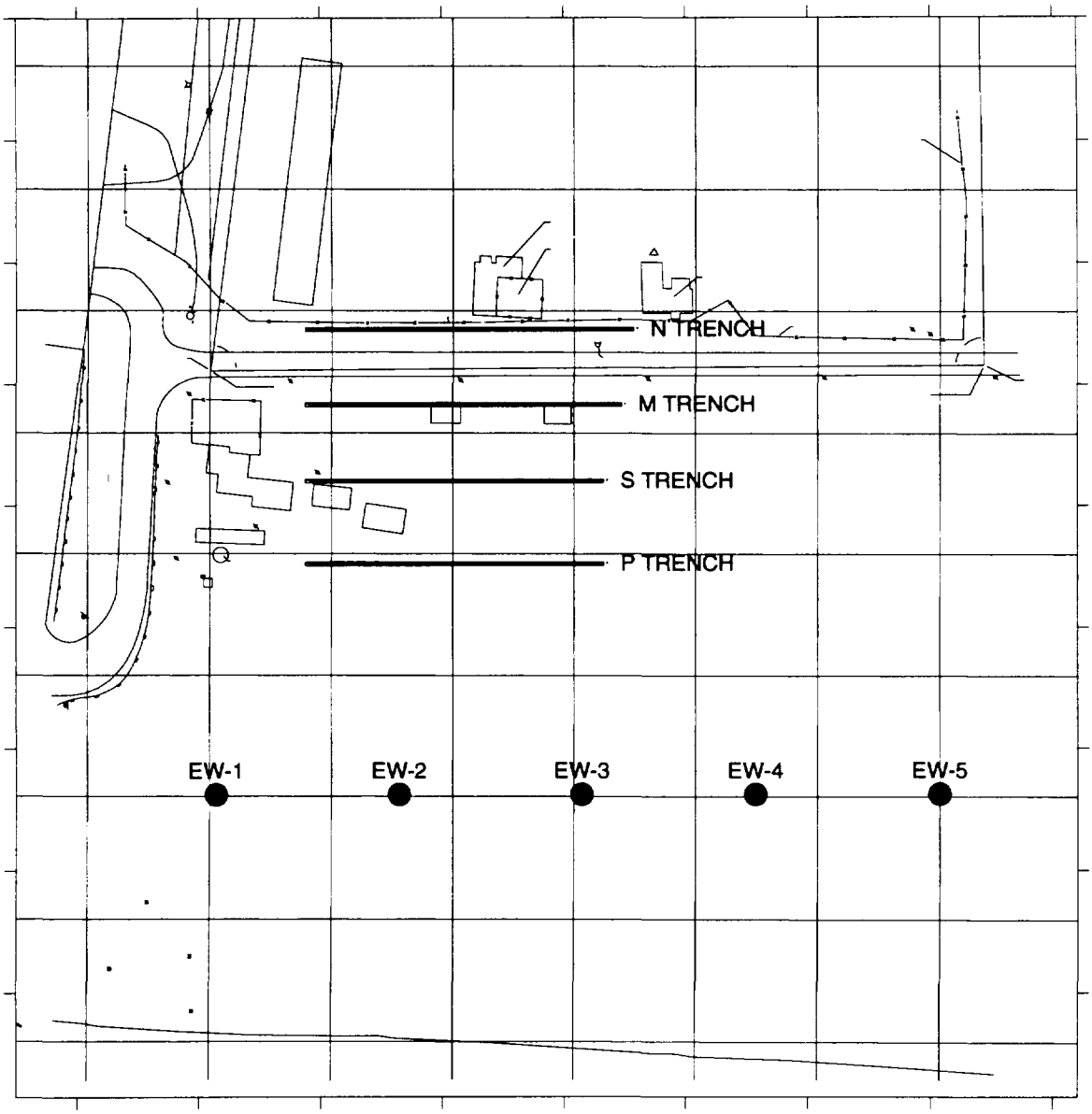
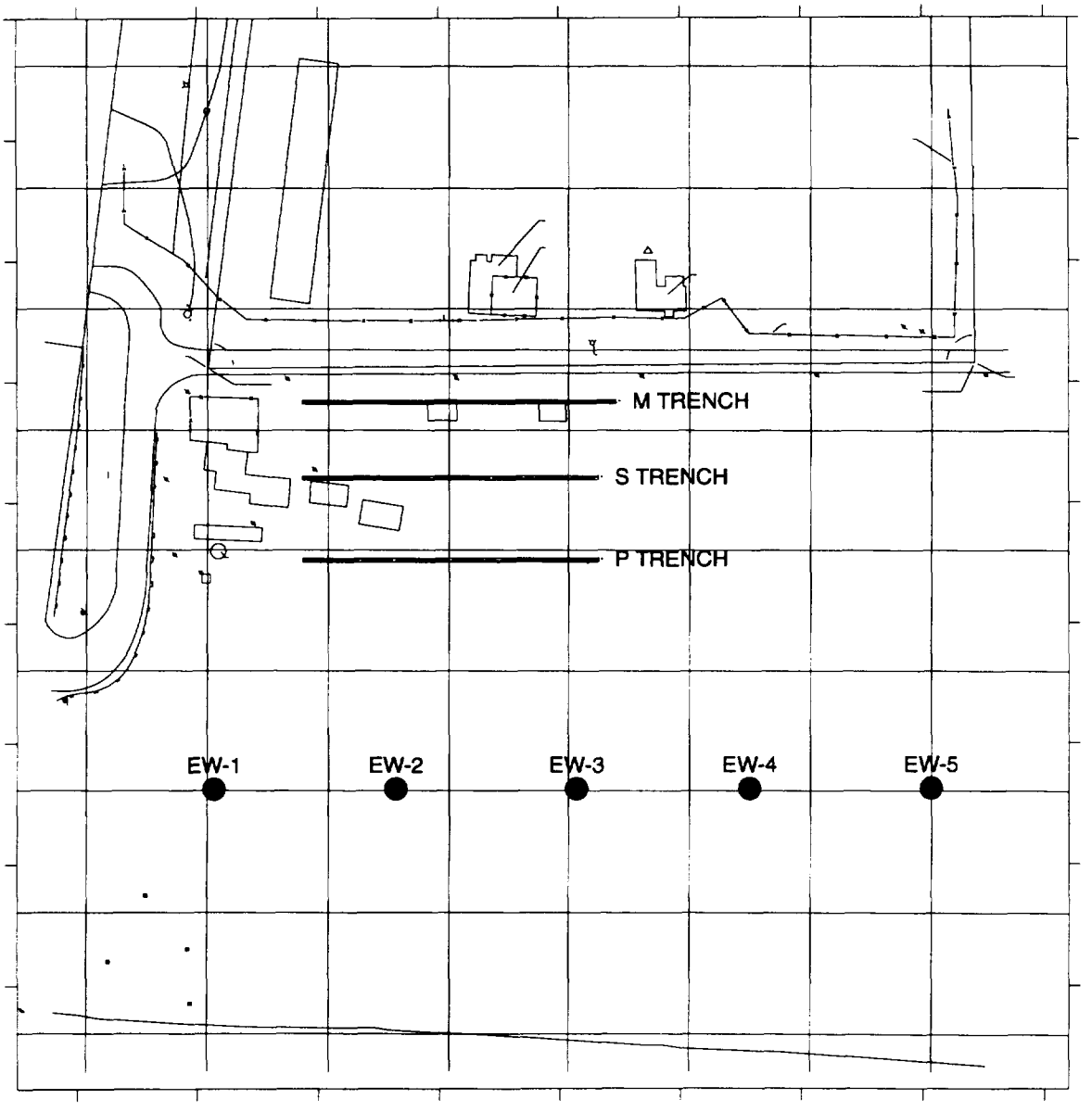
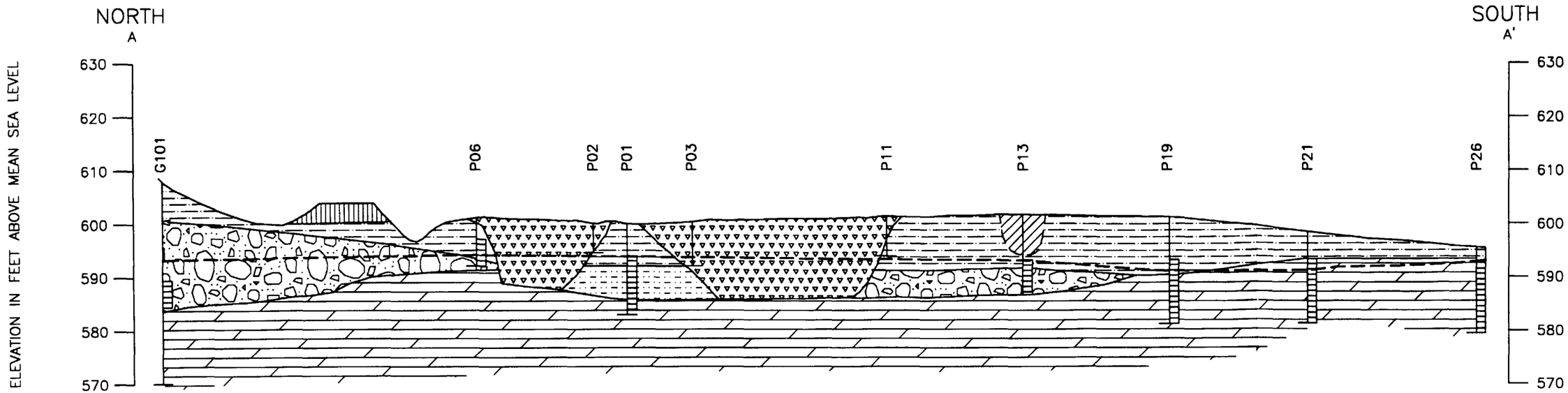
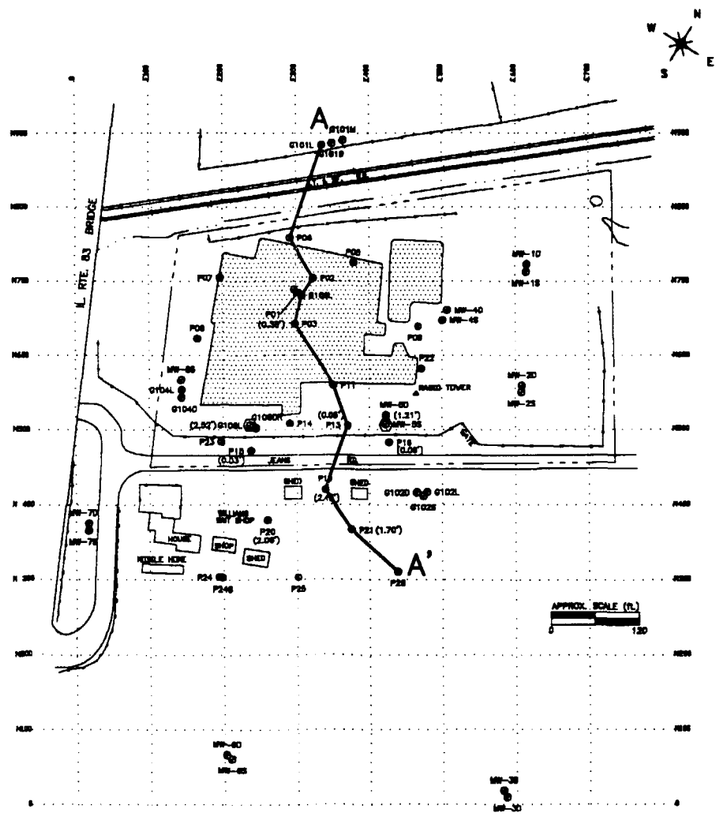


FIGURE F-6

ALTERNATIVE 4
LOCATIONS OF EXTRACTION TRENCHES AND WELLS
LENZ OIL SITE, LEMONT, ILLINOIS







CROSS SECTION LOCATION MAP

20'

0' 50'

SCALE

VERTICAL EXAGGERATION = 2.5X

SYMBOL LEGEND
EXCAVATION BACKFILL
RAILROAD FILL
SILTY-CLAY FACIES
CLAYEY-SILT FACIES
SILTY-GRAVEL FACIES
RACINE DOLOMITE FACIES
MISCELLANEOUS BACKFILL FACIES
PIEZOMETRIC SURFACE

NOTES:

NO PIEZOMETER INSTALLED AT P02, P03, AND P11 LOCATIONS.

SCREEN DEPTHS ARE SHOWN FOR WATER TABLE WELLS ONLY.

FIGURE F-7

GEOLOGIC CROSS SECTION A-A'
LENZ OIL SITE
LEMONT, ILLINOIS

ERM

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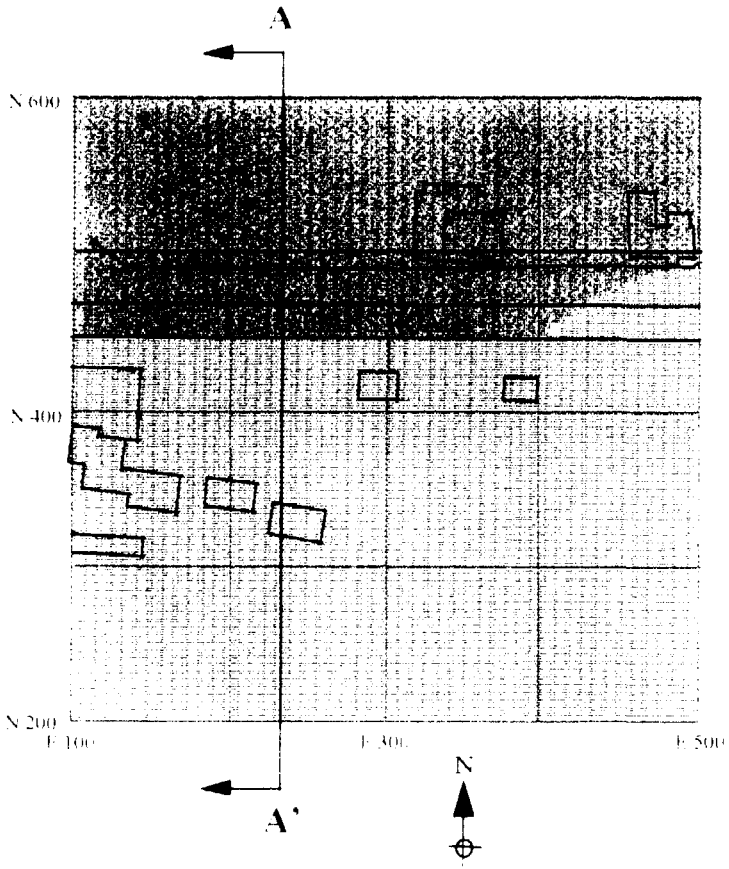
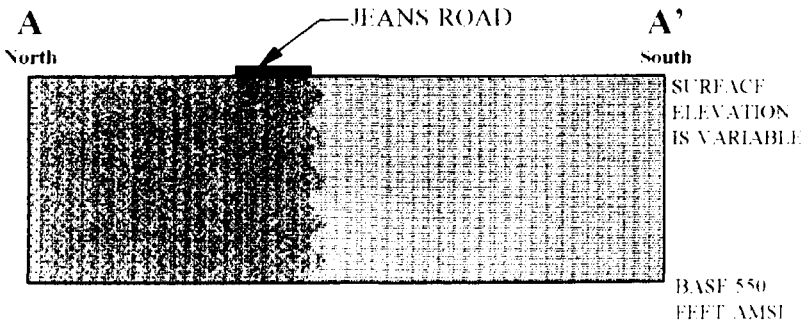
FIGURE F-8

ARMOS CONCEPTUAL MODEL
LENZ OIL SITE
LEMONT, ILLINOIS





LEGEND

Unconsolidated materials: clay, silt, sand and gravel, and fill.

Fractured bedrock

FIGURE F-9

DES PLAINES RIVER DISCHARGE DATA
RIVERSIDE, ILLINOIS

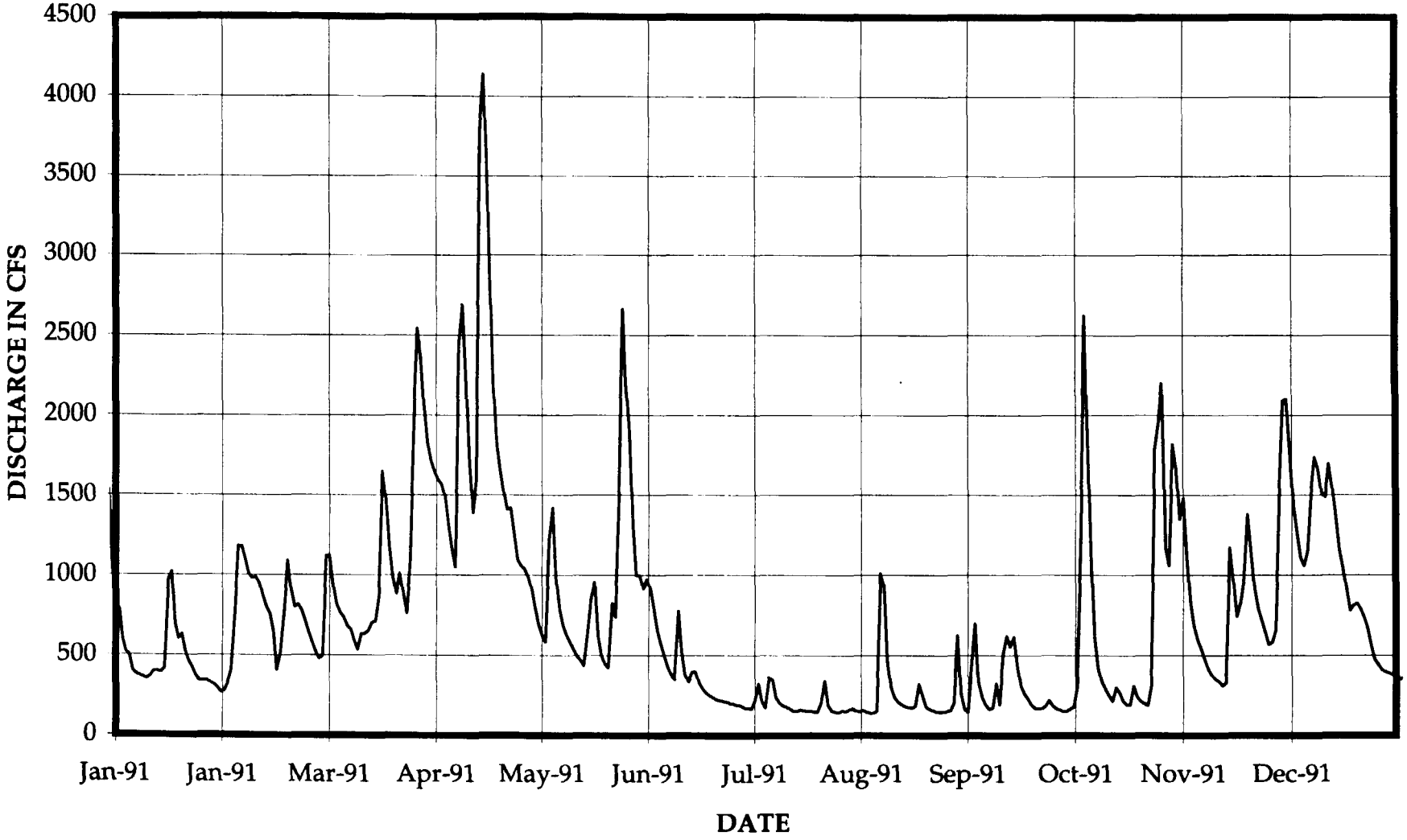
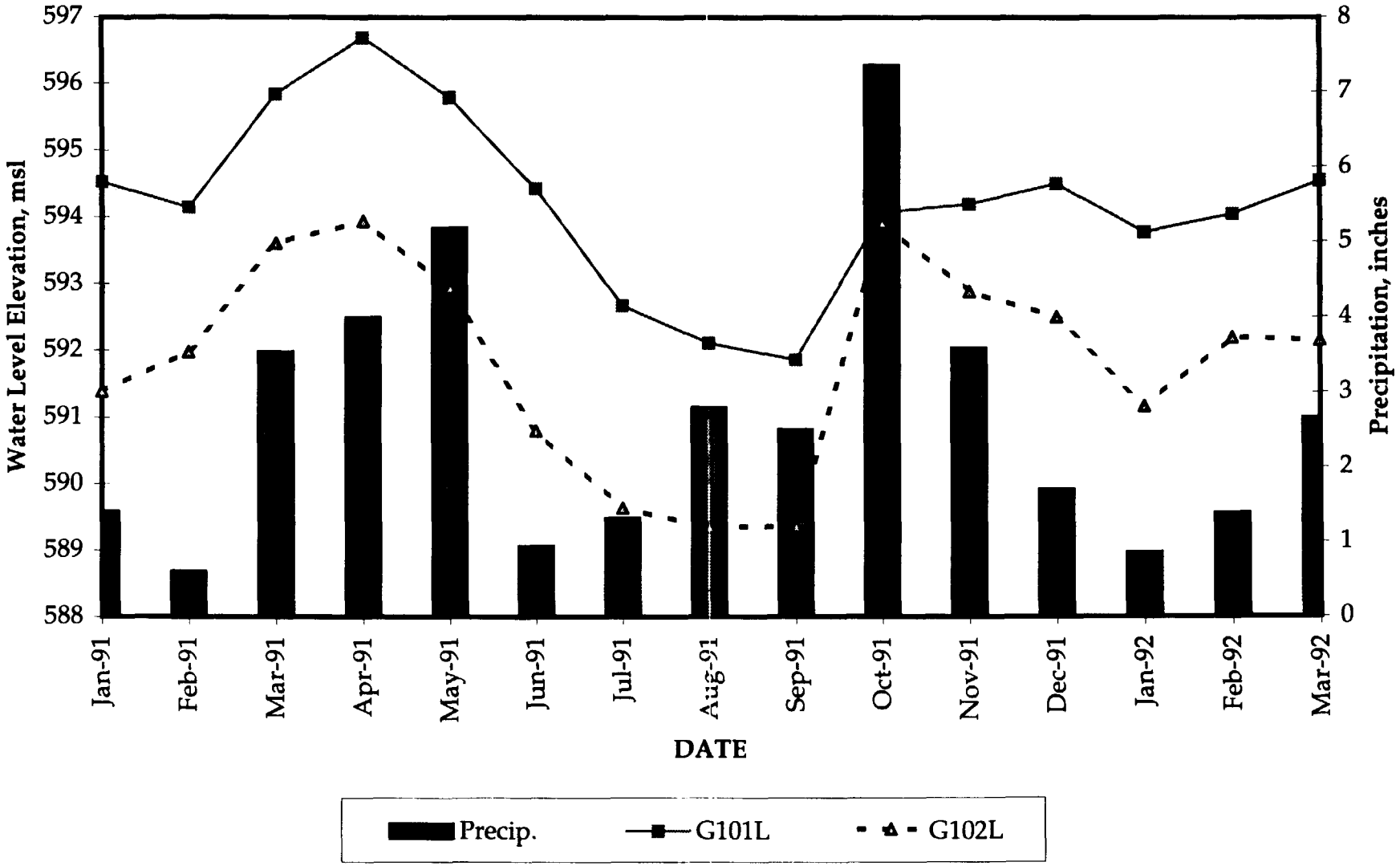
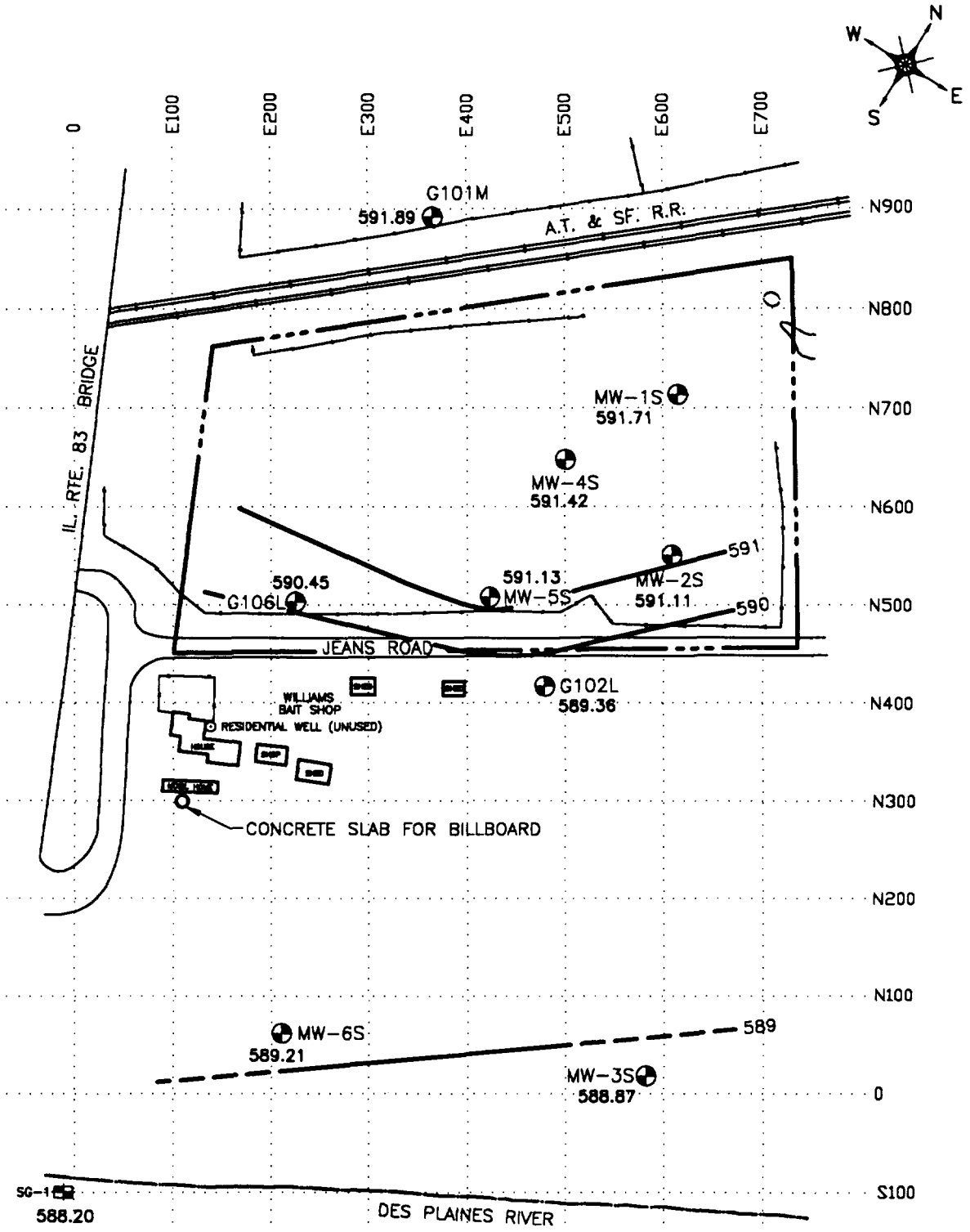


FIGURE F-10

PRECIPITATION VERSUS WATER LEVEL
LENZ OIL, LEMONT, ILLINOIS



HYDROGRA.XLS



APPROX. SCALE (ft.)

0 160

SYMBOL LEGEND	
591.71	PIEZOMETRIC SURFACE ELEVATION IN FEET
591	CONTOUR LINE
	PROPERTY LINE
	FENCE LINE
	RAILROAD
	MONITORING WELL
	STREAM GAGE
	BUILDING

ALL UNITS IN FEET (MSL)

FIGURE F-11

PIEZOMETRIC SURFACE MAP
SHALLOW WELLS-SEPTEMBER 27, 1991
LENZ OIL SITE
LEMONT, ILLINOIS

ERM

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FIGURE F-12

GROUND WATER CONTOUR MAP
MAY 9, 1991
LENZ OIL SITE, LEMONT, ILLINOIS

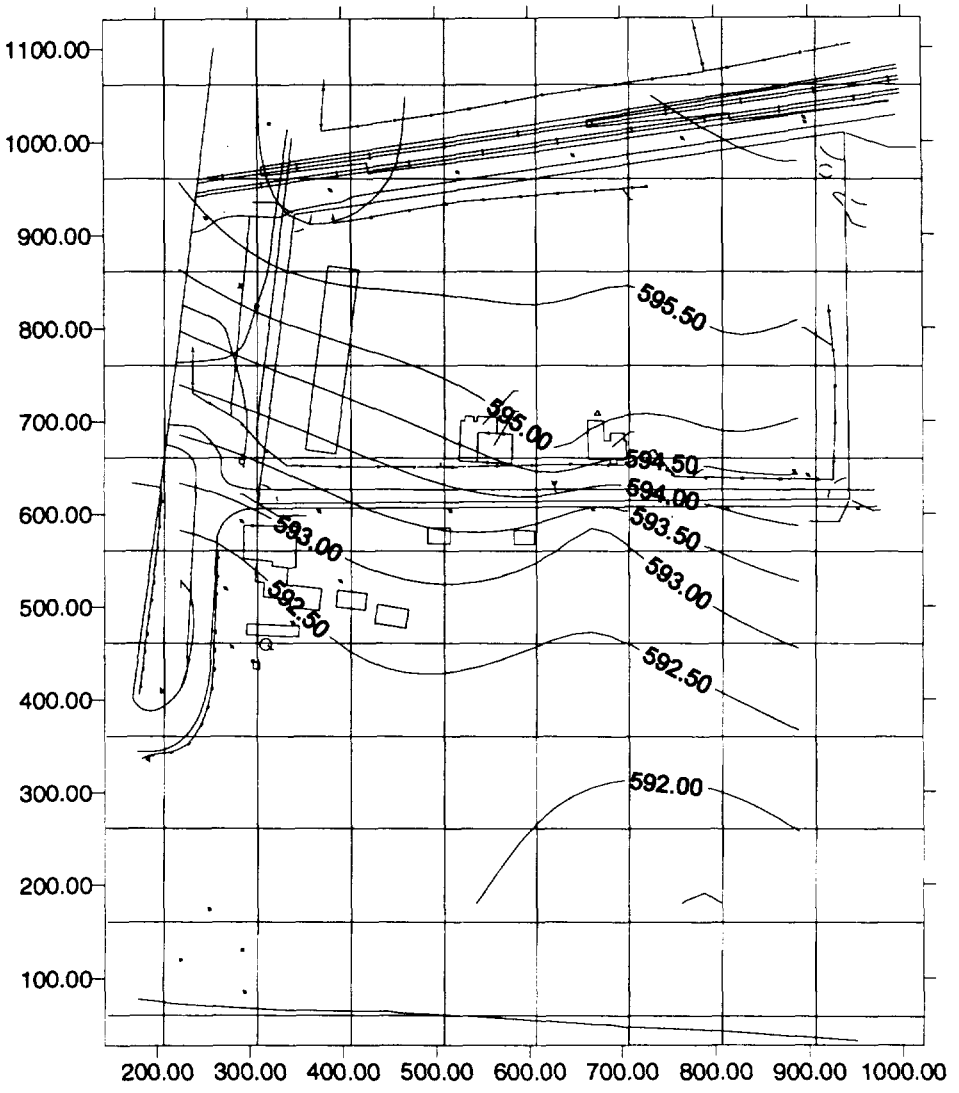
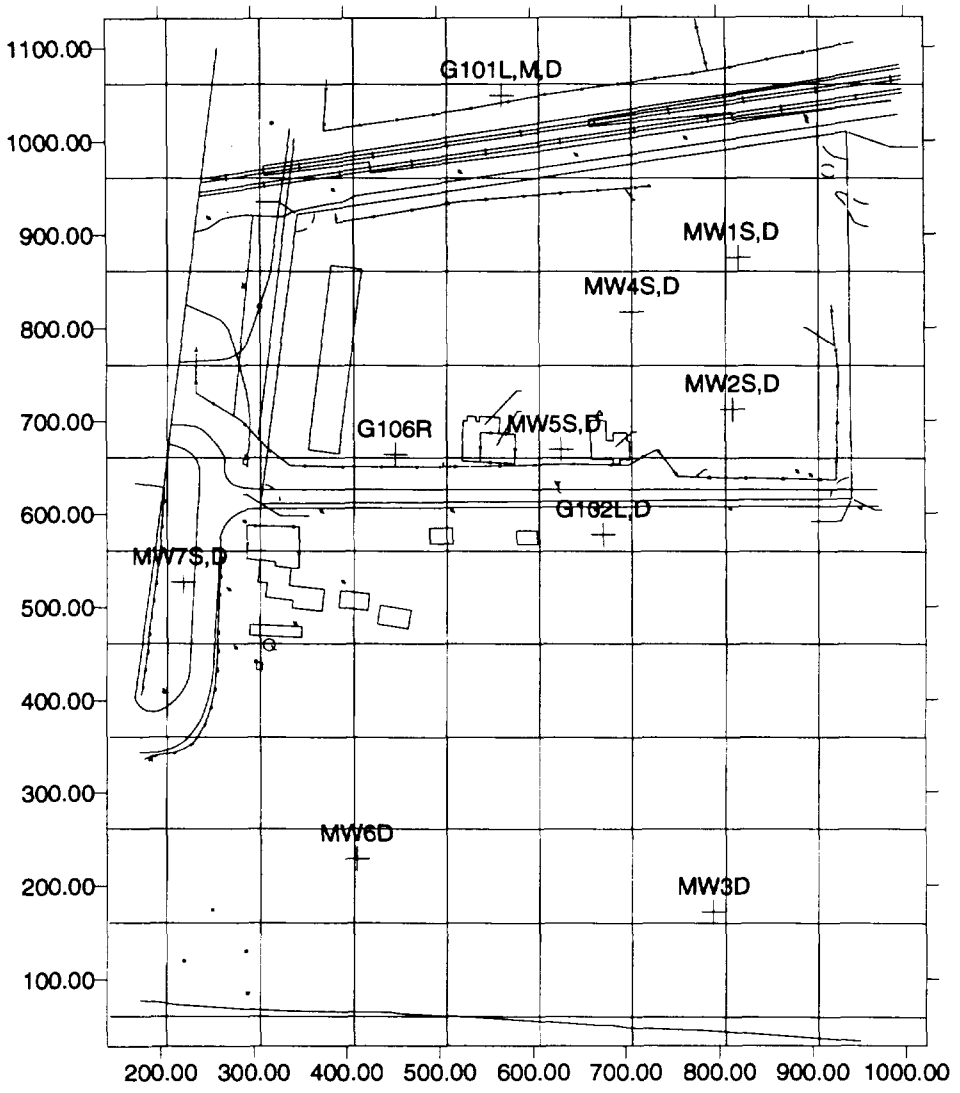


FIGURE F-13

LOCATIONS OF HYDRAULIC CONDUCTIVITY TESTING
LENZ OIL SITE, LEMONT, ILLINOIS



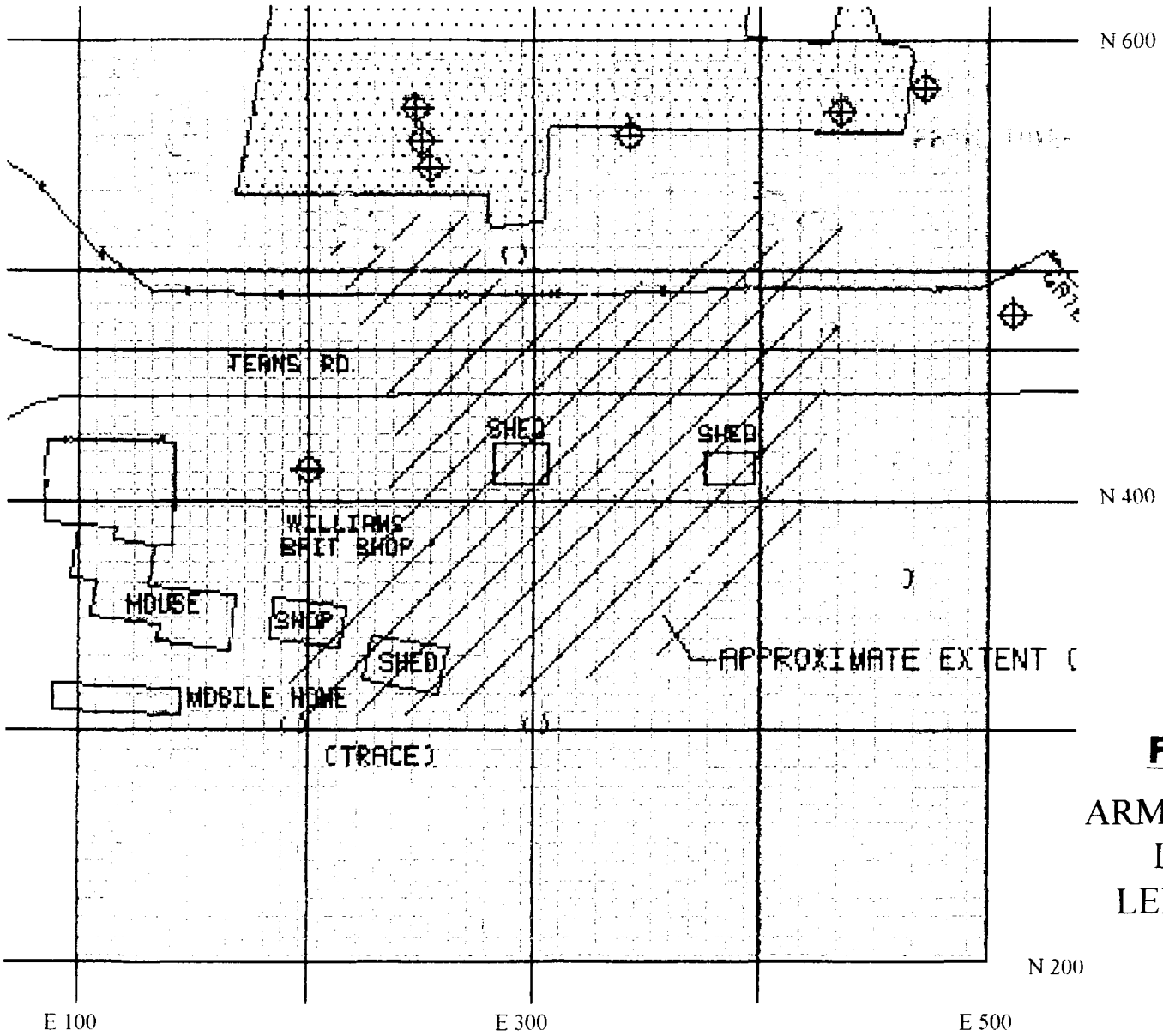


FIGURE F-14

ARMOS GRID DOMAIN
LENZ OIL SITE
LEMONT, ILLINOIS

FIGURE F-15

GROUND WATER FLOW MODEL - DETERMINATION OF INITIAL CONDITIONS
September 27, 1991 Water Levels
LENZ OIL SITE, LEMONT, ILLINOIS

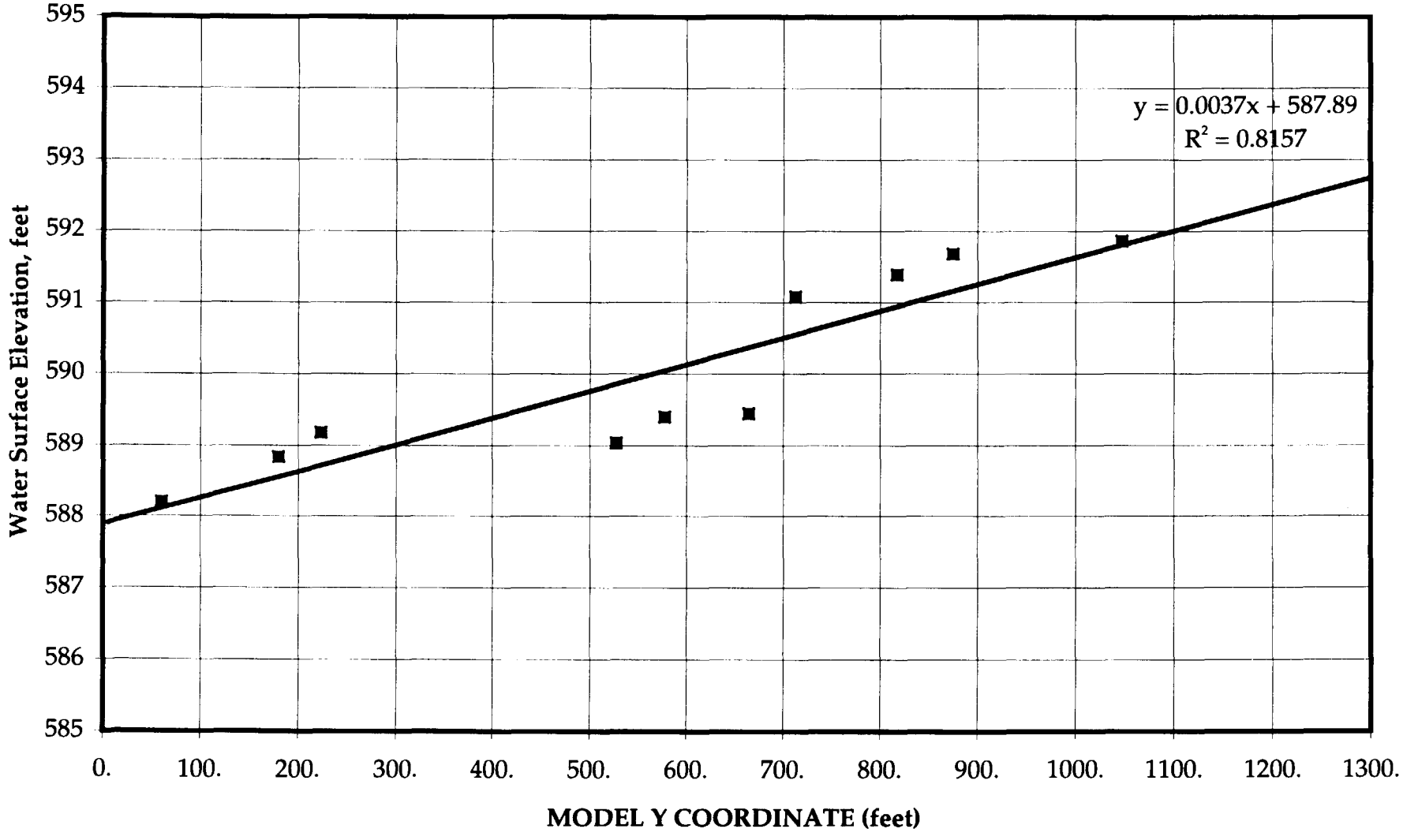
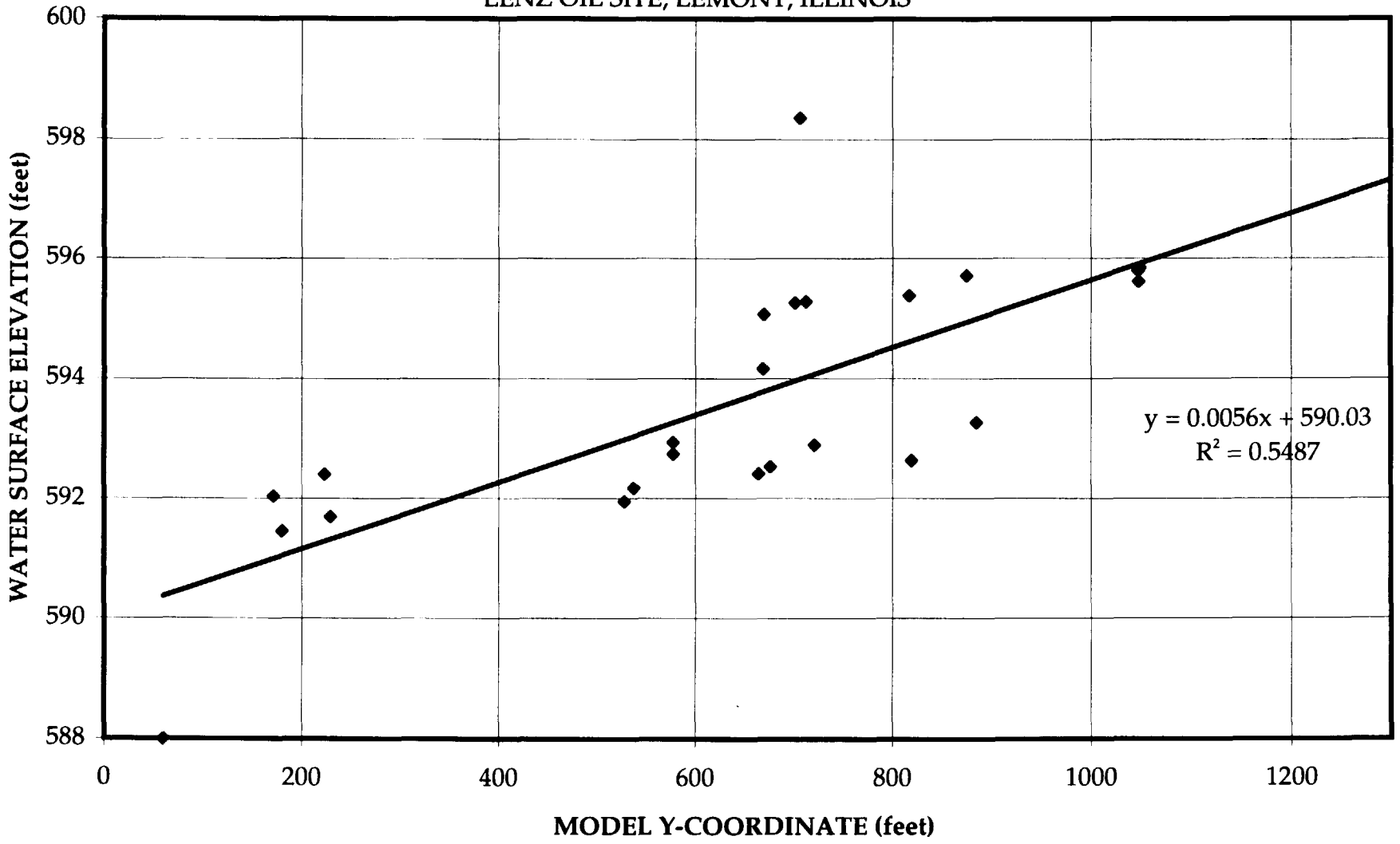
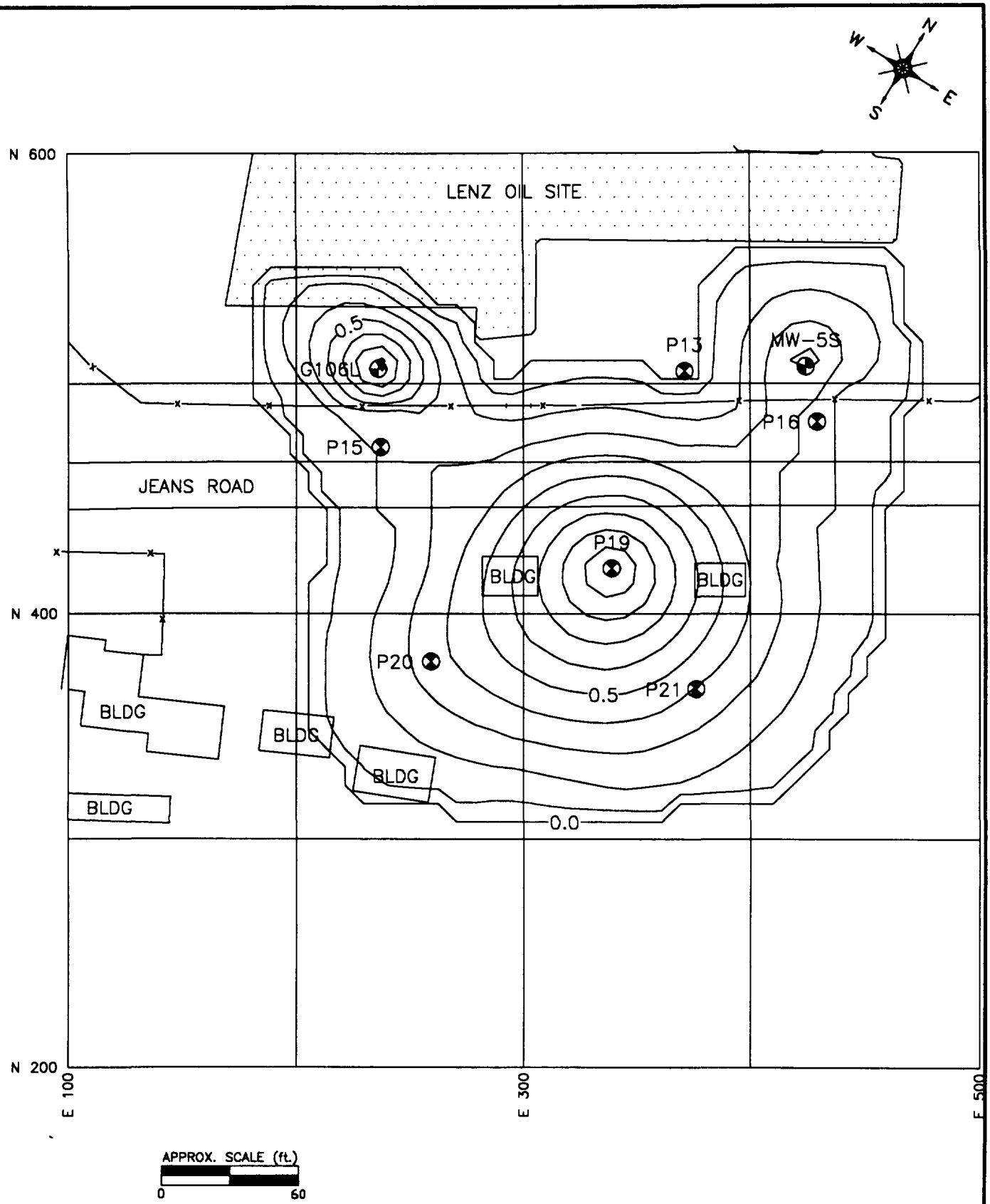


FIGURE F-16

GROUND WATER MODEL, DETERMINATION OF INITIAL CONDITIONS
MAY 9, 1991 WATER LEVELS
LENZ OIL SITE, LEMONT, ILLINOIS





APPROX. SCALE (ft.)

0 60

SYMBOL LEGEND	
———	CONTOUR OF LNAPL THICKNESS (0.1 FOOT INTERVAL)
⊕	EXISTING MONITORING WELL
⊗	EXISTING PIEZOMETER
—×—×—×—	EXISTING FENCE

FIGURE F-17

THICKNESS OF LIGHT NONAQUEOUS PHASE LIQUID AT INITIAL CONDITIONS
LENZ OIL SITE
LEMONT, ILLINOIS

ERM

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DMP

FIGURE F-18

GROUND WATER FLOW MODEL
Sensitivity Analysis - Recharge
LENZ OIL SITE, LEMONT, ILLINOIS

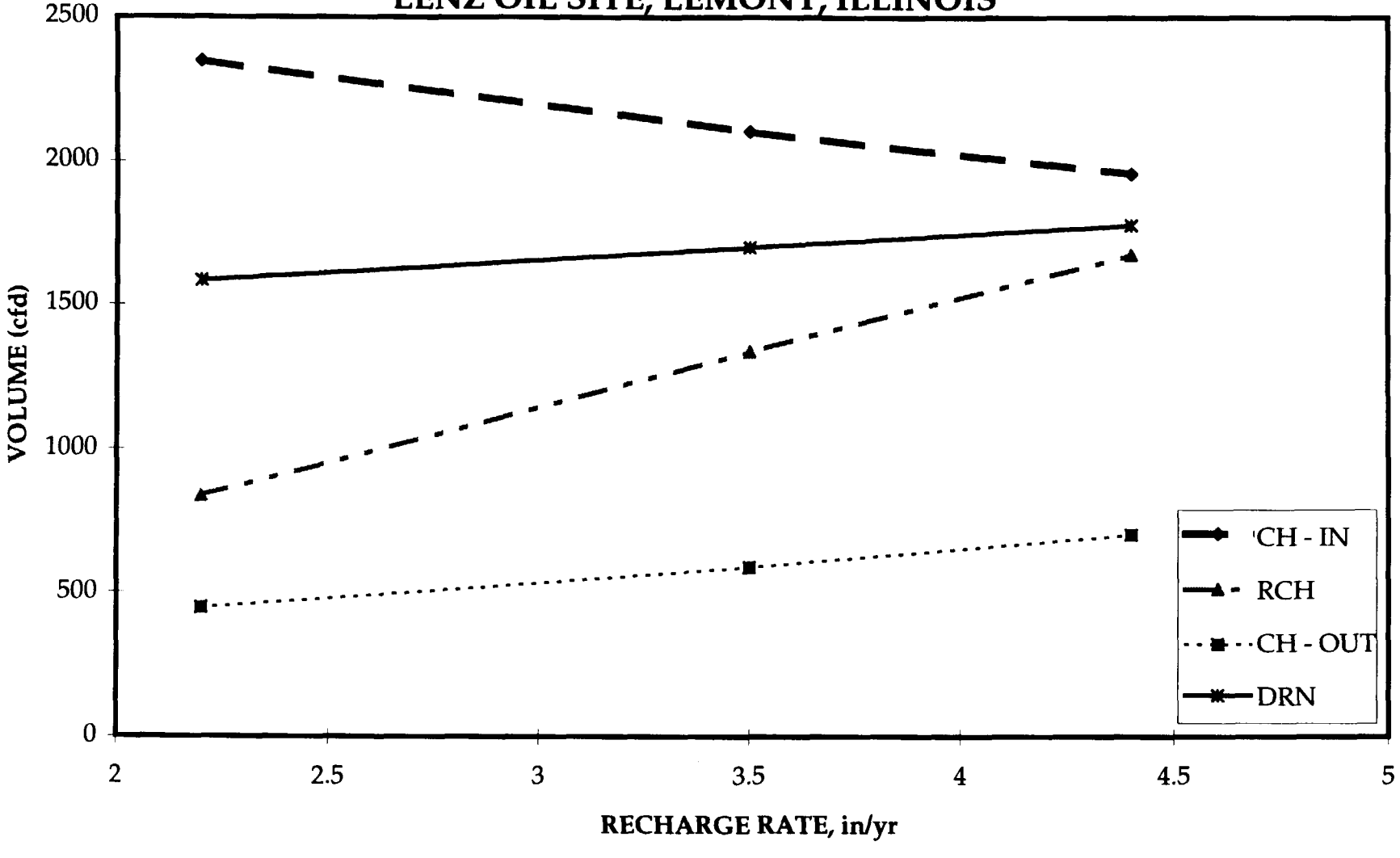


FIGURE F-19

GROUND WATER FLOW MODEL
Sensitivity Analysis - Hydraulic Conductivity
LENZ OIL SITE, LEMONT, ILLINOIS

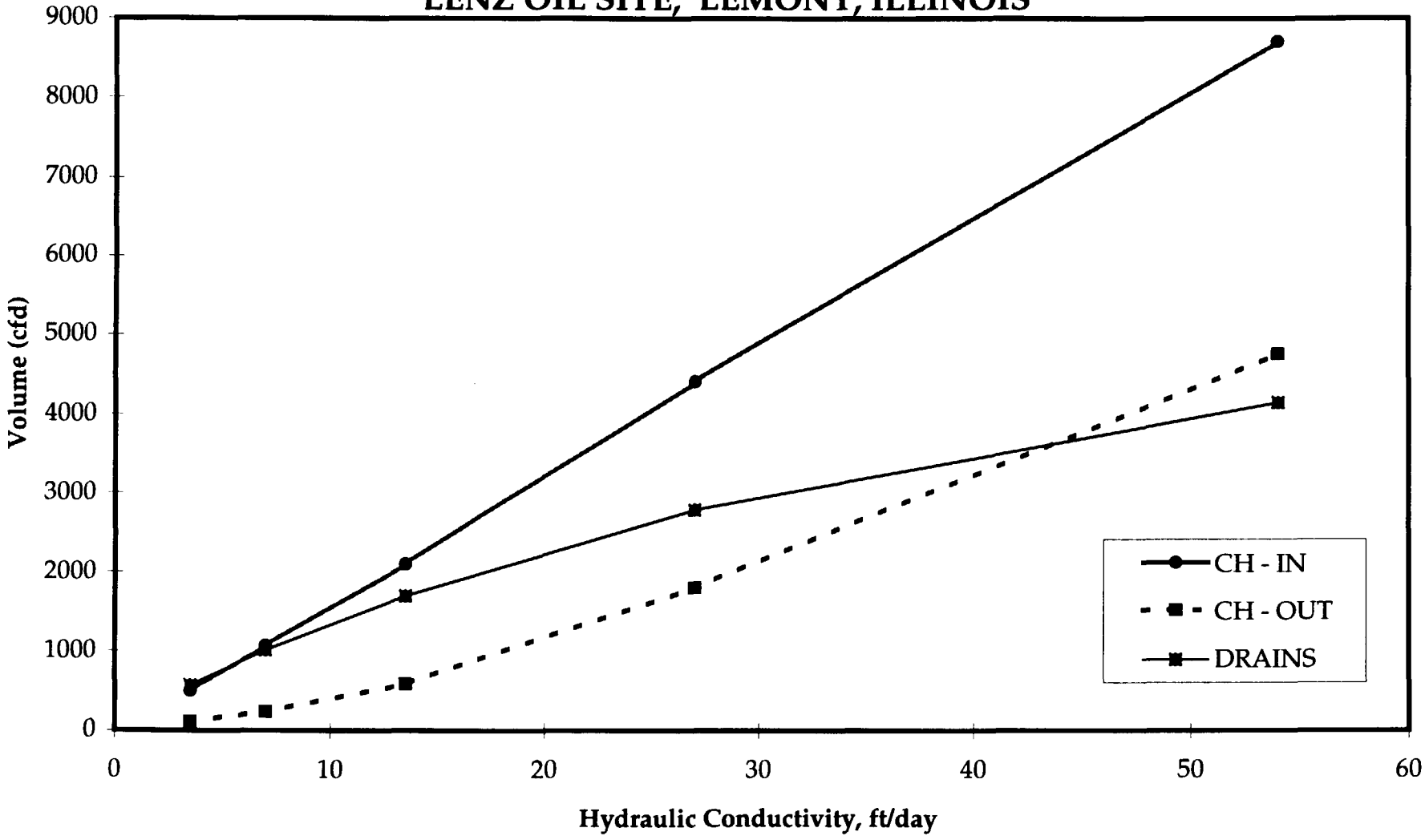


FIGURE F-20

GROUND WATER FLOW MODEL
Sensitivity Analysis - Drain Elevation
LENZ OIL SITE, LEMONT, ILLINOIS

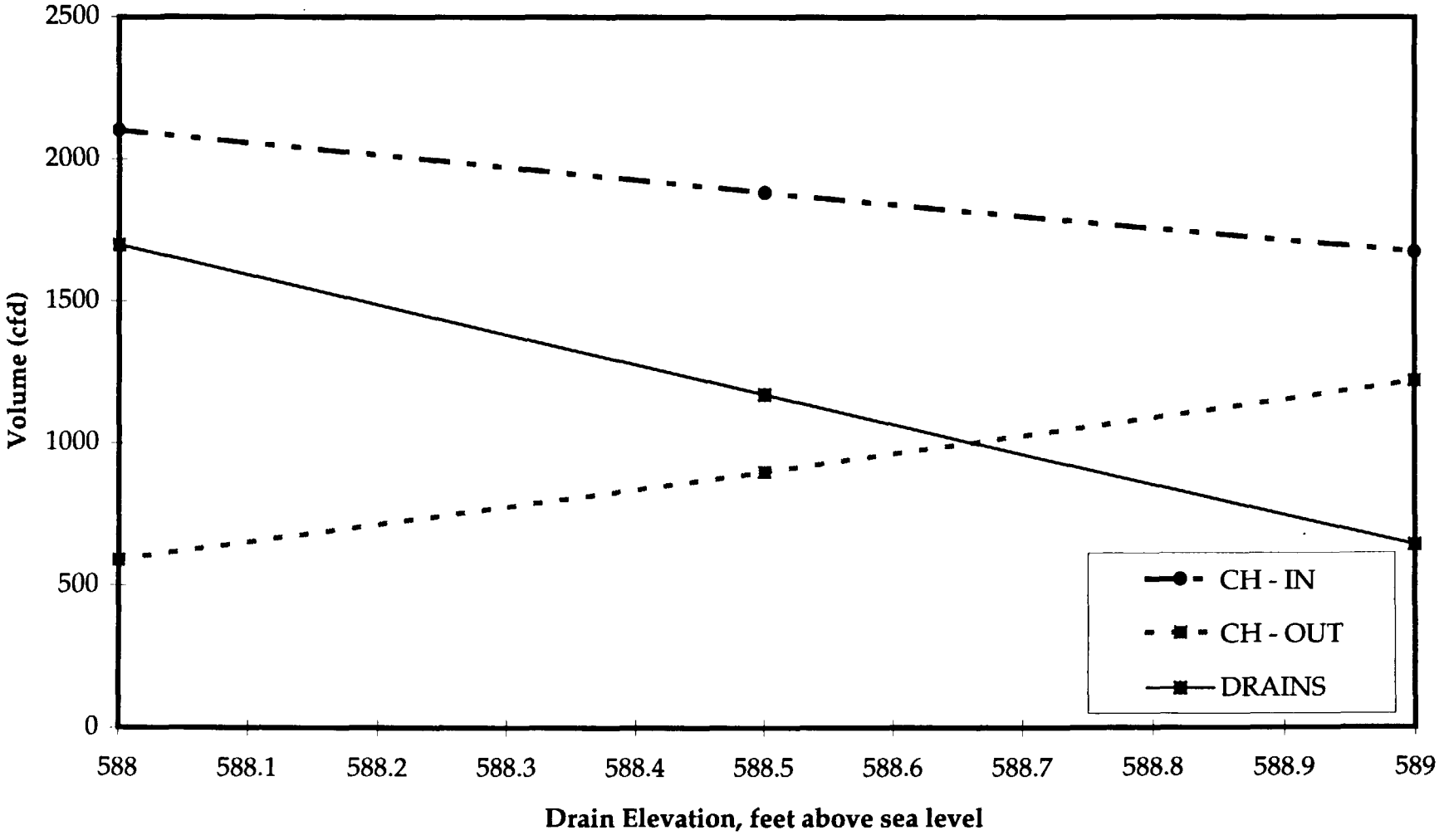


FIGURE F-21

GROUND WATER FLOW MODEL
Sensitivity Analysis - Drain Conductance
LENZ OIL SITE, LEMONT, ILLINOIS

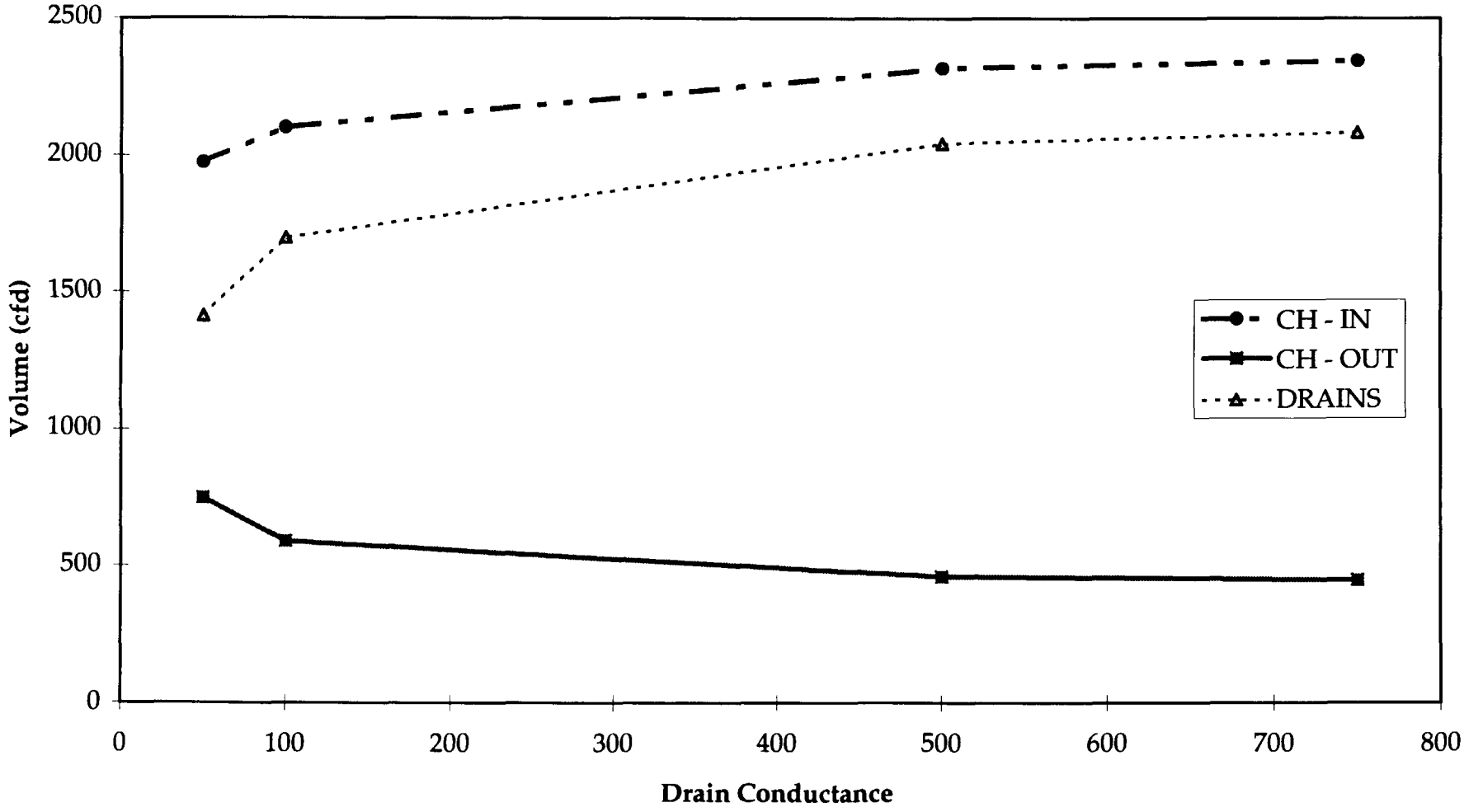


FIGURE F-22

GROUND WATER FLOW MODEL
Sensitivity Analysis - Aquifer Bottom Elevation
LENZ OIL SITE, LEMONT, ILLINOIS

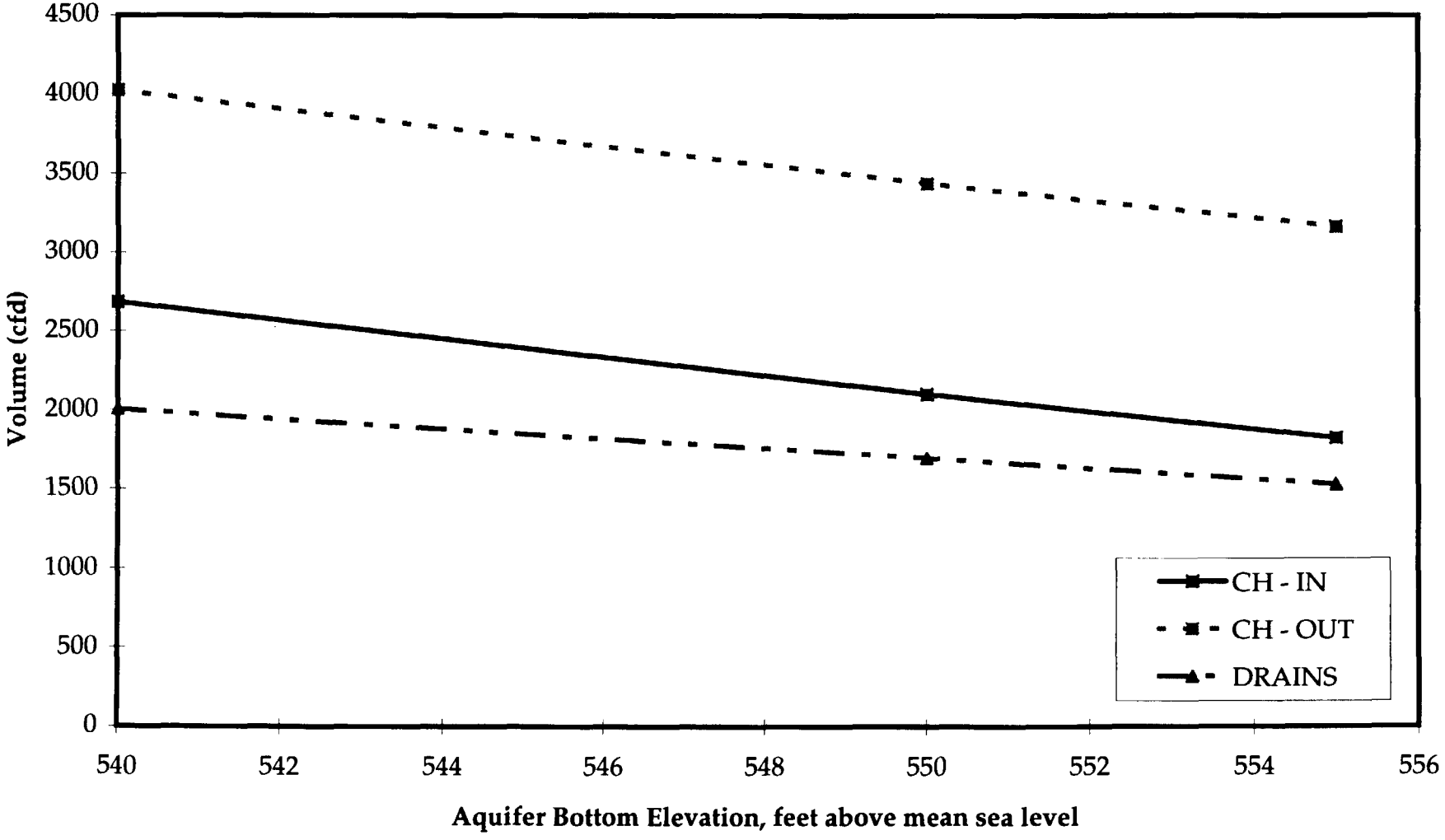


FIGURE F-23

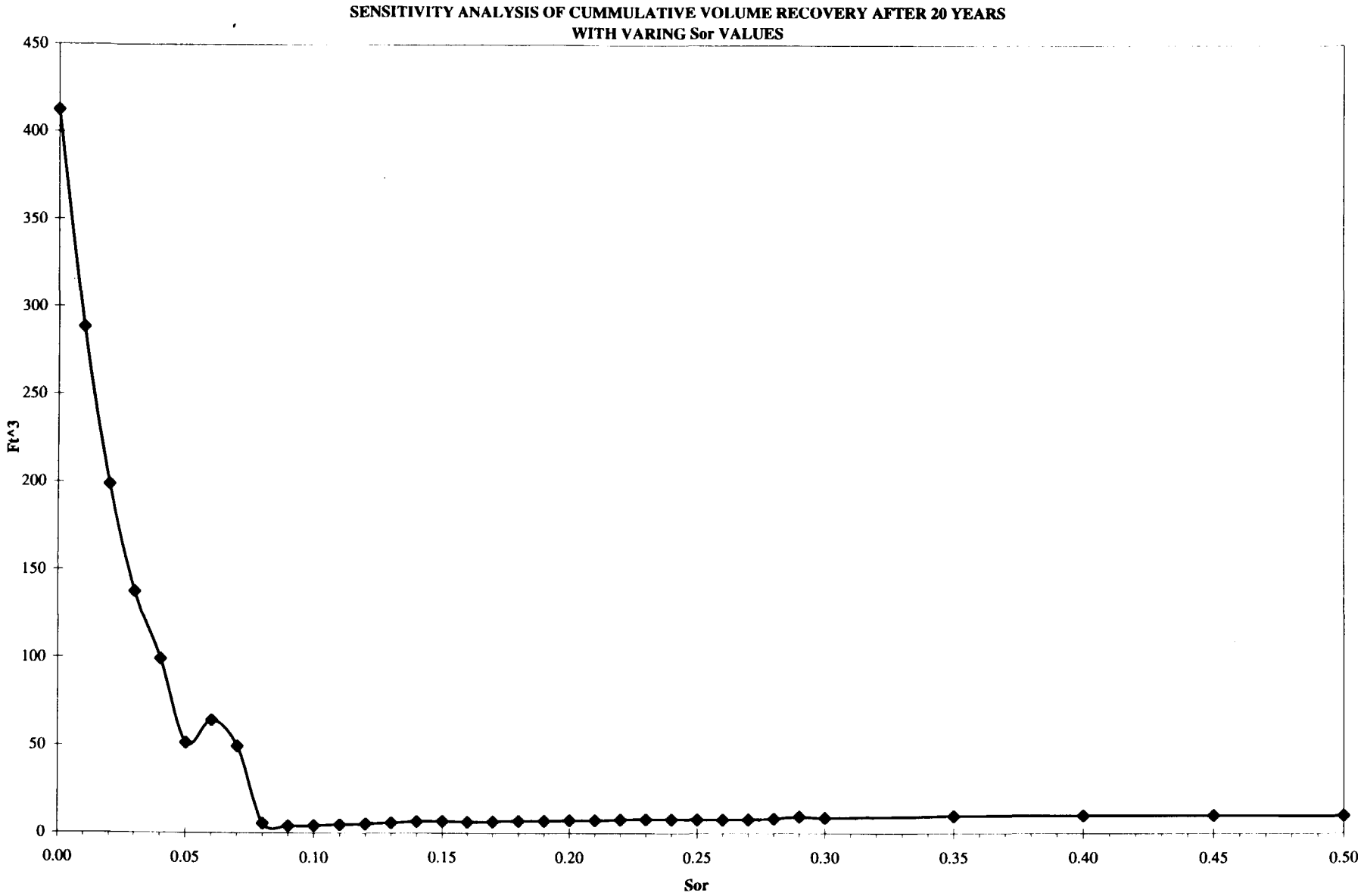

SENSITIVITY ANALYSIS OF CUMMULATIVE VOLUME RECOVERY AFTER 20 YEARS
WITH VARING Sor VALUES
Ft^3
450
400
350
300
250
200
150
100
50
0
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
Sor

FIGURE F-24

SENSITIVITY ANALYSIS OF CUMMULATIVE VOLUME RECOVERY AFTER 20 YEARS WITH VARING VISCOSITY VALUES

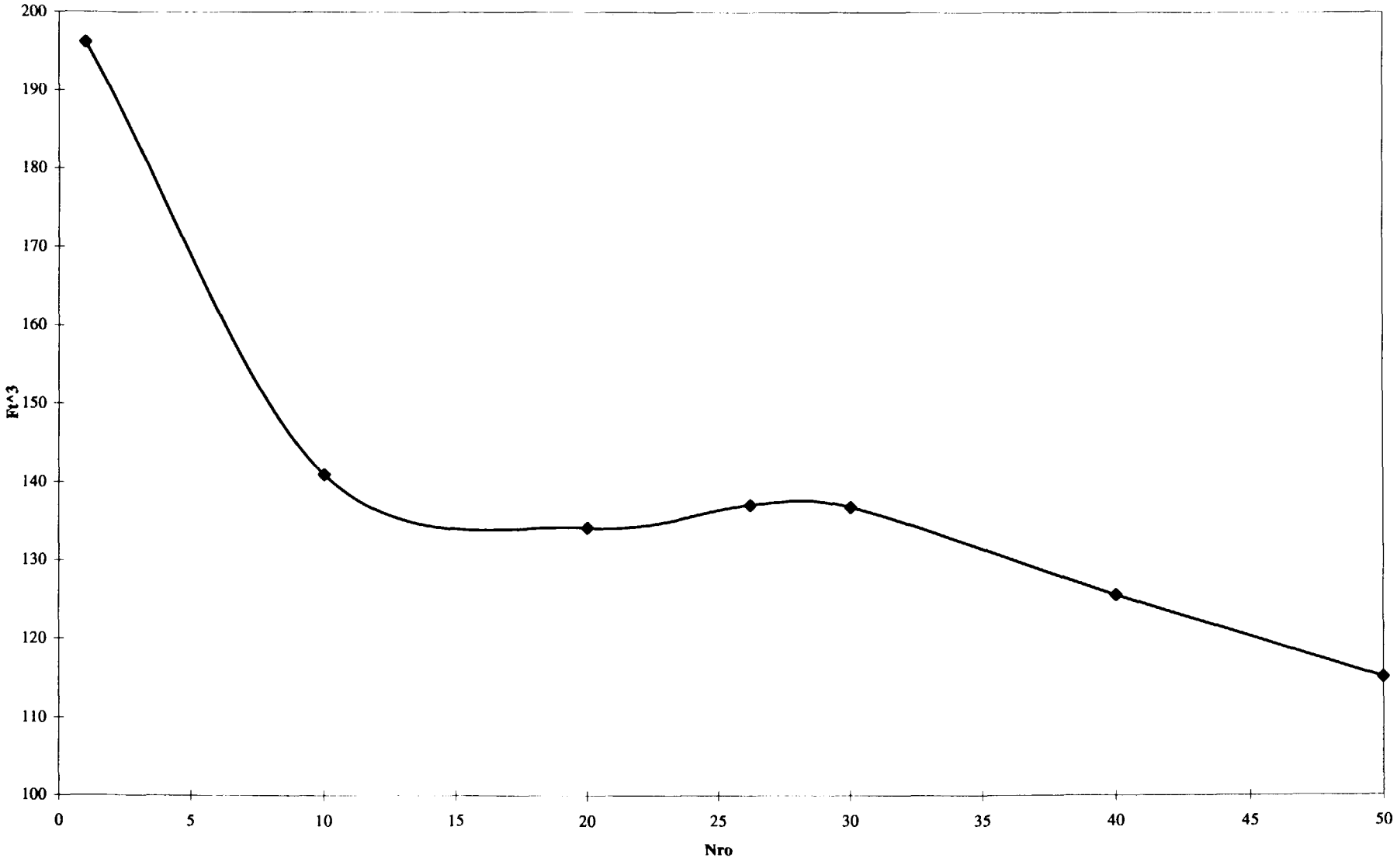


FIGURE F-25

GROUND WATER FLOW MODEL
INITIAL HEAD CONDITIONS - SEPTEMBER 27, 1991
LENZ OIL SITE, LEMONT, ILLINOIS

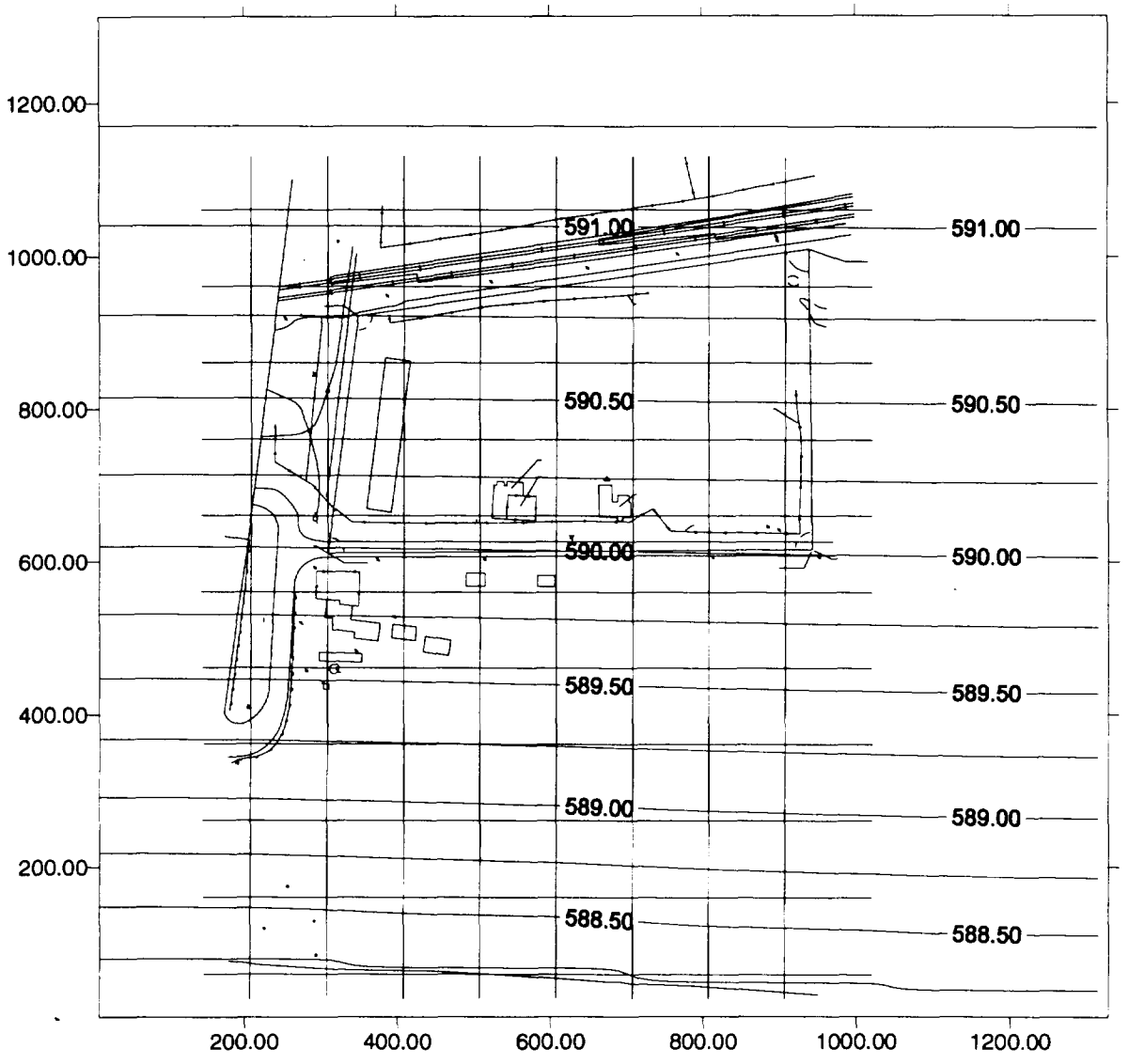


FIGURE F-26

GROUND WATER FLOW MODEL
INITIAL HEAD CONDITIONS - MAY 9, 1991
LENZ OIL SITE, LEMONT, ILLINOIS

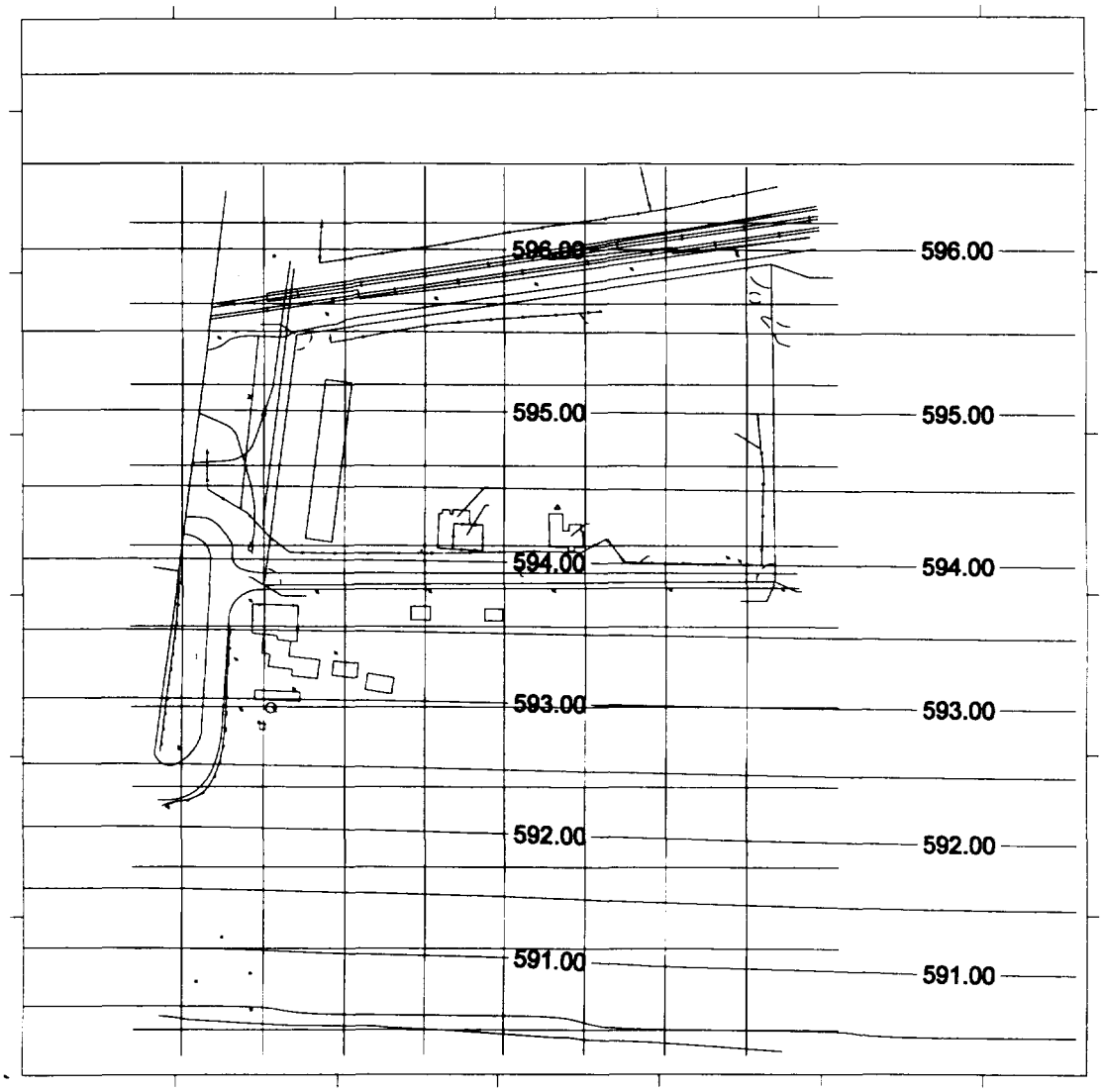


FIGURE F-27

RESULTS OF GROUND WATER FLOW MODEL - ALTERNATIVE 1A
SEPTEMBER 27, 1991 HEADS AND TRENCH ELEVATION AT 588 FEET
LENZ OIL SITE, LEMONT, ILLINOIS

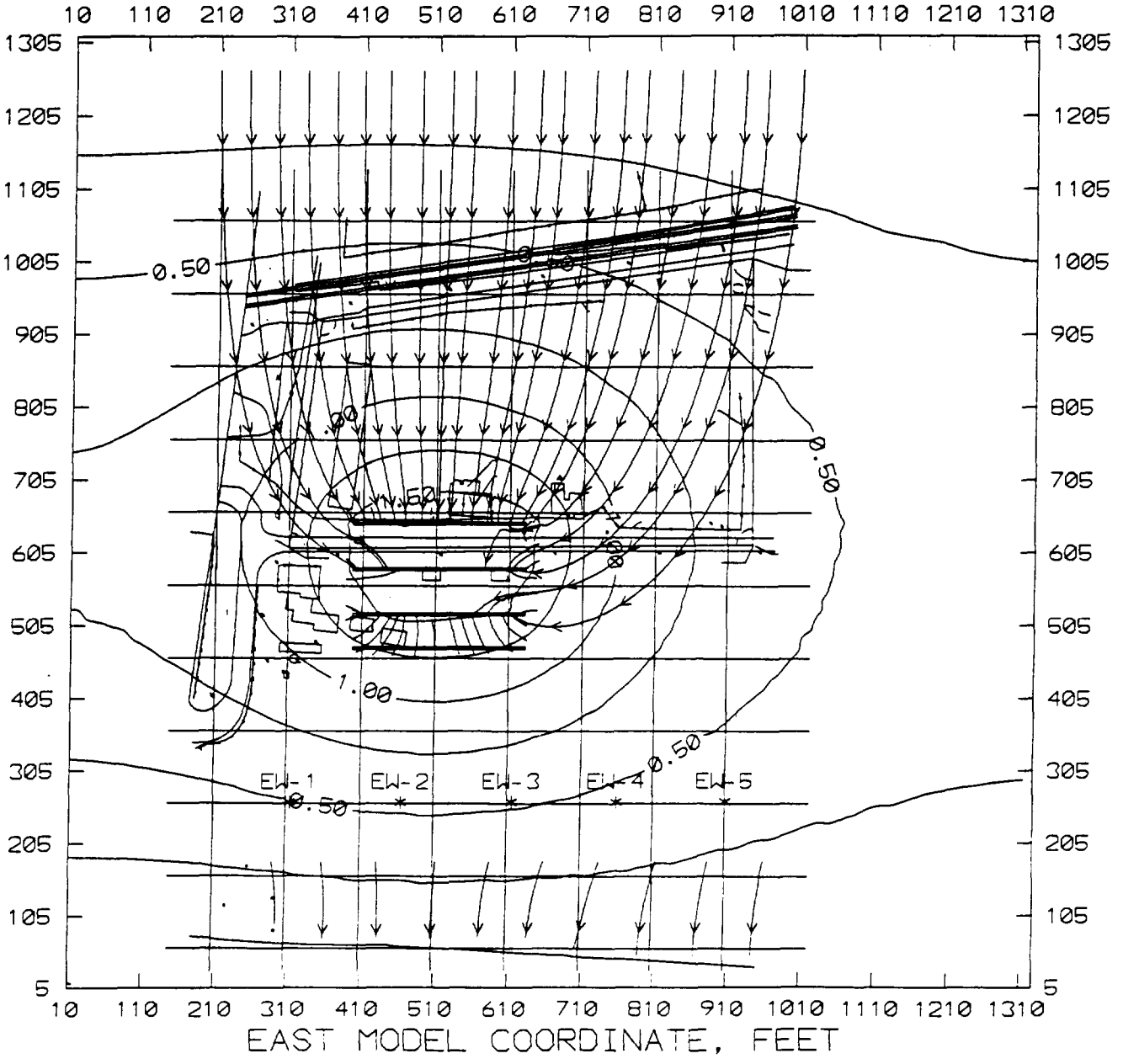


FIGURE F-28

RESULTS OF GROUND WATER FLOW MODEL - ALTERNATIVE 1A
SEPTEMBER 27, 1991 HEADS AND TRENCH ELEVATION AT 589.5 FEET
LENZ OIL SITE, LEMONT, ILLINOIS

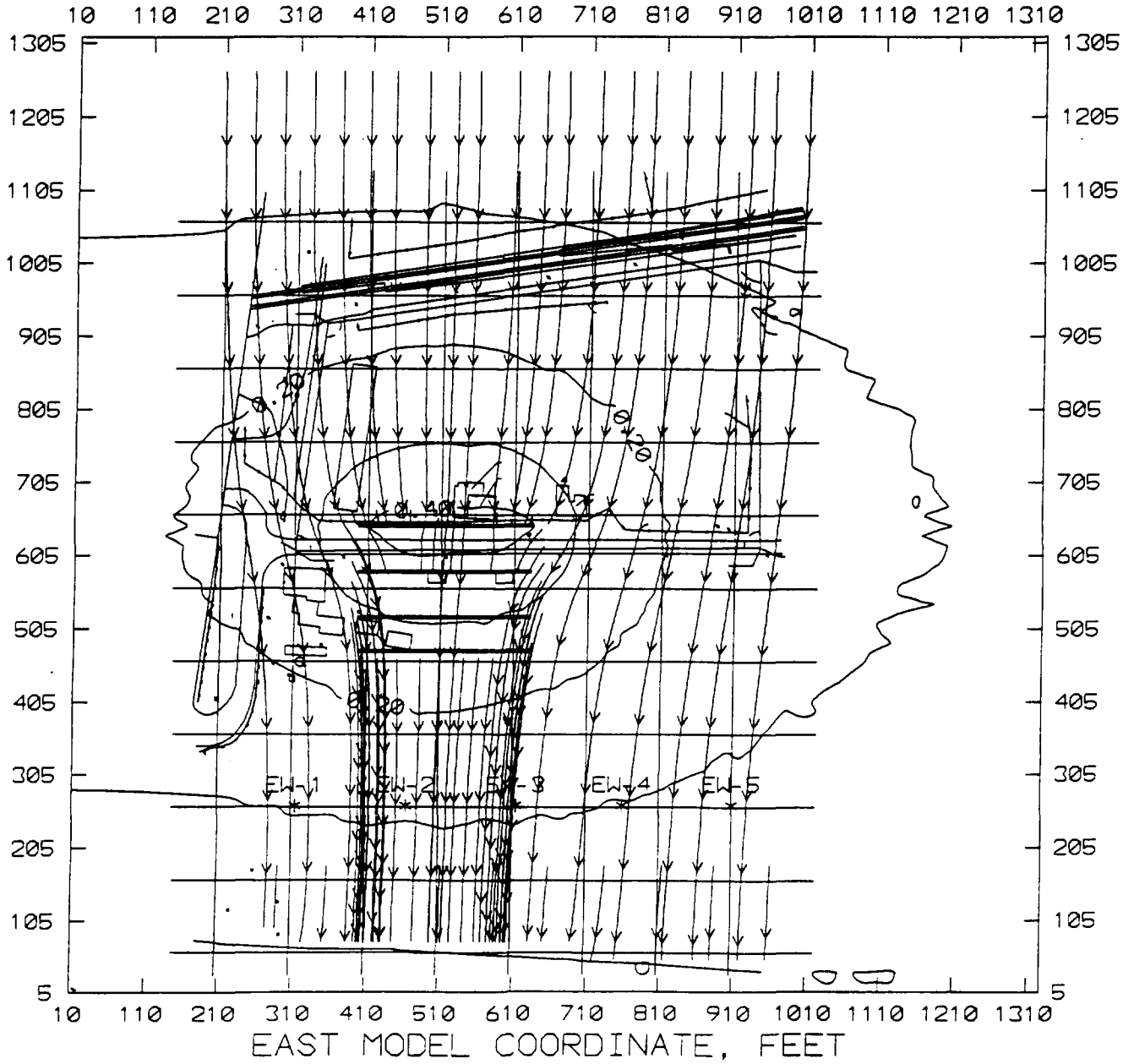


FIGURE F-29

RESULTS OF GROUND WATER FLOW MODEL - ALTERNATIVE 1A
MAY 9, 1991 HEADS AND TRENCH ELEVATION AT 589.5 FEET
LENZ OIL SITE, LEMONT, ILLINOIS

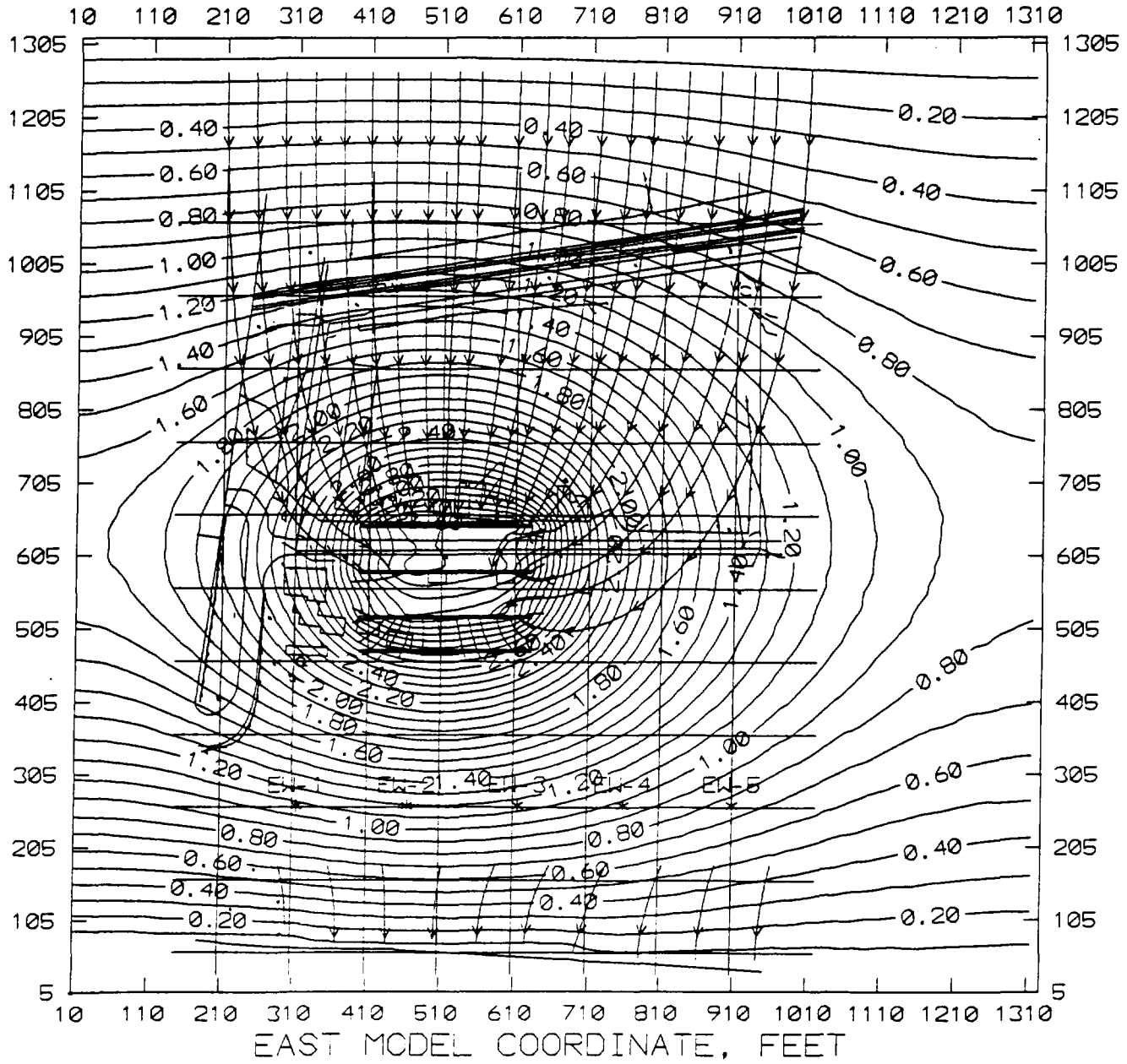


FIGURE F-30

GROUND WATER FLOW MODEL - ALTERNATIVE 1B
SEPTEMBER 27, 1991 HEADS AND TRENCH ELEVATION AT 588 FEET
LENZ OIL SITE, LEMONT, ILLINOIS

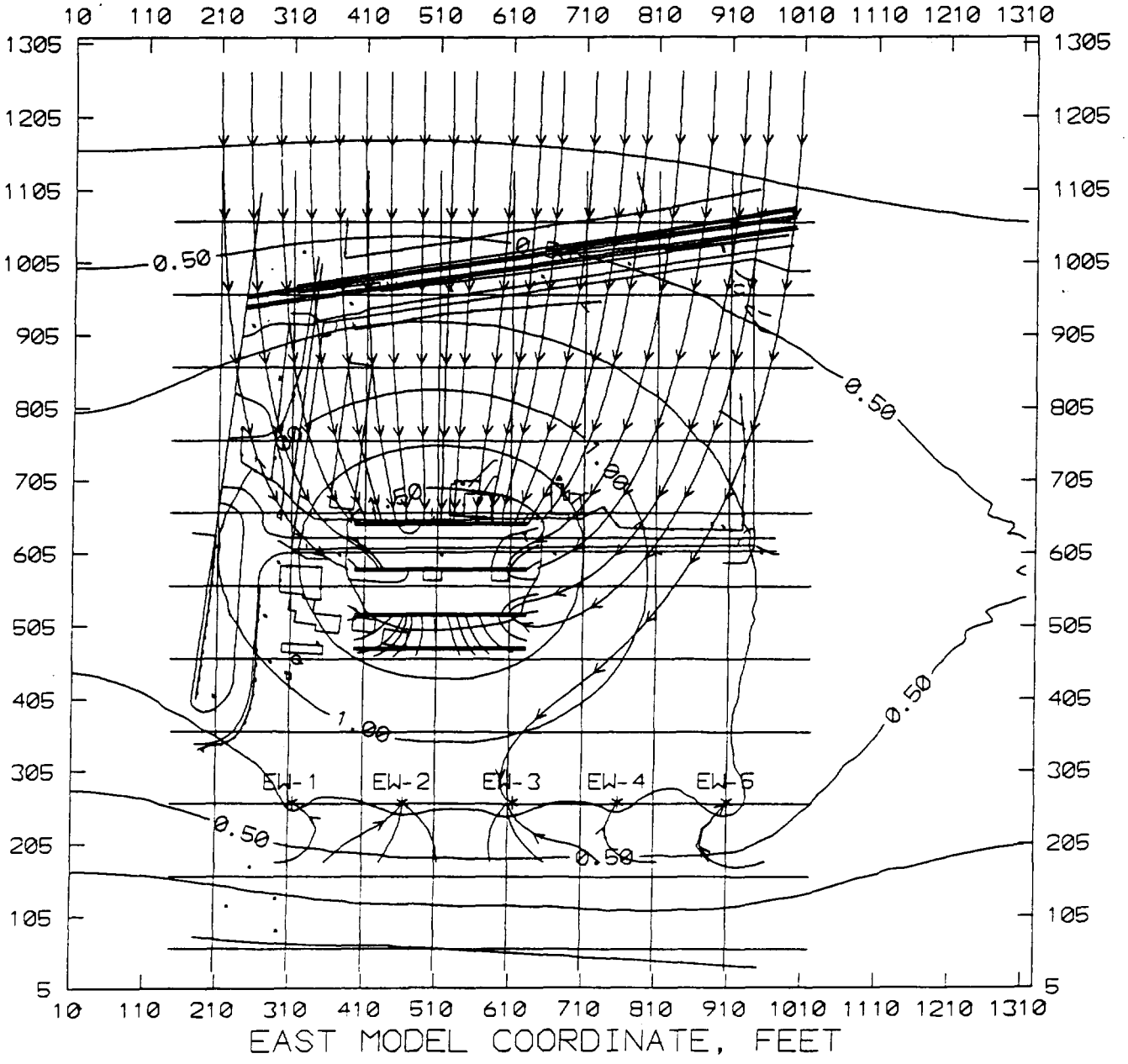


FIGURE F-31

GROUND WATER FLOW MODEL - ALTERNATIVE 1B
SEPTEMBER 27, 1991 HEADS AND TRENCH ELEVATION AT 589.5 FEET
LENZ OIL SITE, LEMONT, ILLINOIS

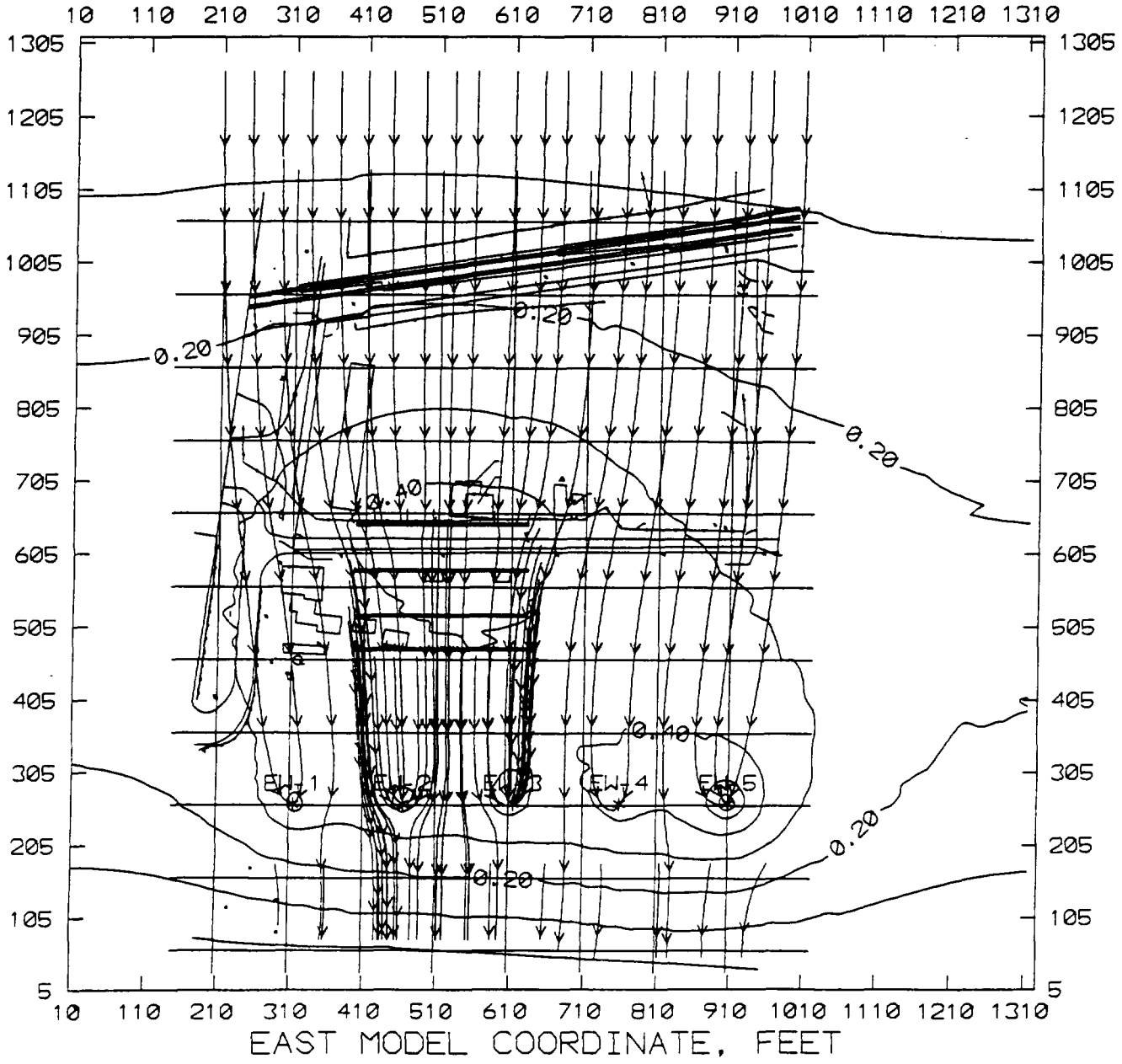


FIGURE F-32

GROUND WATER FLOW MODEL - ALTERNATIVE 1B
MAY 9, 1991 HEADS AND TRENCH ELEVATION AT 589.5 FEET
LENZ OIL SITE, LEMONT, ILLINOIS

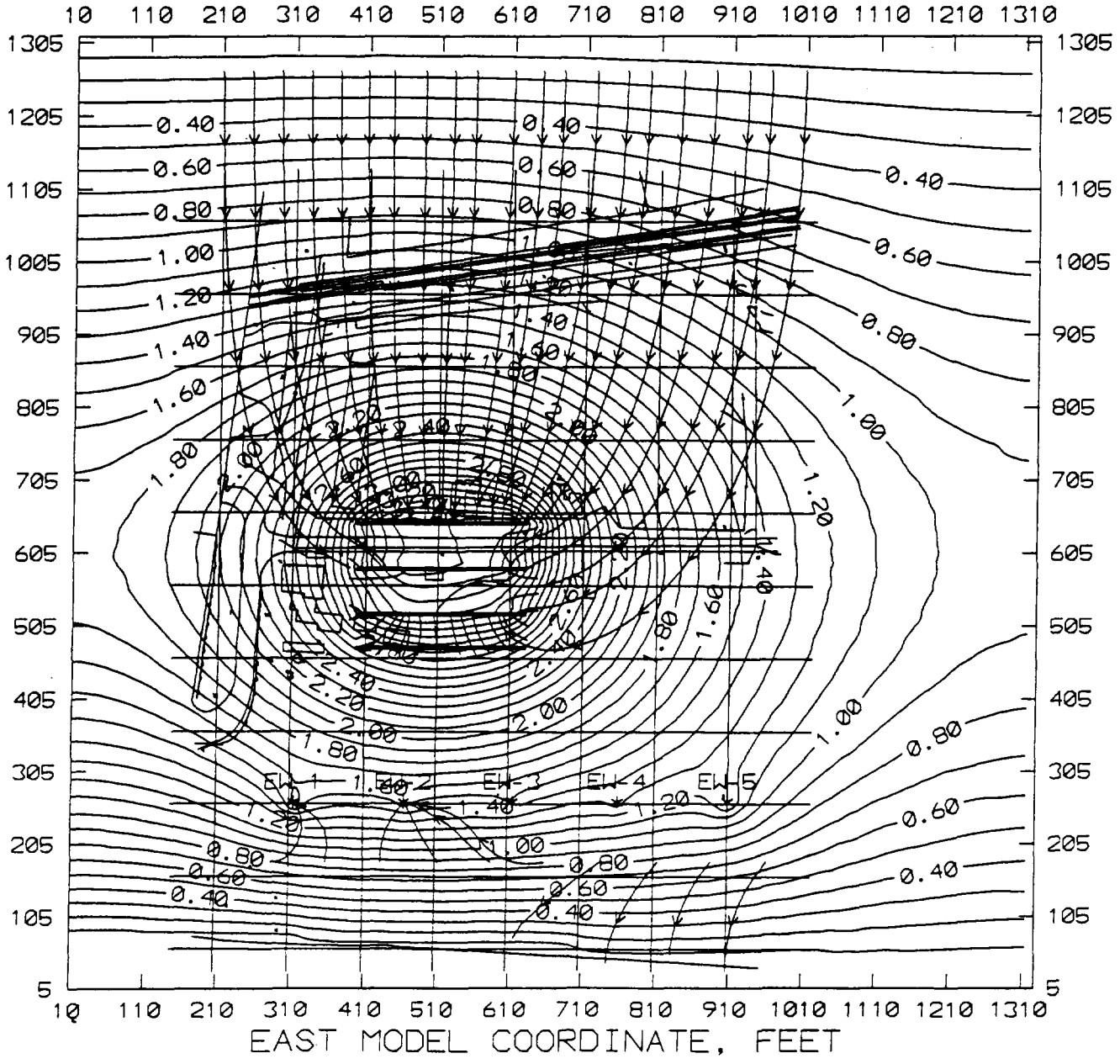


FIGURE F-33

GROUND WATER FLOW MODEL - ALTERNATIVE 1B
ADJUSTED EXTRACTION WELL RATES
LENZ OIL SITE, LEMONT, ILLINOIS

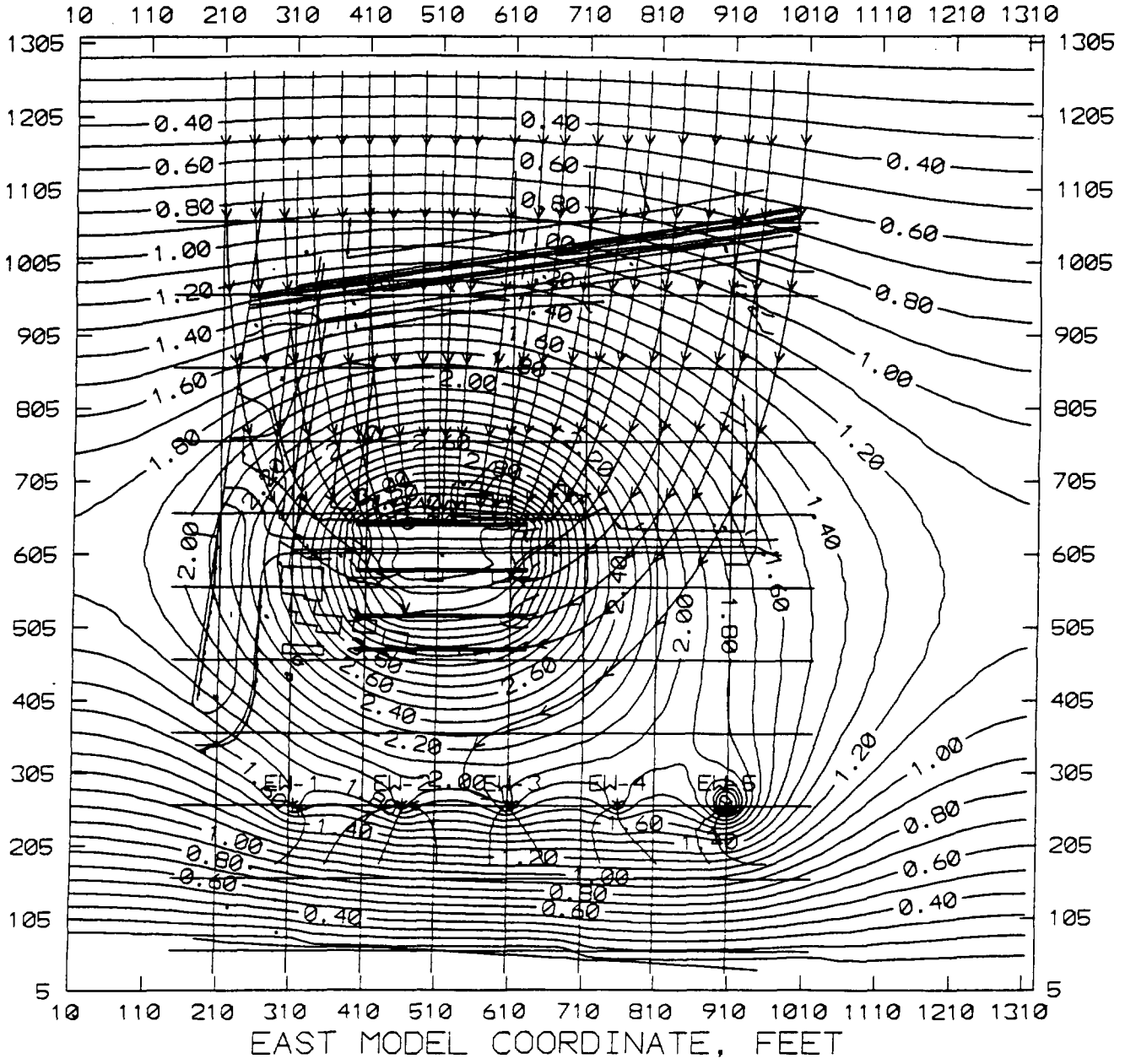


FIGURE F-34

GROUND WATER FLOW MODEL - ALTERNATIVE 2
SEPTEMBER 27, 1991 HEADS AND TRENCH ELEVATION AT 588 FEET
LENZ OIL SITE, LEMONT, ILLINOIS

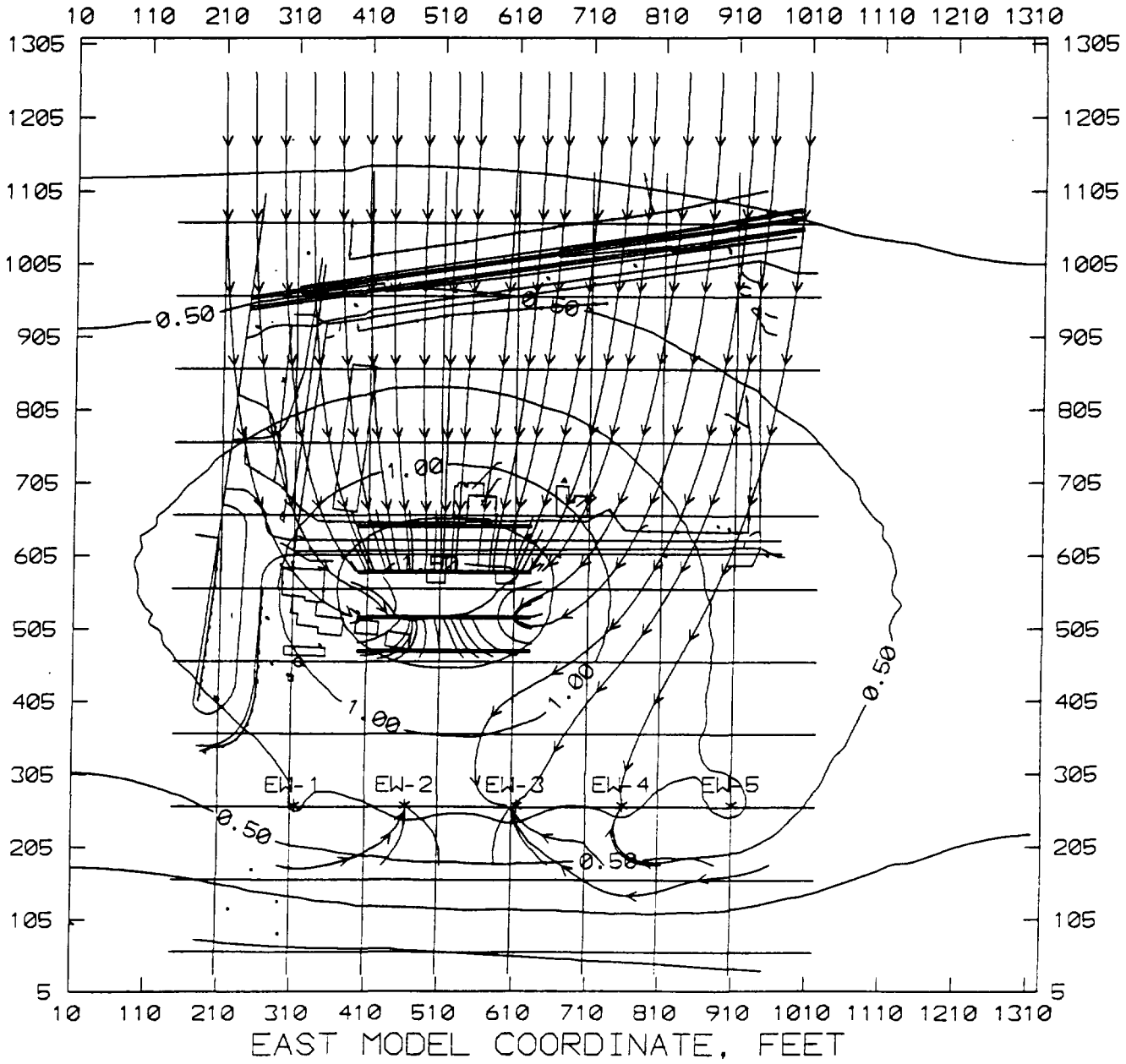


FIGURE F-35

GROUND WATER FLOW MODEL - ALTERNATIVE 2
SEPTEMBER 27, 1991 HEADS AND TRENCH ELEVATION AT 589.5 FEET
LENZ OIL SITE, LEMONT, ILLINOIS

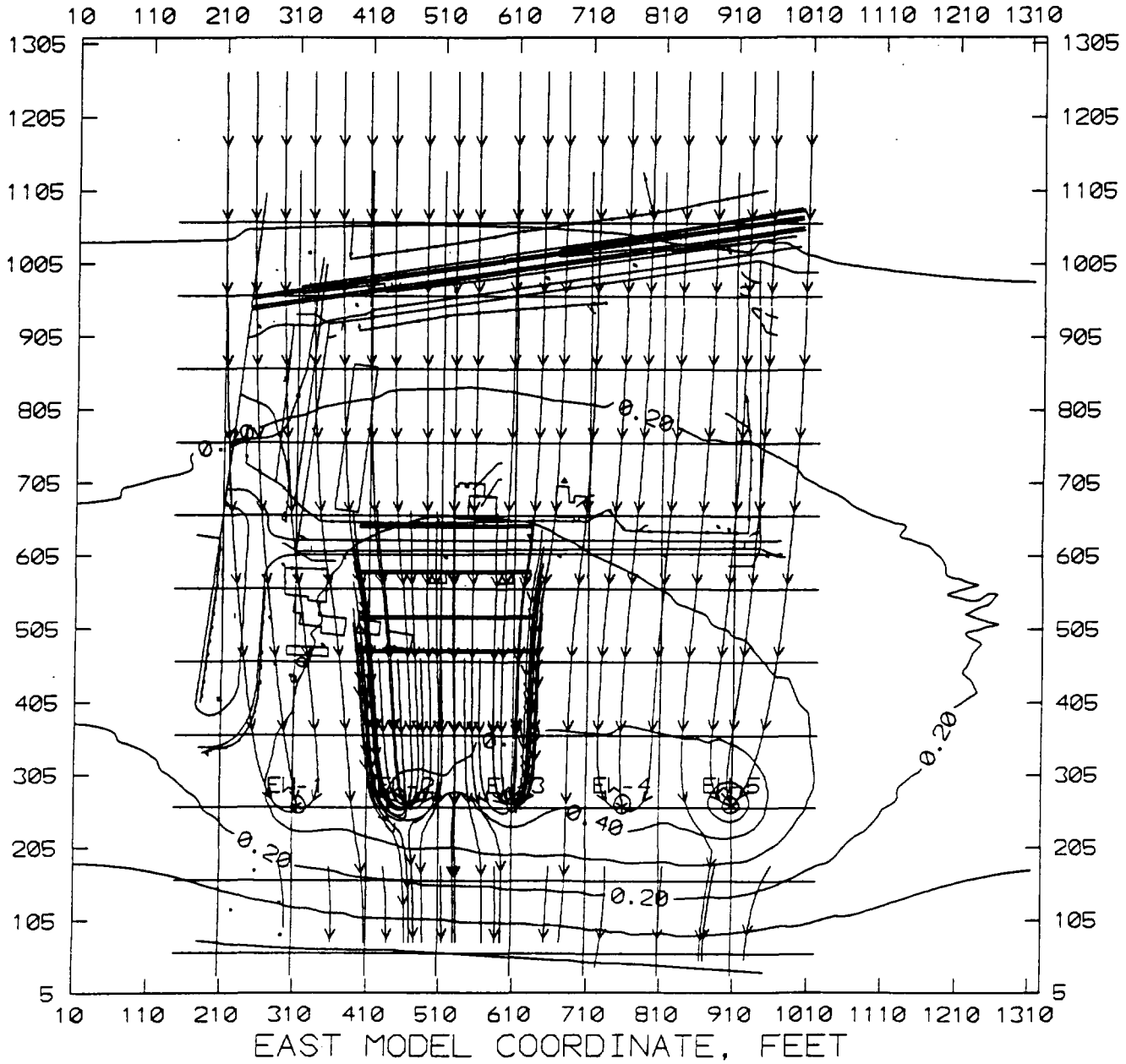


FIGURE F-36

GROUND WATER FLOW MODEL - ALTERNATIVE 2
MAY 9, 1991 HEADS AND TRENCH ELEVATION AT 589.5 FEET
LENZ OIL SITE, LEMONT, ILLINOIS

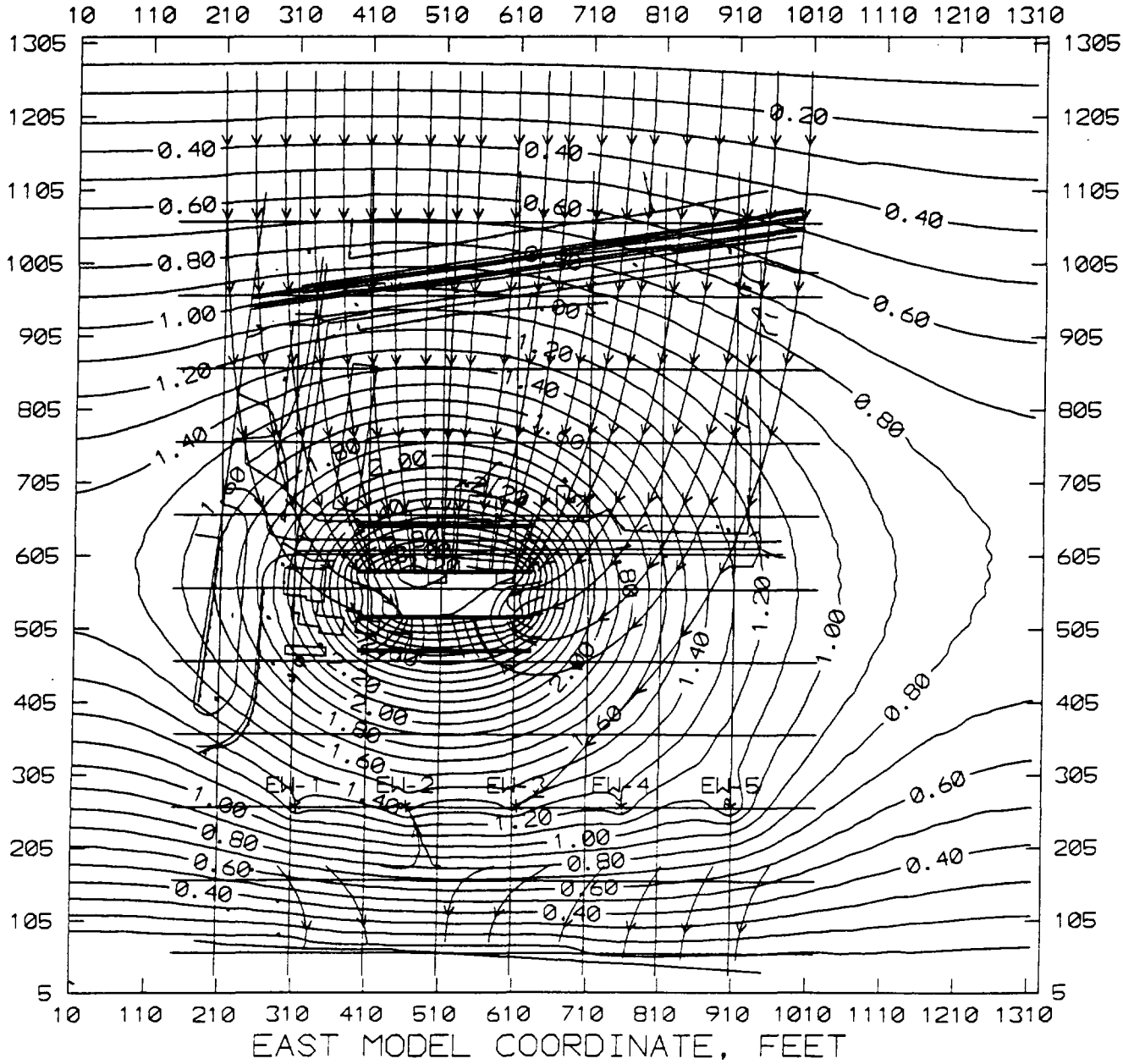


FIGURE F-37

GROUND WATER FLOW MODEL - ALTERNATIVE 2
ADJUSTED EXTRACTION WELL RATES
LENZ OIL SITE, LEMONT, ILLINOIS

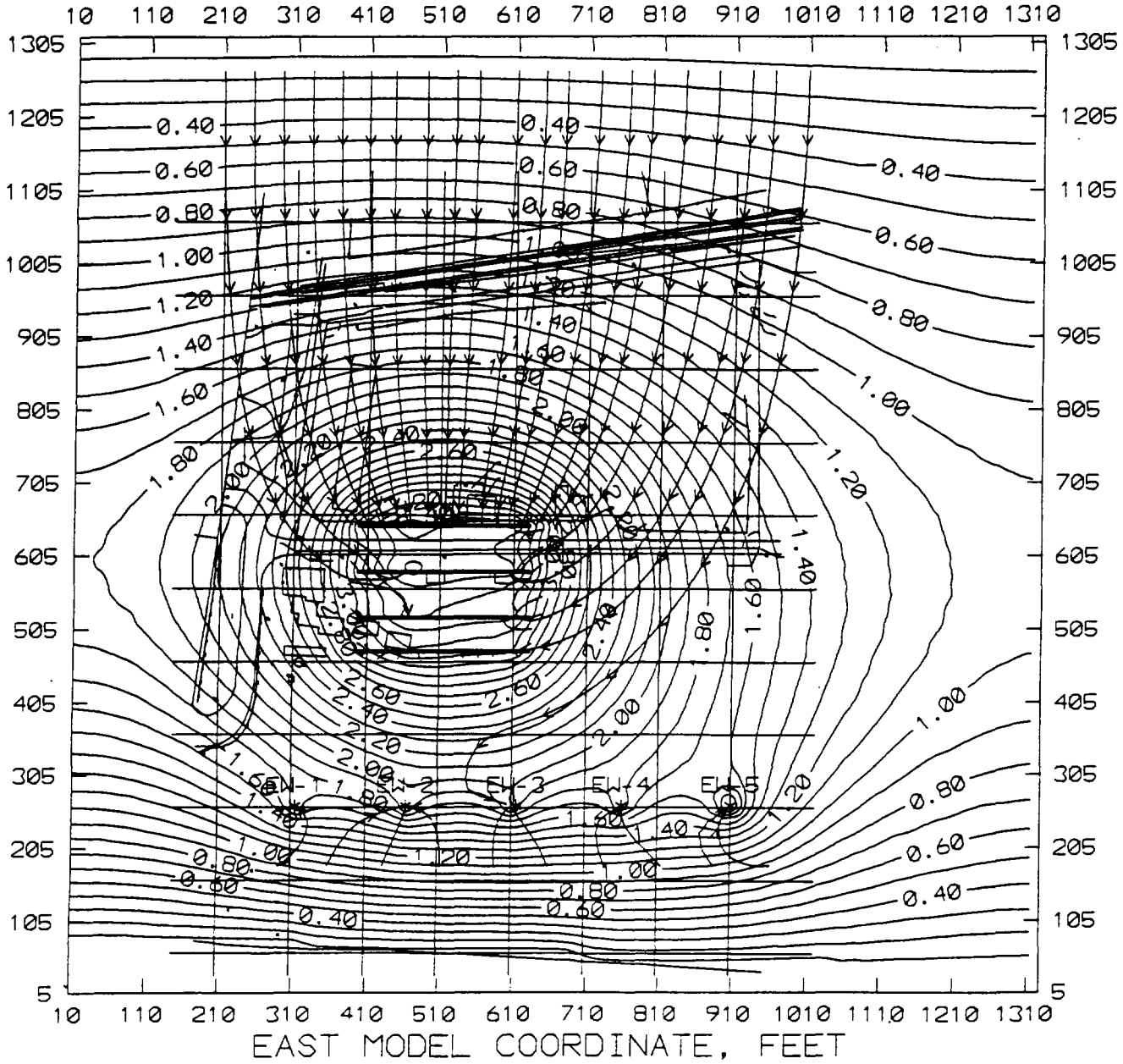


FIGURE F-38

GROUND WATER FLOW MODEL - ALTERNATIVE 3
SEPTEMBER 27, 1991 HEADS AND TRENCH ELEVATION AT 588 FEET
LENZ OIL SITE, LEMONT, ILLINOIS

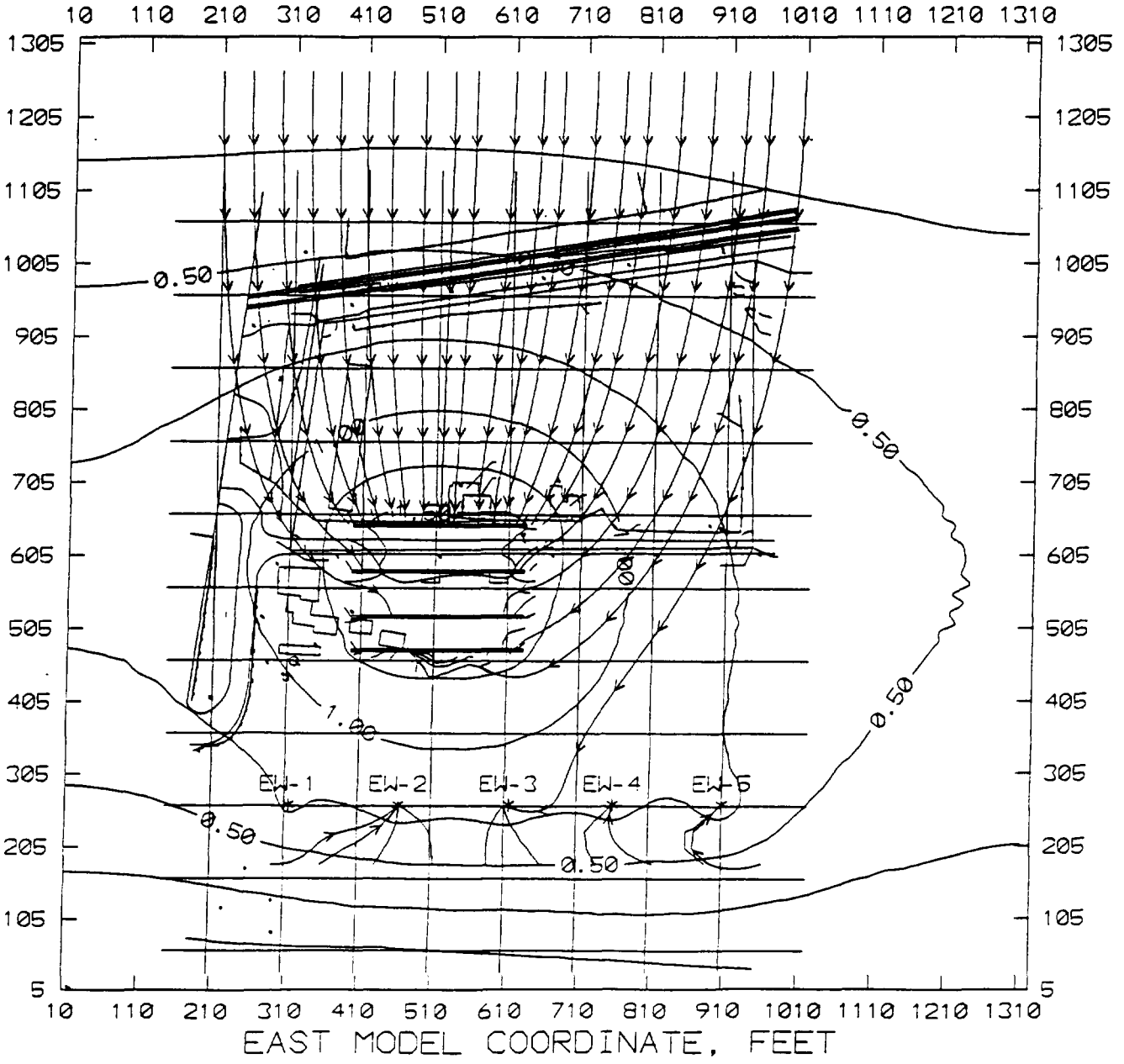


FIGURE F-39

GROUND WATER FLOW MODEL - ALTERNATIVE 3
SEPTEMBER 27, 1991 HEADS AND TRENCH ELEVATION AT 589.5 FEET
LENZ OIL SITE, LEMONT, ILLINOIS

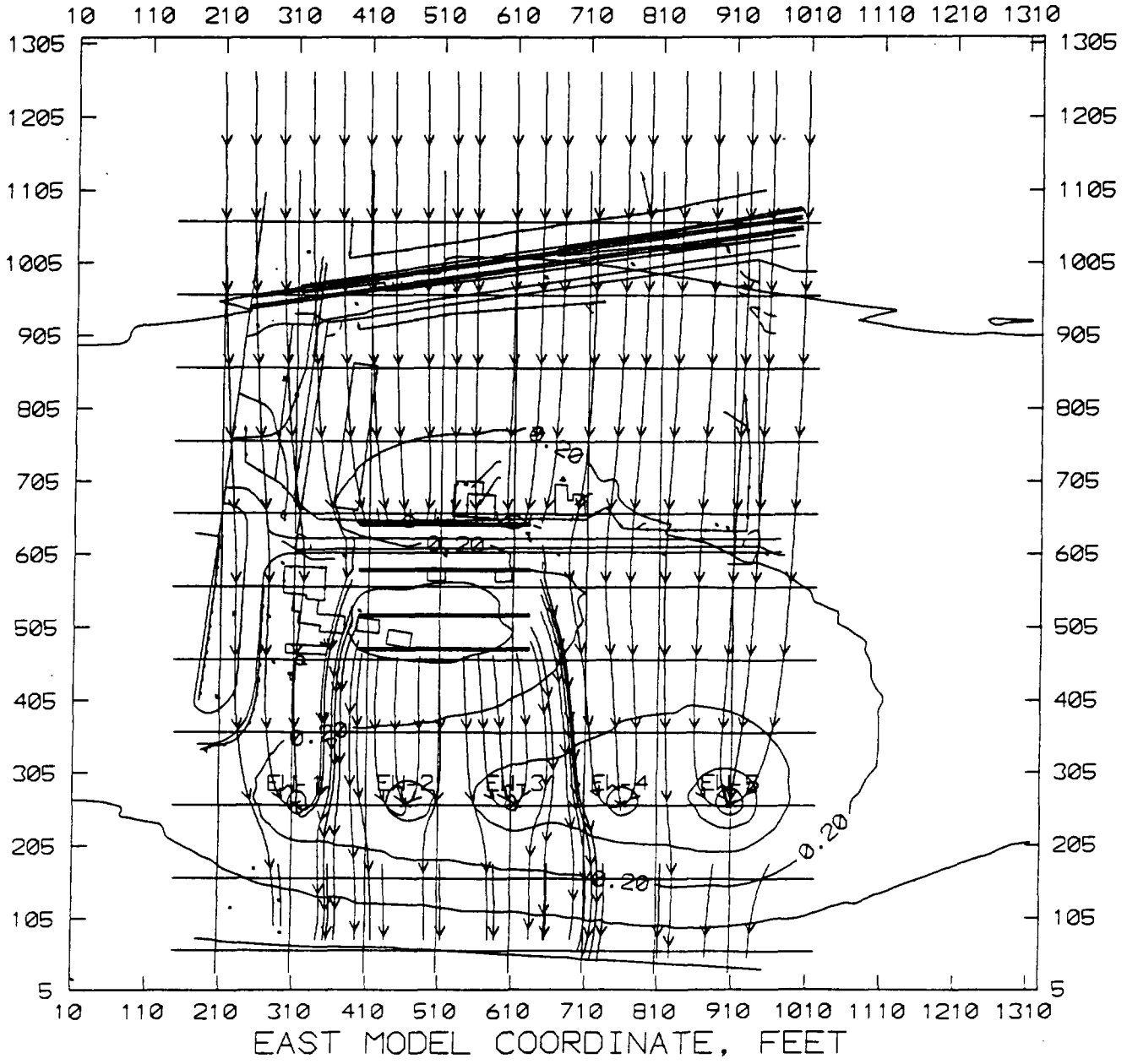


FIGURE F-40

GROUND WATER FLOW MODEL - ALTERNATIVE 3
MAY 9, 1991 HEADS AND TRENCH ELEVATION AT 589.5 FEET
LENZ OIL SITE, LEMONT, ILLINOIS

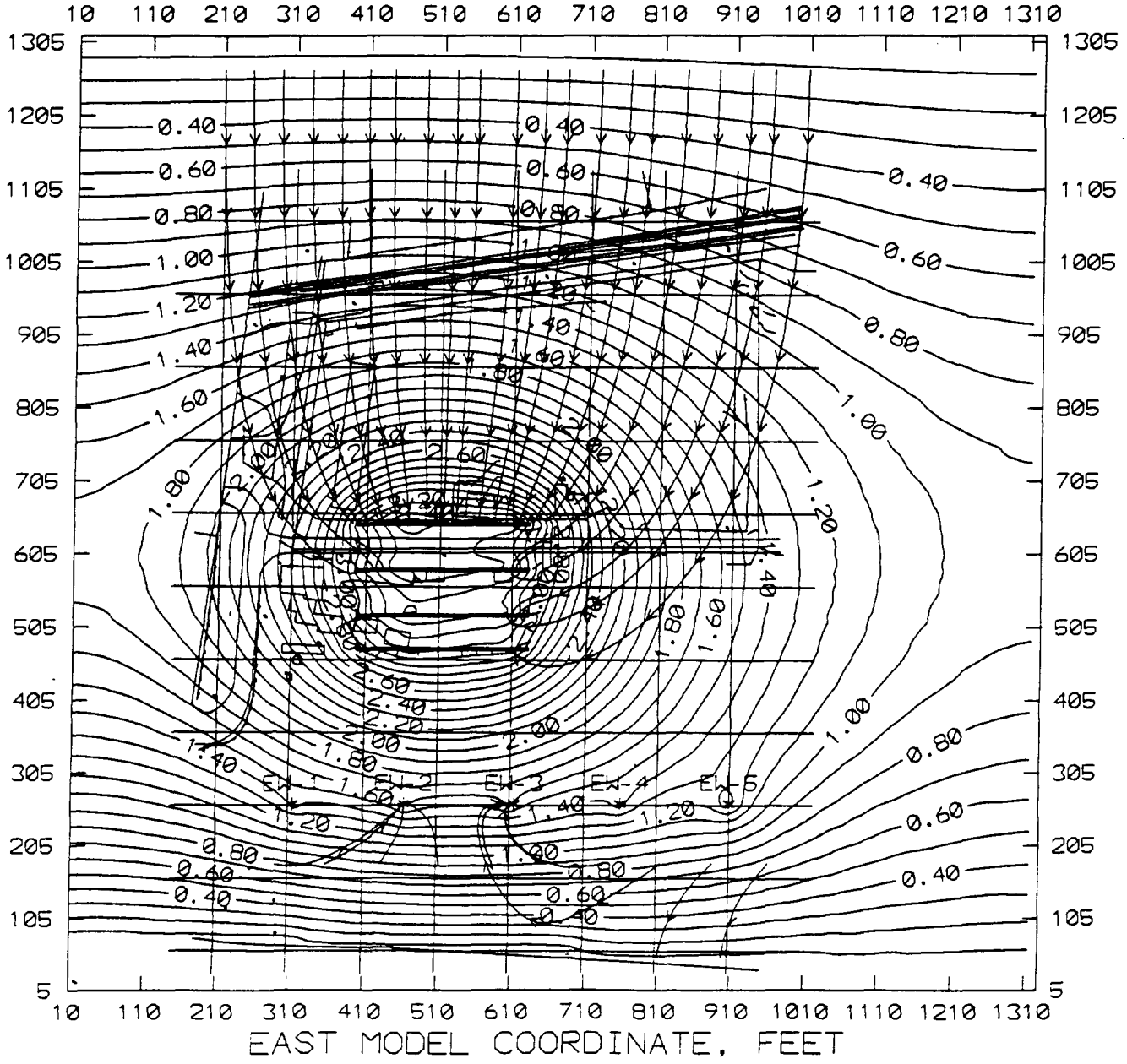


FIGURE F-41

GROUND WATER FLOW MODEL - ALTERNATIVE 3
ADJUSTED EXTRACTION WELL RATES
LENZ OIL SITE, LEMONT, ILLINOIS

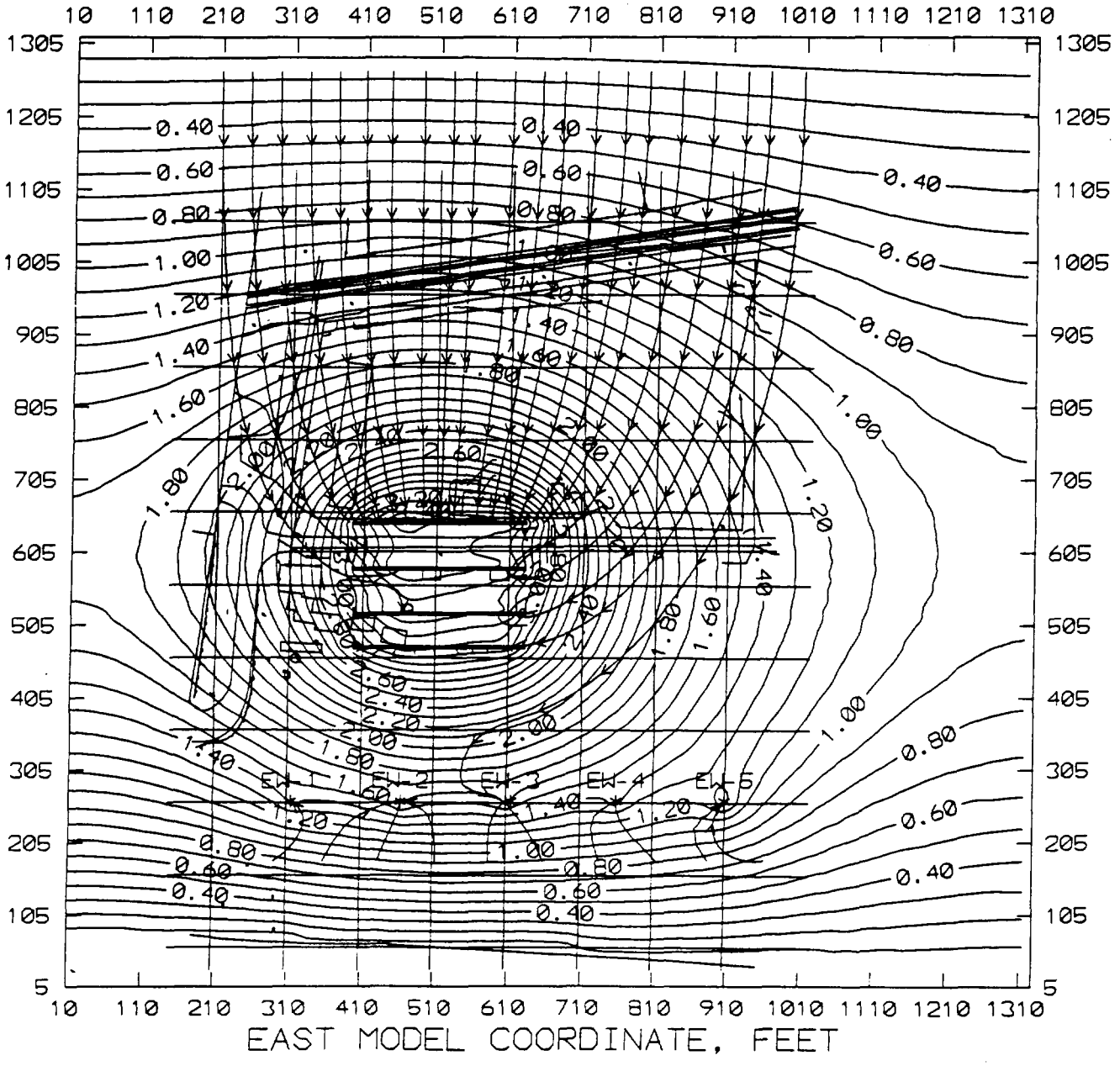


FIGURE F-42

GROUND WATER FLOW MODEL - ALTERNATIVE 4
SEPTEMBER 27, 1991 HEADS AND TRENCH ELEVATION AT 588 FEET
LENZ OIL SITE, LEMONT, ILLINOIS

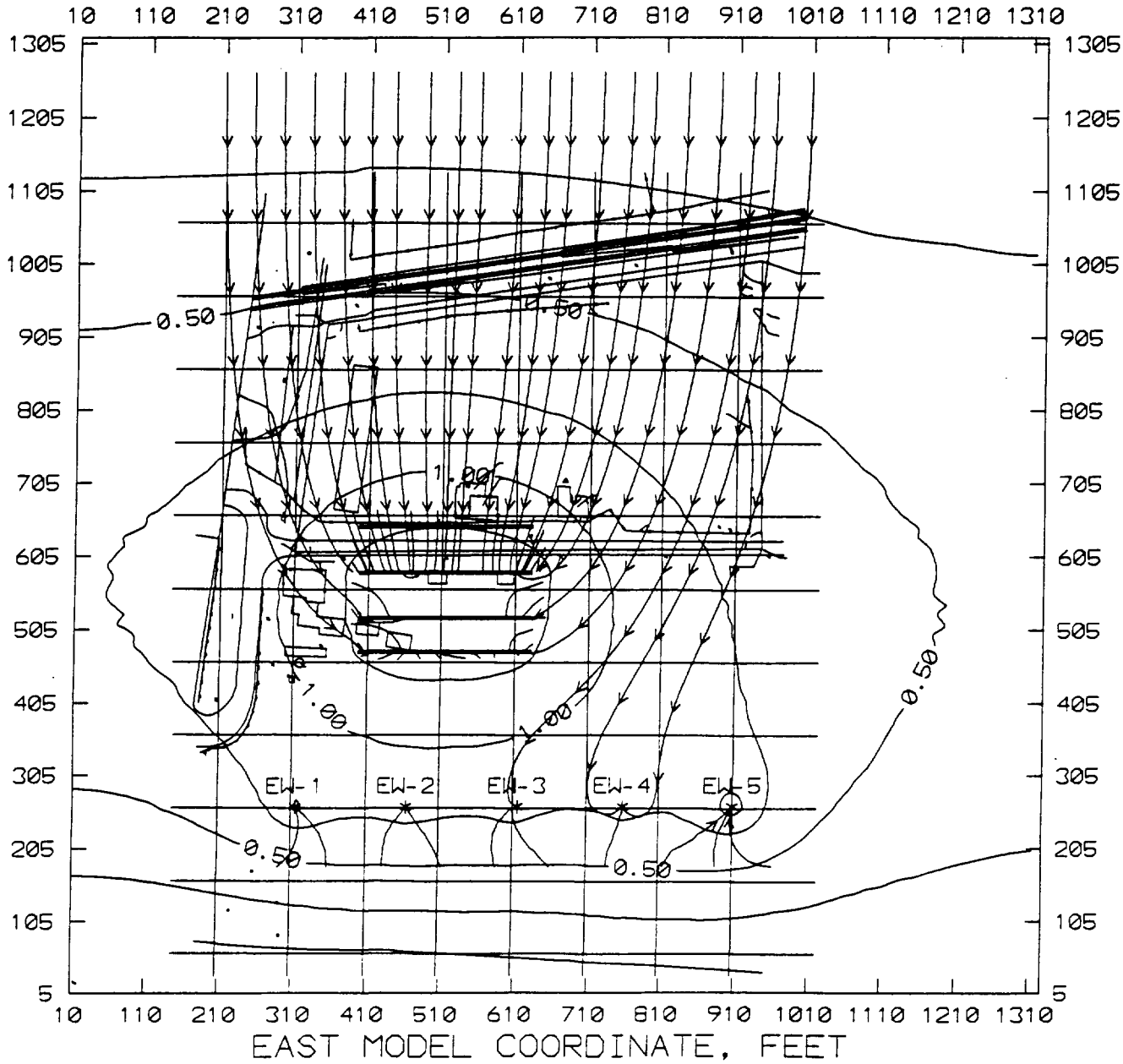


FIGURE F-43

GROUND WATER FLOW MODEL - ALTERNATIVE 4
SEPTEMBER 27, 1991 HEADS AND TRENCH ELEVATION AT 589.5 FEET
LENZ OIL SITE, LEMONT, ILLINOIS

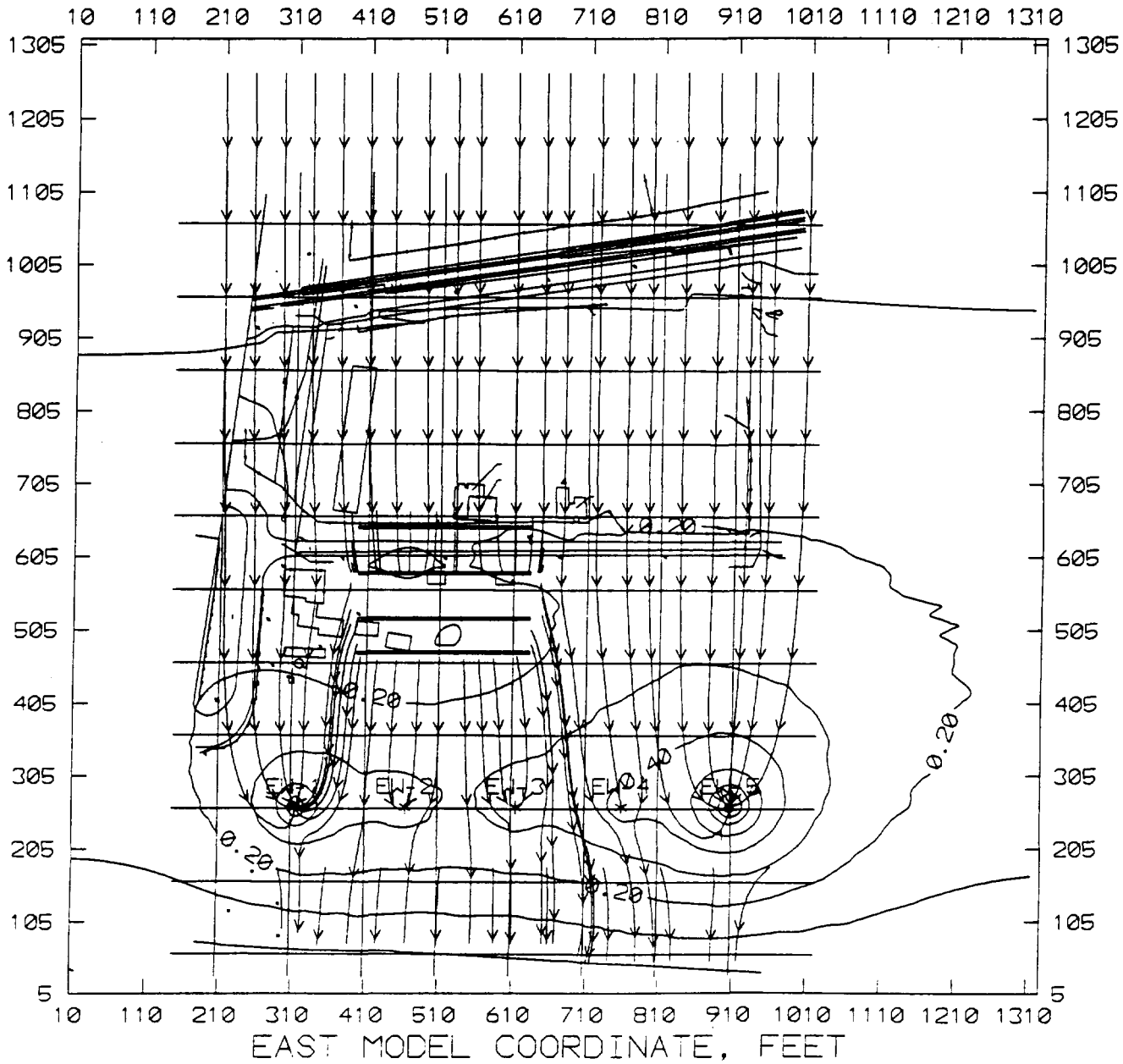


FIGURE F-44

GROUND WATER FLOW MODEL - ALTERNATIVE 4
MAY 9, 1991 HEADS AND TRENCH ELEVATION AT 589.5 FEET
LENZ OIL SITE, LEMONT, ILLINOIS

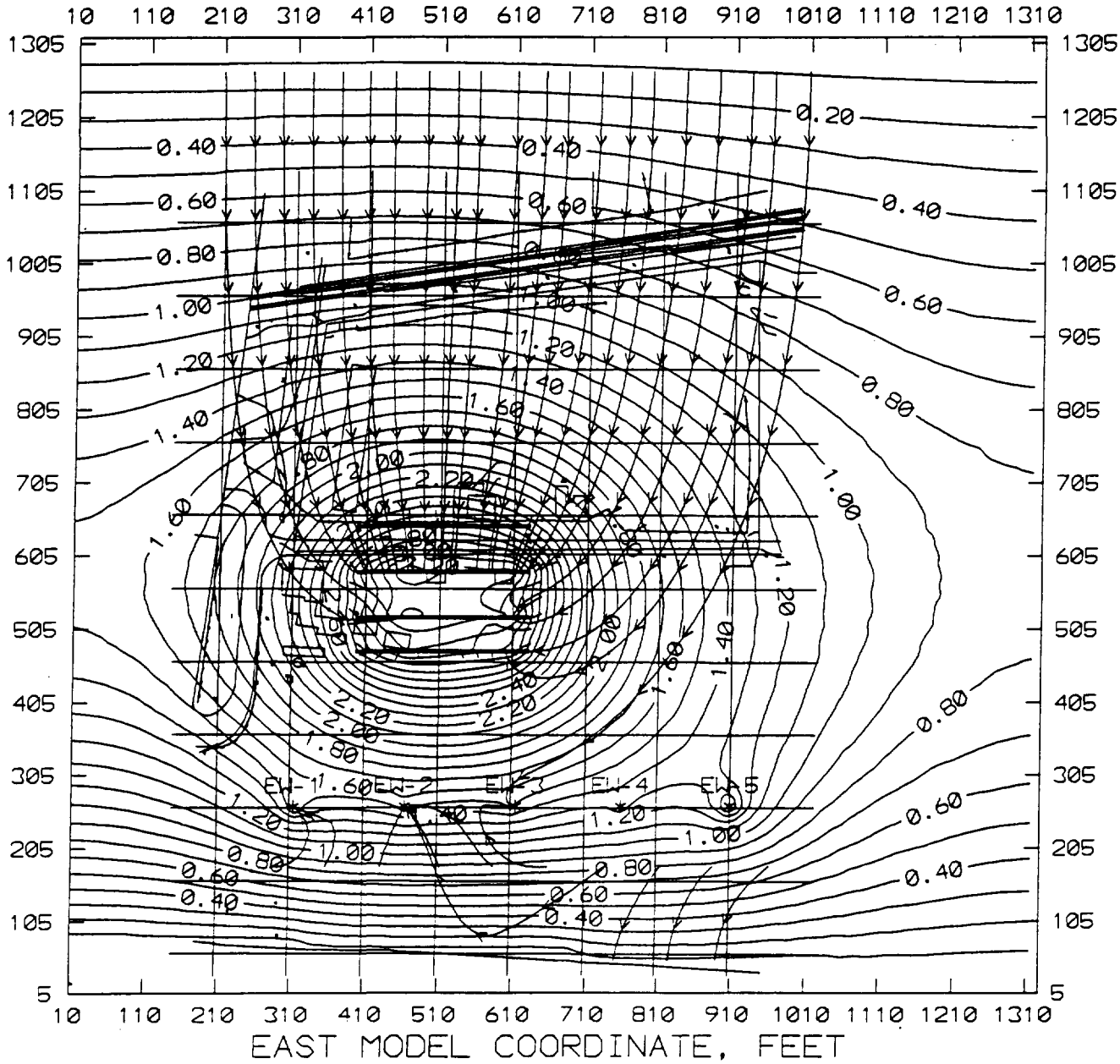


FIGURE F-45

GROUND WATER FLOW MODEL - ALTERNATIVE 4
ADJUSTED EXTRACTION WELL RATES
LENZ OIL SITE, LEMONT, ILLINOIS

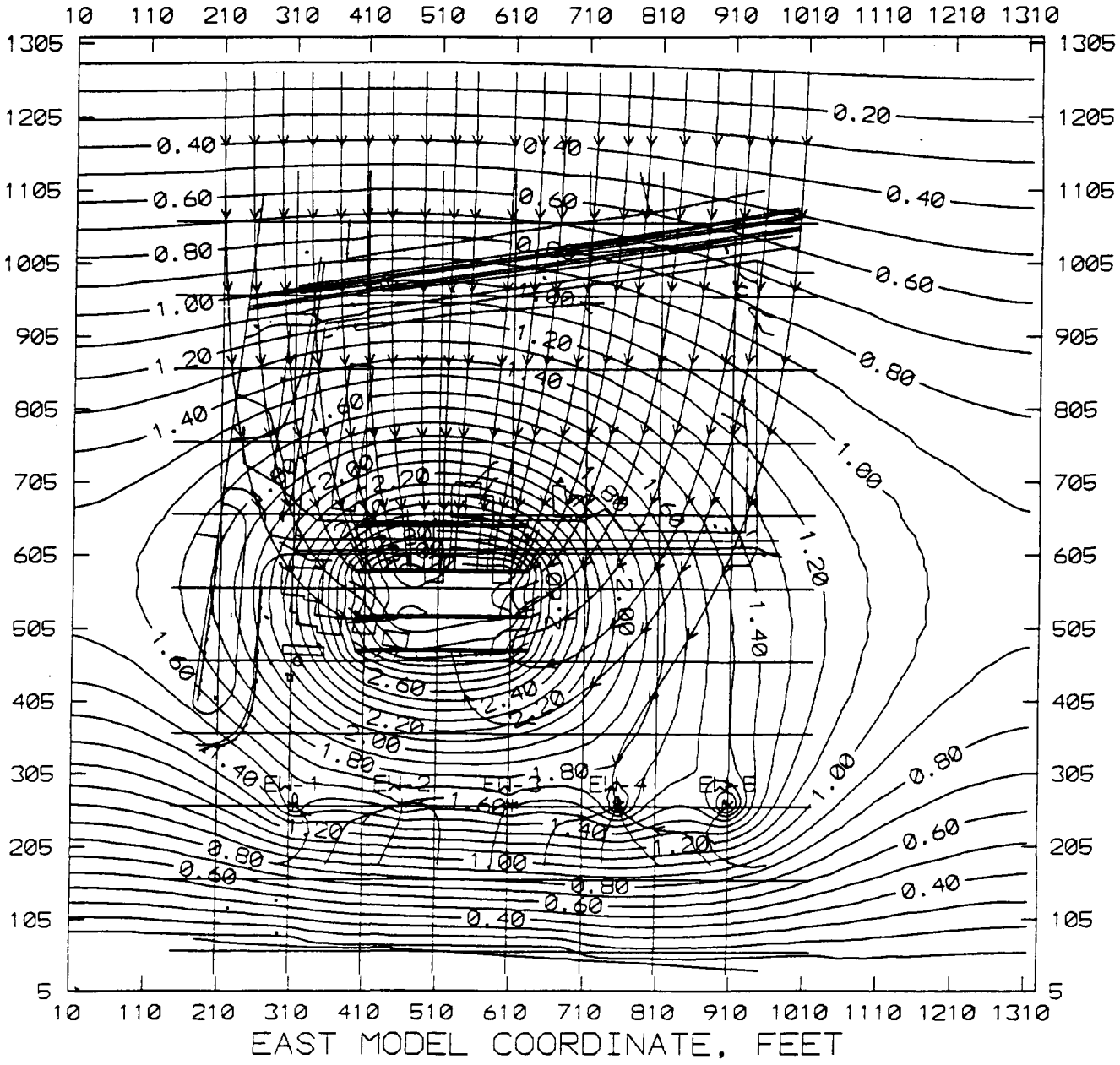


FIGURE F-46
PASSIVE RECOVERY TRENCH SIMULATIONS - LOW RESIDUAL
LENZ OIL SITE
LEMONT, ILLINOIS

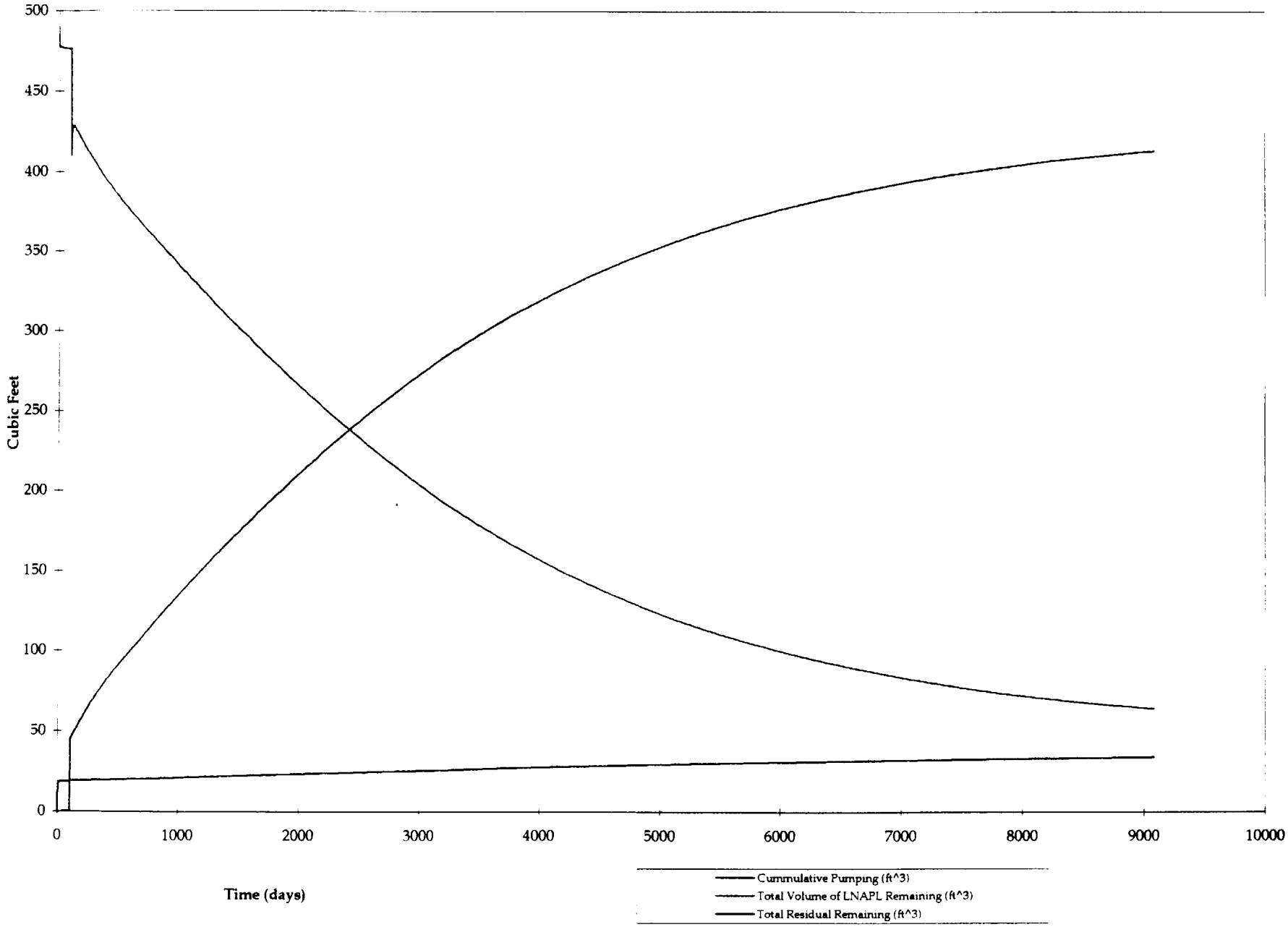


FIGURE F-47
PASSIVE RECOVERY TRENCH SIMULATIONS - MODERATE RESIDUAL
LENZ OIL SITE
LEMONT, ILLINOIS

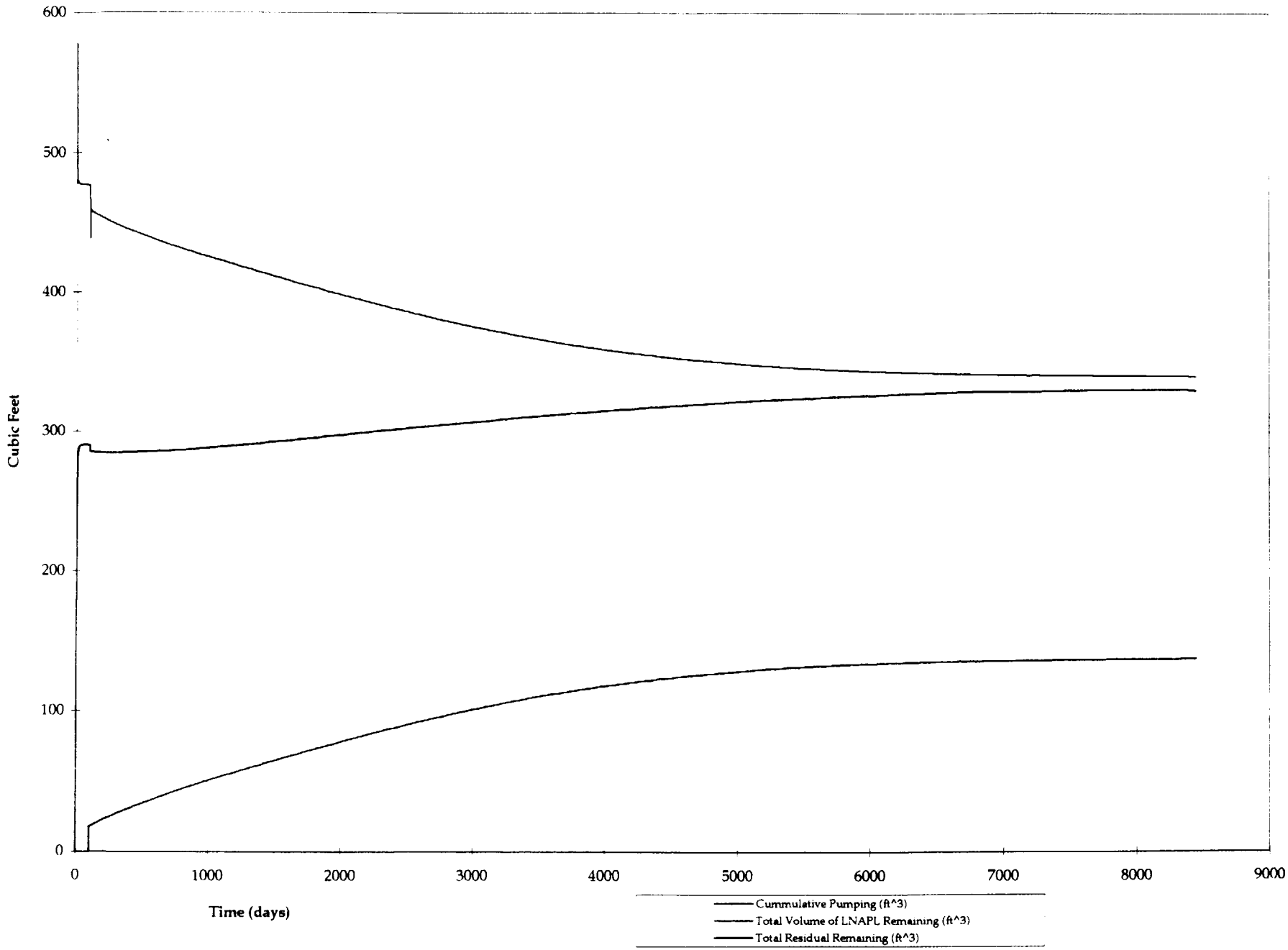


FIGURE F-48
PASSIVE RECOVERY TRENCH SIMULATIONS - HIGH RESIDUAL
LENZ OIL SITE
LEMONT, ILLINOIS

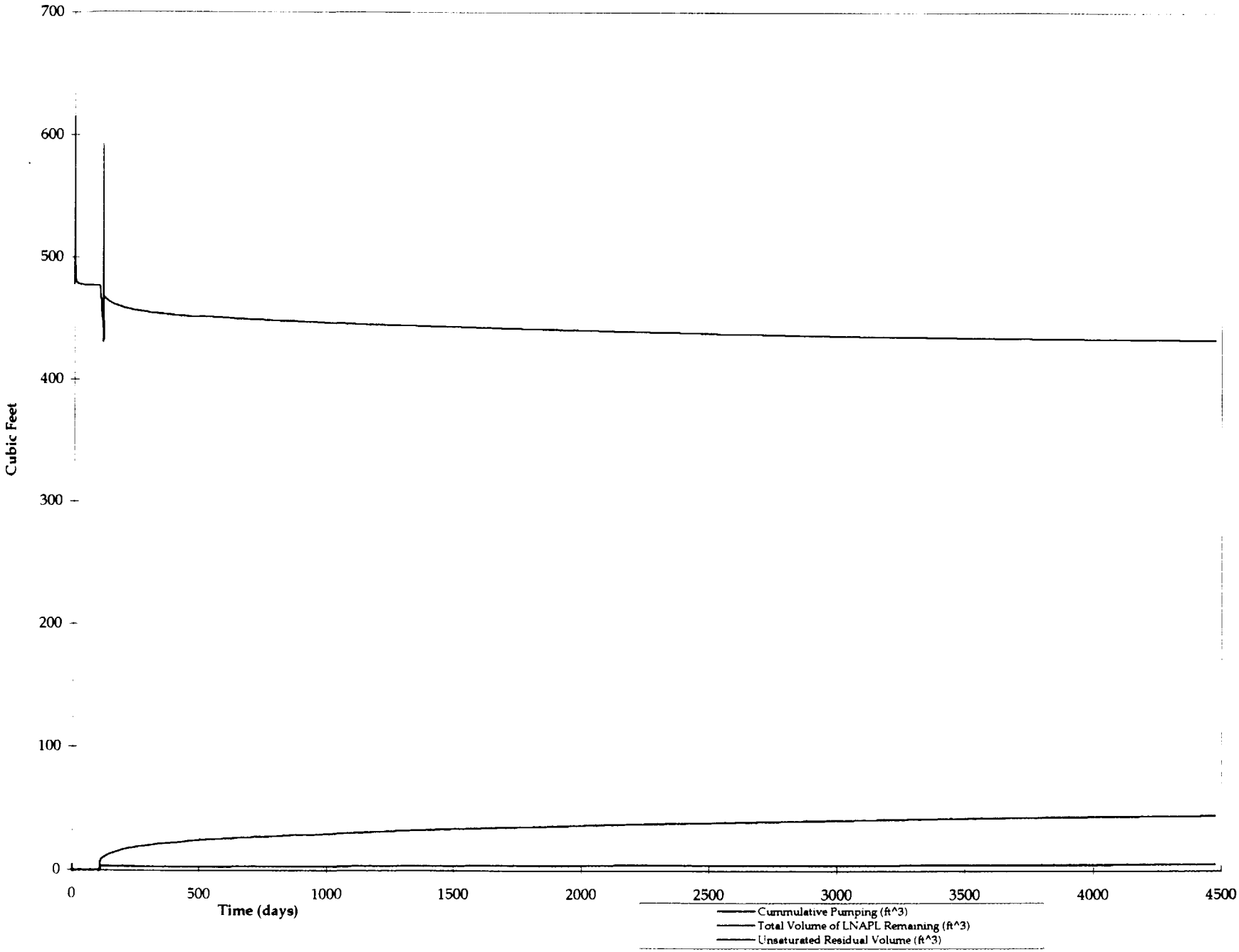


FIGURE F-49
ACTIVE RECOVERY TRENCH SIMULATIONS - LOW RESIDUAL
LENZ OIL SITE
LEMONT, ILLINOIS

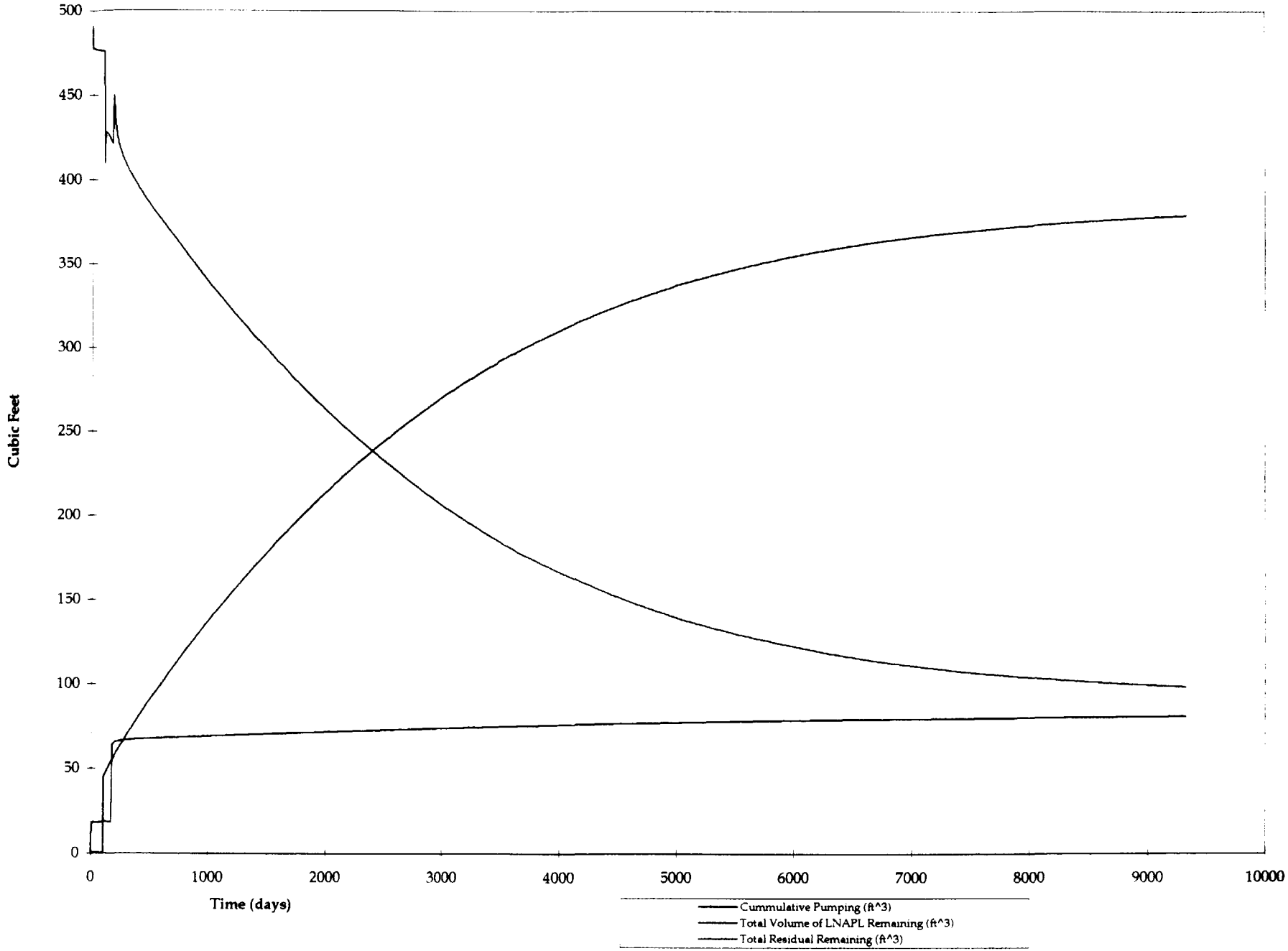


FIGURE F-50
ACTIVE RECOVERY TRENCH SIMULATIONS - MODERATE RESIDUAL
LENZ OIL SITE
LEMONT, ILLINOIS

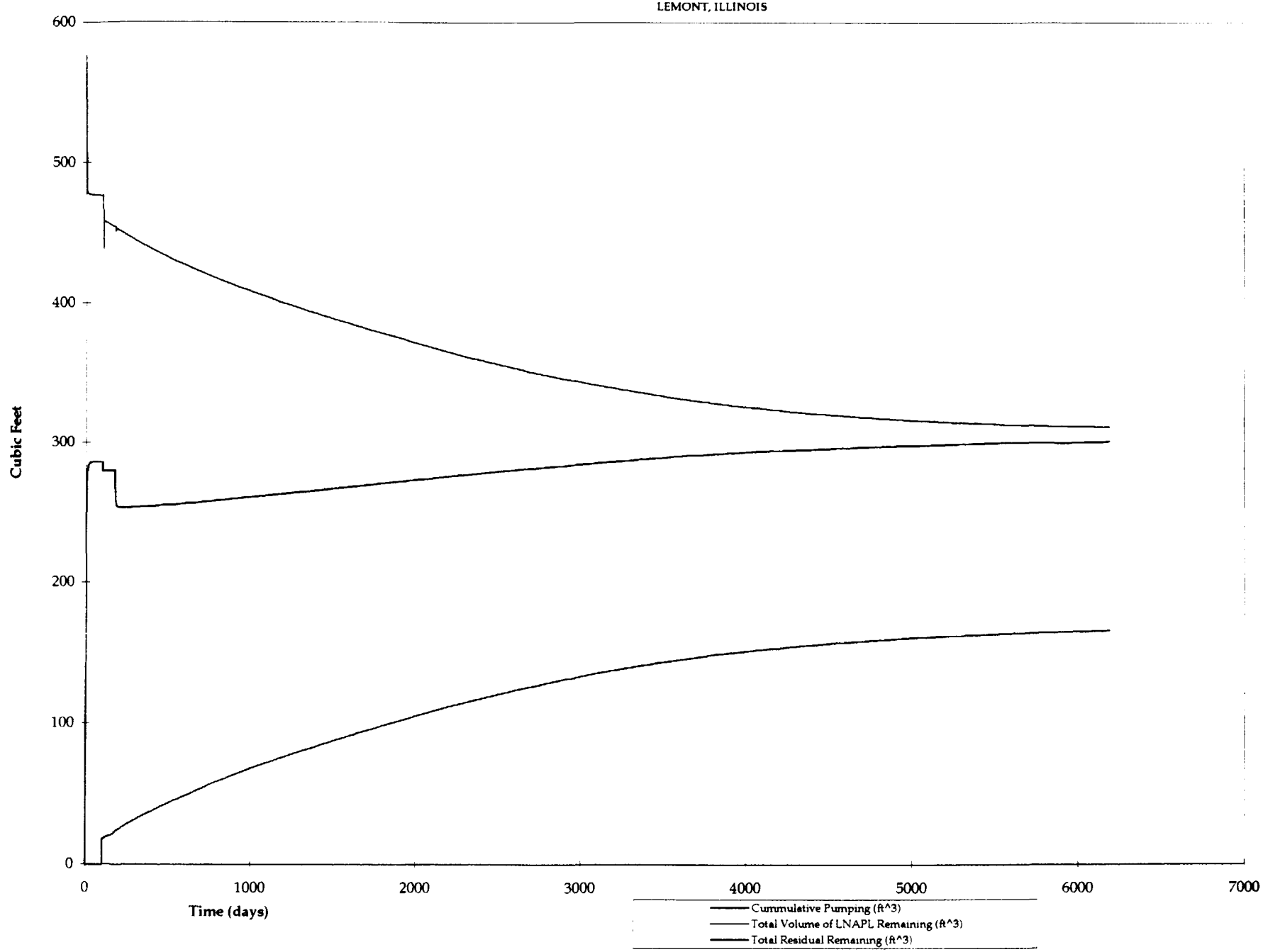


FIGURE F-51
ACTIVE RECOVERY TRENCH SIMULATIONS - HIGH RESIDUAL
LENZ OIL SITE
LEMONT, ILLINOIS

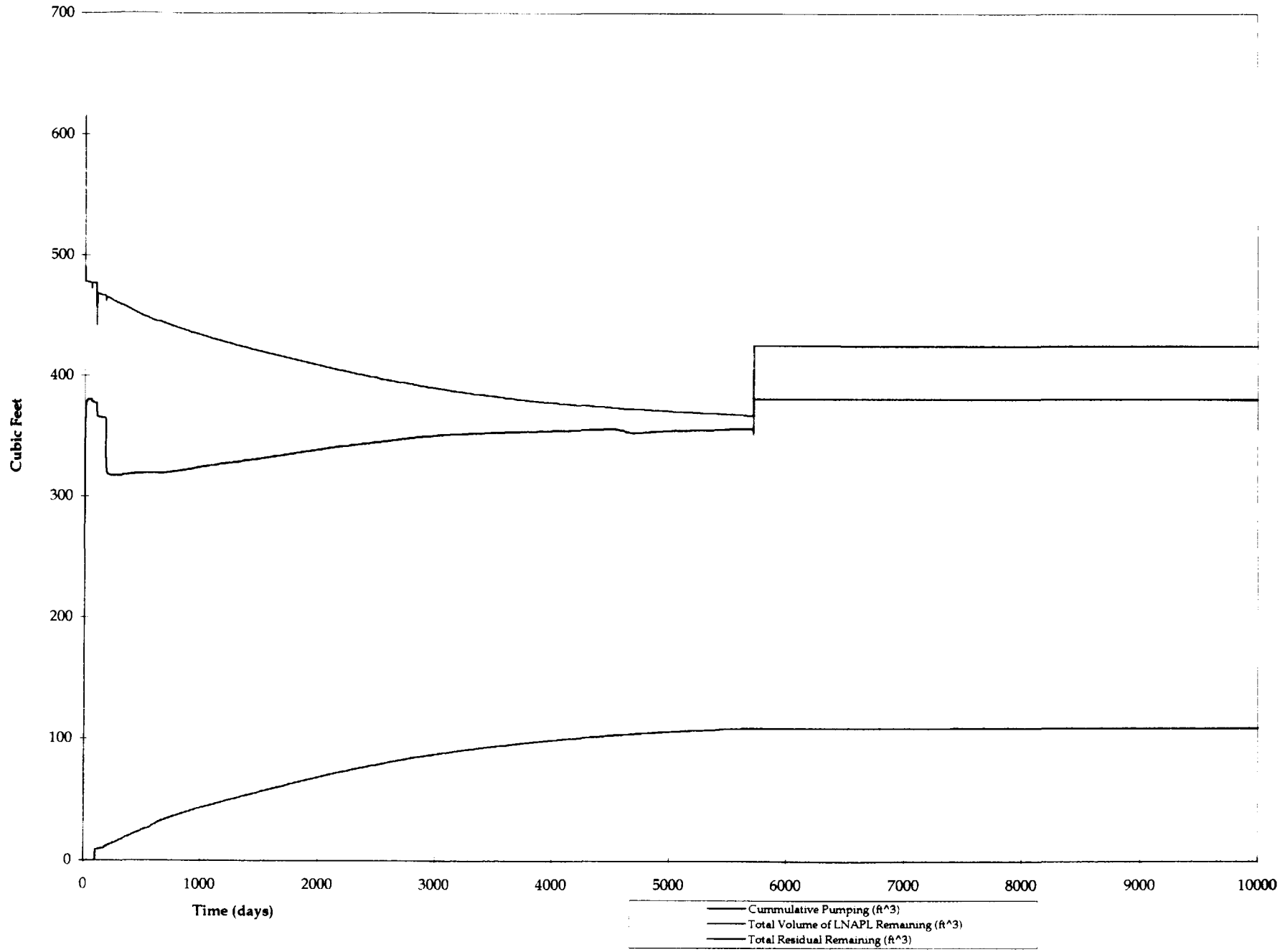


FIGURE F-52
ACTIVE RECOVERY TRENCH WITH SURFACTANT INFILTRATION
SIMULATIONS - LOW RESIDUAL
LENZ OIL SITE
LEMONT, ILLINOIS

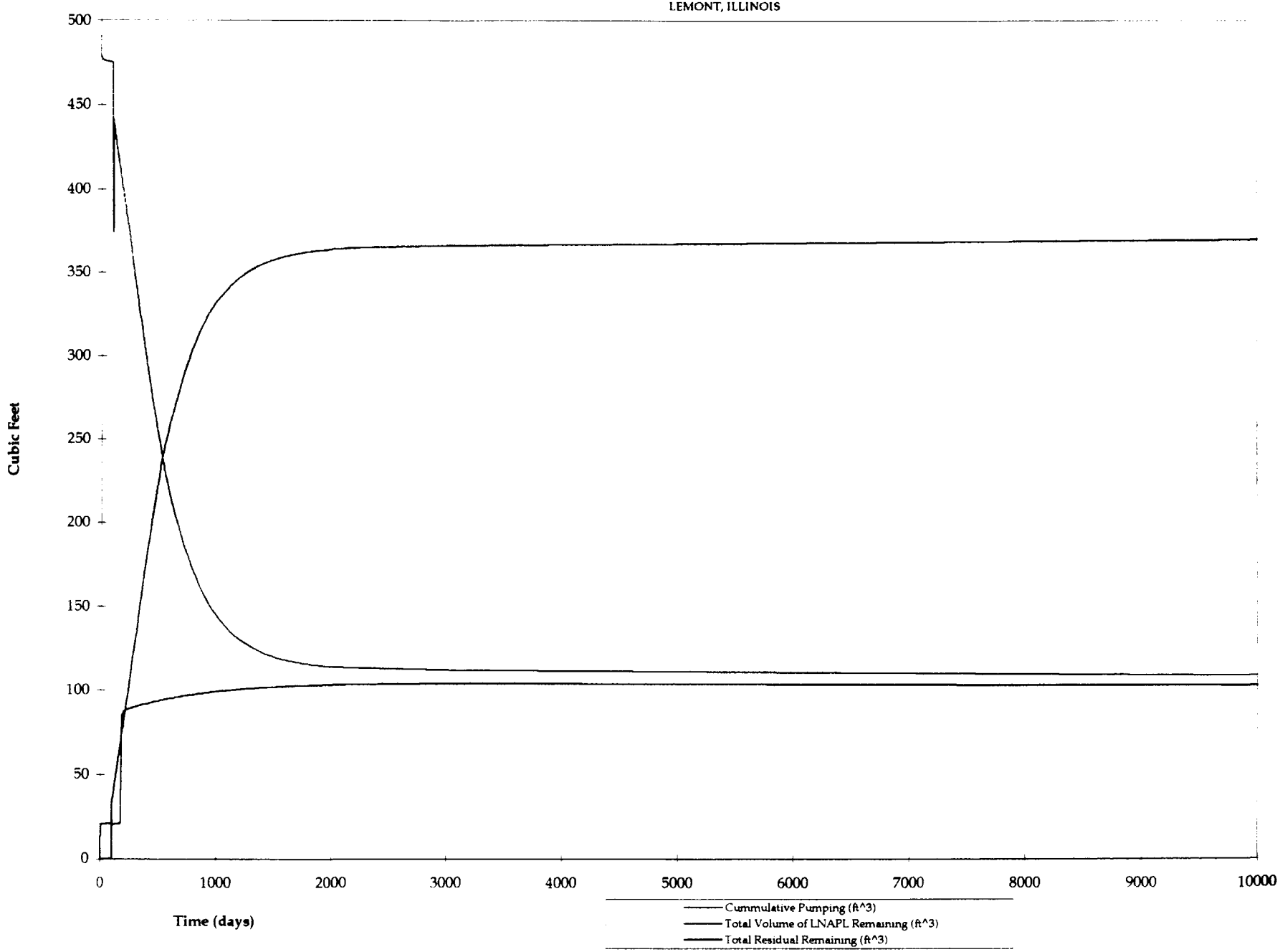


FIGURE F-53
ACTIVE RECOVERY TRENCH WITH SURFACTANT INFILTRATION
SIMULATIONS - MODERATE RESIDUAL
LENZ OIL SITE
LEMONT, ILLINOIS

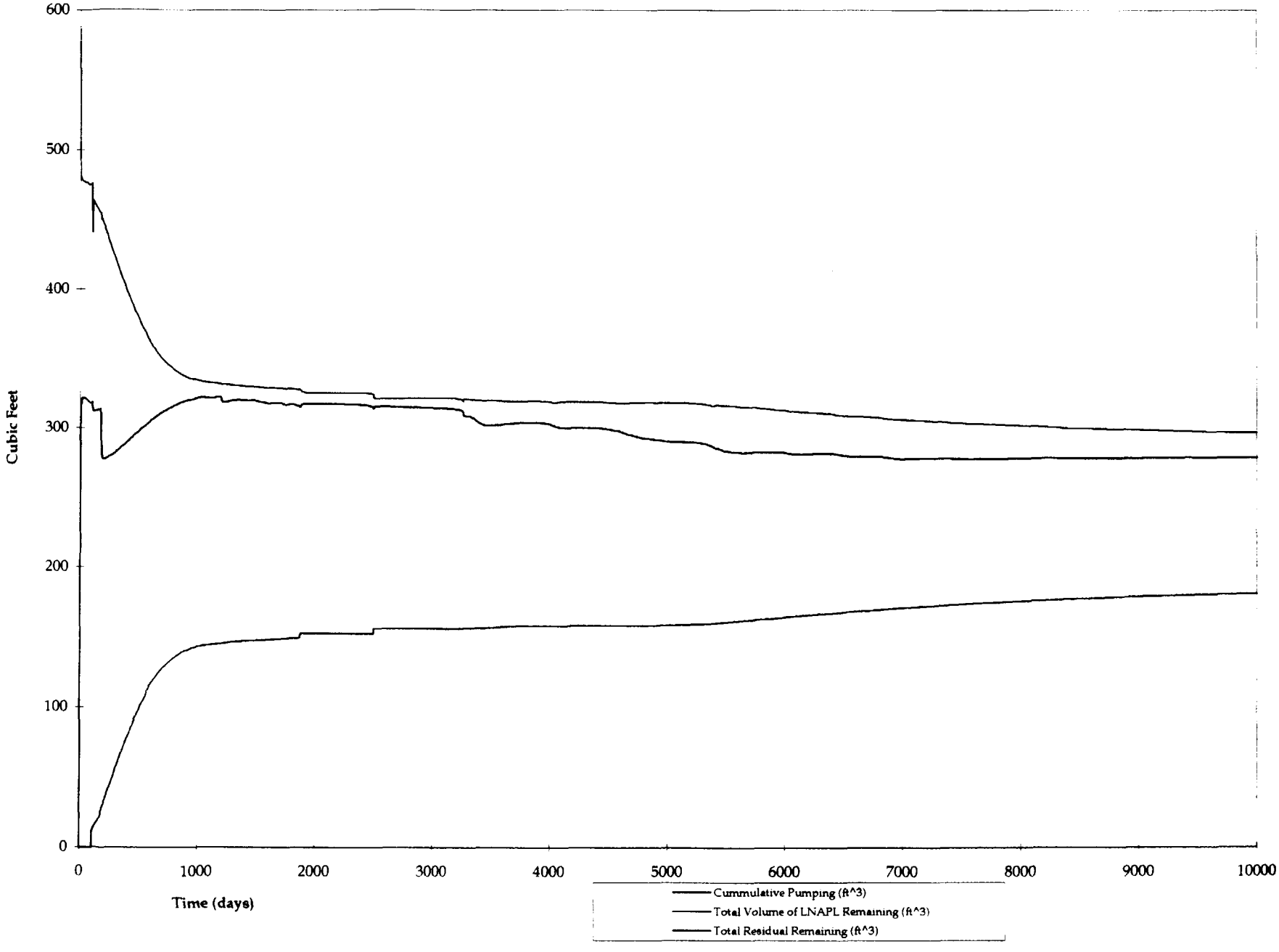


FIGURE F-54
ACTIVE RECOVERY TRENCH WITH SURFACTANT INFILTRATION
SIMULATIONS - HIGH RESIDUAL
LENZ OIL SITE
LEMONT, ILLINOIS

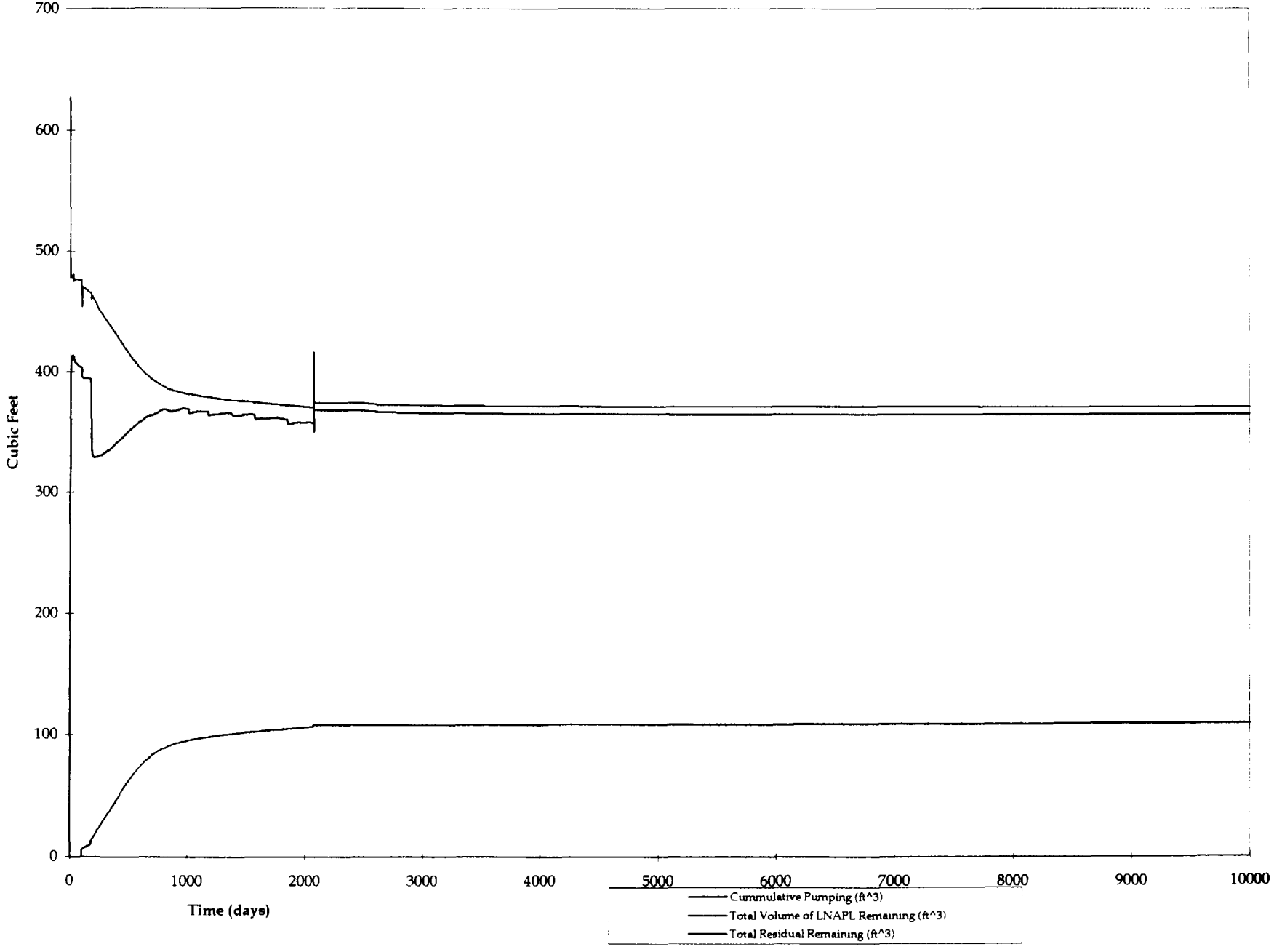


FIGURE F-55
LNAPL EXCAVATION AND ACTIVE RECOVERY TRENCH
SIMULATIONS - LOW RESIDUAL
LENZ OIL SITE
LEMONT, ILLINOIS

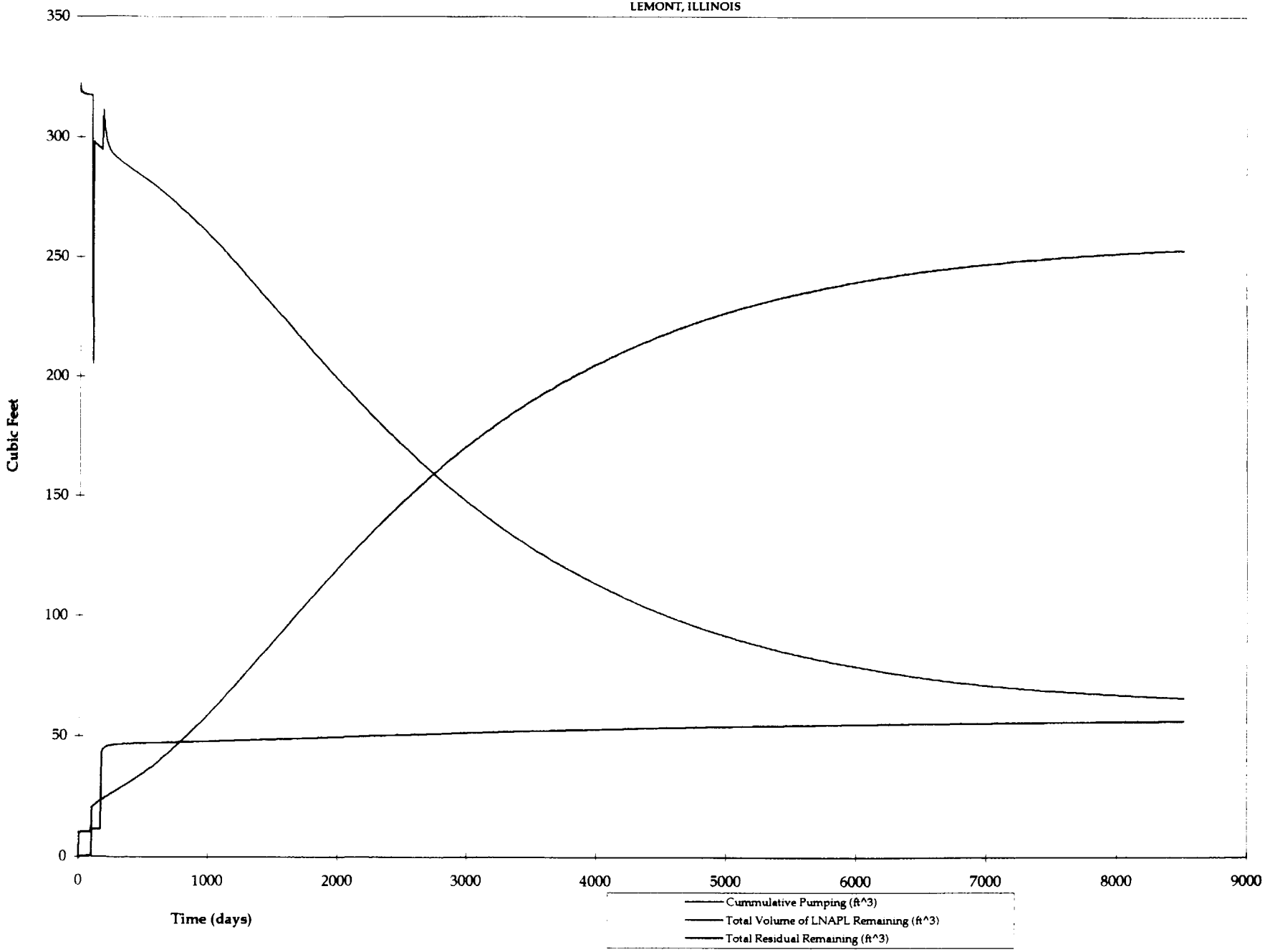


FIGURE F-56
LNAPL EXCAVATION AND ACTIVE RECOVERY TRENCH
SIMULATIONS - MODERATE RESIDUAL
LENZ OIL SITE
LEMONT, ILLINOIS

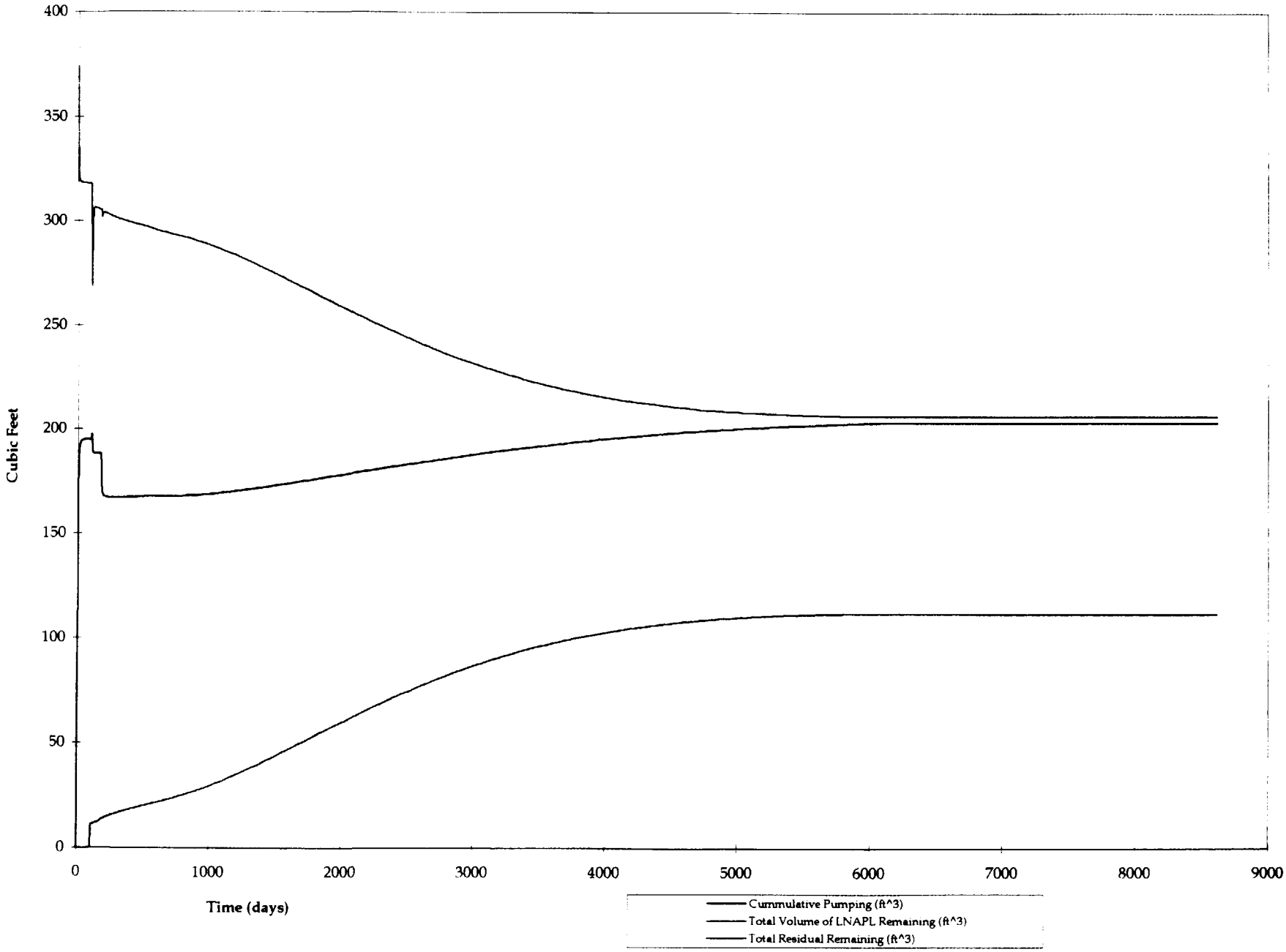


FIGURE F-57
LNAPL EXCAVATION AND ACTIVE RECOVERY TRENCH
SIMULATIONS - HIGH RESIDUAL
LENZ OIL SITE
LEMONT, ILLINOIS

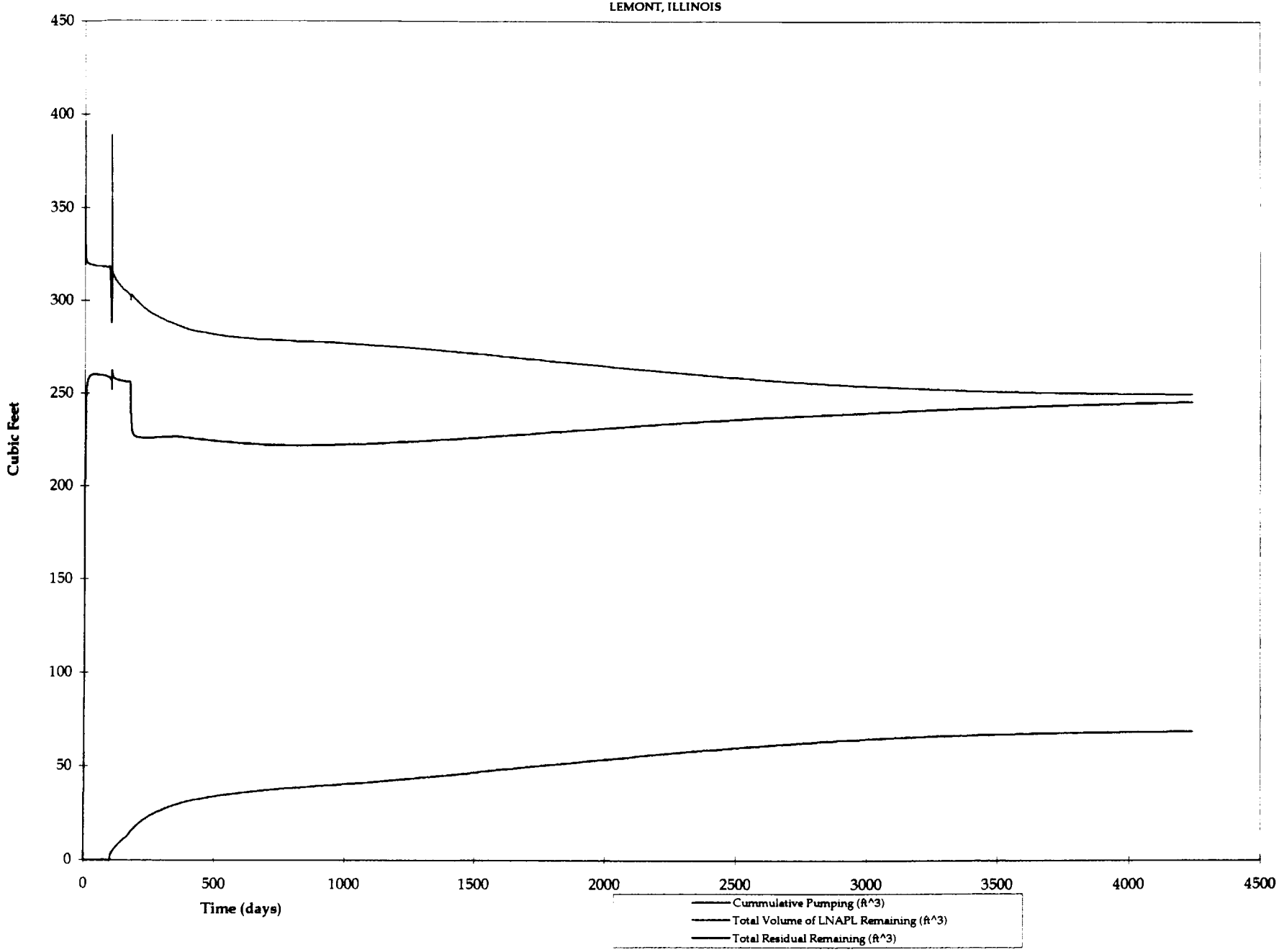


FIGURE F-58
LNAPL EXCAVATION, ACTIVE RECOVERY TRENCH AND SURFACTANT INFILTRATION
SIMULATIONS - LOW RESIDUAL
LENZ OIL SITE
LEMONT, ILLINOIS

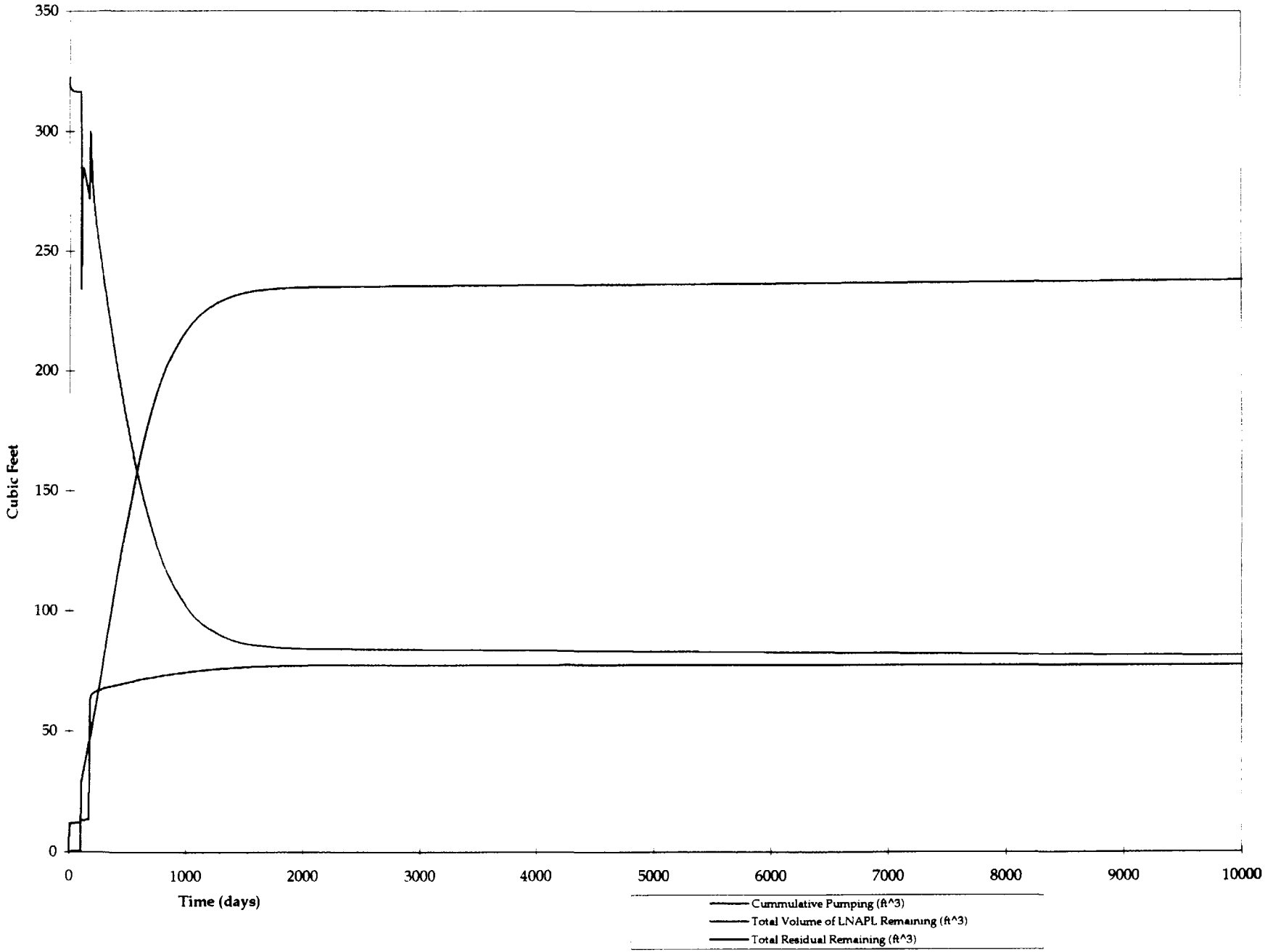


FIGURE F-59
LNAPL EXCAVATION, ACTIVE RECOVERY TRENCH AND SURFACTANT INFILTRATION
SIMULATIONS - MODERATE RESIDUAL
LENZ OIL SITE
LEMONT, ILLINOIS

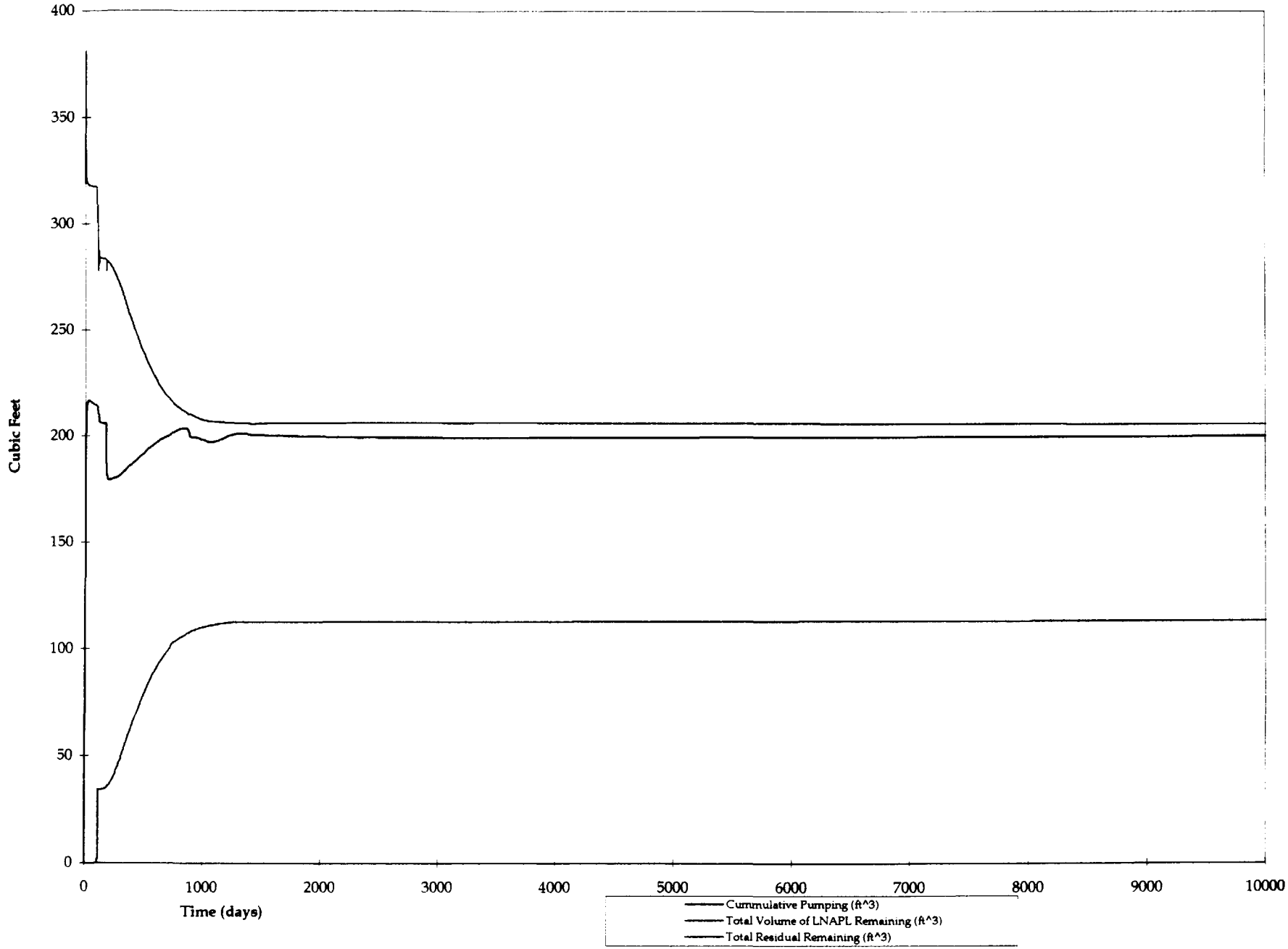


FIGURE F-60
LNAPL EXCAVATION, ACTIVE RECOVERY TRENCH AND SURFACTANT INFILTRATION
SIMULATIONS - HIGH RESIDUAL
LENZ OIL SITE
LEMONT, ILLINOIS

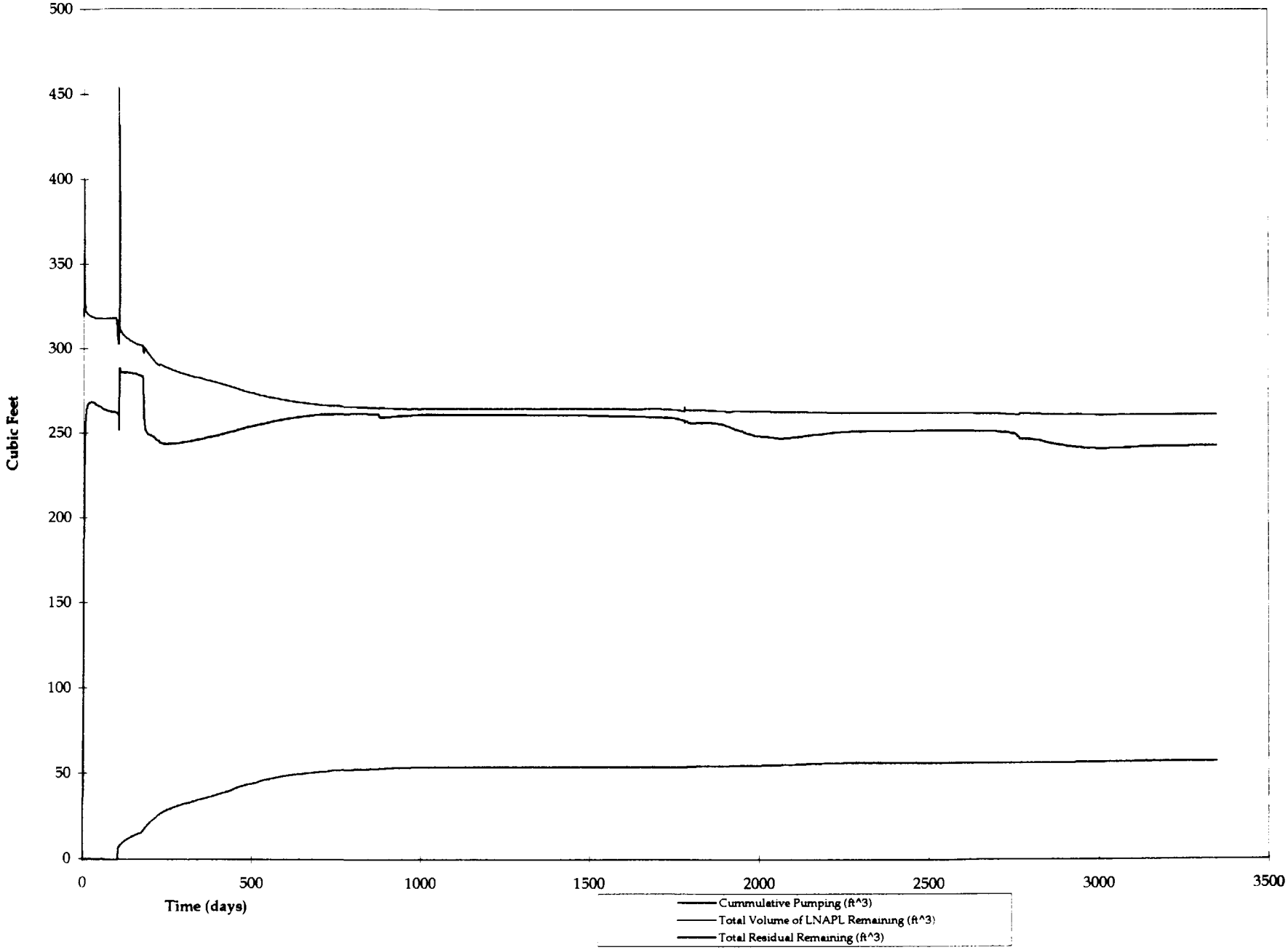


FIGURE F-61
LIGHT NONAQUEOUS PHASE LIQUID RECOVERY OVER TIME
Sor = 0.001

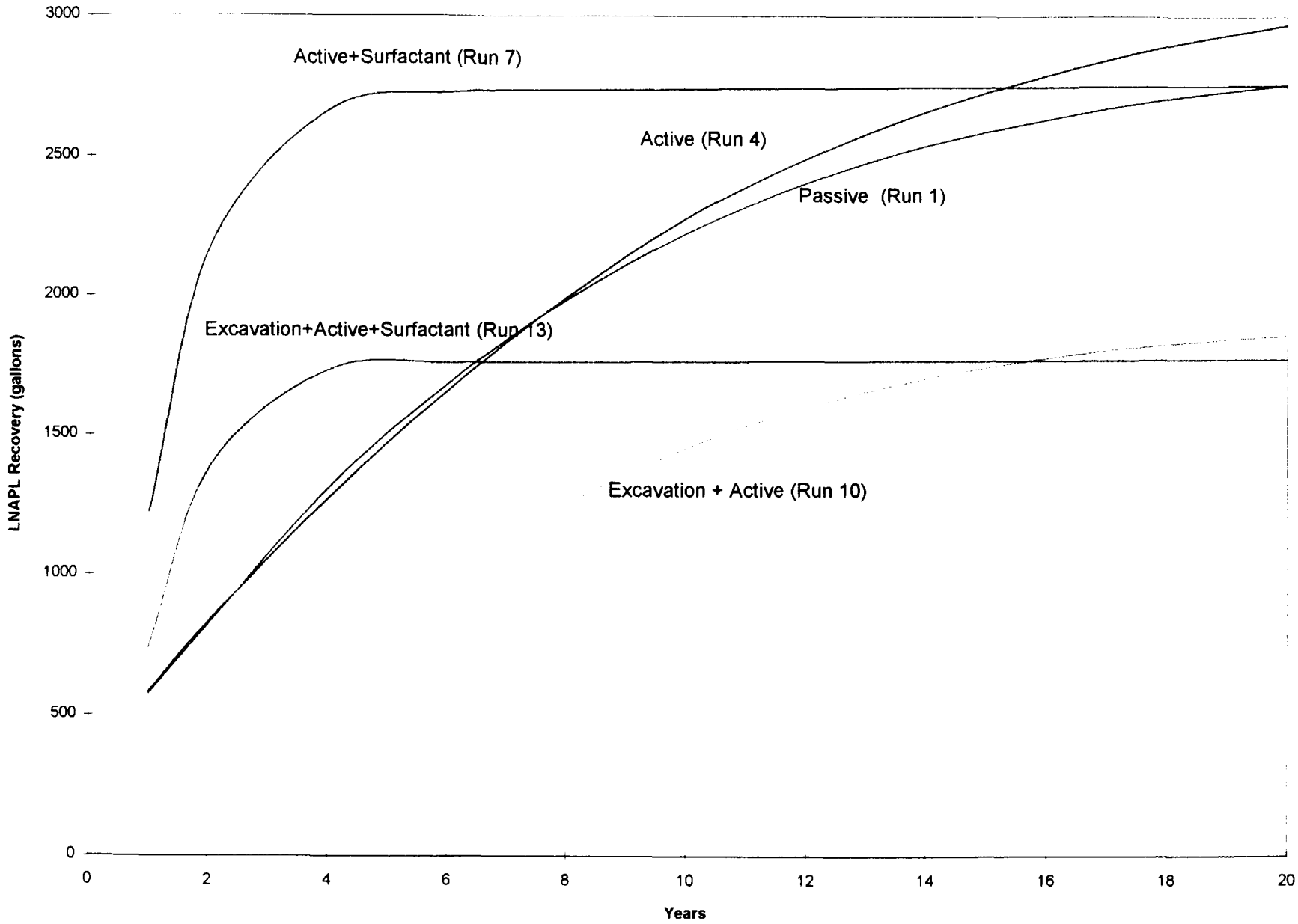


FIGURE F-62
LIGHT NONAQUEOUS PHASE LIQUID RECOVERY OVER TIME
Sor = 0.03

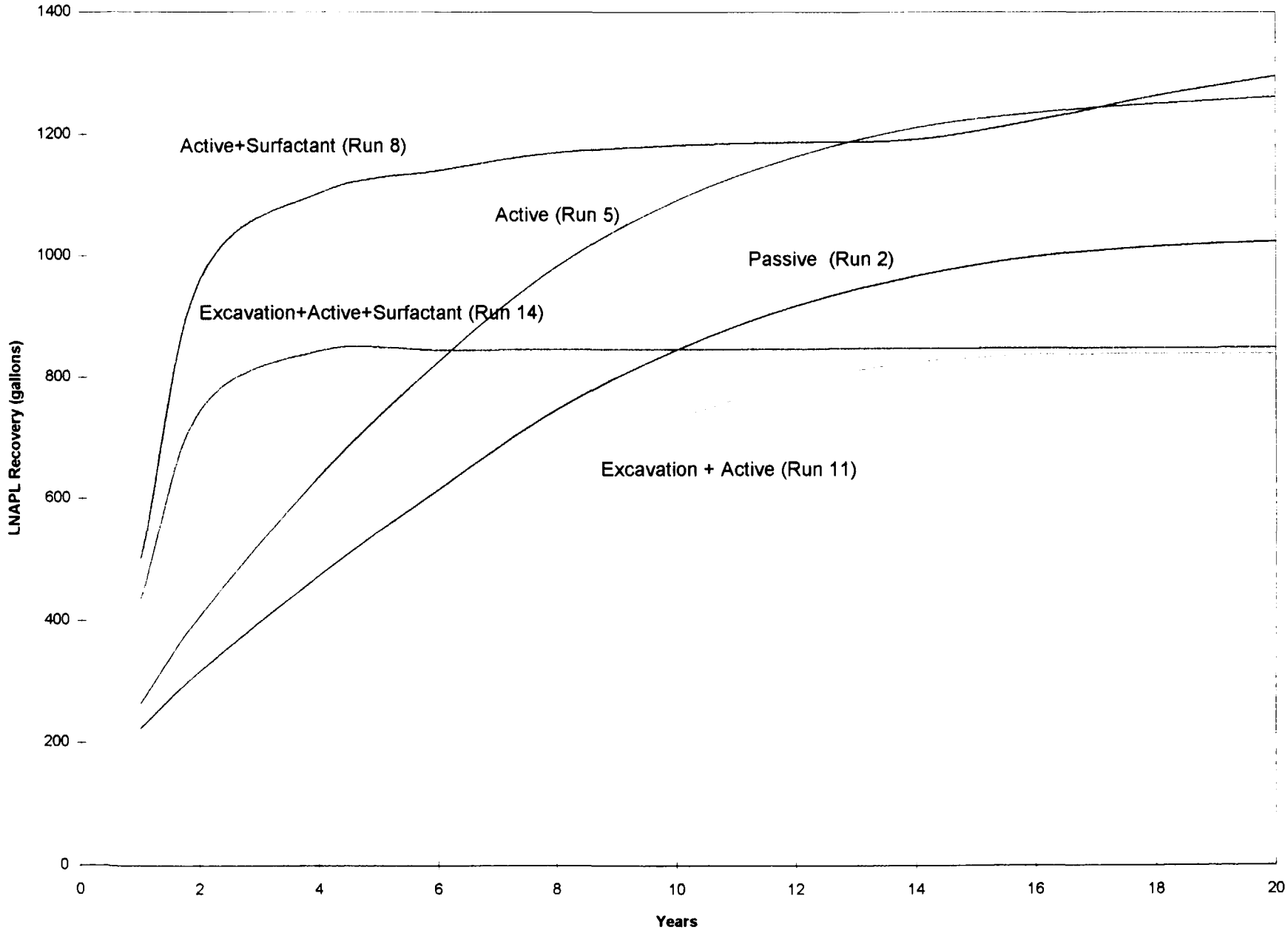
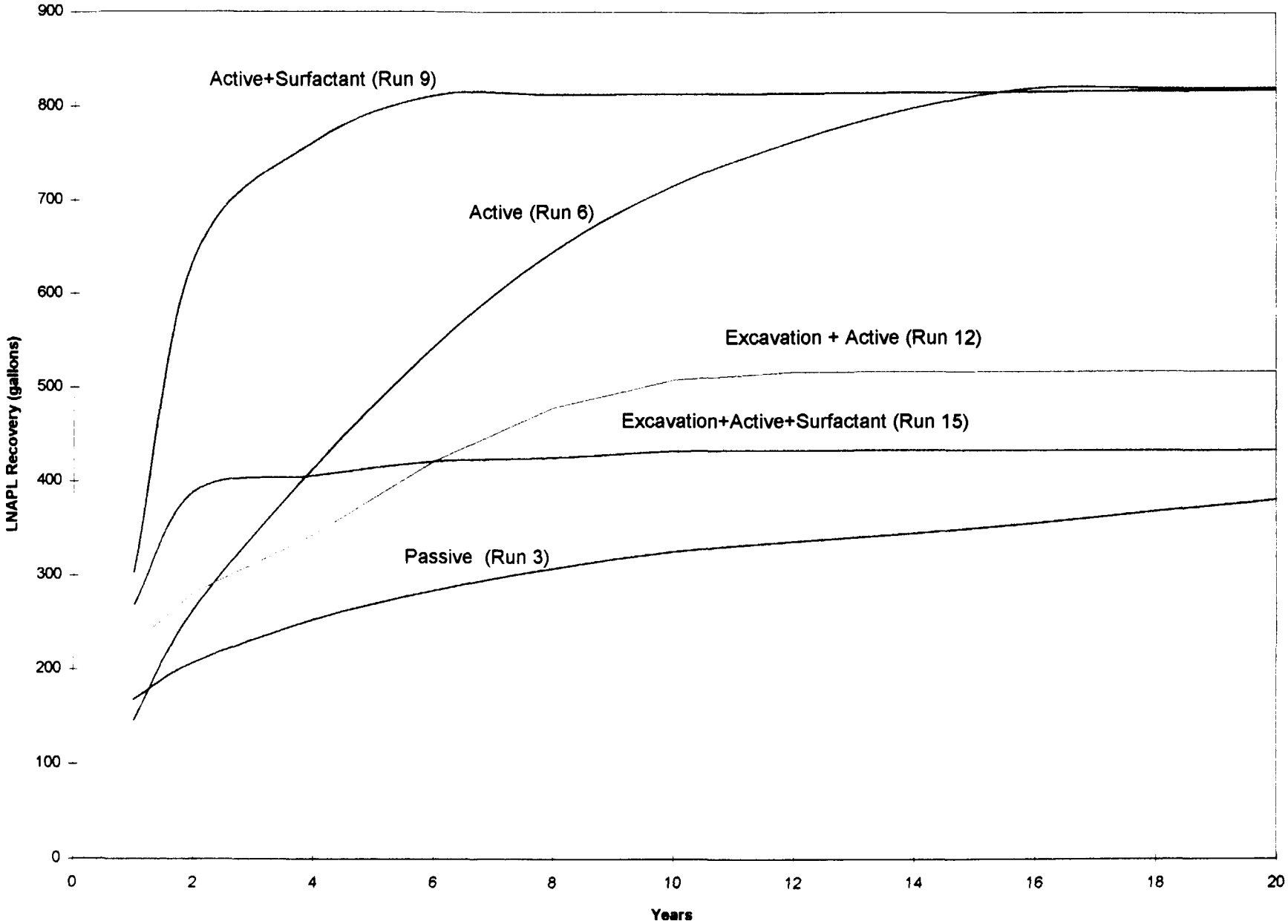


FIGURE F-63
LIGHT NONAQUEOUS PHASE LIQUID RECOVERY OVER TIME
Sor = 0.05



ATTACHMENT 1 TO APPENDIX F:

UNITED STATES GEOLOGICAL SURVEY
DAILY MEAN DISCHARGE DATA
OCTOBER 1, 1987 TO SEPTEMBER 30, 1993

US GEOLOGICAL SURVEY
DAILY MEAN DISCHARGE DATA
#
Station name : DES PLAINES RIVER AT RIVERSIDE, IL
Station number: 05532500
latitude (degrees, minutes, and seconds)..... 414920
longitude (degrees, minutes, and seconds)..... 0874915
state code..... 17
county code..... 031
hydrologic unit code..... 07120004
drainage area (square miles)..... 630.00
contributing drainage area (square miles).....
gage datum (feet above NGVD)..... 594.68
WATSTORE parameter code..... 00060
WATSTORE statistic code..... 00003
Discharge is listed in the table in cubic feet per second.
#
Daily mean discharge data were retrieved from the
National Water Information System files called ADAPS.
processed into RDB table Sat Jan 28 20:47:14 EST 1995
filter version 6
#
Format of table is as follows.
Lines starting with the # character are comment lines describing the data
included in this file. The next line is a row of tab-delimited column
names that are Date and Discharge. The next line is a row of tab-delimited
data type codes that describe a 10-character-wide date (10d) and an
8-character-wide numeric value for discharge (8n). All following lines are
rows of tab-delimited data values of date (year.month.day) and discharge.
#
NOTE: The header above is from an original file which has
has been further processed by IL-SWR web retrieval
software on Wed Sep 25 12:37:36 CDT 1996.
Dates are now in MM/DD/YYYY format.
#
----Date Range In File----
1 10/01/1987-09/30/1993

Date	Discharge						
10s	8n						
10/01/1987	317	10/15/1987	210	10/31/1987	238	11/16/1987	221
10/02/1987	305	10/16/1987	216	11/01/1987	377	11/17/1987	394
10/03/1987	292	10/17/1987	326	11/02/1987	783	11/18/1987	307
10/04/1987	267	10/18/1987	260	11/03/1987	495	11/19/1987	253
10/05/1987	245	10/19/1987	229	11/04/1987	379	11/20/1987	241
10/06/1987	242	10/20/1987	344	11/05/1987	318	11/21/1987	213
10/07/1987	244	10/21/1987	277	11/06/1987	276	11/22/1987	204
10/08/1987	236	10/22/1987	240	11/07/1987	248	11/23/1987	204
10/09/1987	226	10/23/1987	220	11/08/1987	247	11/24/1987	216
10/10/1987	218	10/24/1987	271	11/09/1987	242	11/25/1987	434
10/11/1987	212	10/25/1987	302	11/10/1987	232	11/26/1987	415
10/12/1987	203	10/26/1987	266	11/11/1987	211	11/27/1987	344
10/13/1987	205	10/27/1987	296	11/12/1987	206	11/28/1987	967
10/14/1987	203	10/28/1987	298	11/13/1987	202	11/29/1987	1380
		10/29/1987	275	11/14/1987	201	11/30/1987	1110
		10/30/1987	266	11/15/1987	196	12/01/1987	1050

12/02/1987	860	01/25/1988	1740	03/19/1988	552	05/12/1988	359
12/03/1987	789	01/26/1988	1490	03/20/1988	531	05/13/1988	362
12/04/1987	821	01/27/1988	1250	03/21/1988	506	05/14/1988	321
12/05/1987	699	01/28/1988	1140	03/22/1988	487	05/15/1988	345
12/06/1987	621	01/29/1988	1140	03/23/1988	474	05/16/1988	392
12/07/1987	991	01/30/1988	1490	03/24/1988	656	05/17/1988	291
12/08/1987	1860	01/31/1988	2230	03/25/1988	711	05/18/1988	263
12/09/1987	2020	02/01/1988	2680	03/26/1988	616	05/19/1988	254
12/10/1987	1880	02/02/1988	2640	03/27/1988	575	05/20/1988	234
12/11/1987	1600	02/03/1988	2340	03/28/1988	806	05/21/1988	224
12/12/1987	1360	02/04/1988	2090	03/29/1988	1530	05/22/1988	225
12/13/1987	1200	02/05/1988	1780	03/30/1988	2030	05/23/1988	396
12/14/1987	1090	02/06/1988	1600	03/31/1988	1740	05/24/1988	618
12/15/1987	1100	02/07/1988	1400	04/01/1988	1410	05/25/1988	368
12/16/1987	1130	02/08/1988	1200	04/02/1988	1270	05/26/1988	308
12/17/1987	1110	02/09/1988	1100	04/03/1988	1490	05/27/1988	284
12/18/1987	997	02/10/1988	980	04/04/1988	1500	05/28/1988	255
12/19/1987	1000	02/11/1988	880	04/05/1988	1430	05/29/1988	238
12/20/1987	2340	02/12/1988	800	04/06/1988	2870	05/30/1988	223
12/21/1987	2490	02/13/1988	740	04/07/1988	2970	05/31/1988	213
12/22/1987	2270	02/14/1988	680	04/08/1988	2590	06/01/1988	224
12/23/1987	2000	02/15/1988	710	04/09/1988	2100	06/02/1988	217
12/24/1987	1830	02/16/1988	690	04/10/1988	1850	06/03/1988	214
12/25/1987	2080	02/17/1988	680	04/11/1988	1720	06/04/1988	218
12/26/1987	2060	02/18/1988	650	04/12/1988	1620	06/05/1988	209
12/27/1987	1930	02/19/1988	640	04/13/1988	1490	06/06/1988	208
12/28/1987	1800	02/20/1988	638	04/14/1988	1350	06/07/1988	206
12/29/1987	1720	02/21/1988	569	04/15/1988	1170	06/08/1988	210
12/30/1987	1580	02/22/1988	606	04/16/1988	984	06/09/1988	198
12/31/1987	1430	02/23/1988	700	04/17/1988	839	06/10/1988	188
01/01/1988	1210	02/24/1988	680	04/18/1988	728	06/11/1988	179
01/02/1988	877	02/25/1988	665	04/19/1988	649	06/12/1988	186
01/03/1988	903	02/26/1988	604	04/20/1988	584	06/13/1988	195
01/04/1988	901	02/27/1988	673	04/21/1988	559	06/14/1988	181
01/05/1988	606	02/28/1988	669	04/22/1988	486	06/15/1988	174
01/06/1988	565	02/29/1988	695	04/23/1988	715	06/16/1988	176
01/07/1988	520	03/01/1988	737	04/24/1988	826	06/17/1988	174
01/08/1988	475	03/02/1988	822	04/25/1988	648	06/18/1988	176
01/09/1988	450	03/03/1988	846	04/26/1988	565	06/19/1988	166
01/10/1988	415	03/04/1988	809	04/27/1988	604	06/20/1988	168
01/11/1988	400	03/05/1988	766	04/28/1988	607	06/21/1988	361
01/12/1988	400	03/06/1988	717	04/29/1988	531	06/22/1988	235
01/13/1988	412	03/07/1988	695	04/30/1988	479	06/23/1988	383
01/14/1988	380	03/08/1988	722	05/01/1988	451	06/24/1988	244
01/15/1988	370	03/09/1988	858	05/02/1988	422	06/25/1988	193
01/16/1988	365	03/10/1988	859	05/03/1988	403	06/26/1988	180
01717/1988	866	03/11/1988	826	05/04/1988	372	06/27/1988	164
01/18/1988	1730	03/12/1988	809	05/05/1988	354	06/28/1988	167
01/19/1988	1750	03/13/1988	794	05/06/1988	335	06/29/1988	500
01/20/1988	2710	03/14/1988	758	05/07/1988	321	06/30/1988	308
01/21/1988	2900	03/15/1988	724	05/08/1988	303	07/01/1988	229
01/22/1988	2790	03/16/1988	659	05/09/1988	381	07/02/1988	201
01/23/1988	2270	03/17/1988	603	05/10/1988	437	07/03/1988	182
01/24/1988	1910	03/18/1988	574	05/11/1988	377	07/04/1988	164

07/05/1988	165	08/28/1988	312	10/21/1988	319	12/14/1988	208
07/06/1988	171	08/29/1988	169	10/22/1988	272	12/15/1988	219
07/07/1988	177	08/30/1988	157	10/23/1988	396	12/16/1988	184
07/08/1988	179	08/31/1988	152	10/24/1988	433	12/17/1988	187
07/09/1988	168	09/01/1988	149	10/25/1988	308	12/18/1988	183
07/10/1988	163	09/02/1988	143	10/26/1988	251	12/19/1988	191
07/11/1988	164	09/03/1988	180	10/27/1988	223	12/20/1988	212
07/12/1988	167	09/04/1988	221	10/28/1988	219	12/21/1988	226
07/13/1988	159	09/05/1988	251	10/29/1988	203	12/22/1988	341
07/14/1988	146	09/06/1988	171	10/30/1988	187	12/23/1988	875
07/15/1988	164	09/07/1988	160	10/31/1988	181	12/24/1988	488
07/16/1988	291	09/08/1988	143	11/01/1988	195	12/25/1988	378
07/17/1988	590	09/09/1988	144	11/02/1988	199	12/26/1988	315
07/18/1988	680	09/10/1988	148	11/03/1988	195	12/27/1988	786
07/19/1988	460	09/11/1988	143	11/04/1988	872	12/28/1988	1110
07/20/1988	271	09/12/1988	680	11/05/1988	1220	12/29/1988	697
07/21/1988	213	09/13/1988	895	11/06/1988	675	12/30/1988	493
07/22/1988	219	09/14/1988	352	11/07/1988	474	12/31/1988	405
07/23/1988	184	09/15/1988	236	11/08/1988	368	01/01/1989	347
07/24/1988	165	09/16/1988	207	11/09/1988	432	01/02/1989	299
07/25/1988	184	09/17/1988	174	11/10/1988	1270	01/03/1989	276
07/26/1988	193	09/18/1988	286	11/11/1988	861	01/04/1989	258
07/27/1988	181	09/19/1988	694	11/12/1988	721	01/05/1989	258
07/28/1988	157	09/20/1988	479	11/13/1988	846	01/06/1989	428
07/29/1988	149	09/21/1988	312	11/14/1988	576	01/07/1989	489
07/30/1988	1020	09/22/1988	295	11/15/1988	639	01/08/1989	1030
07/31/1988	631	09/23/1988	527	11/16/1988	1740	01/09/1989	605
08/01/1988	252	09/24/1988	372	11/17/1988	1400	01/10/1989	546
08/02/1988	208	09/25/1988	250	11/18/1988	858	01/11/1989	432
08/03/1988	183	09/26/1988	207	11/19/1988	830	01/12/1989	408
08/04/1988	173	09/27/1988	190	11/20/1988	709	01/13/1989	366
08/05/1988	221	09/28/1988	169	11/21/1988	547	01/14/1989	323
08/06/1988	168	09/29/1988	170	11/22/1988	469	01/15/1989	293
08/07/1988	159	09/30/1988	165	11/23/1988	407	01/16/1989	270
08/08/1988	200	10/01/1988	175	11/24/1988	376	01/17/1989	260
08/09/1988	1190	10/02/1988	424	11/25/1988	352	01/18/1989	259
08/10/1988	705	10/03/1988	353	11/26/1988	578	01/19/1989	255
08/11/1988	1020	10/04/1988	249	11/27/1988	707	01/20/1989	250
08/12/1988	645	10/05/1988	203	11/28/1988	576	01/21/1989	241
08/13/1988	518	10/06/1988	185	11/29/1988	494	01/22/1989	233
08/14/1988	594	10/07/1988	175	11/30/1988	430	01/23/1989	228
08/15/1988	317	10/08/1988	168	12/01/1988	380	01/24/1989	235
08/16/1988	259	10/09/1988	164	12/02/1988	340	01/25/1989	246
08/17/1988	227	10/10/1988	165	12/03/1988	310	01/26/1989	289
08/18/1988	221	10/11/1988	174	12/04/1988	283	01/27/1989	310
08/19/1988	337	10/12/1988	158	12/05/1988	265	01/28/1989	294
08/20/1988	250	10/13/1988	161	12/06/1988	261	01/29/1989	386
08/21/1988	199	10/14/1988	160	12/07/1988	254	01/30/1989	440
08/22/1988	173	10/15/1988	156	12/08/1988	242	01/31/1989	426
08/23/1988	192	10/16/1988	189	12/09/1988	227	02/01/1989	411
08/24/1988	179	10/17/1988	799	12/10/1988	221	02/02/1989	381
08/25/1988	156	10/18/1988	1940	12/11/1988	196	02/03/1989	357
08/26/1988	147	10/19/1988	815	12/12/1988	194	02/04/1989	288
08/27/1988	186	10/20/1988	409	12/13/1988	206	02/05/1989	202

02/06/1989	250	04/01/1989	521	05/25/1989	365	07/18/1989	334
02/07/1989	240	04/02/1989	493	05/26/1989	325	07/19/1989	2010
02/08/1989	230	04/03/1989	524	05/27/1989	285	07/20/1989	2110
02/09/1989	220	04/04/1989	497	05/28/1989	247	07/21/1989	1530
02/10/1989	210	04/05/1989	477	05/29/1989	495	07/22/1989	832
02/11/1989	220	04/06/1989	456	05/30/1989	446	07/23/1989	525
02/12/1989	225	04/07/1989	427	05/31/1989	373	07/24/1989	376
02/13/1989	230	04/08/1989	403	06/01/1989	2060	07/25/1989	334
02/14/1989	260	04/09/1989	379	06/02/1989	1290	07/26/1989	484
02/15/1989	240	04/10/1989	337	06/03/1989	950	07/27/1989	384
02/16/1989	230	04/11/1989	333	06/04/1989	806	07/28/1989	355
02/17/1989	220	04/12/1989	332	06/05/1989	564	07/29/1989	337
02/18/1989	210	04/13/1989	308	06/06/1989	444	07/30/1989	1610
02/19/1989	200	04/14/1989	298	06/07/1989	371	07/31/1989	1010
02/20/1989	200	04/15/1989	295	06/08/1989	329	08/01/1989	695
02/21/1989	210	04/16/1989	280	06/09/1989	277	08/02/1989	472
02/22/1989	210	04/17/1989	298	06/10/1989	239	08/03/1989	364
02/23/1989	190	04/18/1989	334	06/11/1989	215	08/04/1989	1990
02/24/1989	180	04/19/1989	337	06/12/1989	547	08/05/1989	3600
02/25/1989	190	04/20/1989	302	06/13/1989	527	08/06/1989	3370
02/26/1989	200	04/21/1989	285	06/14/1989	386	08/07/1989	2400
02/27/1989	200	04/22/1989	275	06/15/1989	314	08/08/1989	1490
02/28/1989	205	04/23/1989	262	06/16/1989	275	08/09/1989	933
03/01/1989	200	04/24/1989	251	06/17/1989	243	08/10/1989	696
03/02/1989	190	04/25/1989	327	06/18/1989	222	08/11/1989	654
03/03/1989	220	04/26/1989	366	06/19/1989	205	08/12/1989	612
03/04/1989	794	04/27/1989	331	06/20/1989	200	08/13/1989	490
03/05/1989	884	04/28/1989	576	06/21/1989	196	08/14/1989	605
03/06/1989	650	04/29/1989	596	06/22/1989	192	08/15/1989	455
03/07/1989	499	04/30/1989	446	06/23/1989	196	08/16/1989	373
03/08/1989	406	05/01/1989	372	06/24/1989	200	08/17/1989	340
03/09/1989	372	05/02/1989	370	06/25/1989	224	08/18/1989	312
03/10/1989	424	05/03/1989	359	06/26/1989	320	08/19/1989	283
03/11/1989	559	05/04/1989	321	06/27/1989	261	08/20/1989	442
03/12/1989	648	05/05/1989	387	06/28/1989	264	08/21/1989	302
03/13/1989	640	05/06/1989	319	06/29/1989	287	08/22/1989	318
03/14/1989	632	05/07/1989	282	06/30/1989	247	08/23/1989	270
03/15/1989	814	05/08/1989	259	07/01/1989	212	08/24/1989	238
03/16/1989	683	05/09/1989	262	07/02/1989	280	08/25/1989	226
03/17/1989	733	05/10/1989	250	07/03/1989	279	08/26/1989	207
03/18/1989	1140	05/11/1989	224	07/04/1989	180	08/27/1989	192
03/19/1989	836	05/12/1989	219	07/05/1989	168	08/28/1989	485
03/20/1989	699	05/13/1989	215	07/06/1989	160	08/29/1989	530
03/21/1989	627	05/14/1989	204	07/07/1989	164	08/30/1989	325
03/22/1989	548	05/15/1989	197	07/08/1989	156	08/31/1989	269
03/23/1989	464	05/16/1989	206	07/09/1989	155	09/01/1989	2640
03/24/1989	423	05/17/1989	201	07/10/1989	165	09/02/1989	2580
03/25/1989	393	05/18/1989	194	07/11/1989	233	09/03/1989	1630
03/26/1989	372	05/19/1989	314	07/12/1989	395	09/04/1989	957
03/27/1989	406	05/20/1989	495	07/13/1989	250	09/05/1989	681
03/28/1989	615	05/21/1989	323	07/14/1989	192	09/06/1989	1140
03/29/1989	859	05/22/1989	259	07/15/1989	168	09/07/1989	1020
03/30/1989	638	05/23/1989	238	07/16/1989	155	09/08/1989	741
03/31/1989	568	05/24/1989	218	07/17/1989	147	09/09/1989	957

09/10/1989	894	11/03/1989	210	12/27/1989	151	02/19/1990	593
09/11/1989	643	11/04/1989	200	12/28/1989	150	02/20/1990	552
09/12/1989	558	11/05/1989	199	12/29/1989	150	02/21/1990	514
09/13/1989	783	11/06/1989	336	12/30/1989	153	02/22/1990	1250
09/14/1989	798	11/07/1989	458	12/31/1989	159	02/23/1990	2020
09/15/1989	648	11/08/1989	410	01/01/1990	154	02/24/1990	1770
09/16/1989	542	11/09/1989	304	01/02/1990	180	02/25/1990	1300
09/17/1989	455	11/10/1989	267	01/03/1990	214	02/26/1990	926
09/18/1989	404	11/11/1989	243	01/04/1990	593	02/27/1990	776
09/19/1989	366	11/12/1989	229	01/05/1990	553	02/28/1990	736
09/20/1989	327	11/13/1989	214	01/06/1990	413	03/01/1990	684
09/21/1989	297	11/14/1989	270	01/07/1990	344	03/02/1990	675
09/22/1989	272	11/15/1989	944	01/08/1990	310	03/03/1990	804
09/23/1989	242	11/16/1989	1010	01/09/1990	315	03/04/1990	786
09/24/1989	226	11/17/1989	619	01/10/1990	375	03/05/1990	745
09/25/1989	217	11/18/1989	435	01/11/1990	404	03/06/1990	747
09/26/1989	223	11/19/1989	351	01/12/1990	385	03/07/1990	680
09/27/1989	208	11/20/1989	321	01/13/1990	326	03/08/1990	1200
09/28/1989	210	11/21/1989	297	01/14/1990	313	03/09/1990	2520
09/29/1989	209	11/22/1989	285	01/15/1990	291	03/10/1990	2760
09/30/1989	204	11/23/1989	291	01/16/1990	371	03/11/1990	2910
10/01/1989	214	11/24/1989	267	01/17/1990	579	03/12/1990	2730
10/02/1989	213	11/25/1989	255	01/18/1990	594	03/13/1990	2690
10/03/1989	215	11/26/1989	256	01/19/1990	486	03/14/1990	2620
10/04/1989	214	11/27/1989	369	01/20/1990	450	03/15/1990	2430
10/05/1989	246	11/28/1989	410	01/21/1990	465	03/16/1990	2230
10/06/1989	305	11/29/1989	314	01/22/1990	416	03/17/1990	2070
10/07/1989	242	11/30/1989	298	01/23/1990	382	03/18/1990	1990
10/08/1989	226	12/01/1989	282	01/24/1990	365	03/19/1990	1900
10/09/1989	207	12/02/1989	271	01/25/1990	1240	03/20/1990	1820
10/10/1989	208	12/03/1989	247	01/26/1990	1370	03/21/1990	1710
10/11/1989	212	12/04/1989	242	01/27/1990	902	03/22/1990	1730
10/12/1989	212	12/05/1989	251	01/28/1990	944	03/23/1990	1770
10/13/1989	197	12/06/1989	250	01/29/1990	780	03/24/1990	1450
10/14/1989	198	12/07/1989	226	01/30/1990	655	03/25/1990	1190
10/15/1989	190	12/08/1989	213	01/31/1990	574	03/26/1990	1020
10/16/1989	191	12/09/1989	211	02/01/1990	523	03/27/1990	903
10/17/1989	224	12/10/1989	213	02/02/1990	740	03/28/1990	803
10/18/1989	242	12/11/1989	203	02/03/1990	744	03/29/1990	810
10/19/1989	308	12/12/1989	205	02/04/1990	721	03/30/1990	982
10/20/1989	727	12/13/1989	196	02/05/1990	663	03/31/1990	826
10/21/1989	503	12/14/1989	189	02/06/1990	648	04/01/1990	743
10/22/1989	330	12/15/1989	171	02/07/1990	651	04/02/1990	795
10/23/1989	272	12/16/1989	169	02/08/1990	646	04/03/1990	738
10/24/1989	253	12/17/1989	167	02/09/1990	663	04/04/1990	681
10/25/1989	242	12/18/1989	164	02/10/1990	682	04/05/1990	669
10/26/1989	237	12/19/1989	163	02/11/1990	698	04/06/1990	628
10/27/1989	234	12/20/1989	162	02/12/1990	671	04/07/1990	578
10/28/1989	225	12/21/1989	159	02/13/1990	644	04/08/1990	538
10/29/1989	216	12/22/1989	145	02/14/1990	616	04/09/1990	503
10/30/1989	210	12/23/1989	138	02/15/1990	616	04/10/1990	786
10/31/1989	242	12/24/1989	142	02/16/1990	631	04/11/1990	760
11/01/1989	234	12/25/1989	139	02/17/1990	584	04/12/1990	670
11/02/1989	220	12/26/1989	144	02/18/1990	547	04/13/1990	627

04/14/1990	1000	06/07/1990	463	07/31/1990	512	09/23/1990	370
04/15/1990	944	06/08/1990	988	08/01/1990	440	09/24/1990	282
04/16/1990	804	06/09/1990	661	08/02/1990	379	09/25/1990	268
04/17/1990	713	06/10/1990	467	08/03/1990	346	09/26/1990	240
04/18/1990	650	06/11/1990	394	08/04/1990	386	09/27/1990	224
04/19/1990	592	06/12/1990	369	08/05/1990	346	09/28/1990	219
04/20/1990	622	06/13/1990	352	08/06/1990	283	09/29/1990	213
04/21/1990	913	06/14/1990	974	08/07/1990	261	09/30/1990	211
04/22/1990	758	06/15/1990	685	08/08/1990	246	10/01/1990	207
04/23/1990	674	06/16/1990	484	08/09/1990	225	10/02/1990	212
04/24/1990	626	06/17/1990	513	08/10/1990	250	10/03/1990	241
04/25/1990	592	06/18/1990	481	08/11/1990	1050	10/04/1990	416
04/26/1990	568	06/19/1990	466	08/12/1990	883	10/05/1990	274
04/27/1990	525	06/20/1990	527	08/13/1990	1400	10/06/1990	233
04/28/1990	487	06/21/1990	538	08/14/1990	632	10/07/1990	355
04/29/1990	450	06/22/1990	841	08/15/1990	403	10/08/1990	601
04/30/1990	426	06/23/1990	1100	08/16/1990	302	10/09/1990	1630
05/01/1990	410	06/24/1990	773	08/17/1990	294	10/10/1990	2130
05/02/1990	384	06/25/1990	594	08/18/1990	1980	10/11/1990	2010
05/03/1990	362	06/26/1990	556	08/19/1990	3370	10/12/1990	1370
05/04/1990	1600	06/27/1990	606	08/20/1990	4040	10/13/1990	926
05/05/1990	2040	06/28/1990	556	08/21/1990	4570	10/14/1990	775
05/06/1990	1580	06/29/1990	1580	08/22/1990	4630	10/15/1990	930
05/07/1990	1150	06/30/1990	1570	08/23/1990	3720	10/16/1990	720
05/08/1990	872	07/01/1990	1120	08/24/1990	2580	10/17/1990	647
05/09/1990	1460	07/02/1990	823	08/25/1990	1700	10/18/1990	1010
05/10/1990	5490	07/03/1990	674	08/26/1990	1190	10/19/1990	790
05/11/1990	5100	07/04/1990	580	08/27/1990	962	10/20/1990	640
05/12/1990	4120	07/05/1990	525	08/28/1990	882	10/21/1990	543
05/13/1990	3210	07/06/1990	504	08/29/1990	809	10/22/1990	491
05/14/1990	2400	07/07/1990	449	08/30/1990	717	10/23/1990	449
05/15/1990	1940	07/08/1990	381	08/31/1990	597	10/24/1990	413
05/16/1990	1790	07/09/1990	336	09/01/1990	469	10/25/1990	381
05/17/1990	1680	07/10/1990	321	09/02/1990	389	10/26/1990	355
05/18/1990	1560	07/11/1990	525	09/03/1990	324	10/27/1990	322
05/19/1990	1560	07/12/1990	335	09/04/1990	294	10/28/1990	302
05/20/1990	1790	07/13/1990	276	09/05/1990	301	10/29/1990	286
05/21/1990	1740	07/14/1990	267	09/06/1990	279	10/30/1990	283
05/22/1990	1630	07/15/1990	343	09/07/1990	722	10/31/1990	277
05/23/1990	1480	07/16/1990	480	09/08/1990	391	11/01/1990	266
05/24/1990	1350	07/17/1990	312	09/09/1990	281	11/02/1990	257
05/25/1990	1460	07/18/1990	267	09/10/1990	246	11/03/1990	252
05/26/1990	1920	07/19/1990	545	09/11/1990	270	11/04/1990	376
05/27/1990	1630	07/20/1990	1640	09/12/1990	249	11/05/1990	2370
05/28/1990	1310	07/21/1990	1390	09/13/1990	237	11/06/1990	2800
05/29/1990	1110	07/22/1990	860	09/14/1990	298	11/07/1990	2190
05/30/1990	963	07/23/1990	630	09/15/1990	349	11/08/1990	1470
05/31/1990	844	07/24/1990	544	09/16/1990	281	11/09/1990	1100
06/01/1990	743	07/25/1990	452	09/17/1990	257	11/10/1990	959
06/02/1990	664	07/26/1990	387	09/18/1990	245	11/11/1990	920
06/03/1990	607	07/27/1990	340	09/19/1990	246	11/12/1990	852
06/04/1990	533	07/28/1990	302	09/20/1990	240	11/13/1990	792
06/05/1990	508	07/29/1990	342	09/21/1990	656	11/14/1990	761
06/06/1990	531	07/30/1990	553	09/22/1990	587	11/15/1990	721

11/16/1990	686	01/09/1991	360	03/04/1991	937	04/27/1991	1060
11/17/1990	616	01/10/1991	350	03/05/1991	819	04/28/1991	1040
11/18/1990	547	01/11/1991	367	03/06/1991	769	04/29/1991	993
11/19/1990	483	01/12/1991	398	03/07/1991	739	04/30/1991	915
11/20/1990	446	01/13/1991	399	03/08/1991	684	05/01/1991	796
11/21/1990	557	01/14/1991	392	03/09/1991	662	05/02/1991	692
11/22/1990	577	01/15/1991	415	03/10/1991	591	05/03/1991	626
11/23/1990	459	01/16/1991	971	03/11/1991	535	05/04/1991	585
11/24/1990	415	01/17/1991	1020	03/12/1991	633	05/05/1991	1230
11/25/1990	399	01/18/1991	697	03/13/1991	636	05/06/1991	1420
11/26/1990	379	01/19/1991	605	03/14/1991	654	05/07/1991	983
11/27/1990	1770	01/20/1991	630	03/15/1991	704	05/08/1991	787
11/28/1990	5030	01/21/1991	520	03/16/1991	713	05/09/1991	689
11/29/1990	4360	01/22/1991	460	03/17/1991	873	05/10/1991	627
11/30/1990	3320	01/23/1991	420	03/18/1991	1650	05/11/1991	584
12/01/1990	2120	01/24/1991	370	03/19/1991	1470	05/12/1991	537
12/02/1990	1460	01/25/1991	340	03/20/1991	1180	05/13/1991	494
12/03/1990	1510	01/26/1991	340	03/21/1991	989	05/14/1991	469
12/04/1990	1610	01/27/1991	342	03/22/1991	888	05/15/1991	434
12/05/1990	1340	01/28/1991	328	03/23/1991	1010	05/16/1991	644
12/06/1990	1150	01/29/1991	316	03/24/1991	889	05/17/1991	870
12/07/1990	1030	01/30/1991	296	03/25/1991	764	05/18/1991	957
12/08/1990	937	01/31/1991	268	03/26/1991	1080	05/19/1991	623
12/09/1990	853	02/01/1991	277	03/27/1991	1900	05/20/1991	498
12/10/1990	803	02/02/1991	325	03/28/1991	2540	05/21/1991	445
12/11/1990	774	02/03/1991	403	03/29/1991	2370	05/22/1991	421
12/12/1990	745	02/04/1991	766	03/30/1991	2060	05/23/1991	827
12/13/1990	728	02/05/1991	1180	03/31/1991	1830	05/24/1991	740
12/14/1990	709	02/06/1991	1180	04/01/1991	1720	05/25/1991	1540
12/15/1990	759	02/07/1991	1100	04/02/1991	1650	05/26/1991	2660
12/16/1990	780	02/08/1991	1010	04/03/1991	1600	05/27/1991	2190
12/17/1990	790	02/09/1991	981	04/04/1991	1570	05/28/1991	1910
12/18/1990	875	02/10/1991	986	04/05/1991	1490	05/29/1991	1320
12/19/1990	845	02/11/1991	950	04/06/1991	1310	05/30/1991	1000
12/20/1990	796	02/12/1991	867	04/07/1991	1160	05/31/1991	1000
12/21/1990	843	02/13/1991	802	04/08/1991	1050	06/01/1991	918
12/22/1990	865	02/14/1991	758	04/09/1991	2450	06/02/1991	974
12/23/1990	742	02/15/1991	648	04/10/1991	2690	06/03/1991	915
12/24/1990	547	02/16/1991	406	04/11/1991	2250	06/04/1991	788
12/25/1990	471	02/17/1991	508	04/12/1991	1730	06/05/1991	655
12/26/1990	493	02/18/1991	776	04/13/1991	1390	06/06/1991	572
12/27/1990	479	02/19/1991	1090	04/14/1991	1590	06/07/1991	499
12/28/1990	524	02/20/1991	909	04/15/1991	3790	06/08/1991	429
12/29/1990	1460	02/21/1991	804	04/16/1991	4140	06/09/1991	381
12/30/1990	1550	02/22/1991	819	04/17/1991	3630	06/10/1991	348
12/31/1990	1050	02/23/1991	782	04/18/1991	2850	06/11/1991	778
01/01/1991	798	02/24/1991	719	04/19/1991	2220	06/12/1991	528
01/02/1991	788	02/25/1991	648	04/20/1991	1830	06/13/1991	380
01/03/1991	600	02/26/1991	583	04/21/1991	1660	06/14/1991	335
01/04/1991	520	02/27/1991	522	04/22/1991	1520	06/15/1991	395
01/05/1991	500	02/28/1991	478	04/23/1991	1410	06/16/1991	398
01/06/1991	400	03/01/1991	494	04/24/1991	1420	06/17/1991	329
01/07/1991	380	03/02/1991	1120	04/25/1991	1260	06/18/1991	292
01/08/1991	370	03/03/1991	1120	04/26/1991	1100	06/19/1991	265

06/20/1991	249	08/13/1991	208	10/06/1991	1830	11/29/1991	1500
06/21/1991	237	08/14/1991	194	10/07/1991	1090	11/30/1991	2090
06/22/1991	223	08/15/1991	181	10/08/1991	615	12/01/1991	2100
06/23/1991	218	08/16/1991	176	10/09/1991	421	12/02/1991	1760
06/24/1991	212	08/17/1991	170	10/10/1991	337	12/03/1991	1430
06/25/1991	210	08/18/1991	184	10/11/1991	288	12/04/1991	1260
06/26/1991	199	08/19/1991	319	10/12/1991	248	12/05/1991	1110
06/27/1991	195	08/20/1991	247	10/13/1991	213	12/06/1991	1060
06/28/1991	188	08/21/1991	180	10/14/1991	298	12/07/1991	1150
06/29/1991	185	08/22/1991	164	10/15/1991	268	12/08/1991	1510
06/30/1991	172	08/23/1991	156	10/16/1991	215	12/09/1991	1740
07/01/1991	169	08/24/1991	148	10/17/1991	191	12/10/1991	1670
07/02/1991	166	08/25/1991	144	10/18/1991	192	12/11/1991	1510
07/03/1991	219	08/26/1991	147	10/19/1991	309	12/12/1991	1490
07/04/1991	323	08/27/1991	152	10/20/1991	240	12/13/1991	1700
07/05/1991	212	08/28/1991	154	10/21/1991	214	12/14/1991	1550
07/06/1991	173	08/29/1991	202	10/22/1991	200	12/15/1991	1360
07/07/1991	360	08/30/1991	625	10/23/1991	187	12/16/1991	1160
07/08/1991	348	08/31/1991	259	10/24/1991	315	12/17/1991	1050
07/09/1991	237	09/01/1991	165	10/25/1991	1790	12/18/1991	920
07/10/1991	204	09/02/1991	146	10/26/1991	1950	12/19/1991	782
07/11/1991	185	09/03/1991	425	10/27/1991	2200	12/20/1991	815
07/12/1991	178	09/04/1991	698	10/28/1991	1170	12/21/1991	827
07/13/1991	166	09/05/1991	327	10/29/1991	1060	12/22/1991	789
07/14/1991	153	09/06/1991	237	10/30/1991	1820	12/23/1991	740
07/15/1991	152	09/07/1991	190	10/31/1991	1670	12/24/1991	672
07/16/1991	159	09/08/1991	164	11/01/1991	1350	12/25/1991	567
07/17/1991	155	09/09/1991	171	11/02/1991	1480	12/26/1991	476
07/18/1991	153	09/10/1991	322	11/03/1991	1120	12/27/1991	445
07/19/1991	151	09/11/1991	191	11/04/1991	835	12/28/1991	410
07/20/1991	147	09/12/1991	505	11/05/1991	686	12/29/1991	398
07/21/1991	148	09/13/1991	621	11/06/1991	598	12/30/1991	390
07/22/1991	204	09/14/1991	554	11/07/1991	541	12/31/1991	380
07/23/1991	339	09/15/1991	615	11/08/1991	477	01/01/1992	360
07/24/1991	189	09/16/1991	440	11/09/1991	416	01/02/1992	350
07/25/1991	151	09/17/1991	311	11/10/1991	376	01/03/1992	361
07/26/1991	147	09/18/1991	261	11/11/1991	351	01/04/1992	368
07/27/1991	143	09/19/1991	231	11/12/1991	336	01/05/1992	366
07/28/1991	153	09/20/1991	193	11/13/1991	310	01/06/1992	373
07/29/1991	148	09/21/1991	172	11/14/1991	331	01/07/1992	377
07/30/1991	160	09/22/1991	168	11/15/1991	1170	01/08/1992	449
07/31/1991	168	09/23/1991	167	11/16/1991	965	01/09/1992	544
08/01/1991	151	09/24/1991	184	11/17/1991	743	01/10/1992	500
08/02/1991	149	09/25/1991	219	11/18/1991	829	01/11/1992	488
08/03/1991	156	09/26/1991	188	11/19/1991	976	01/12/1992	483
08/04/1991	145	09/27/1991	167	11/20/1991	1380	01/13/1992	514
08/05/1991	140	09/28/1991	161	11/21/1991	1150	01/14/1992	550
08/06/1991	140	09/29/1991	150	11/22/1991	924	01/15/1992	522
08/07/1991	152	09/30/1991	152	11/23/1991	792	01/16/1992	317
08/08/1991	1010	10/01/1991	165	11/24/1991	719	01/17/1992	406
08/09/1991	934	10/02/1991	180	11/25/1991	645	01/18/1992	397
08/10/1991	469	10/03/1991	310	11/26/1991	567	01/19/1992	357
08/11/1991	298	10/04/1991	1210	11/27/1991	582	01/20/1992	354
08/12/1991	236	10/05/1991	2620	11/28/1991	659	01/21/1992	351

01/22/1992	347	03/16/1992	802	05/09/1992	336	07/02/1992	298
01/23/1992	615	03/17/1992	895	05/10/1992	323	07/03/1992	459
01/24/1992	557	03/18/1992	947	05/11/1992	308	07/04/1992	234
01/25/1992	456	03/19/1992	869	05/12/1992	314	07/05/1992	253
01/26/1992	428	03/20/1992	756	05/13/1992	310	07/06/1992	188
01/27/1992	406	03/21/1992	666	05/14/1992	274	07/07/1992	181
01/28/1992	375	03/22/1992	694	05/15/1992	263	07/08/1992	179
01/29/1992	345	03/23/1992	804	05/16/1992	254	07/09/1992	174
01/30/1992	337	03/24/1992	977	05/17/1992	243	07/10/1992	172
01/31/1992	334	03/25/1992	1460	05/18/1992	243	07/11/1992	181
02/01/1992	329	03/26/1992	1530	05/19/1992	229	07/12/1992	333
02/02/1992	317	03/27/1992	1380	05/20/1992	218	07/13/1992	602
02/03/1992	334	03/28/1992	1160	05/21/1992	215	07/14/1992	1240
02/04/1992	388	03/29/1992	1150	05/22/1992	209	07/15/1992	901
02/05/1992	406	03/30/1992	1180	05/23/1992	225	07/16/1992	624
02/06/1992	405	03/31/1992	1090	05/24/1992	343	07/17/1992	452
02/07/1992	390	04/01/1992	990	05/25/1992	269	07/18/1992	444
02/08/1992	362	04/02/1992	887	05/26/1992	241	07/19/1992	809
02/09/1992	320	04/03/1992	803	05/27/1992	237	07/20/1992	363
02/10/1992	303	04/04/1992	736	05/28/1992	216	07/21/1992	290
02/11/1992	306	04/05/1992	669	05/29/1992	209	07/22/1992	249
02/12/1992	275	04/06/1992	610	05/30/1992	198	07/23/1992	370
02/13/1992	267	04/07/1992	558	05/31/1992	196	07/24/1992	441
02/14/1992	269	04/08/1992	514	06/01/1992	192	07/25/1992	335
02/15/1992	835	04/09/1992	471	06/02/1992	198	07/26/1992	321
02/16/1992	629	04/10/1992	458	06/03/1992	181	07/27/1992	283
02/17/1992	541	04/11/1992	870	06/04/1992	183	07/28/1992	250
02/18/1992	701	04/12/1992	795	06/05/1992	184	07/29/1992	220
02/19/1992	1020	04/13/1992	659	06/06/1992	189	07/30/1992	509
02/20/1992	1040	04/14/1992	623	06/07/1992	184	07/31/1992	849
02/21/1992	936	04/15/1992	971	06/08/1992	182	08/01/1992	544
02/22/1992	856	04/16/1992	1650	06/09/1992	185	08/02/1992	416
02/23/1992	809	04/17/1992	1690	06/10/1992	169	08/03/1992	620
02/24/1992	824	04/18/1992	1450	06/11/1992	161	08/04/1992	441
02/25/1992	1100	04/19/1992	1160	06/12/1992	161	08/05/1992	326
02/26/1992	960	04/20/1992	1050	06/13/1992	156	08/06/1992	249
02/27/1992	871	04/21/1992	942	06/14/1992	210	08/07/1992	275
02/28/1992	777	04/22/1992	845	06/15/1992	277	08/08/1992	647
02/29/1992	711	04/23/1992	762	06/16/1992	179	08/09/1992	404
03/01/1992	662	04/24/1992	829	06/17/1992	375	08/10/1992	305
03/02/1992	629	04/25/1992	767	06/18/1992	818	08/11/1992	255
03/03/1992	584	04/26/1992	716	06/19/1992	357	08/12/1992	300
03/04/1992	548	04/27/1992	716	06/20/1992	240	08/13/1992	428
03/05/1992	531	04/28/1992	669	06/21/1992	185	08/14/1992	326
03/06/1992	731	04/29/1992	628	06/22/1992	165	08/15/1992	241
03/07/1992	985	04/30/1992	616	06/23/1992	168	08/16/1992	205
03/08/1992	897	05/01/1992	561	06/24/1992	172	08/17/1992	192
03/09/1992	889	05/02/1992	546	06/25/1992	166	08/18/1992	202
03/10/1992	1330	05/03/1992	499	06/26/1992	162	08/19/1992	267
03/11/1992	1210	05/04/1992	462	06/27/1992	148	08/20/1992	187
03/12/1992	1130	05/05/1992	433	06/28/1992	143	08/21/1992	176
03/13/1992	1040	05/06/1992	400	06/29/1992	143	08/22/1992	151
03/14/1992	917	05/07/1992	371	06/30/1992	144	08/23/1992	161
03/15/1992	862	05/08/1992	353	07/01/1992	139	08/24/1992	167

08/25/1992	174	10/18/1992	302	12/11/1992	538	02/03/1993	703
08/26/1992	856	10/19/1992	256	12/12/1992	512	02/04/1993	627
08/27/1992	1120	10/20/1992	279	12/13/1992	489	02/05/1993	593
08/28/1992	710	10/21/1992	292	12/14/1992	475	02/06/1993	592
08/29/1992	490	10/22/1992	244	12/15/1992	534	02/07/1993	605
08/30/1992	494	10/23/1992	244	12/16/1992	2000	02/08/1993	613
08/31/1992	355	10/24/1992	233	12/17/1992	2000	02/09/1993	581
09/01/1992	274	10/25/1992	220	12/18/1992	1600	02/10/1993	582
09/02/1992	229	10/26/1992	217	12/19/1992	1200	02/11/1993	590
09/03/1992	245	10/27/1992	228	12/20/1992	980	02/12/1993	586
09/04/1992	437	10/28/1992	227	12/21/1992	912	02/13/1993	560
09/05/1992	307	10/29/1992	219	12/22/1992	854	02/14/1993	537
09/06/1992	251	10/30/1992	213	12/23/1992	799	02/15/1993	499
09/07/1992	221	10/31/1992	212	12/24/1992	694	02/16/1993	481
09/08/1992	329	11/01/1992	628	12/25/1992	534	02/17/1993	444
09/09/1992	1020	11/02/1992	2120	12/26/1992	500	02/18/1993	334
09/10/1992	1340	11/03/1992	1940	12/27/1992	533	02/19/1993	373
09/11/1992	744	11/04/1992	2270	12/28/1992	593	02/20/1993	350
09/12/1992	489	11/05/1992	1690	12/29/1992	624	02/21/1993	330
09/13/1992	369	11/06/1992	1230	12/30/1992	1050	02/22/1993	315
09/14/1992	542	11/07/1992	913	12/31/1992	2400	02/23/1993	300
09/15/1992	888	11/08/1992	772	01/01/1993	2000	02/24/1993	290
09/16/1992	1110	11/09/1992	848	01/02/1993	1400	02/25/1993	315
09/17/1992	572	11/10/1992	879	01/03/1993	1050	02/26/1993	346
09/18/1992	680	11/11/1992	910	01/04/1993	1800	02/27/1993	326
09/19/1992	654	11/12/1992	1180	01/05/1993	2800	02/28/1993	317
09/20/1992	555	11/13/1992	1500	01/06/1993	2820	03/01/1993	340
09/21/1992	720	11/14/1992	1290	01/07/1993	2410	03/02/1993	472
09/22/1992	710	11/15/1992	1080	01/08/1993	1840	03/03/1993	659
09/23/1992	573	11/16/1992	939	01/09/1993	1460	03/04/1993	1090
09/24/1992	484	11/17/1992	851	01/10/1993	1280	03/05/1993	1250
09/25/1992	425	11/18/1992	777	01/11/1993	1190	03/06/1993	1120
09/26/1992	752	11/19/1992	755	01/12/1993	1140	03/07/1993	1060
09/27/1992	1130	11/20/1992	791	01/13/1993	1390	03/08/1993	1060
09/28/1992	675	11/21/1992	1030	01/14/1993	1320	03/09/1993	1080
09/29/1992	494	11/22/1992	1050	01/15/1993	1150	03/10/1993	1130
09/30/1992	409	11/23/1992	1410	01/16/1993	1000	03/11/1993	1210
10/01/1992	357	11/24/1992	1530	01/17/1993	902	03/12/1993	1160
10/02/1992	326	11/25/1992	1410	01/18/1993	760	03/13/1993	1100
10/03/1992	285	11/26/1992	1480	01/19/1993	690	03/14/1993	971
10/04/1992	254	11/27/1992	1360	01/20/1993	623	03/15/1993	870
10/05/1992	247	11/28/1992	1220	01/21/1993	1130	03/16/1993	894
10/06/1992	248	11/29/1992	1110	01/22/1993	1920	03/17/1993	1040
10/07/1992	233	11/30/1992	1040	01/23/1993	1800	03/18/1993	1000
10/08/1992	244	12/01/1992	988	01/24/1993	1870	03/19/1993	885
10/09/1992	275	12/02/1992	949	01/25/1993	1670	03/20/1993	854
10/10/1992	231	12/03/1992	909	01/26/1993	1380	03/21/1993	837
10/11/1992	211	12/04/1992	856	01/27/1993	1230	03/22/1993	1080
10/12/1992	214	12/05/1992	797	01/28/1993	1130	03/23/1993	3130
10/13/1992	224	12/06/1992	746	01/29/1993	1040	03/24/1993	3560
10/14/1992	288	12/07/1992	695	01/30/1993	902	03/25/1993	3360
10/15/1992	999	12/08/1992	651	01/31/1993	916	03/26/1993	2810
10/16/1992	584	12/09/1992	602	02/01/1993	856	03/27/1993	2330
10/17/1992	384	12/10/1992	563	02/02/1993	800	03/28/1993	2030

03/29/1993	1860
03/30/1993	1760
03/31/1993	2370
04/01/1993	4250
04/02/1993	4640
04/03/1993	4460
04/04/1993	3840
04/05/1993	3290
04/06/1993	2940
04/07/1993	2680
04/08/1993	2660
04/09/1993	2780
04/10/1993	2610
04/11/1993	2400
04/12/1993	2150
04/13/1993	1940
04/14/1993	1760
04/15/1993	2850
04/16/1993	3930
04/17/1993	3890
04/18/1993	3390
04/19/1993	3230
04/20/1993	4550
04/21/1993	4220
04/22/1993	3700
04/23/1993	3250
04/24/1993	3030
04/25/1993	2860
04/26/1993	2620
04/27/1993	2260
04/28/1993	1840
04/29/1993	1780
04/30/1993	1700
05/01/1993	1460
05/02/1993	1310
05/03/1993	1210
05/04/1993	1190
05/05/1993	1180
05/06/1993	1060
05/07/1993	937
05/08/1993	846
05/09/1993	770
05/10/1993	693
05/11/1993	636
05/12/1993	594
05/13/1993	540
05/14/1993	504
05/15/1993	458
05/16/1993	421
05/17/1993	403
05/18/1993	386
05/19/1993	370
05/20/1993	336
05/21/1993	339

05/22/1993	338
05/23/1993	505
05/24/1993	730
05/25/1993	589
05/26/1993	453
05/27/1993	367
05/28/1993	401
05/29/1993	443
05/30/1993	692
05/31/1993	922
06/01/1993	562
06/02/1993	458
06/03/1993	403
06/04/1993	534
06/05/1993	1040
06/06/1993	609
06/07/1993	1150
06/08/1993	2460
06/09/1993	2710
06/10/1993	2200
06/11/1993	1710
06/12/1993	1260
06/13/1993	1050
06/14/1993	1480
06/15/1993	1230
06/16/1993	967
06/17/1993	868
06/18/1993	1060
06/19/1993	1830
06/20/1993	2130
06/21/1993	1910
06/22/1993	1520
06/23/1993	1190
06/24/1993	1020
06/25/1993	933
06/26/1993	928
06/27/1993	1630
06/28/1993	1870
06/29/1993	1390
06/30/1993	1680
07/01/1993	2110
07/02/1993	2340
07/03/1993	2290
07/04/1993	1950
07/05/1993	1530
07/06/1993	1450
07/07/1993	1230
07/08/1993	1110
07/09/1993	1020
07/10/1993	1200
07/11/1993	1400
07/12/1993	1350
07/13/1993	1160
07/14/1993	996

07/15/1993	813
07/16/1993	752
07/17/1993	661
07/18/1993	1180
07/19/1993	2600
07/20/1993	2760
07/21/1993	2360
07/22/1993	1540
07/23/1993	1050
07/24/1993	856
07/25/1993	1350
07/26/1993	1480
07/27/1993	1070
07/28/1993	797
07/29/1993	647
07/30/1993	527
07/31/1993	416
08/01/1993	396
08/02/1993	367
08/03/1993	338
08/04/1993	318
08/05/1993	292
08/06/1993	494
08/07/1993	346
08/08/1993	287
08/09/1993	291
08/10/1993	394
08/11/1993	320
08/12/1993	286
08/13/1993	291
08/14/1993	256
08/15/1993	534
08/16/1993	1130
08/17/1993	524
08/18/1993	368
08/19/1993	386
08/20/1993	404
08/21/1993	309
08/22/1993	276
08/23/1993	461
08/24/1993	2010
08/25/1993	1120
08/26/1993	656
08/27/1993	429
08/28/1993	348
08/29/1993	664
08/30/1993	920
08/31/1993	1110
09/01/1993	1070
09/02/1993	772
09/03/1993	752
09/04/1993	500
09/05/1993	410
09/06/1993	380

09/07/1993	350
09/08/1993	330
09/09/1993	305
09/10/1993	286
09/11/1993	282
09/12/1993	278
09/13/1993	280
09/14/1993	766
09/15/1993	323
09/16/1993	290
09/17/1993	265
09/18/1993	250
09/19/1993	245
09/20/1993	270
09/21/1993	300
09/22/1993	275
09/23/1993	250
09/24/1993	230
09/25/1993	400
09/26/1993	640
09/27/1993	800
09/28/1993	658
09/29/1993	503
09/30/1993	491

ATTACHMENT 2 TO APPENDIX F:

MODFLOW GRID DIMENSIONS

ModelCad-386
Model Design Software for Extended-DOS

Developed by

James O. Rumbaugh, III

(c) 1992 Geraghty & Miller, Inc.

Date: 10/23/1996
Time: 17:41: 7.10

Input File: D:\FLUSH3\SENSITIV\FLUSH.grd
Root Name : 1

Map File 1 : LENZ.MAP

GRID INFORMATION:

Number of Rows : 101
Number of Columns : 101
Number of Layers : 1

Total Cells : 10201
Total Active Cells: 10201
Percent Inactive : 0

GRID DIMENSIONS

>>>>> ROW SPACINGS (DELTA-Y) <<<<<

Row 1: 25.000000
Row 2: 25.000000
Row 3: 25.000000
Row 4: 25.000000
Row 5: 25.000000
Row 6: 25.000000
Row 7: 25.000000
Row 8: 25.000000
Row 9: 25.000000
Row 10: 20.000000
Row 11: 24.250000
Row 12: 20.000000
Row 13: 17.500000

Row 14: 15.000000
Row 15: 15.004000
Row 16: 15.000000
Row 17: 15.000000
Row 18: 15.000000
Row 19: 15.000000
Row 20: 15.000000
Row 21: 15.000000
Row 22: 15.000000
Row 23: 13.130000
Row 24: 16.000000
Row 25: 16.000000
Row 26: 16.000000
Row 27: 16.000000
Row 28: 16.000000
Row 29: 16.000000
Row 30: 16.000000
Row 31: 16.000000
Row 32: 16.000000
Row 33: 16.000000
Row 34: 12.290000
Row 35: 15.000000
Row 36: 14.780000
Row 37: 9.950000
Row 38: 6.660000
Row 39: 4.440000
Row 40: 3.000000
Row 41: 4.470000
Row 42: 6.660000
Row 43: 9.920000
Row 44: 7.510000
Row 45: 9.920000
Row 46: 9.920000
Row 47: 6.660000
Row 48: 4.470000
Row 49: 3.000000
Row 50: 4.470000
Row 51: 6.660000
Row 52: 9.920000
Row 53: 6.660000
Row 54: 6.660000
Row 55: 6.660000
Row 56: 7.140000
Row 57: 6.660000
Row 58: 4.470000
Row 59: 3.000000
Row 60: 4.470000
Row 61: 6.660000
Row 62: 9.920000
Row 63: 10.443000
Row 64: 6.660000
Row 65: 4.470000
Row 66: 3.000000
Row 67: 4.470000
Row 68: 6.660000

Row 69: 9.920000
Row 70: 9.920000
Row 71: 10.827000
Row 72: 14.780000
Row 73: 16.966000
Row 74: 20.000000
Row 75: 20.000000
Row 76: 20.000000
Row 77: 20.000000
Row 78: 19.920000
Row 79: 14.780000
Row 80: 9.920000
Row 81: 6.660000
Row 82: 4.470000
Row 83: 3.000000
Row 84: 4.470000
Row 85: 6.660000
Row 86: 9.920000
Row 87: 14.780000
Row 88: 23.670000
Row 89: 21.750000
Row 90: 20.000000
Row 91: 20.000000
Row 92: 20.000000
Row 93: 25.000000
Row 94: 20.000000
Row 95: 15.000000
Row 96: 10.000000
Row 97: 10.000000
Row 98: 10.000000
Row 99: 10.000000
Row 100: 10.000000
Row 101: 10.000000

Minimum Delta-Y: 3.000000
Maximum Delta-Y: 25.000000

>>>>> COLUMN SPACINGS (DELTA-X) <<<<<

Column 1: 20.000000
Column 2: 20.000000
Column 3: 20.000000
Column 4: 20.000000
Column 5: 20.000000
Column 6: 20.000000
Column 7: 20.000000
Column 8: 20.000000
Column 9: 20.000000
Column 10: 21.228000
Column 11: 24.572000
Column 12: 18.000000
Column 13: 18.000000
Column 14: 15.500000
Column 15: 14.780000
Column 16: 9.920000

Column 17: 6.660000
Column 18: 4.470000
Column 19: 3.000000
Column 20: 4.470000
Column 21: 6.660000
Column 22: 9.920000
Column 23: 10.310000
Column 24: 10.000000
Column 25: 15.650000
Column 26: 13.860000
Column 27: 9.300000
Column 28: 10.972000
Column 29: 12.898000
Column 30: 11.990000
Column 31: 9.920000
Column 32: 9.920000
Column 33: 6.660000
Column 34: 4.470000
Column 35: 3.000000
Column 36: 4.470000
Column 37: 6.660000
Column 38: 9.920000
Column 39: 14.780000
Column 40: 10.312000
Column 41: 15.000000
Column 42: 15.000000
Column 43: 15.000000
Column 44: 15.000000
Column 45: 12.678000
Column 46: 9.920000
Column 47: 6.660000
Column 48: 4.470000
Column 49: 3.000000
Column 50: 4.470000
Column 51: 6.660000
Column 52: 12.230000
Column 53: 15.000000
Column 54: 10.000000
Column 55: 19.912000
Column 56: 15.000000
Column 57: 15.000000
Column 58: 15.000000
Column 59: 12.178000
Column 60: 9.920000
Column 61: 6.660000
Column 62: 4.470000
Column 63: 3.000000
Column 64: 4.470000
Column 65: 6.660000
Column 66: 9.920000
Column 67: 14.780000
Column 68: 17.942000
Column 69: 13.058000
Column 70: 14.780000
Column 71: 14.780000

Column 72: 14.780000
Column 73: 14.780000
Column 74: 9.920000
Column 75: 6.660000
Column 76: 4.470000
Column 77: 3.000000
Column 78: 4.470000
Column 79: 6.660000
Column 80: 9.920000
Column 81: 15.500000
Column 82: 15.500000
Column 83: 15.500000
Column 84: 15.500000
Column 85: 15.500000
Column 86: 17.200000
Column 87: 15.000000
Column 88: 15.000000
Column 89: 15.000000
Column 90: 15.000000
Column 91: 15.750000
Column 92: 20.000000
Column 93: 20.000000
Column 94: 25.000000
Column 95: 25.000000
Column 96: 25.000000
Column 97: 25.000000
Column 98: 25.000000
Column 99: 25.000000
Column 100: 25.000000
Column 101: 25.000000

Minimum Delta-X: 3.000000
Maximum Delta-X: 25.000000

MODEL PARAMETER INFORMATION:

>>>>>>>>>> PARAMETER ZONES IN LAYER 1 <<<<<<<<<<

Hydraulic Cond Zone.. 49: Kx = 1.348e+001
Ky = 1.348e+001
Kz = 6.740e-001

Storage Zone..... 1: S = 3.600e-001
Sy = 3.600e-001
Porosity = 3.600e-001

Top Zone..... 21 Top = 6.000e+002

Bottom Zone..... 32 Bottom = 5.500e+002

Recharge Zone..... 1: R = 7.991e-004 Area = 1.733e+006
Concentration = 0.000e+000
Recharge Zone..... 5: R = 4.509e-002 Area = 1.624e+004

Concentration = 0.000e+000
Recharge Zone..... 6: R = 3.640e-002 Area = 2.648e+004
Concentration = 0.000e+000

MODEL BOUNDARY CONDITIONS:

Constant Heads.....: 624
Rivers.....: 0
Drains.....: 107
General Heads.....: 0
Wells.....: 5

CONSTANT HEAD CELLS:

Reach	Row	Column	Layer	Head	Concentration Time	Starting Time	Ending
2	101	1	1	588.200	0.000e+000	0.000	0.000
2	101	2	1	588.200	0.000e+000	0.000	0.000
2	101	3	1	588.200	0.000e+000	0.000	0.000
2	101	4	1	588.200	0.000e+000	0.000	0.000
2	101	5	1	588.200	0.000e+000	0.000	0.000
2	101	6	1	588.200	0.000e+000	0.000	0.000
2	101	7	1	588.200	0.000e+000	0.000	0.000
2	101	8	1	588.200	0.000e+000	0.000	0.000
2	101	9	1	588.200	0.000e+000	0.000	0.000
2	101	10	1	588.200	0.000e+000	0.000	0.000
2	101	11	1	588.200	0.000e+000	0.000	0.000
2	101	12	1	588.200	0.000e+000	0.000	0.000
2	101	13	1	588.200	0.000e+000	0.000	0.000
2	101	14	1	588.200	0.000e+000	0.000	0.000
2	101	15	1	588.200	0.000e+000	0.000	0.000
2	101	17	1	588.200	0.000e+000	0.000	0.000
2	101	20	1	588.200	0.000e+000	0.000	0.000
2	101	22	1	588.200	0.000e+000	0.000	0.000
2	101	25	1	588.200	0.000e+000	0.000	0.000
2	101	26	1	588.200	0.000e+000	0.000	0.000
2	101	27	1	588.200	0.000e+000	0.000	0.000
2	101	28	1	588.200	0.000e+000	0.000	0.000
2	101	30	1	588.200	0.000e+000	0.000	0.000
2	101	57	1	588.200	0.000e+000	0.000	0.000
2	101	69	1	588.200	0.000e+000	0.000	0.000
2	101	70	1	588.200	0.000e+000	0.000	0.000
2	101	85	1	588.200	0.000e+000	0.000	0.000
2	101	86	1	588.200	0.000e+000	0.000	0.000
2	101	87	1	588.200	0.000e+000	0.000	0.000
2	101	88	1	588.200	0.000e+000	0.000	0.000
2	101	89	1	588.200	0.000e+000	0.000	0.000
2	101	90	1	588.200	0.000e+000	0.000	0.000
2	101	91	1	588.200	0.000e+000	0.000	0.000
2	101	92	1	588.200	0.000e+000	0.000	0.000
2	101	93	1	588.200	0.000e+000	0.000	0.000
2	101	94	1	588.200	0.000e+000	0.000	0.000
2	101	95	1	588.200	0.000e+000	0.000	0.000

2	101	96	1	588.200	0.000e+000	0.000	0.000
2	101	97	1	588.200	0.000e+000	0.000	0.000
2	101	98	1	588.200	0.000e+000	0.000	0.000
2	101	99	1	588.200	0.000e+000	0.000	0.000
2	101	100	1	588.200	0.000e+000	0.000	0.000
2	101	101	1	588.200	0.000e+000	0.000	0.000
1	1	1	1	591.500	0.000e+000	0.000	0.000
1	1	2	1	591.500	0.000e+000	0.000	0.000
1	1	3	1	591.500	0.000e+000	0.000	0.000
1	1	4	1	591.500	0.000e+000	0.000	0.000
1	1	5	1	591.500	0.000e+000	0.000	0.000
1	1	6	1	591.500	0.000e+000	0.000	0.000
1	1	7	1	591.500	0.000e+000	0.000	0.000
1	1	8	1	591.500	0.000e+000	0.000	0.000
1	1	9	1	591.500	0.000e+000	0.000	0.000
1	1	10	1	591.500	0.000e+000	0.000	0.000
1	1	11	1	591.500	0.000e+000	0.000	0.000
1	1	12	1	591.500	0.000e+000	0.000	0.000
1	1	13	1	591.500	0.000e+000	0.000	0.000
1	1	14	1	591.500	0.000e+000	0.000	0.000
1	1	15	1	591.500	0.000e+000	0.000	0.000
1	1	17	1	591.500	0.000e+000	0.000	0.000
1	1	20	1	591.500	0.000e+000	0.000	0.000
1	1	22	1	591.500	0.000e+000	0.000	0.000
1	1	25	1	591.500	0.000e+000	0.000	0.000
1	1	26	1	591.500	0.000e+000	0.000	0.000
1	1	27	1	591.500	0.000e+000	0.000	0.000
1	1	28	1	591.500	0.000e+000	0.000	0.000
1	1	30	1	591.500	0.000e+000	0.000	0.000
1	1	70	1	591.500	0.000e+000	0.000	0.000
1	1	86	1	591.500	0.000e+000	0.000	0.000
1	1	87	1	591.500	0.000e+000	0.000	0.000
1	1	88	1	591.500	0.000e+000	0.000	0.000
1	1	89	1	591.500	0.000e+000	0.000	0.000
1	1	90	1	591.500	0.000e+000	0.000	0.000
1	1	91	1	591.500	0.000e+000	0.000	0.000
1	1	92	1	591.500	0.000e+000	0.000	0.000
1	1	93	1	591.500	0.000e+000	0.000	0.000
1	1	94	1	591.500	0.000e+000	0.000	0.000
1	1	95	1	591.500	0.000e+000	0.000	0.000
1	1	96	1	591.500	0.000e+000	0.000	0.000
1	1	97	1	591.500	0.000e+000	0.000	0.000
1	1	98	1	591.500	0.000e+000	0.000	0.000
1	1	99	1	591.500	0.000e+000	0.000	0.000
1	1	100	1	591.500	0.000e+000	0.000	0.000
1	1	101	1	591.500	0.000e+000	0.000	0.000
2	95	1	1	588.200	0.000e+000	0.000	0.000
2	95	2	1	588.200	0.000e+000	0.000	0.000
2	95	3	1	588.200	0.000e+000	0.000	0.000
2	95	4	1	588.200	0.000e+000	0.000	0.000
2	95	5	1	588.200	0.000e+000	0.000	0.000
2	95	6	1	588.200	0.000e+000	0.000	0.000
2	95	7	1	588.200	0.000e+000	0.000	0.000
2	95	8	1	588.200	0.000e+000	0.000	0.000
2	95	9	1	588.200	0.000e+000	0.000	0.000

2	95	10	1	588.200	0.000e+000	0.000	0.000
2	96	1	1	588.200	0.000e+000	0.000	0.000
2	96	2	1	588.200	0.000e+000	0.000	0.000
2	96	3	1	588.200	0.000e+000	0.000	0.000
2	96	4	1	588.200	0.000e+000	0.000	0.000
2	96	5	1	588.200	0.000e+000	0.000	0.000
2	96	6	1	588.200	0.000e+000	0.000	0.000
2	96	7	1	588.200	0.000e+000	0.000	0.000
2	96	8	1	588.200	0.000e+000	0.000	0.000
2	96	9	1	588.200	0.000e+000	0.000	0.000
2	96	10	1	588.200	0.000e+000	0.000	0.000
2	97	1	1	588.200	0.000e+000	0.000	0.000
2	97	2	1	588.200	0.000e+000	0.000	0.000
2	97	3	1	588.200	0.000e+000	0.000	0.000
2	97	4	1	588.200	0.000e+000	0.000	0.000
2	97	5	1	588.200	0.000e+000	0.000	0.000
2	97	6	1	588.200	0.000e+000	0.000	0.000
2	97	7	1	588.200	0.000e+000	0.000	0.000
2	97	8	1	588.200	0.000e+000	0.000	0.000
2	97	9	1	588.200	0.000e+000	0.000	0.000
2	97	10	1	588.200	0.000e+000	0.000	0.000
2	98	1	1	588.200	0.000e+000	0.000	0.000
2	98	2	1	588.200	0.000e+000	0.000	0.000
2	98	3	1	588.200	0.000e+000	0.000	0.000
2	98	4	1	588.200	0.000e+000	0.000	0.000
2	98	5	1	588.200	0.000e+000	0.000	0.000
2	98	6	1	588.200	0.000e+000	0.000	0.000
2	98	7	1	588.200	0.000e+000	0.000	0.000
2	98	8	1	588.200	0.000e+000	0.000	0.000
2	98	9	1	588.200	0.000e+000	0.000	0.000
2	98	10	1	588.200	0.000e+000	0.000	0.000
2	99	1	1	588.200	0.000e+000	0.000	0.000
2	99	2	1	588.200	0.000e+000	0.000	0.000
2	99	3	1	588.200	0.000e+000	0.000	0.000
2	99	4	1	588.200	0.000e+000	0.000	0.000
2	99	5	1	588.200	0.000e+000	0.000	0.000
2	99	6	1	588.200	0.000e+000	0.000	0.000
2	99	7	1	588.200	0.000e+000	0.000	0.000
2	99	8	1	588.200	0.000e+000	0.000	0.000
2	99	9	1	588.200	0.000e+000	0.000	0.000
2	99	10	1	588.200	0.000e+000	0.000	0.000
2	100	1	1	588.200	0.000e+000	0.000	0.000
2	100	2	1	588.200	0.000e+000	0.000	0.000
2	100	3	1	588.200	0.000e+000	0.000	0.000
2	100	4	1	588.200	0.000e+000	0.000	0.000
2	100	5	1	588.200	0.000e+000	0.000	0.000
2	100	6	1	588.200	0.000e+000	0.000	0.000
2	100	7	1	588.200	0.000e+000	0.000	0.000
2	100	8	1	588.200	0.000e+000	0.000	0.000
2	100	9	1	588.200	0.000e+000	0.000	0.000
2	100	10	1	588.200	0.000e+000	0.000	0.000
2	96	11	1	588.200	0.000e+000	0.000	0.000
2	96	12	1	588.200	0.000e+000	0.000	0.000
2	96	13	1	588.200	0.000e+000	0.000	0.000
2	96	14	1	588.200	0.000e+000	0.000	0.000

2	96	15	1	588.200	0.000e+000	0.000	0.000
2	96	17	1	588.200	0.000e+000	0.000	0.000
2	96	20	1	588.200	0.000e+000	0.000	0.000
2	96	22	1	588.200	0.000e+000	0.000	0.000
2	96	25	1	588.200	0.000e+000	0.000	0.000
2	96	26	1	588.200	0.000e+000	0.000	0.000
2	96	27	1	588.200	0.000e+000	0.000	0.000
2	96	28	1	588.200	0.000e+000	0.000	0.000
2	96	30	1	588.200	0.000e+000	0.000	0.000
2	97	11	1	588.200	0.000e+000	0.000	0.000
2	97	12	1	588.200	0.000e+000	0.000	0.000
2	97	13	1	588.200	0.000e+000	0.000	0.000
2	97	14	1	588.200	0.000e+000	0.000	0.000
2	97	15	1	588.200	0.000e+000	0.000	0.000
2	97	17	1	588.200	0.000e+000	0.000	0.000
2	97	20	1	588.200	0.000e+000	0.000	0.000
2	97	22	1	588.200	0.000e+000	0.000	0.000
2	97	25	1	588.200	0.000e+000	0.000	0.000
2	97	26	1	588.200	0.000e+000	0.000	0.000
2	97	27	1	588.200	0.000e+000	0.000	0.000
2	97	28	1	588.200	0.000e+000	0.000	0.000
2	97	30	1	588.200	0.000e+000	0.000	0.000
2	98	11	1	588.200	0.000e+000	0.000	0.000
2	98	12	1	588.200	0.000e+000	0.000	0.000
2	98	13	1	588.200	0.000e+000	0.000	0.000
2	98	14	1	588.200	0.000e+000	0.000	0.000
2	98	15	1	588.200	0.000e+000	0.000	0.000
2	98	17	1	588.200	0.000e+000	0.000	0.000
2	98	20	1	588.200	0.000e+000	0.000	0.000
2	98	22	1	588.200	0.000e+000	0.000	0.000
2	98	25	1	588.200	0.000e+000	0.000	0.000
2	98	26	1	588.200	0.000e+000	0.000	0.000
2	98	27	1	588.200	0.000e+000	0.000	0.000
2	98	28	1	588.200	0.000e+000	0.000	0.000
2	98	30	1	588.200	0.000e+000	0.000	0.000
2	99	11	1	588.200	0.000e+000	0.000	0.000
2	99	12	1	588.200	0.000e+000	0.000	0.000
2	99	13	1	588.200	0.000e+000	0.000	0.000
2	99	14	1	588.200	0.000e+000	0.000	0.000
2	99	15	1	588.200	0.000e+000	0.000	0.000
2	99	17	1	588.200	0.000e+000	0.000	0.000
2	99	20	1	588.200	0.000e+000	0.000	0.000
2	99	22	1	588.200	0.000e+000	0.000	0.000
2	99	25	1	588.200	0.000e+000	0.000	0.000
2	99	26	1	588.200	0.000e+000	0.000	0.000
2	99	27	1	588.200	0.000e+000	0.000	0.000
2	99	28	1	588.200	0.000e+000	0.000	0.000
2	99	30	1	588.200	0.000e+000	0.000	0.000
2	100	11	1	588.200	0.000e+000	0.000	0.000
2	100	12	1	588.200	0.000e+000	0.000	0.000
2	100	13	1	588.200	0.000e+000	0.000	0.000
2	100	14	1	588.200	0.000e+000	0.000	0.000
2	100	15	1	588.200	0.000e+000	0.000	0.000
2	100	17	1	588.200	0.000e+000	0.000	0.000
2	100	20	1	588.200	0.000e+000	0.000	0.000

2	100	22	1	588.200	0.000e+000	0.000	0.000
2	100	25	1	588.200	0.000e+000	0.000	0.000
2	100	26	1	588.200	0.000e+000	0.000	0.000
2	100	27	1	588.200	0.000e+000	0.000	0.000
2	100	28	1	588.200	0.000e+000	0.000	0.000
2	100	30	1	588.200	0.000e+000	0.000	0.000
2	95	11	1	588.200	0.000e+000	0.000	0.000
2	95	12	1	588.200	0.000e+000	0.000	0.000
2	95	13	1	588.200	0.000e+000	0.000	0.000
2	95	14	1	588.200	0.000e+000	0.000	0.000
2	95	15	1	588.200	0.000e+000	0.000	0.000
2	95	17	1	588.200	0.000e+000	0.000	0.000
2	95	20	1	588.200	0.000e+000	0.000	0.000
1	97	57	1	588.200	0.000e+000	0.000	0.000
1	98	57	1	588.200	0.000e+000	0.000	0.000
1	99	57	1	588.200	0.000e+000	0.000	0.000
1	100	57	1	588.200	0.000e+000	0.000	0.000
1	98	69	1	588.200	0.000e+000	0.000	0.000
1	98	70	1	588.200	0.000e+000	0.000	0.000
1	98	85	1	588.200	0.000e+000	0.000	0.000
1	98	86	1	588.200	0.000e+000	0.000	0.000
1	98	87	1	588.200	0.000e+000	0.000	0.000
1	99	69	1	588.200	0.000e+000	0.000	0.000
1	99	70	1	588.200	0.000e+000	0.000	0.000
2	99	85	1	588.200	0.000e+000	0.000	0.000
2	99	86	1	588.200	0.000e+000	0.000	0.000
2	99	87	1	588.200	0.000e+000	0.000	0.000
1	100	69	1	588.200	0.000e+000	0.000	0.000
1	100	70	1	588.200	0.000e+000	0.000	0.000
2	100	85	1	588.200	0.000e+000	0.000	0.000
2	100	86	1	588.200	0.000e+000	0.000	0.000
2	100	87	1	588.200	0.000e+000	0.000	0.000
2	99	88	1	588.200	0.000e+000	0.000	0.000
2	99	89	1	588.200	0.000e+000	0.000	0.000
2	99	90	1	588.200	0.000e+000	0.000	0.000
2	99	91	1	588.200	0.000e+000	0.000	0.000
2	99	92	1	588.200	0.000e+000	0.000	0.000
2	99	93	1	588.200	0.000e+000	0.000	0.000
2	99	94	1	588.200	0.000e+000	0.000	0.000
2	99	95	1	588.200	0.000e+000	0.000	0.000
2	99	96	1	588.200	0.000e+000	0.000	0.000
2	99	97	1	588.200	0.000e+000	0.000	0.000
2	99	98	1	588.200	0.000e+000	0.000	0.000
2	99	99	1	588.200	0.000e+000	0.000	0.000
2	99	100	1	588.200	0.000e+000	0.000	0.000
2	99	101	1	588.200	0.000e+000	0.000	0.000
2	100	88	1	588.200	0.000e+000	0.000	0.000
2	100	89	1	588.200	0.000e+000	0.000	0.000
2	100	90	1	588.200	0.000e+000	0.000	0.000
2	100	91	1	588.200	0.000e+000	0.000	0.000
2	100	92	1	588.200	0.000e+000	0.000	0.000
2	100	93	1	588.200	0.000e+000	0.000	0.000
2	100	94	1	588.200	0.000e+000	0.000	0.000
2	100	95	1	588.200	0.000e+000	0.000	0.000
2	100	96	1	588.200	0.000e+000	0.000	0.000

2	100	97	1	588.200	0.000e+000	0.000	0.000
2	100	98	1	588.200	0.000e+000	0.000	0.000
2	100	99	1	588.200	0.000e+000	0.000	0.000
2	100	100	1	588.200	0.000e+000	0.000	0.000
2	100	101	1	588.200	0.000e+000	0.000	0.000
2	96	29	1	588.200	0.000e+000	0.000	0.000
2	96	31	1	588.200	0.000e+000	0.000	0.000
2	96	37	1	588.200	0.000e+000	0.000	0.000
2	96	38	1	588.200	0.000e+000	0.000	0.000
2	96	40	1	588.200	0.000e+000	0.000	0.000
2	96	41	1	588.200	0.000e+000	0.000	0.000
2	96	42	1	588.200	0.000e+000	0.000	0.000
2	96	43	1	588.200	0.000e+000	0.000	0.000
2	96	44	1	588.200	0.000e+000	0.000	0.000
2	96	45	1	588.200	0.000e+000	0.000	0.000
2	96	46	1	588.200	0.000e+000	0.000	0.000
2	96	49	1	588.200	0.000e+000	0.000	0.000
2	96	50	1	588.200	0.000e+000	0.000	0.000
2	96	53	1	588.200	0.000e+000	0.000	0.000
2	96	54	1	588.200	0.000e+000	0.000	0.000
2	96	55	1	588.200	0.000e+000	0.000	0.000
2	96	56	1	588.200	0.000e+000	0.000	0.000
2	97	29	1	588.200	0.000e+000	0.000	0.000
2	97	31	1	588.200	0.000e+000	0.000	0.000
2	97	37	1	588.200	0.000e+000	0.000	0.000
2	97	38	1	588.200	0.000e+000	0.000	0.000
2	97	40	1	588.200	0.000e+000	0.000	0.000
2	97	41	1	588.200	0.000e+000	0.000	0.000
2	97	42	1	588.200	0.000e+000	0.000	0.000
2	97	43	1	588.200	0.000e+000	0.000	0.000
2	97	44	1	588.200	0.000e+000	0.000	0.000
2	97	45	1	588.200	0.000e+000	0.000	0.000
2	97	46	1	588.200	0.000e+000	0.000	0.000
2	97	49	1	588.200	0.000e+000	0.000	0.000
2	97	50	1	588.200	0.000e+000	0.000	0.000
2	97	53	1	588.200	0.000e+000	0.000	0.000
2	97	54	1	588.200	0.000e+000	0.000	0.000
2	97	55	1	588.200	0.000e+000	0.000	0.000
2	97	56	1	588.200	0.000e+000	0.000	0.000
2	98	29	1	588.200	0.000e+000	0.000	0.000
2	98	31	1	588.200	0.000e+000	0.000	0.000
2	98	37	1	588.200	0.000e+000	0.000	0.000
2	98	38	1	588.200	0.000e+000	0.000	0.000
2	98	40	1	588.200	0.000e+000	0.000	0.000
2	98	41	1	588.200	0.000e+000	0.000	0.000
2	98	42	1	588.200	0.000e+000	0.000	0.000
2	98	43	1	588.200	0.000e+000	0.000	0.000
2	98	44	1	588.200	0.000e+000	0.000	0.000
2	98	45	1	588.200	0.000e+000	0.000	0.000
2	98	46	1	588.200	0.000e+000	0.000	0.000
2	98	49	1	588.200	0.000e+000	0.000	0.000
2	98	50	1	588.200	0.000e+000	0.000	0.000
2	98	53	1	588.200	0.000e+000	0.000	0.000
2	98	54	1	588.200	0.000e+000	0.000	0.000
2	98	55	1	588.200	0.000e+000	0.000	0.000

2	98	56	1	588.200	0.000e+000	0.000	0.000
2	99	29	1	588.200	0.000e+000	0.000	0.000
2	99	31	1	588.200	0.000e+000	0.000	0.000
2	99	37	1	588.200	0.000e+000	0.000	0.000
2	99	38	1	588.200	0.000e+000	0.000	0.000
2	99	40	1	588.200	0.000e+000	0.000	0.000
2	99	41	1	588.200	0.000e+000	0.000	0.000
2	99	42	1	588.200	0.000e+000	0.000	0.000
2	99	43	1	588.200	0.000e+000	0.000	0.000
2	99	44	1	588.200	0.000e+000	0.000	0.000
2	99	45	1	588.200	0.000e+000	0.000	0.000
2	99	46	1	588.200	0.000e+000	0.000	0.000
2	99	49	1	588.200	0.000e+000	0.000	0.000
2	99	50	1	588.200	0.000e+000	0.000	0.000
2	99	53	1	588.200	0.000e+000	0.000	0.000
2	99	54	1	588.200	0.000e+000	0.000	0.000
2	99	55	1	588.200	0.000e+000	0.000	0.000
2	99	56	1	588.200	0.000e+000	0.000	0.000
2	100	29	1	588.200	0.000e+000	0.000	0.000
2	100	31	1	588.200	0.000e+000	0.000	0.000
2	100	37	1	588.200	0.000e+000	0.000	0.000
2	100	38	1	588.200	0.000e+000	0.000	0.000
2	100	40	1	588.200	0.000e+000	0.000	0.000
2	100	41	1	588.200	0.000e+000	0.000	0.000
2	100	42	1	588.200	0.000e+000	0.000	0.000
2	100	43	1	588.200	0.000e+000	0.000	0.000
2	100	44	1	588.200	0.000e+000	0.000	0.000
2	100	45	1	588.200	0.000e+000	0.000	0.000
2	100	46	1	588.200	0.000e+000	0.000	0.000
2	100	49	1	588.200	0.000e+000	0.000	0.000
2	100	50	1	588.200	0.000e+000	0.000	0.000
2	100	53	1	588.200	0.000e+000	0.000	0.000
2	100	54	1	588.200	0.000e+000	0.000	0.000
2	100	55	1	588.200	0.000e+000	0.000	0.000
2	100	56	1	588.200	0.000e+000	0.000	0.000
2	101	29	1	588.200	0.000e+000	0.000	0.000
2	101	31	1	588.200	0.000e+000	0.000	0.000
2	101	37	1	588.200	0.000e+000	0.000	0.000
2	101	38	1	588.200	0.000e+000	0.000	0.000
2	101	40	1	588.200	0.000e+000	0.000	0.000
2	101	41	1	588.200	0.000e+000	0.000	0.000
2	101	42	1	588.200	0.000e+000	0.000	0.000
2	101	43	1	588.200	0.000e+000	0.000	0.000
2	101	44	1	588.200	0.000e+000	0.000	0.000
2	101	45	1	588.200	0.000e+000	0.000	0.000
2	101	46	1	588.200	0.000e+000	0.000	0.000
2	101	49	1	588.200	0.000e+000	0.000	0.000
2	101	50	1	588.200	0.000e+000	0.000	0.000
2	101	53	1	588.200	0.000e+000	0.000	0.000
2	101	54	1	588.200	0.000e+000	0.000	0.000
2	101	55	1	588.200	0.000e+000	0.000	0.000
2	101	56	1	588.200	0.000e+000	0.000	0.000
1	98	58	1	588.200	0.000e+000	0.000	0.000
1	98	59	1	588.200	0.000e+000	0.000	0.000
1	98	60	1	588.200	0.000e+000	0.000	0.000

1	98	63	1	588.200	0.000e+000	0.000	0.000
1	98	65	1	588.200	0.000e+000	0.000	0.000
1	98	67	1	588.200	0.000e+000	0.000	0.000
1	98	68	1	588.200	0.000e+000	0.000	0.000
1	98	71	1	588.200	0.000e+000	0.000	0.000
1	98	72	1	588.200	0.000e+000	0.000	0.000
1	98	73	1	588.200	0.000e+000	0.000	0.000
1	98	76	1	588.200	0.000e+000	0.000	0.000
1	98	77	1	588.200	0.000e+000	0.000	0.000
1	98	80	1	588.200	0.000e+000	0.000	0.000
1	98	81	1	588.200	0.000e+000	0.000	0.000
1	98	82	1	588.200	0.000e+000	0.000	0.000
1	98	83	1	588.200	0.000e+000	0.000	0.000
1	98	84	1	588.200	0.000e+000	0.000	0.000
1	99	58	1	588.200	0.000e+000	0.000	0.000
1	99	59	1	588.200	0.000e+000	0.000	0.000
1	99	60	1	588.200	0.000e+000	0.000	0.000
1	99	63	1	588.200	0.000e+000	0.000	0.000
1	99	65	1	588.200	0.000e+000	0.000	0.000
1	99	67	1	588.200	0.000e+000	0.000	0.000
1	99	68	1	588.200	0.000e+000	0.000	0.000
1	99	71	1	588.200	0.000e+000	0.000	0.000
1	99	72	1	588.200	0.000e+000	0.000	0.000
1	99	73	1	588.200	0.000e+000	0.000	0.000
1	99	76	1	588.200	0.000e+000	0.000	0.000
1	99	77	1	588.200	0.000e+000	0.000	0.000
1	99	80	1	588.200	0.000e+000	0.000	0.000
1	99	81	1	588.200	0.000e+000	0.000	0.000
1	99	82	1	588.200	0.000e+000	0.000	0.000
2	99	83	1	588.200	0.000e+000	0.000	0.000
2	99	84	1	588.200	0.000e+000	0.000	0.000
1	100	58	1	588.200	0.000e+000	0.000	0.000
1	100	59	1	588.200	0.000e+000	0.000	0.000
1	100	60	1	588.200	0.000e+000	0.000	0.000
1	100	63	1	588.200	0.000e+000	0.000	0.000
1	100	65	1	588.200	0.000e+000	0.000	0.000
1	100	67	1	588.200	0.000e+000	0.000	0.000
1	100	68	1	588.200	0.000e+000	0.000	0.000
1	100	71	1	588.200	0.000e+000	0.000	0.000
1	100	72	1	588.200	0.000e+000	0.000	0.000
1	100	73	1	588.200	0.000e+000	0.000	0.000
1	100	76	1	588.200	0.000e+000	0.000	0.000
1	100	77	1	588.200	0.000e+000	0.000	0.000
1	100	80	1	588.200	0.000e+000	0.000	0.000
1	100	81	1	588.200	0.000e+000	0.000	0.000
1	100	82	1	588.200	0.000e+000	0.000	0.000
2	100	83	1	588.200	0.000e+000	0.000	0.000
2	100	84	1	588.200	0.000e+000	0.000	0.000
1	101	58	1	588.200	0.000e+000	0.000	0.000
1	101	59	1	588.200	0.000e+000	0.000	0.000
1	101	60	1	588.200	0.000e+000	0.000	0.000
1	101	63	1	588.200	0.000e+000	0.000	0.000
1	101	65	1	588.200	0.000e+000	0.000	0.000
1	101	67	1	588.200	0.000e+000	0.000	0.000
1	101	68	1	588.200	0.000e+000	0.000	0.000

1	101	71	1	588.200	0.000e+000	0.000	0.000
1	101	72	1	588.200	0.000e+000	0.000	0.000
1	101	73	1	588.200	0.000e+000	0.000	0.000
1	101	76	1	588.200	0.000e+000	0.000	0.000
1	101	77	1	588.200	0.000e+000	0.000	0.000
1	101	80	1	588.200	0.000e+000	0.000	0.000
1	101	81	1	588.200	0.000e+000	0.000	0.000
1	101	82	1	588.200	0.000e+000	0.000	0.000
2	101	83	1	588.200	0.000e+000	0.000	0.000
2	101	84	1	588.200	0.000e+000	0.000	0.000
1	1	40	1	591.500	0.000e+000	0.000	0.000
1	1	29	1	591.500	0.000e+000	0.000	0.000
1	1	31	1	591.500	0.000e+000	0.000	0.000
1	1	37	1	591.500	0.000e+000	0.000	0.000
1	1	38	1	591.500	0.000e+000	0.000	0.000
1	1	41	1	591.500	0.000e+000	0.000	0.000
1	1	42	1	591.500	0.000e+000	0.000	0.000
1	1	43	1	591.500	0.000e+000	0.000	0.000
1	1	44	1	591.500	0.000e+000	0.000	0.000
1	1	45	1	591.500	0.000e+000	0.000	0.000
1	1	46	1	591.500	0.000e+000	0.000	0.000
1	1	49	1	591.500	0.000e+000	0.000	0.000
1	1	50	1	591.500	0.000e+000	0.000	0.000
1	1	53	1	591.500	0.000e+000	0.000	0.000
1	1	54	1	591.500	0.000e+000	0.000	0.000
1	1	55	1	591.500	0.000e+000	0.000	0.000
1	1	56	1	591.500	0.000e+000	0.000	0.000
1	1	57	1	591.500	0.000e+000	0.000	0.000
1	1	65	1	591.500	0.000e+000	0.000	0.000
1	1	67	1	591.500	0.000e+000	0.000	0.000
1	1	68	1	591.500	0.000e+000	0.000	0.000
1	1	69	1	591.500	0.000e+000	0.000	0.000
1	1	71	1	591.500	0.000e+000	0.000	0.000
1	1	72	1	591.500	0.000e+000	0.000	0.000
1	1	73	1	591.500	0.000e+000	0.000	0.000
1	1	76	1	591.500	0.000e+000	0.000	0.000
1	1	77	1	591.500	0.000e+000	0.000	0.000
1	1	80	1	591.500	0.000e+000	0.000	0.000
1	1	81	1	591.500	0.000e+000	0.000	0.000
1	1	82	1	591.500	0.000e+000	0.000	0.000
1	1	83	1	591.500	0.000e+000	0.000	0.000
1	1	84	1	591.500	0.000e+000	0.000	0.000
1	1	85	1	591.500	0.000e+000	0.000	0.000
1	1	58	1	591.500	0.000e+000	0.000	0.000
1	1	59	1	591.500	0.000e+000	0.000	0.000
1	1	60	1	591.500	0.000e+000	0.000	0.000
1	1	63	1	591.500	0.000e+000	0.000	0.000
1	1	16	1	591.500	0.000e+000	0.000	0.000
1	1	18	1	591.500	0.000e+000	0.000	0.000
1	1	19	1	591.500	0.000e+000	0.000	0.000
1	1	21	1	591.500	0.000e+000	0.000	0.000
1	1	23	1	591.500	0.000e+000	0.000	0.000
1	1	32	1	591.500	0.000e+000	0.000	0.000
1	1	33	1	591.500	0.000e+000	0.000	0.000
1	1	34	1	591.500	0.000e+000	0.000	0.000

1	1	35	1	591.500	0.000e+000	0.000	0.000
1	1	36	1	591.500	0.000e+000	0.000	0.000
1	1	39	1	591.500	0.000e+000	0.000	0.000
1	1	47	1	591.500	0.000e+000	0.000	0.000
1	1	48	1	591.500	0.000e+000	0.000	0.000
1	1	51	1	591.500	0.000e+000	0.000	0.000
1	1	52	1	591.500	0.000e+000	0.000	0.000
1	1	61	1	591.500	0.000e+000	0.000	0.000
1	1	62	1	591.500	0.000e+000	0.000	0.000
1	1	64	1	591.500	0.000e+000	0.000	0.000
1	1	66	1	591.500	0.000e+000	0.000	0.000
1	1	74	1	591.500	0.000e+000	0.000	0.000
1	1	75	1	591.500	0.000e+000	0.000	0.000
1	1	78	1	591.500	0.000e+000	0.000	0.000
1	1	79	1	591.500	0.000e+000	0.000	0.000
2	95	16	1	588.200	0.000e+000	0.000	0.000
2	95	18	1	588.200	0.000e+000	0.000	0.000
2	95	19	1	588.200	0.000e+000	0.000	0.000
2	96	16	1	588.200	0.000e+000	0.000	0.000
2	96	18	1	588.200	0.000e+000	0.000	0.000
2	96	19	1	588.200	0.000e+000	0.000	0.000
2	97	16	1	588.200	0.000e+000	0.000	0.000
2	97	18	1	588.200	0.000e+000	0.000	0.000
2	97	19	1	588.200	0.000e+000	0.000	0.000
2	98	16	1	588.200	0.000e+000	0.000	0.000
2	98	18	1	588.200	0.000e+000	0.000	0.000
2	98	19	1	588.200	0.000e+000	0.000	0.000
2	99	16	1	588.200	0.000e+000	0.000	0.000
2	99	18	1	588.200	0.000e+000	0.000	0.000
2	99	19	1	588.200	0.000e+000	0.000	0.000
2	100	16	1	588.200	0.000e+000	0.000	0.000
2	100	18	1	588.200	0.000e+000	0.000	0.000
2	100	19	1	588.200	0.000e+000	0.000	0.000
2	101	16	1	588.200	0.000e+000	0.000	0.000
2	101	18	1	588.200	0.000e+000	0.000	0.000
2	101	19	1	588.200	0.000e+000	0.000	0.000
2	96	21	1	588.200	0.000e+000	0.000	0.000
2	96	23	1	588.200	0.000e+000	0.000	0.000
2	97	21	1	588.200	0.000e+000	0.000	0.000
2	97	23	1	588.200	0.000e+000	0.000	0.000
2	98	21	1	588.200	0.000e+000	0.000	0.000
2	98	23	1	588.200	0.000e+000	0.000	0.000
2	99	21	1	588.200	0.000e+000	0.000	0.000
2	99	23	1	588.200	0.000e+000	0.000	0.000
2	100	21	1	588.200	0.000e+000	0.000	0.000
2	100	23	1	588.200	0.000e+000	0.000	0.000
2	101	21	1	588.200	0.000e+000	0.000	0.000
2	101	23	1	588.200	0.000e+000	0.000	0.000
2	96	32	1	588.200	0.000e+000	0.000	0.000
2	96	33	1	588.200	0.000e+000	0.000	0.000
2	96	34	1	588.200	0.000e+000	0.000	0.000
2	96	35	1	588.200	0.000e+000	0.000	0.000
2	96	36	1	588.200	0.000e+000	0.000	0.000
2	96	39	1	588.200	0.000e+000	0.000	0.000
2	96	47	1	588.200	0.000e+000	0.000	0.000

2	96	48	1	588.200	0.000e+000	0.000	0.000
2	96	51	1	588.200	0.000e+000	0.000	0.000
2	96	52	1	588.200	0.000e+000	0.000	0.000
2	97	32	1	588.200	0.000e+000	0.000	0.000
2	97	33	1	588.200	0.000e+000	0.000	0.000
2	97	34	1	588.200	0.000e+000	0.000	0.000
2	97	35	1	588.200	0.000e+000	0.000	0.000
2	97	36	1	588.200	0.000e+000	0.000	0.000
2	97	39	1	588.200	0.000e+000	0.000	0.000
2	97	47	1	588.200	0.000e+000	0.000	0.000
2	97	48	1	588.200	0.000e+000	0.000	0.000
2	97	51	1	588.200	0.000e+000	0.000	0.000
2	97	52	1	588.200	0.000e+000	0.000	0.000
2	98	32	1	588.200	0.000e+000	0.000	0.000
2	98	33	1	588.200	0.000e+000	0.000	0.000
2	98	34	1	588.200	0.000e+000	0.000	0.000
2	98	35	1	588.200	0.000e+000	0.000	0.000
2	98	36	1	588.200	0.000e+000	0.000	0.000
2	98	39	1	588.200	0.000e+000	0.000	0.000
2	98	47	1	588.200	0.000e+000	0.000	0.000
2	98	48	1	588.200	0.000e+000	0.000	0.000
2	98	51	1	588.200	0.000e+000	0.000	0.000
2	98	52	1	588.200	0.000e+000	0.000	0.000
2	99	32	1	588.200	0.000e+000	0.000	0.000
2	99	33	1	588.200	0.000e+000	0.000	0.000
2	99	34	1	588.200	0.000e+000	0.000	0.000
2	99	35	1	588.200	0.000e+000	0.000	0.000
2	99	36	1	588.200	0.000e+000	0.000	0.000
2	99	39	1	588.200	0.000e+000	0.000	0.000
2	99	47	1	588.200	0.000e+000	0.000	0.000
2	99	48	1	588.200	0.000e+000	0.000	0.000
2	99	51	1	588.200	0.000e+000	0.000	0.000
2	99	52	1	588.200	0.000e+000	0.000	0.000
2	100	32	1	588.200	0.000e+000	0.000	0.000
2	100	33	1	588.200	0.000e+000	0.000	0.000
2	100	34	1	588.200	0.000e+000	0.000	0.000
2	100	35	1	588.200	0.000e+000	0.000	0.000
2	100	36	1	588.200	0.000e+000	0.000	0.000
2	100	39	1	588.200	0.000e+000	0.000	0.000
2	100	47	1	588.200	0.000e+000	0.000	0.000
2	100	48	1	588.200	0.000e+000	0.000	0.000
2	100	51	1	588.200	0.000e+000	0.000	0.000
2	100	52	1	588.200	0.000e+000	0.000	0.000
2	101	32	1	588.200	0.000e+000	0.000	0.000
2	101	33	1	588.200	0.000e+000	0.000	0.000
2	101	34	1	588.200	0.000e+000	0.000	0.000
2	101	35	1	588.200	0.000e+000	0.000	0.000
2	101	36	1	588.200	0.000e+000	0.000	0.000
2	101	39	1	588.200	0.000e+000	0.000	0.000
2	101	47	1	588.200	0.000e+000	0.000	0.000
2	101	48	1	588.200	0.000e+000	0.000	0.000
2	101	51	1	588.200	0.000e+000	0.000	0.000
2	101	52	1	588.200	0.000e+000	0.000	0.000
2	98	61	1	588.200	0.000e+000	0.000	0.000
2	98	62	1	588.200	0.000e+000	0.000	0.000

2	98	64	1	588.200	0.000e+000	0.000	0.000
2	98	66	1	588.200	0.000e+000	0.000	0.000
2	98	74	1	588.200	0.000e+000	0.000	0.000
2	98	75	1	588.200	0.000e+000	0.000	0.000
2	98	78	1	588.200	0.000e+000	0.000	0.000
2	98	79	1	588.200	0.000e+000	0.000	0.000
2	99	61	1	588.200	0.000e+000	0.000	0.000
2	99	62	1	588.200	0.000e+000	0.000	0.000
2	99	64	1	588.200	0.000e+000	0.000	0.000
2	99	66	1	588.200	0.000e+000	0.000	0.000
2	99	74	1	588.200	0.000e+000	0.000	0.000
2	99	75	1	588.200	0.000e+000	0.000	0.000
2	99	78	1	588.200	0.000e+000	0.000	0.000
2	99	79	1	588.200	0.000e+000	0.000	0.000
2	100	61	1	588.200	0.000e+000	0.000	0.000
2	100	62	1	588.200	0.000e+000	0.000	0.000
2	100	64	1	588.200	0.000e+000	0.000	0.000
2	100	66	1	588.200	0.000e+000	0.000	0.000
2	100	74	1	588.200	0.000e+000	0.000	0.000
2	100	75	1	588.200	0.000e+000	0.000	0.000
2	100	78	1	588.200	0.000e+000	0.000	0.000
2	100	79	1	588.200	0.000e+000	0.000	0.000
2	101	61	1	588.200	0.000e+000	0.000	0.000
2	101	62	1	588.200	0.000e+000	0.000	0.000
2	101	64	1	588.200	0.000e+000	0.000	0.000
2	101	66	1	588.200	0.000e+000	0.000	0.000
2	101	74	1	588.200	0.000e+000	0.000	0.000
2	101	75	1	588.200	0.000e+000	0.000	0.000
2	101	78	1	588.200	0.000e+000	0.000	0.000
2	101	79	1	588.200	0.000e+000	0.000	0.000
3	1	24	1	591.500	0.000e+000	0.000	0.000
3	96	24	1	588.200	0.000e+000	0.000	0.000
3	97	24	1	588.200	0.000e+000	0.000	0.000
3	98	24	1	588.200	0.000e+000	0.000	0.000
3	99	24	1	588.200	0.000e+000	0.000	0.000
3	100	24	1	588.200	0.000e+000	0.000	0.000
3	101	24	1	588.200	0.000e+000	0.000	0.000

DRAIN CELLS:

Reach	Row	Column	Layer	Head	Conductance	Starting Time	Ending Time
1	40	27	1	588.000	1.000e+002	0.000	0.000
1	40	28	1	588.000	1.000e+002	0.000	0.000
1	40	29	1	588.000	1.000e+002	0.000	0.000
1	40	30	1	588.000	1.000e+002	0.000	0.000
1	40	31	1	588.000	1.000e+002	0.000	0.000
1	40	32	1	588.000	1.000e+002	0.000	0.000
1	40	33	1	588.000	1.000e+002	0.000	0.000
1	40	34	1	588.000	1.000e+002	0.000	0.000
1	40	35	1	588.000	1.000e+002	0.000	0.000
1	40	36	1	588.000	1.000e+002	0.000	0.000
1	40	37	1	588.000	1.000e+002	0.000	0.000
1	40	38	1	588.000	1.000e+002	0.000	0.000

1	40	39	1	588.000	1.000e+002	0.000	0.000
1	40	40	1	588.000	1.000e+002	0.000	0.000
1	40	41	1	588.000	1.000e+002	0.000	0.000
1	40	42	1	588.000	1.000e+002	0.000	0.000
1	40	43	1	588.000	1.000e+002	0.000	0.000
1	40	44	1	588.000	1.000e+002	0.000	0.000
1	40	45	1	588.000	1.000e+002	0.000	0.000
1	40	46	1	588.000	1.000e+002	0.000	0.000
1	40	47	1	588.000	1.000e+002	0.000	0.000
1	40	48	1	588.000	1.000e+002	0.000	0.000
1	40	49	1	588.000	1.000e+002	0.000	0.000
1	40	50	1	588.000	1.000e+002	0.000	0.000
1	40	51	1	588.000	1.000e+002	0.000	0.000
1	40	52	1	588.000	1.000e+002	0.000	0.000
1	40	53	1	588.000	1.000e+002	0.000	0.000
1	40	54	1	588.000	1.000e+002	0.000	0.000
2	49	27	1	588.000	1.000e+002	0.000	0.000
2	49	28	1	588.000	1.000e+002	0.000	0.000
2	49	29	1	588.000	1.000e+002	0.000	0.000
2	49	30	1	588.000	1.000e+002	0.000	0.000
2	49	31	1	588.000	1.000e+002	0.000	0.000
2	49	32	1	588.000	1.000e+002	0.000	0.000
2	49	33	1	588.000	1.000e+002	0.000	0.000
2	49	34	1	588.000	1.000e+002	0.000	0.000
2	49	35	1	588.000	1.000e+002	0.000	0.000
2	49	36	1	588.000	1.000e+002	0.000	0.000
2	49	37	1	588.000	1.000e+002	0.000	0.000
2	49	38	1	588.000	1.000e+002	0.000	0.000
2	49	39	1	588.000	1.000e+002	0.000	0.000
2	49	40	1	588.000	1.000e+002	0.000	0.000
2	49	41	1	588.000	1.000e+002	0.000	0.000
2	49	42	1	588.000	1.000e+002	0.000	0.000
2	49	43	1	588.000	1.000e+002	0.000	0.000
2	49	44	1	588.000	1.000e+002	0.000	0.000
2	49	45	1	588.000	1.000e+002	0.000	0.000
2	49	46	1	588.000	1.000e+002	0.000	0.000
2	49	47	1	588.000	1.000e+002	0.000	0.000
2	49	48	1	588.000	1.000e+002	0.000	0.000
2	49	49	1	588.000	1.000e+002	0.000	0.000
2	49	50	1	588.000	1.000e+002	0.000	0.000
2	49	51	1	588.000	1.000e+002	0.000	0.000
2	49	52	1	588.000	1.000e+002	0.000	0.000
2	49	53	1	588.000	1.000e+002	0.000	0.000
3	59	27	1	588.000	1.000e+002	0.000	0.000
3	59	28	1	588.000	1.000e+002	0.000	0.000
3	59	29	1	588.000	1.000e+002	0.000	0.000
3	59	30	1	588.000	1.000e+002	0.000	0.000
3	59	31	1	588.000	1.000e+002	0.000	0.000
3	59	32	1	588.000	1.000e+002	0.000	0.000
3	59	33	1	588.000	1.000e+002	0.000	0.000
3	59	34	1	588.000	1.000e+002	0.000	0.000
3	59	35	1	588.000	1.000e+002	0.000	0.000
3	59	36	1	588.000	1.000e+002	0.000	0.000
3	59	37	1	588.000	1.000e+002	0.000	0.000
3	59	38	1	588.000	1.000e+002	0.000	0.000

3	59	39	1	588.000	1.000e+002	0.000	0.000
3	59	40	1	588.000	1.000e+002	0.000	0.000
3	59	41	1	588.000	1.000e+002	0.000	0.000
3	59	42	1	588.000	1.000e+002	0.000	0.000
3	59	43	1	588.000	1.000e+002	0.000	0.000
3	59	44	1	588.000	1.000e+002	0.000	0.000
3	59	45	1	588.000	1.000e+002	0.000	0.000
3	59	46	1	588.000	1.000e+002	0.000	0.000
3	59	47	1	588.000	1.000e+002	0.000	0.000
3	59	48	1	588.000	1.000e+002	0.000	0.000
3	59	49	1	588.000	1.000e+002	0.000	0.000
3	59	50	1	588.000	1.000e+002	0.000	0.000
3	59	51	1	588.000	1.000e+002	0.000	0.000
3	59	52	1	588.000	1.000e+002	0.000	0.000
4	66	27	1	588.000	1.000e+002	0.000	0.000
4	66	28	1	588.000	1.000e+002	0.000	0.000
4	66	29	1	588.000	1.000e+002	0.000	0.000
4	66	30	1	588.000	1.000e+002	0.000	0.000
4	66	31	1	588.000	1.000e+002	0.000	0.000
4	66	32	1	588.000	1.000e+002	0.000	0.000
4	66	33	1	588.000	1.000e+002	0.000	0.000
4	66	34	1	588.000	1.000e+002	0.000	0.000
4	66	35	1	588.000	1.000e+002	0.000	0.000
4	66	36	1	588.000	1.000e+002	0.000	0.000
4	66	37	1	588.000	1.000e+002	0.000	0.000
4	66	38	1	588.000	1.000e+002	0.000	0.000
4	66	39	1	588.000	1.000e+002	0.000	0.000
4	66	40	1	588.000	1.000e+002	0.000	0.000
4	66	41	1	588.000	1.000e+002	0.000	0.000
4	66	42	1	588.000	1.000e+002	0.000	0.000
4	66	43	1	588.000	1.000e+002	0.000	0.000
4	66	44	1	588.000	1.000e+002	0.000	0.000
4	66	45	1	588.000	1.000e+002	0.000	0.000
4	66	46	1	588.000	1.000e+002	0.000	0.000
4	66	47	1	588.000	1.000e+002	0.000	0.000
4	66	48	1	588.000	1.000e+002	0.000	0.000
4	66	49	1	588.000	1.000e+002	0.000	0.000
4	66	50	1	588.000	1.000e+002	0.000	0.000
4	66	51	1	588.000	1.000e+002	0.000	0.000
4	66	52	1	588.000	1.000e+002	0.000	0.000

WELLS:

Reach	Row	Column	Layer	Flow Rate	Concentration Time	Starting Time	Ending
1	83	19	1	-770.000	0.000e+000	0.000	0.000
2	83	35	1	-770.000	0.000e+000	0.000	0.000
3	83	49	1	-770.000	0.000e+000	0.000	0.000
4	83	63	1	-770.000	0.000e+000	0.000	0.000
5	83	77	1	-962.500	0.000e+000	0.000	0.000

CALIBRATION TARGETS:

Head Targets.....: 17
Flux Targets.....: 0
Concentration Targets..: 0

HEAD TARGET DATA:

Well Name	Row	Column	Layer	Head	Standard Deviation	Time
G-101L	12	43	1	591.860	1.000	0.000	0.000
G-101M	12	44	1	591.890	1.000	0.000	0.000
G-102L	50	56	1	589.360	1.000	0.000	0.000
G-104D	34	23	1	591.500	1.000	0.000	0.000
G-106S (OIL)	37	33	1	590.590	1.000	0.000	0.000
G-106DR	36	33	1	589.450	1.000	0.000	0.000
MW-01S	23	69	1	591.680	1.000	0.000	0.000
MW-01D	22	69	1	589.930	1.000	0.000	0.000
MW-02S	33	69	1	591.080	1.000	0.000	0.000
MW-02D	49	58	1	589.690	1.000	0.000	0.000
MW-03D	90	67	1	589.140	1.000	0.000	0.000
MW-04D	27	58	1	589.550	1.000	0.000	0.000
MW-05D	36	53	1	589.460	1.000	0.000	0.000
MW-06S	88	29	1	589.180	1.000	0.000	0.000
MW-06D	87	29	1	588.950	1.000	0.000	0.000
MW-07S	59	11	1	589.040	1.000	0.000	0.000
MW-07D	55	11	1	589.260	1.000	0.000	0.000