

APPENDIX A-1

REFERENCES

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APPENDIX A-2

**CARCINOGENIC/NONCARCINOGENIC
EXPOSURE AND RISK SUMMARY TABLES**

TABLE A-2-I. KHOBAR TOWERS

Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TO1) - May 1991

	Concentration*	Outdoor Exposure ug/m ³	indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Rfsk
Benzene	1.17E+01	6.80E-06	5.78E-07	7.38E-06	2.9E-02	2E-07
Toluene	3.20E+01	1.85E-05	1.58E-06	2.01E-05	0.0E+00	0E+00
Ethyl Benzene	8.19E+00	4.74E-06	4.03E-07	5.14E-06	0.0E+00	0E+00
m,p-Xylene	2.73E+01	1.58E-05	1.35E-06	1.72E-05	0.0E+00	0E+00
o-Xylene	7.41E+00	4.29E-06	3.65E-07	4.66E-06	0.0E+00	0E+00
Heptane	1.08E+01	6.27E-06	5.33E-07	6.80E-06	0.0E+00	0E+00
n-Propyl Benzene	1.45E+00	8.41E-07	7.15E-08	9.13E-07	0.0E+00	0E+00
					Total Risk =	2E-07

* Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis period

TABLE A-2-2. KHOBAR TOWERS

Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TOI) -June 1991

	Concentration*	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
	ug/m3					
Benzene	NA	0.00E+00	0.00E+00	0.00E+00	2.9E-02	0E+00
Toluene	3.66E+01	2.12E-05	1.80E-06	2.30E-05	0.0E+00	0E+00
Ethyl Benzene	6.52E+00	3.77E-06	3.21E-07	4.09E-06	0.0E+00	0E+00
m,p-Xylene	1.88E+01	1.09E-05	9.24E-07	1.18E-05	0.0E+00	0E+00
o-Xylene	6.69E+00	3.87E-06	3.29E-07	4.20E-06	0.0E+00	0E+00
Heptane	5.41E+00	3.13E-06	2.66E-07	3.40E-06	0.0E+00	0E+00
n-Propyl Benzene	1.39E+00	8.03E-07	6.82E-08	8.71E-07	0.0E+00	0E+00
					Total Risk =	0E+00

* Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis period

TABLE A-2-3. KHOBAR TOWERS
Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TO1) - July 1991

	Concentration*	Outdoor Exposure ug/m ³	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Benzene	NA	0.00E+00	0.00E+00	0.00E+00	2.9E-02	0E+00
Toluene	2.05E+01	1.19E-05	1.01E-06	1.29E-05	0E+00	0E+00
Ethyl Benzene	6.77E+00	3.92E-06	3.33E-07	4.25E-06	0.0E+00	0E+00
m, p-Xylene	1.83E+01	1.06E-05	9.00E-07	1.15E-05	0.0E+00	0E+00
o-Xylene	6.75E+00	3.91E-06	3.32E-07	4.24E-06	0.0E+00	0E+00
Heptane	9.18E+00	5.32E-06	4.52E-07	5.77E-06	0.0E+00	0E+00
n-Propyl Benzene	1.21E+00	7.02E-07	5.97E-08	7.62E-07	0.0E+00	0E+00
					Total Risk =	0E+00

* Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis period

TABLE A-24. KHOBAR TOWERS
Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TO1) - August 1991

	Concentration*	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
	ug/m ³					
Benzene	1.04E+01	6.00E-06	5.10E-07	6.51 E-06	2.9E-02	2E-07
Toluene	3.10E+01	1.80E-05	1.53E-06	1.95E-05	0.0E+00	0E+00
Ethyl Benzene	1.12E+01	6.50E-06	5.53E-07	7.05E-06	0.0E+00	0E+00
m,p-Xylene	2.46E+01	1.43E-05	1.21E-06	1.55E-05	0.0E+00	0E+00
o-Xylene	1.05E+01	6.05E-06	5.14E-07	6.56E-06	0.0E+00	0E+00
Heptane	1.81E+01	1.05E-05	8.91E-07	1.14E-05	0.0E+00	0E+00
n-Propyl Benzene	1.97E+00	1.14E-06	9.71E-08	1.24E-06	0.0E+00	0E+00
					Total Risk =	2E-07

* Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis period

TABLE A-2-5. KHOBAR TOWERS

Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TO1) - September 1991

	Concentration*	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
	ug/m ³					
Benzene	7.88E+00	4.56E-06	3.88E-07	4.95E-06	2.9E-02	1E-07
Toluene	2.36E+01	1.37E-05	1.16E-06	1.48E-05	0.0E+00	0E+00
Ethyl Benzene	6.56E+00	3.80E-06	3.23E-07	4.12E-06	0.0E+00	0E+00
m,p-Xyfene	1.84E+01	1.06E-05	9.05E-07	1.16E-05	0.0E+00	0E+00
o-Xylene	6.97E+00	4.04E-06	3.43E-07	4.38E-06	0.0E+00	0E+00
Heptane	7.87E+00	4.55E-06	3.87E-07	4.94E-06	0.0E+00	0E+00
n-Propyl Benzene	1.19E+00	6.92E-07	5.88E-08	7.51E-07	0.0E+00	0E+00
					Total Risk =	1E-07

* Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis period

TABLE A-2-6. KHOBAR TOWERS
Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TOI) - October 1991

	Concentration*	Outdoor Exposure ug/m ³	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Benzene	7.21E+00	4.17E-06	3.55E-07	4.53E-06	2.9E-02	1E-07
Toluene	4.78E+01	2.77E-05	2.35E-06	3.00E-05	0.0E+00	0E+00
Ethyl Benzene	2.79E+01	1.62E-05	1.37E-06	1.75E-05	0.0E+00	0E+00
m,p-Xylene	9.21E+01	5.33E-05	4.53E-06	5.78E-05	0.0E+00	0E+00
o-Xylene	2.29E+01	1.33E-05	1.13E-06	1.44E-05	0.0E+00	0E+00
Heptane	1.02E+01	5.89E-06	5.00E-07	6.39E-06	0.0E+00	0E+00
n-Propyl Benzene	1.04E+00	6.04E-07	5.14E-08	6.55E-07	0.0E+00	0E+00
					Total Risk =	1E-07

* Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis-period

TABLE A-2-7. KHOBAR TOWERS

Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TO1) - November 1991

	Concentration*	Outdoor Exposure ug/m ³	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Benzene	4.52E+00		2.62E-06	2.23E-07	2.84E-06	2.9E-02	8E-08
Toluene	1.85E+01		1.07E-05	9.09E-07	1.16E-05	0.0E+00	0E+00
Ethyl Benzene	3.91E+00		2.27E-06	1.93E-07	2.46E-06	0.0E+00	0E+00
m,p-Xylene	1.13E+01		6.55E-06	5.57E-07	7.11E-06	0.0E+00	0E+00
o-Xylene	4.34E+00		2.52E-06	2.14E-07	2.73E-06	0.0E+00	0E+00
Heptane	5.13E+00		2.97E-06	2.52E-07	3.22E-06	0.0E+00	0E+00
n-Propyl Benzene	6.30E-01		3.65E-07	3.10E-08	3.96E-07	0.0E+00	0E+00
						Total Risk =	8E-08

* Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis period

TABLE A-2-8. CAMP 1
Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TO1) - May 1991

	Concentration*	Outdoor Exposure ug/m ³	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Benzene	1.00E+01	5.81E-06	4.94E-07	6.30E-06	2.9E-02	2E-07
Toluene	1.08E+01	6.24E-06	5.31E-07	6.78E-06	0.0E+00	0E+00
Ethyl Benzene	3.82E+00	2.21E-06	1.88E-07	2.40E-06	0.0E+00	0E+00
m,p-Xylene	9.27E+00	5.37E-06	4.56E-07	5.82E-06	0.0E+00	0E+00
o-Xylene	3.44E+00	1.99E-06	1.69E-07	2.16E-06	0.0E+00	0E+00
Heptane	3.59E+00	2.08E-06	1.77E-07	2.26E-06	0.0E+00	0E+00
n-Propyl Benzene	6.92E-01	4.00E-07	3.40E-08	4.34E-07	0.0E+00	0E+00
					Total Risk =	2E-07

* Concentrations are the 95th A upper bound of the sample data set

NA - No valid samples for analysis period

TABLE A-2-i. CAMP 1

Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TO1) -June 1991

	Concentration*	Outdoor Exposure ug/m ³	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Benzene	NA	0.00E+00	0.00E+00	0.00E+00	2.9E-02	0E+00
Toluene	4.26E+00	2.47E-06	2.10E-07	2.68E-06	0.0E+00	0E+00
Ethyl Benzene	1.81E+00	1.05E-06	8.89E-08	1.13E-06	0.0E+00	0E+00
m,p-Xylene	4.90E+00	2.84E-06	2.41E-07	3.08E-06	0.0E+00	0E+00
o-Xylene	1.84E+00	1.07E-06	9.07E-08	1.16E-06	0.0E+00	0E+00
Heptane	4.05E+00	2.35E-06	2.00E-07	2.55E-06	0.0E+00	0E+00
n-Propyl Benzene	3.79E-01	2.20E-07	1.87E-08	2.38E-07	0.0E+00	0E+00
					Total Risk =	0E+00

* Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis period

TABLE A-2-10. CAMP 1

Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TO1) - July 1991

	Concentration*	Outdoor Exposure ug/m ³	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Benzene	1.52E+00	8.81E-07	7.49E-08	9.56E-07	2.9E-02	3E-08
Toluene	4.14E+00	2.40E-06	2.04E-07	2.60E-06	0.0E+00	0E+00
Ethyl Benzene	1.59E+00	9.22E-07	7.84E-08	1.00E-06	0.0E+00	0E+00
m,p-Xylene	4.74E+00	2.74E-06	2.33E-07	2.97E-06	0.0E+00	0E+00
o-Xylene	1.45E+00	8.42E-07	7.16E-08	9.13E-07	0.0E+00	0E+00
Heptane	7.28E+00	4.22E-06	3.58E-07	4.57E-06	0.0E+00	0E+00
n-Propyl Benzene	3.41E-01	1.97E-07	1.68E-08	2.14E-07	0.0E+00	0E+00
Total Risk =						3E-08

* Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis period

TABLE A-2-11. ESKAN VILLAGE

Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TOI) -June 1991

	Concentration*	Outdoor Exposure ug/m ³	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Benzene	NA	0.00E+00	0.00E+00	0.00E+00	3.9E-02	0E+00
Toluene	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Ethyl Benzene	2.55E+00	1.47E-06	1.25E-07	1.60E-06	0.0E+00	0E+00
m, p-Xylene	8.58E+00	4.97E-06	4.23E-07	5.39E-06	0.0E+00	0E+00
o-Xylene	2.91E+00	1.68E-06	1.43E-07	1.83E-06	0.0E+00	0E+00
Heptane	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
n-Propyl Benzene	5.06E-01	2.93E-07	2.49E-08	3.18E-07	0.0E+00	0E+00
					Total Risk =	0E+00

* Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis period

TABLE A-2-12. ESKAN VILLAGE

Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TO1) - July 1991

	Concentration*	Outdoor Exposure ug/m ³	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Benzene	NA	0.00E+00	0.00E+00	0.00E+00	2.9E-02	0E+00
Toluene	2.25E+01	1.30E-05	1.11E-06	1.42E-05	0.0E+00	0E+00
Ethyl Benzene	4.78E+00	2.77E-06	2.35E-07	3.00E-06	0.0E+00	0E+00
m,p-Xylene	1.31E+01	7.58E-06	6.44E-07	8.22E-06	0.0E+00	0E+00
o-Xylene	4.66E+00	2.70E-06	2.29E-07	2.93E-06	0.0E+00	0E+00
Heptane	3.06E+00	1.77E-06	1.51E-07	1.92E-06	0.0E+00	0E+00
n-Propyl Benzene	9.30E-01	5.38E-07	4.58E-08	5.84E-07	0.0E+00	0E+00
					Total Risk =	0E+00

* Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis period

TABLE A-2-13. ESKAN VILLAGE
Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TOI) - August 1991

	Concentration* ug/m ³	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Benzene	5.75E+00	3.33E-06	2.83E-07	3.61E-06	2.9E-02	1E-07
Toluene	1.71E+01	9.89E-06	8.41E-07	1.07E-05	0.0E+00	0E+00
Ethyl Benzene	5.60E+00	3.24E-06	2.76E-07	3.52E-06	0.0E+00	0E+00
m,p-Xylene	1.08E+01	6.27E-06	5.33E-07	6.80E-06	0.0E+00	0E+00
o-Xylene	5.27E+00	3.05E-06	2.60E-07	3.31E-06	0.0E+00	0E+00
Heptane	1.36E+01	7.85E-06	6.67E-07	8.51E-06	0.0E+00	0E+00
n-Propyl Benzene	9.18E-01	5.31E-07	4.52E-08	5.77E-07	0.0E+00	0E+00
					Total Risk =	1E-07

*Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis period

**TABLE A-2-14. KKMC
Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TO1) - May 1991**

	Concentration*	Outdoor Exposure ug/m ³	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Benzene	3.91E+00	2.27E-06	1.93E-07	2.46E-06	2.9E-02	7E-08
Toluene	3.12E+00	1.81E-06	1.54E-07	1.96E-06	0.0E+00	0E+00
Ethyl Benzene	1.07E+01	6.21E-06	5.28E-07	6.74E-06	0.0E+00	0E+00
m,p-Xylene	9.81E+00	5.68E-06	4.83E-07	6.16E-06	0.0E+00	0E+00
o-Xylene	6.54E+00	3.79E-06	3.22E-07	4.11E-06	0.0E+00	0E+00
Heptane	9.56E-01	5.53E-07	4.71E-08	6.00E-07	0.0E+00	0E+00
n-Propyl Benzene	5.60E+00	3.24E-06	2.76E-07	3.52E-06	0.0E+00	0E+00
					Total Risk =	7E-08

* Concentrations are the 95th % upper bound of the sample data set

A-2-15

NA - No valid samples for analysis period

TABLE A-2-15. KKMC

Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TO1) -June 1991

	Concentration*	Outdoor Exposure ug/m ³	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Benzene	NA	0.00E+00	0.00E+00	0.00E+00	2.9E-02	0E+00
Toluene	6.54E+00	3.78E-06	3.22E-07	4.1 1E-06	0.0E+00	0E+00
Ethyl Benzene	1.97E+00	1.14E-06	9.71E-08	1.24E-06	0.0E+00	0E+00
m,pXylene	4.90E+00	2.84E-06	2.41E-07	3.08E-06	0.0E+00	0E+00
o-Xylene	1.90E+00	1.10E-06	9.35E-08	1.19E-06	0.0E+00	0E+00
Heptane	1.76E+00	1.02E-06	8.66E-08	1.10E-06	0.0E+00	0E+00
n-Propyl Benzene	3.99E-01	2.31E-07	1.96E-08	2.51E-07	0.0E+00	0E+00
					Total Risk =	0E+00

* Concentrations are the '95th % upper bound of the sample data set

NA - No valid samples for analysis period

TABLE A-2-16. KKMC

Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TO1) -July 1991

	Concentration*	Outdoor Exposure ug/m ³	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Benzene	NA	0.00E+00	0.00E+00	0.00E+00	2.9E-02	OE+00
Toluene	4.53E+00	2.62E-06	2.23E-07	2.85E-06	0.0E+00	OE+00
Ethyl Benzene	1.56E+00	9.00E-07	7.65E-08	9.77E-07	0.0E+00	OE+00
m,pXylene	3.58E+00	2.07E-06	1.76E-07	2.25E-06	0.0E+00	OE+00
o-Xylene	1.39E+00	8.07E-07	6.86E-08	8.76E-07	0.0E+00	OE+00
Heptane	1.62E+00	9.39E-07	7.99E-08	1.02E-06	0.0E+00	OE+00
n-Propyl Benzene	3.10E-01	1.80E-07	1.53E-08	1.95E-07	0.0E+00	OE+00
					Total Risk =	0E+00

* Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis-period

TABLE A-2-17. KKMC
Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TOI) - August 1991

	Concentration*	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
	ug/m3					
Benzene	NA	0.00E+00	0.00E+00	0.00E+00	2.9E-02	0E+00
Toluene	1.12E+01	6.46E-06	5.49E-07	7.00E-06	0.0E+00	0E+00
Ethyl Benzene	2.59E+00	1.50E-06	1.28E-07	1.63E-06	0.0E+00	0E+00
m,p-Xylene	1.00E+01	5.79E-06	4.92E-07	6.28E-06	0.0E+00	0E+00
o-Xylene	2.59E+00	1.50E-06	1.28E-07	1.63E-06	0.0E+00	0E+00
Heptane	2.75E+00	1.59E-06	1.35E-07	1.73E-06	0.0E+00	0E+00
n-Propyl Benzene	9.16E-01	5.30E-07	4.51E-08	5.75E-07	0.0E+00	0E+00
					Total Risk =	0E+00

* Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis period

TABLE A-2-18. MILITARY HOSPITAL/CAMP FREEDOM
Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TO1) - May 1991

	Concentration*	Outdoor Exposure mg/kg-day	indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Benzene	NA	0.00E+00	0.00E+00	0.00E+00	2.9E-02	0E+00
Toluene	1.40E+01	8.09E-06	6.88E-07	8.78E-06	0.0E+00	0E+00
Ethyl Benzene	2.03E+00	1.18E-06	1.00E-07	1.28E-06	0.0E+00	0E+00
m,p-Xyrene	5.52E+00	3.19E-06	2.72E-07	3.46E-06	0.0E+00	0E+00
o-Xylene	2.07E+00	1.20E-06	1.02E-07	1.30E-06	0.0E+00	0E+00
Heptane	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
n-Propyl Benzene	4.48E-01	2.59E-07	2.20E-08	2.81E-07	0.0E+00	0E+00
						Total Risk = 0E+00

* Concentrations are the 95% upper bound of the sample data set

NA - No valid samples for analysis period

TABLE A-2-19. MILITARY HOSPITAL/CAMP FREEDOM
Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TO1) -June 1991

	Concentration* ug/m3	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Benzene	(NA)	0.00E+00	0.00E+00	0.00E+00	2.9E-02	0E+00
Toluene	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Et hyi Benzene	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
m,p-Xyiene	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
o-Xylene	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Heptane	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
n-Propyl Benzene	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
					Total Risk =	0E+00

* Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis period

TABLE A-2-20. MILITARY HOSPITAL/CAMP FREEDOM
Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TO1) - July 1991

	Concentration*	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Benzene	NA	0.00E+00	0.00E+00	0.00E+00	2.9E-02	0E+00
Toluene	5.87E+01	3.40E-05	2.89E-06	3.69E-05	0.0E+00	0E+00
Ethyl Benzene	1.56E+00	9.06E-07	7.70E-08	9.83E-07	0.0E+00	0E+00
m,p-Xylene	7.68E+00	4.44E-06	3.78E-07	4.82E-06	0.0E+00	0Et00
o-Xylene	2.29E+00	1.33E-06	1.13E-07	1.44E-06	0.0E+00	0E+00
Heptane	1.02E+01	5.92E-06	5.03E-07	6.42E-06	0.0E+00	0Et00
n-Propyl Benzene	6.16E-01	3.57E-07	3.03E-08	3.87E-07	0.0E+00	0Et00
					Total Risk =	0E+00

* Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis period

TABLE A-2-21. MILITARY HOSPITAL/CAMP FREEDOM
Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TOI) - August 1991

	Concentration* ug/m³	Outdoor Exposure mglkg-day	Indoor Exposure mglkg-day	Total Exposure mglkg-day	Slope Factor (mg/kg-day)-1	Risk
Benzene	1.31E+00	7.58E-07	6.45E-08	8.23E-07	2.9E-02	2E-08
Toluene	1.88E+01	1.09E-05	9.28E-07	1.18E-05	0.0E+00	0E+00
Ethyl Benzene	1.77E+00	1.02E-06	8.71E-08	1.11E-06	0.0E+00	0E+00
m,p-Xylene	4.28E+00	2.48E-06	2.11E-07	2.69E-06	0.0E+00	0E+00
o-Xylene	1.30E+00	7.52E-07	6.40E-08	8.16E-07	0.0E+00	0E+00
Heptane	2.66E+00	1.54E-06	1.31E-07	1.67E-06	0.0E+00	0E+00
n-Propyl Benzene	4.58E-01	2.65E-07	2.25E-08	2.88E-07	0.0E+00	0E+00
					Total Risk =	2E-08

* Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis period

TABLE A-2-22. MJLTARY HOSPITAL/CAMP FREEDOM
Carcinogenic Risk - Inhalation of Volatile Organic compounds (TO1) - September 1991

	Concentration* ug/m3	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Benzene	4.52E+00	2.62E-06	2.22E-07	2.84E-06	2.9E-02	8E-08
Toluene ,	4.15E+01	2.40E-05	2.04E-06	2.61E-05	0.0E+00	0E+00
Ethyl Benzene	6.31E+00	3.65E-06	3.10E-07	3.96E-06	0.0E+00	0E+00
m,p-Xylene	1.27E+01	7.33E-06	6.23E-07	7.95E-06	0.0E+00	0E+00
o-Xylene	5.37E+00	3.11E-06	2.64E-07	3.37E-06	0.0E+00	0E+00
Heptane	4.25E+01	2.46E-05	2.09E-06	2.67E-05	0.0E+00	0E+00
n-Propyl Benzene	1.34E+00	7.76E-07	6.60E-08	8.42E-07	0.0E+00	0E+00
					Total Risk =	8E-08

* Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis period

TABLE A-2-23, MILITARY HOSPITAL/CAMP FREEDOM
Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TOI) - October 1991

	Concentration* ug/m ³	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Benzene	5.52E+00	3.19E-06	2.72E-07	3.47E-06	2.9E-02	1E-07
Toluene	1.98E+02	1.15E-04	9.75E-06	1.24E-04	0.0E+00	0E+00
Ethyl Benzene	7.58E+00	4.39E-06	3.73E-07	4.76E-06	0.0E+00	0E+00
m,p-Xylene	1.83E+01	1.06E-05	8.99E-07	1.15E-05	0.0E+00	0E+00
o-Xylene	8.42E+00	4.87E-06	4.14E-07	5.29E-06	0.0E+00	0E+00
Heptane	2.99E+01	1.73E-05	1.47E-06	1.88E-05	0.0E+00	0E+00
n-Propyl Benzene	1.26E+00	7.31E-07	6.22E-08	7.93E-07	0.0E+00	0E+00
					Total Risk =	1E-07

* Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis period

TABLE A-2-24. MILITARY HOSPITAL/CAMP FREEDOM
Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TO1) - November 1991

	Concentration*	Outdoor Exposure ug/m ³	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Benzene	4.87E+00	2.82E-06	2.40E-07	3.06E-06	2.9E-02	9E-08
Toluene	1.19E+02	6.89E-05	5.86E-06	7.48E-05	0.0E+00	0E+00
Ethyl Benzene	3.08E+00	1.78E-06	1.51E-07	1.93E-06	0.0E+00	0E+00
m,p-Xylene	7.31E+00	4.23E-06	3.60E-07	4.59E-06	0.0E+00	0E+00
o-Xylene	3.43E+00	1.99E-06	1.69E-07	2.16E-06	0.0E+00	0E+00
Heptane	3.65E+01	2.11E-05	1.80E-06	2.29E-05	0.0E+00	0E+00
n-Propyl Benzene	4.53E-01	2.62E-07	2.23E-08	2.84E-07	0.0E+00	0E+00
Total Risk =						9E-08

* Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis period

TABLE A-2-25. U.S. EMBASSY, KUWAIT

Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TOI) - May 1991

	Concentration* ug/m ³	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Benzene	NA	0.00E+00	0.00E+00	0.00E+00	2.9E-02	0E+00
Toluene	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Ethyl Benzene	1.14E+01	6.58E-06	5.60E-07	7.14E-06	0.0E+00	0E+00
m,p-Xylene	2.76E+01	1.60E-05	1.36E-06	1.74E-05	0.01E+00	0E+00
o-Xylene	1.18E+01	6.81E-06	5.79E-07	7.39E-06	0.0E+00	0E+00
Heptane	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
n-Propyl Benzene	1.93E+00	1.12E-06	9.49E-08	1.21E-06	0.0E+00	0E+00
					Total Risk =	0E+00

* Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis period

TABLE A-2-26. U.S. EMBASSY, KUWAIT

Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TO1) -June 1991

	Concentration*	Outdoor Exposure ug/m ³	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Benzene	1.18E+01	6.82E-06	5.80E-07	7.40E-06	2.9E-02	2E-07
Toluene	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Ethyl Benzene	2.68E+01	1.55E-05	1.32E-06	1.69E-05	0.0E+00	0E+00
m,pXylene	7.75E+01	4.49E-05	3.82E-06	4.87E-05	0.0E+00	0E+00
o-Xylene	2.95E+01	1.71E-05	1.45E-06	1.85E-05	0.0E+00	0E+00
Heptane	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
n-Propyl Benzene	2.91E+00	1.68E-06	1.43E-07	1.83E-06	0.0E+00	0E+00
						Total Risk = 2E-07

* Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis period

TABLE A-2-27. U.S. EMBASSY, KUWAIT

Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TOI) - July 1991

	Concentration* ug/m ³	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Benzene --	NA	0.00E+00	0.00E+00	0.00E+00	2.9E-02	OEt00
Toluene	NA	0.00E+00	0.00E+00	0.00E+00	0.OEt00	0E+00
Ethyl Benzene	NA	0.00E+00	0.00E+00	0.00E+00	0.OEt00	0E+00
m,p-Xylene	NA	0.00E+00	0.00E+00	0.00E+00	0.OEt00	0E+00
o-Xylene	NA	0.00E+00	0.00E+00	0.00E+00	0.OEt00	0E+00
Heptane	NA	0.00E+00	0.00E+00	0.00E+00	0.OEt00	0E+00
n-Propyl Benzene	NA	0.00E+00	0.00E+00	0.00E+00	0.OEt00	0E+00
					Total Risk =	OEt00

* Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis period

TABLE A-2-28. CAMP THUNDEROCK

Carcinogenic Rtsk - Inhalation of Volatile Organic Compounds (TO1) - June 1991

	Concentration*	Outdoor Exposure ug/m ³	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Benzene	8.39E+00	4.86E-06	4.13E-07	5.27E-06	2.9E-02	2E-07
Toluene	2.53E+01	1.46E-05	1.25E-06	1.59E-05	0.0E+00	0E+00
Ethyl Benzene	6.08E+00	3.52E-06	2.99E-07	3.82E-06	0.0E+00	0E+00
m,p-Xylene	1.76E+01	1.02E-05	8.65E-07	1.10E-05	0.0E+00	0E+00
o-Xylene	7.03E+00	4.07E-06	3.46E-07	4.42E-06	0.0E+00	0E+00
Heptane	2.41E+01	1.39E-05	1.18E-06	1.51E-05	0.0E+00	0E+00
n-Propyl Benzene	1.89E+00	1.09E-06	9.29E-08	1.19E-06	0.0E+00	0E+00
					Total Risk =	2E-07

* Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis period

TABLE A-2-29. CAMP THUNDEROCK

Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TOI) -July 1991

	Concentration* ug/m ³	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Benzene	2.94E+01	1.70E-05	1.45E-06	1.85E-05	2.9E-02	5E-07
Toluene	5.41E+01	3.13E-05	2.66E-06	3.40E-05	0.0E+00	0E+00
Ethyl Benzene	3.18E+00	1.84E-06	1.57E-07	2.00E-06	0.0E+00	0E+00
m,p-Xylene	8.54E+00	4.95E-06	4.21E-07	5.37E-06	0.0E+00	0E+00
o-Xylene	2.78E+00	1.61E-06	1.37E-07	1.74E-06	0.0E+00	0E+00
Heptane	3.82E+01	2.21E-05	1.88E-06	2.40E-05	0.0E+00	0E+00
n-Propyl Benzene	1.53E+00	8.83E-07	7.51E-08	9.58E-07	0.0E+00	0E+00
Total Risk =						5E-07

* Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis period

TABLE A-2-30. CAMP THUNDEROCK
Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TO1) - August 1991

	Concentration*	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Benzene	NA	0.00E+00	0.00E+00	0.00E+00	2.9E-02	0E+00
Toluene	3.71E+00	2.15E-06	1.83E-07	2.33E-06	0.0E+00	0E+00
Ethyl Benzene	5.11E-01	2.96E-07	2.52E-08	3.21E-07	0.0E+00	0E+00
m,p-Xylene	9.98E-01	5.78E-07	4.91E-08	6.27E-07	0.0E+00	0E+00
o-Xylene	3.00E-01	1.74E-07	1.48E-08	1.88E-07	0.0E+00	0E+00
Heptane	6.68E-01	3.87E-07	3.29E-08	4.19E-07	0.0E+00	0E+00
n-Propyl Benzene	9.31E-02	5.39E-08	4.58E-09	5.85E-08	0.0E+00	0E+00
					Total Risk =	0E+00

* Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis-period

TABLE A-2-31, CAMP THUNDEROCK

Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TO1) - September 1991

	Concentration*	Outdoor Exposure ug/m ³	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day) ⁻¹	Risk
Benzene	6.03E+00	3.49E-06	2.97E-07	3.79E-06	2.9E-02	1E-07
Toluene	2.01E+01	1.16E-05	9.89E-07	1.26E-05	0.0E+00	OE+00
Ethyl Benzene	8.53E+00	4.94E-06	4.20E-07	5.36E-06	0.0E+00	OE+00
m,p-Xylene	1.56E+01	9.03E-06	7.68E-07	9.80E-06	0.0E+00	OE+00
o-Xylene	5.96E+00	3.45E-06	2.93E-07	3.74E-06	0.0E+00	OE+00
Heptane	1.61E+01	9.33E-06	7.93E-07	1.01E-05	0.0E+00	OE+00
n-Propyl Benzene	1.14E+00	6.58E-07	5.60E-08	7.14E-07	0.0E+00	OE+00
				Total Risk =		1E-07

* Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis period

TABLE A-2-32. CAMP THUNDEROCK
Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TO1) - October 1991

	Concentration* ug/m ³	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Benzene	6.08E+00	3.52E-06	2.99E-07	3.82E-06	2.9E-02	1 E-07
Toluene	8.35E+01	4.84E-05	4.11E-06	5.25E-05	0.0E+00	0E+00
Ethyl Benzene	6.06E+00	3.51E-06	2.98E-07	3.81E-06	0.0E+00	0E+00
m,p-Xylene	1.84E+01	1.07E-05	9.07E-07	1.16E-05	0.0E+00	0E+00
o-Xylene	7.83E+00	4.53E-06	3.85E-07	4.92E-06	0.0E+00	0E+00
Heptane	2.86E+01	1.66E-05	1.41E-06	1.80E-05	0.0E+00	0E+00
n-Propyl Benzene	1.08E+00	6.27E-07	5.33E-08	6.81E-07	0.0E+00	0E+00
					Total Risk =	1E-07

+ Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis period

TABLE A-Z-33. CAMP THUNDEROCK
Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TO1) - November 1991

	Concentration*	Outdoor Exposure ug/m ³	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Benzene	1.06E+01	6.15E-06	5.23E-07	6.67E-06	2.9E-02	2E-07
Toluene	3.39E+02	1.96E-04	1.67E-05	2.13E-04	0.0E+00	0E+00
Ethyl Benzene	3.61E+00	2.09E-06	1.78E-07	2.27E-06	0.0E+00	0E+00
m,p-Xylene	1.88E+01	1.09E-05	9.26E-07	1.18E-05	0.0E+00	0E+00
o-Xylene	1.71E+01	9.88E-06	8.40E-07	1.07E-05	0.0E+00	0E+00
Heptane	1.18E+02	6.81E-05	5.79E-06	7.38E-05	0.0E+00	0E+00
n-Propyl Benzene	1.75E+00	1.01E-06	8.62E-08	1.10E-06	0.0E+00	0E+00
					Total Risk =	2E-07

* Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis period

TABLE A-2-34, AL AHMADI HOSPITAL
Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TOI) - June 1991

	Concentration*	Outdoor Exposure ug/m ³	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Benzene	1.31E+01	7.56E-06	6.43E-07	8.20E-06	2.9E-02	2E-07
Toluene	3.60E+01	2.08E-05	1.77E-06	2.26E-05	0.0E+00	0E+00
Ethyl Benzene	4.12E+01	2.38E-05	2.03E-06	2.59E-05	0.0E+00	0E+00
m,p-Xylene	1.16E+02	6.74E-05	5.73E-06	7.32E-05	0.0E+00	0E+00
o-Xylene	3.04E+01	1.76E-05	1.49E-06	1.91E-05	0.0E+00	0E+00
Heptane	1.27E+02	7.34E-05	6.24E-06	7.97E-05	0.0E+00	0E+00
n-Propyl Benzene	4.40E+00	2.55E-06	2.17E-07	2.77E-06	0.0E+00	0E+00
					Total Risk =	2E-07

* Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis period

TABLE A-2-35. KHOBAR TOWERS

Non-Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TO1) - May 1991

	Concentration*	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Reference Conc. mg/kg-day	Hazard	Quotient
	ug/m3						
Benzene	1.17E+01	5.61E-03	4.77E-04	6.08E-03	1.5E-03	4E+00	
Toluene	3.20E+01	1.53E-02	1.30E-03	1.66E-02	1.1E-01	2E-01	
Ethyl Benzene	8.19E+00	3.91E-03	3.32E-04	4.24E-03	2.9E-01	1E-02	
m,p-Xylene	2.73E+01	1.30E-02	1.11E-03	1.42E-02	2.0E-01	7E-02	
o-Xylene	7.41E+00	3.54E-03	3.01E-04	3.84E-03	2.0E-01	2E-02	
Heptane	1.08E+01	5.17E-03	4.39E-04	5.61E-03	NAV	0E+00	
n-Propyl Benzene	1.45E+00	6.93E-04	5.89E-05	7.52E-04	NAV	0E+00	
					Hazard Index =		4E+00

* Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis period

NAV - Not Available

TABLE A-Z-36. KHOBAR TOWERS

Non-Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TO1) - June 1991

	Concentration*	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kgday	Reference.Conc. mg/kgday	Hazard Quotient
	ug/m ³					
Benzene	NA	0.00E+00	0.00E+00	0.00E+00	1.5E-03	0E+00
Toluene	3.66E+01	1.75E-02	1.49E-03	1.90E-02	1.1E-01	2E-01
Ethyl Benzene	6.52E+00	3.11E-03	2.64E-04	3.37E-03	2.9E-01	1E-02
m,p-Xylene	1.88E+01	8.95E-03	7.61E-04	9.72E-03	2.0E-01	5E-02
o-Xylene	6.69E+00	3.19E-03	2.71E-04	3.46E-03	2.0E-01	2E-02
Heptane	5.41E+00	2.58E-03	2.20E-04	2.80E-03	NAV	0E+00
n-Prnyl Benzene	1.39E+00	6.61E-04	5.62E-05	7.18E-04	NAV	0E+00
					Hazard Index =	2E-01

* Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis period

NAV - Not Available

TABLE A-2-37. KHOBAR TOWERS

Non-Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TO1) - July 1991

	Concentration* ug/m ³	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Reference Conc. mg/kg-day	Hazard Quotient
Benzene	NA	0.00E+00	0.00E+00	0.00E+00	1.5E-03	0E+00
Toluene	2.05E+01	9.77E-03	8.31E-04	1.06E-02	1.1E-01	1E-01
Ethyl Benzene	6.77E+00	3.23E-03	2.75E-04	3.51E-03	2.9E-01	1E-02
m,p-Xylene	1.83E+01	8.73E-03	7.42E-04	9.47E-03	2.0E-01	5 E-02
o-Xylene	6.75E+00	3.22E-03	2.74E-04	3.49E-03	2.0E-01	2E-02
Heptane	9.18E+00	4.38E-03	3.73E-04	4.75E-03	NAV	0E+00
n-Propyl Benzene	1.21E+00	5.79E-04	4.92E-05	6.28E-04	NAV	0E+00
					Hazard Index =	2E-01

* Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis period

NAV - Not Available

TABLE A-2-38. KHOBAR TOWERS

Non-Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TO1) - August 1991

	Concentration*	Outdoor Exposure ug/m ³	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Reference Conc. mglkgday	Hazard Quotient
Benzene	1.04E+01	9.94E-03	1.20E-04	5.36E-03	1.5E-03	4E+00
Toluene	3.10E+01	1.48E-02	1.26E-03	1.61E-02	1.1E-01	1E-01
Ethyl Benzene	1.12E+01	5.36E-03	4.55E-04	5.81E-03	2.9E-01	2E-02
m,p-Xylene	2.46E+01	1.18E-02	9.99E-04	1.27E-02	2.0E-01	6E-02
o-Xylene	1.05E+01	4.99E-03	4.24E-04	5.41E-03	2.0E-01	3E-02
Heptane	1.81E+01	8.64E-03	7.35E-04	9.37E-03	NAV	0E+00
n-Propyl Benzene	1.97E+00	9.41E-04	8.01E-05	1.02E-03	NAV	0E+00
					Hazard Index =	4E+00

* Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis period

NAV - Not Available

TABLE A-Z-39. KHOBAR TOWERS

Non-Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TO1) - September 1991

	Concentration*	Outdoor Exposure ug/m ³	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Reference Conc. mg/kg-day	Hazard	Quotient
Benzene	7.88E+00	3.76E-03	3.20E-04	4.08E-03	1.5E-03	3E+00	
Toluene	2.36E+01	1.13E-02	9.57E-04	1.22E-02	1.1E-01	1E-01	
Ethyl Benzene	6.56E+00	3.13E-03	2.66E-04	3.40E-03	2.9E-01	1E-02	
m,p-Xylene	1.84E+01	8.78E-03	7.46E-04	9.52E-03	2.0E-01	5E-02	
o-Xylene	6.97E+00	3.33E-03	2.83E-04	3.61E-03	2.0E-01	2E-02	
Heptane	7.87E+00	3.75E-03	3.19E-04	4.07E-03	NAV	0E+00	
n-Propyl Benzene	1.19E+00	5.70E-04	4.85E-05	6.19E-04	NAV	0E+00	
					Hazard Index =		3E+00

* Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis period

NAV - Not Available

TABLE A-240. KHOBAR TOWERS

Non-Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TO1) - October 1991

	Concentration*	Outdoor Exposure ug/m ³	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Reference Conc. mg/kg-day	Hazard Quotient
Benzene	7.21E+00	3.44E-03	2.93E-04	3.73E-03	1.5E-03	2E+00
Toluene	4.78E+01	2.28E-02	1.94E-03	2.47E-02	1.1E-01	2E-01
Ethyl Benzene	2.79E+01	1.33E-02	1.13E-03	1.45E-02	2.9E-01	5E-02
m,p-Xylene	9.21E+01	4.39E-02	3.74E-03	4.77E-02	2.0E-01	2E-01
o-Xylene	2.29E+01	1.09E-02	9.29E-04	1.19E-02	2.0E-01	6E-02
Heptane	1.02E+01	4.85E-03	4.12E-04	5.26E-03	NAV	0E+00
n-Propyl Benzene	1.04E+00	4.98E-04	4.23E-05	5.40E-04	NAV	0E+00
					Hazard Index =	3E+00

A - 2 - 4 0 • Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis period

NAV - Not Available

TABLE A-2-41. KHOBAR TOWERS

Non-Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TO1) - November 1991

	Concentration*	Outdoor Exposure ug/m ³	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Reference Conc. mg/kg-day	Hazard Quotient
Benzene	4.52E+00	2.16E-03	1.83E-04	2.34E-03	1.5E-03	2E+00
Toluene	1.85E+01	8.81E-03	7.49E-04	9.56E-03	1.1E-01	9E-02
Ethyl Benzene	3.91E+00	1.87E-03	1.59E-04	2.03E-03	2.9E-01	7E-03
m,p-Xylene	1.13E+01	5.40E-03	4.59E-04	5.86E-03	2.0E-01	3E-02
o-Xylene	4.34E+00	2.07E-03	1.76E-04	2.25E-03	2.0E-01	1E-02
Heptane	5.13E+00	2.45E-03	2.08E-04	2.65E-03	NAV	0E+00
n-Propyl Benzene	6.30E-01	3.01E-04	2.56E-05	3.26E-04	NAV	0E+00
					Hazard Index =	2E+00

* Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis period

NAV - Not Available

TABLE A-2-42. CAMP 1
Non-Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TOI) - May 1991

	Concentration* ug/m³	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Reference Conc. mg/kg-day	Hazard Quotient
Benzene	1.00E+01	4.79E-03	4.07E-04	5.20E-03	1 SE-03	3E+00
Toluene	1.09E+01	5.15E-03	4.38E-04	5.58E-03	1.1E-01	5E-02
EthylBenzene	3.82E+00	1.82E-03	1.55E-04	1.98E-03	2.9E-01	7E-03
m,p-Xylene	9.27E+00	4.42E-03	3.76E-04	4.80E-03	2.0E-01	2E-02
o-Xylene	3.44E+00	1 HE-03	1.40E-04	1.78E-03	2.0E-01	9E-03
Heptane	3.59E+00	1.71E-03	1.46E-04	1.86E-03	NAV	0E+00
n-Propyl Benzene	6.92E-01	3.30E-04	2.81E-05	3.58E-04	NAV	0E+00
					Hazard Index =	,4E+00

* Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis period

NAV - Not Available

TABLE A-2-43. CAMP 1

Non-Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TO1) - June 1991

	Concentration*	Outdoor Exposure ug/m ³	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Reference Conc. mg/kg-day	Hazard Quotient
Benzene	NA	0.00E+00	0.00E+00	0.00E+00	1.5E-03	0E+00
Toluene	4.26E+00	2.03E-03	1.73E-04	2.21E-03	1.1E-01	2E-02
Ethyl Benzene	1.81E+00	8.62E-04	7.33E-05	9.35E-04	2.9E-01	3E-03
m,p-Xylene	4.90E+00	2.34E-03	1.99E-04	2.54E-03	2.0E-01	1E-02
o-Xylene	1.84E+00	8.79E-04	7.47E-05	9.54E-04	2.0E-01	5E-03
Heptane	4.05E+00	1.93E-03	1.65E-04	2.10E-03	NAV	0E+00
n-Propyl Benzene	3.79E-01	1.81E-04	1.54E-05	1.96E-04	NAV	0E+00
					Hazard Index =	4E-02

- Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis period

NAV - Not Available

TABLE A-2-44, CAMP 1

Non-Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TO1) - July 1991

	Concentration*	Outdoor Exposure ug/m ³	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Reference Conc. mg/kg-day	Hazard Quotient
Benzene	1.52E+00	7.26E-04	6.18E-05	7.88E-04	1.5E-03	5E-01
Toluene	4.14E+00	1.98E-03	1.68E-04	2.14E-03	1.1E-01	2E-02
EthylBenzene	1.59E+00	7.60E-04	6.46E-05	8.25E-04	2.9E-01	3E-03
m,p-Xylene	4.74E+00	2.26E-03	1.92E-04	2.45E-03	2.0E-01	1E-02
o-Xylene	1.45E+00	6.94E-04	5.90E-05	7.53E-04	2.0E-01	4E-03
Heptane	7.28E+00	3.47E-03	2.95E-04	3.77E-03	NAV	0E+00
n-Propyl Benzene	3.41E-01	1.63E-04	1.38E-05	1.76E-04	NAV	0E+00
					Hazard Index =	6E-01

• Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis period

NAV - Not Available

TABLE A-2-45. ESKAN VILLAGE

Non-Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TO1) - June 1991

	Concentration*	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Reference Conc. mg/kg-day	Hazard Quotient
	ug/m3					
Benzene	NA	0.00E+00	0.00E+00	0.00E+00	1.5E-03	0E+00
Toluene	NA	0.00E+00	0.00E+00	0.00E+00	1.1E-01	0E+00
Ethyl Benzene	2.55E+00	1.22E-03	1.03E-04	1.32E-03	2.9E-01	5E-03
m,p-Xylene	8.58E+00	4.10E-03	3.48E-04	4.44E-03	2.0E-01	2E-02
o-Xylene	2.91E+00	1.39E-03	1.18E-04	1.51E-03	2.0E-01	8E-03
Heptane	NA	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
n-Propyl Benzene	5.06E-01	2.41E-04	2.05E-05	2.62E-04	NAV	0E+00
					Hazard Index =	3E-02

* Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis period

NAV - Not Available

TABLE A-246. ESKAN VILLAGE
Non-Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TOI) - July 1991

	Concentration* ug/m3	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Reference Cone. mg/kg-day	Hazard	Quotient
Benzene	NA	0.00E+00	0.00E+00	0.00E+00	1 SE-03	0E+00	
Toluene	2.25E+01	1.07E-02	9.14E-04	1.17E-02	1.1E-01	1E-01	
Ethyl Benzene	4.78E+00	2.18E-03	1.94E-04	2.48E-03	2.9E-01	9E-03	
m,p-Xylene ,	1.31E+01	6.24E-03	5.31E-04	6.77E-03	2.0E-01	3E-02	
o-Xylene	4.66E+00	2.22E-03	1.89E-04	2.41E-03	2.0E-01	1 E-02	
Heptane	3.06E+00	1.46E-03	1.24E-04	1.59E-03	NAV	0E+00	
n-Propyl Benzene	9.30E-01	4.44E-04	3.77E-05	4.81E-04	NAV	0E+00	
					Hazard Index =		2E-01

* Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis period

NAV - Not Available

TABLE A-2-47. ESKAN VILLAGE
Non-Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TO1) - August 1991

	Concentration* ug/m³	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Reference Conc. mg/kg-day	Hazard Quotient
Benzene	5.75E+00	2.74E-03	2.33E-04	2.98E-03	1.5E-03	2E+00
Toluene	1.71E+01	8.15E-03	6.93E-04	8.84E-03	1.1E-01	8E-02
Ethyl Benzene	5.60E+00	2.67E-03	2.27E-04	2.90E-03	2.9E-01	1E-02
m,p-Xylene	1.08E+01	5.17E-03	4.39E-04	5.61E-03	2.0E-01	3E-02
o-Xylene	5.27E+00	2.52E-03	2.14E-04	2.73E-03	2.0E-01	1E-02
Heptane	1.36E+01	6.47E-03	5.50E-04	7.02E-03	NAV	0E+00
n-PropylBenzene	9.18E-01	4.38E-04	3.72E-05	4.75E-04	NAV	0E+00
					Hazard Index	2E+00

* Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis period

NAV - Not Available

TABLE A-248. KKMC

Non-Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TOI) - May 1991

	Concentration* ug/m ³	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Reference Conc. mg/kg-day	Hazard Quotient
Benzene	3.91E+00	1.87E-03	1.59E-04	2.03E-03	1.5E-03	1E+00
Toluene	3.12E+00	1.49E-03	1.27E-04	1.62E-03	1.1E-01	1E-02
Ethyl Benzene	1.07E+01	5.12E-03	4.35E-04	5.55E-03	2.9E-01	2E-02
m,p-Xylene	9.81E+00	4.68E-03	3.98E-04	5.08E-03	2.0E-01	3E-02
o-Xylene	6.54E+00	3.12E-03	2.65E-04	3.39E-03	2.0E-01	2E-02
Heptane	9.56E-01	4.56E-04	3.88E-05	4.95E-04	NAV	OE+00
n-Propyl Benzene	5.60E+00	2.67E-03	2.27E-04	2.90E-03	NAV	OE+00
					Hazard Index =	1E+00

- Concentrations are the 95th % upper bound of the sample data set

N A - No valid samples for analysis period

NAV - Not available

TABLE A-2-49. KKMC

Non-Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TO1) - June 1991

	Concentration*	Outdoor Exposure ug/m ³	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Reference Conc. mg/kg-day	Hazard Quotient
Benzene	NA	0.00E+00	0.00E+00	0.00E+00	1.5E-03	0E+00
Toluene	6.54E+00	3.12E-03	2.65E-04	3.38E-03	1.1E-01	3E-02
Ethyl Benzene	1.97E+00	9.41E-04	8.00E-05	1.02E-03	2.9E-01	4E-03
m,p-Xylene	4.90E+00	2.34E-03	1.99E-04	2.54E-03	2.0E-01	1E-02
o-Xylene	1.90E+00	9.07E-04	7.71E-05	9.84E-04	2.0E-01	5E-03
Heptane	1.76E+00	8.39E-04	7.13E-05	9.10E-04	NAV	0E+00
n-Propyl Benzene	3.99E-01	1.90E-04	1.62E-05	2.06E-04	NAV	0E+00
					Hazard Index =	5E-02

* Concentrations are the 95th % upper bound of the sample data set

A-2-49 NA - No valid samples for analysis period

NAV - Not available

TABLE A-2-50. KKMC

Non-Carcinogenic Risk - Inhalation of **Volatile** Organic Compounds (TOI) - July 1991

	Concentration* ug/m ³	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Reference Conc. mg/kg-day	Hazard Quotient
Benzene	NA	0.00E+00	0.00E+00	0.00E+00	1.5E-03	0E+00
Toluene	4.53E+00	2.16E-03	1.84E-04	2.35E-03	1.1E-01	2E-02
Ethyl Benzene	1.56E+00	7.42E-04	6.31E-05	8.05E-04	2.9E-01	3E-03
m,p-Xylene	3.58E+00	1.71E-03	1.45E-04	1.85E-03	2.0E-01	9E-03
o-Xylene	1.39E+00	6.65E-04	5.66E-05	7.22E-04	2.0E-01	4E-03
Heptane	1.62E+00	7.74E-04	6.58E-05	8.40E-04	NAV	0E+00
n-Propyl Benzene	3.10E-01	1.48E-04	1.26E-05	1.61E-04	NAV	0E+00
					Hazard Index =	4E-02

* Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis period

NAV - Not available

TABLE A-2-51. KKMC

Non-Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TOT) - August 1991

	Concentration* ug/m ³	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Reference Conc. mg/kg-day	Hazard	Quotient
Benzene	NA	0.00E+00	0.00E+00	0.00E+00	1.5E-03	0E+00	
Toluene	1.12E+01	5.32E-03	4.52E-04	5.77E-03	1.1E-01	5E-02	
Ethyl Benzene	2.59E+00	1.24E-03	1.05E-04	1.34E-03	2.9E-01	5E-03	
m,p-Xylene	1.00E+01	4.77E-03	4.06E-04	5.18E-03	2.0E-01	3E-02	
o-Xylene	2.59E+00	1.24E-03	1.05E-04	1.34E-03	2.0E-01	7E-03	
Heptane	2.75E+00	1.31E-03	1.12E-04	1.42E-03	NAV	0E+00	
n-Propyl Benzene	9.16E-01	4.37E-04	3.72E-05	4.74E-04	NAV	0E+00	
					Hazard Index =		9E-02

- Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis period

NAV - Not available

TABLE A-2-52. MILITARY HOSPITAL/CAMP FREEDOM

Non-Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TO1) - May 1991

	Concentration*	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Reference Conc. mg/kg-day	Hazard	Quotient
	ug/m3						
Benzene	NA	0.00E+00	0.00E+00	0.00E+00	1.5E-03	0E+00	
Toluene	1.40E+01	6.67E-03	5.67E-04	7.24E-03	1.1E-01	7E-02	
Ethyl Benzene	2.03E+00	9.70E-04	8.25E-05	1.05E-03	2.9E-01	4E-03	
m,p-Xylene	5.52E+00	2.63E-03	2.24E-04	2.86E-03	2.0E-01	1E-02	
o-Xylene	2.07E+00	9.89E-04	8.41 E-05	1.07E-03	2.0E-01	5E-03	
Heptane	NA	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00	
n-Propyl Benzene	4.48E-01	2.14E-04	1.82E-05	2.32E-04	NAV	0E+00	
					Hazard Index =		9E-02

- Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis period

NAV - Not Available

TABLE A-2-53. MILITARY HOSPITAL/CAMP FREEDOM

Non-Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TO1) - June 1991

	Concentration*	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Reference Conc. mg/kg-day	Hazard Quotient
	ug/m ³					
Benzene	NA	0.00E+00	0.00E+00	0.00E+00	1.5E-03	0E+00
Toluene	NA	0.00E+00	0.00E+00	0.00E+00	1.1E-01	0E+00
Ethyl Benzene	NA	0.00E+00	0.00E+00	0.00E+00	2.9E-01	0E+00
m,p-Xylene	NA	0.00E+00	0.00E+00	0.00E+00	2.0E-01	0E+00
o-Xylene	NA	0.00E+00	0.00E+00	0.00E+00	2.0E-01	0E+00
Heptane	NA	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
n-Propyl Benzene	NA	0.00E+00	0.00E+00	MM-W.+~	NAV	0E+00
					Hazard Index =	0E+00

* Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis period

NAV - Not Available

TABLE A-2-54. MILITARY HOSPITAL/CAMP FREEDOM

Non-Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TO1) - July 1991

	Concentration*	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Reference Conc. mg/kg-day	Hazard Quotient
Benzene	NA	0.00E+00	0.00E+00	0.00E+00	1 SE-03	0E+00
Toluene	5.87E+01	2.00E-02	2.38E-03	3.04E-02	1.1E-01	3E-01
Ethyl Benzene	1.56E+00	7.47E-04	6.35E-05	8.10E-04	2.9E-01	3E-03
m,p-Xylene	7.68E+00	3.66E-03	3.11E-04	3.97E-03	2.0E-01	2E-02
o-Xylene	2.29E+00	1.09E-03	9.31E-05	1.19E-03	2.0E-01	6E-03
Heptane	1.02E+01	4.88E-03	4.15E-04	5.29E-03	NAV	0E+00
n-Propyl Benzene	6.16E-01	2.94E-04	2.50E-05	3.19E-04	NAV	0E+00
					Hazard Index =	3E-01

* Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis period

NAV - Not Available

TABLE A-2-55, MILITARY HOSPITAL/CAMP FREEDOM
Non-Carcinogenic Risk - inhalation of Volatile Organic Compounds (TOI) - August 1991

	Concentration*	Outdoor Exposure ug/m ³	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Reference Conc. mg/kg-day	Hazard Quotient
Benzene	1.31E+00	6.25E-04	5.31E-05	6.78E-04	1.5E-03	SE-01
Toluene	1.88E+01	8.99E-03	7.65E-04	9.76E-03	1.1E-01	9E-02
Ethyl Benzene	1.77E+00	8.44E-04	7.18E-05	9.16E-04	2.9E-01	3E-03
m,p-Xylene	4.28E+00	2.04E-03	1.74E-04	2.22E-03	2.0E-01	1E-02
o-Xylene	1.30E+00	6.20E-04	5.27E-05	6.73E-04	2.0E-01	3E-03
Heptane	2.66E+00	1.27E-03	1.08E-04	1.38E-03	NAV	0E+00
n-Propyl Benzene	4.58E-01	2.19E-04	1.86E-05	2.37E-04	NAV	0E+00
					Hazard Index	6E-01

• Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis period

NAV - Not Available

TABLE A-2-56. MILITARY HOSPITAL/CAMP FREEDOM
Non-Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TOI) - September 1991

	Concentration* ug/m³	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Reference Conc. mg/kg-day	Hazard Quotient
Benzene	4.52E+00	2.16E-03	1.83E-04	2.34E-03	1.5E-03	2E+00
Toluene	4.15E+01	1.98E-02	1.68E-03	2.15E-02	1.1E-01	2E-01
Ethyl Benzene	6.31E+00	3.01E-03	2.56E-04	3.26E-03	2.9E-01	1E-02
m,p-Xylene	1.27E+01	6.04E-03	5.14E-04	6.56E-03	2.0E-01	3E-02
o-Xylene	5.37E+00	2.56E-03	2.18E-04	2.78E-03	2.0E-01	1E-02
Heptane	4.25E+01	2.03E-02	1.73E-03	2.20E-02	NAV	0E+00
n-Propyl Benzene	1.34E+00	6.39E-04	5.44E-05	6.94E-04	NAV	0E+00
					Hazard Index =	2E + 00

* Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis period

NAV - Not Available

TABLE A-2-57. MILITARY HOSPITAL/CAMP FREEDOM
Non-Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TO1) - October 1991

	Concentration* ug/m ³	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Reference Conc. mg/kg-day	Hazard Quotient
Benzene	5.52E+00	2.63E-03	2.24E-04	2.86E-03	1.5E-03	2E+00
Toluene	1.98E+02	9.45E-02	8.04E-03	1.03E-01	1.1E-01	9E-01
Ethyl Benzene	7.58E+00	3.62E-03	3.08E-04	3.93E-03	2.9E-01	1 E-02
m,p-Xylene	1.83E+01	8.72E-03	7.41E-04	9.46E-03	2.0E-01	5E-02
o-Xylene	8.42E+00	4.02E-03	3.41E-04	4.36E-03	2.0E-01	2E-02
Heptane	2.99E+01	1.43E-02	1.21E-03	1.55E-02	NAV	0E+00
n-Propyl Benzene	1.26E+00	6.03E-04	5.12E-05	6.54E-04	NAV	0E+00
					Hazard Index =	3E+00

* Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis period

NAV - Not Available

TABLE A-2-58, MILITARY HOSPITAL/CAMP FREEDOM
Non-Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TOI) - November 1991

	Concentration* ug/m ³	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Reference Conc. mg/kg-day	Hazard	Quotient
Benzene	4.87E+00	2.32E-03	1.98E-04	2.52E-03	1.5E-03	2E+00	
Toluene	1.19E+02	5.68E-02	4.83E-03	6.17E-02	1.1E-01	6E-01	
Ethyl Benzene	3.08E+00	1.47E-03	1.25E-04	1.59E-03	2.9E-01	5E-03	
m,p-Xylene	7.31E+00	3.49E-03	2.97E-04	3.79E-03	2.0E-01	2E-02	
o-Xylene	3.43E+00	1.64E-03	1.39E-04	1.78E-03	2.0E-01	9E-03	
Heptane	3.65E+01	1.74E-02	1.48E-03	1.89E-02	NAV	0E+00	
n-Propyl Benzene	4.53E-01	2.16E-04	1.84E-05	2.34E-04	NAV	0E+00	
					Hazard Index =		2E+00

* Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis period

NAV - Not Available

TABLE A-2-59. U.S. EMBASSY, KUWAIT

Non-Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TOI) - May 1991

	Concentration*	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Reference Conc. mg/kg-day	Hazard Quotient
	ug/m3					
Benzene	NA	0.00E+00	0.00E+00	0.00E+00	1.5E-03	0E+00
Toluene	NA	0.00E+00	0.00E+00	0.00E+00	1.1E-01	0E+00
Ethyl Benzene	1.14E+01	5.42E-03	4.61E-04	5.89E-03	2.9E-01	2E-02
m,p-Xylene	2.76E+01	1.32E-02	1.12E-03	1.43E-02	2.0E-01	7E-02
Xylene	1.18E+01	5.61E-03	4.77E-04	6.09E-03	2.0E-01	3E-02
Heptane	NA	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
n-PropylBenzene	1.93E+00	9.19E-04	7.82E-05	9.98E-04	NAV	0E+00
					Hazard Index =	1E-01

* Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis period

NAV - Not Available

TABLE A-2-60. U.S. EMBASSY, KUWAIT

Non-Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TOI) - June 1991

	Concentration*	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Reference Conc. mg/kg-day	Hazard Quotient
	ug/m ³					
Benzene	1.18E+01	5.62E-03	4.78E-04	6.10E-03	1.5E-03	4E+00
Toluene	NA	0.00E+00	0.00E+00	0.00E+00	1.1E-01	0E+00
Ethyl Benzene	2.68E+01	1.28E-02	1 BE-03	1.39E-02	2.9E-01	SE-02
m,p-Xylene	7.75E+01	3.70E-02	3.14E-03	4.01E-02	2.0E-01	2E-01
o-Xylene	2.95E+01	1.41E-02	1.20E-03	1.53E-02	2.0E-01	BE-02
Heptane	NA	0.00E+00	0.00E+00	0.00E+00	NAV	0EtO0
n-Propyl Benzene	2.91E+00	1.39E-03	1.18E-04	1.50E-03	N	A
					Hazard Index =	4EtO0

* Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis period

NAV - Not Available

TABLE A-2-61, U.S. EMBASSY, KUWAIT

Non-Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TO1) - July 1991

	Concentration*	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg day	Total Exposure mg/kg-day	Reference Conc. mg/kg-day	Hazard	Quotient
	ug/m3						
(Benzene	NA	0.00E+00	0.00E+00	0.00E+00	1.5E-03	0E+00	
Toluene	NA	0.00E+00	0.00E+00	0.00E+00	1.1E-01	0E+00	
Ethyl Benzene	NA	0.00E+00	0.00E+00	0.00E+00	2.9E-01	0E+00	
m,p-Xylene	NA	0.00E+00	0.00E+00	0.00E+00	2.0E-01	0E+00	
o-Xylene	NA	0.00E+00	0.00E+00	0.00E+00	2.0E-01	0E+00	
Heptane	NA	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00	
n-Propyl Benzene	NA	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00	
					Hazard Index =		0E+00

* Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis period

NAV - Not Available

TABLE A-2-62, CAMP THUNDEROCK

Non-Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TO1) - June 1991

	Concentration*	Outdoor Exposure ug/m ³	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Reference Conc. mg/kg-day	Hazard Quotient
Benzene	8.39E+00	4.00E-03	3.40E-04	4.34E-03	1 SE-03	3E+00
Toluene	2.53E+01	1.21E-02	1.03E-03	1.31E-02	1.1E-01	1E-01
Ethyl Benzene	6.08E+00	2.90E-03	2.46E-04	3.15E-03	2.9E-01	1E-02
m,p-Xylene	1.76E+01	8.39E-03	7.13E-04	9.10E-03	2.0E-01	SE-02
o-Xylene	7.03E+00	3.36E-03	2.85E-04	3.64E-03	2.0E-01	2E-02
Heptane	1E+01	1.15E-02	9.76E-04	1.25E-02	NAV	0E+00
n-Propyl Benzene	1.89E+00	9.01E-04	7.66E-05	9.77E-04	NAV	0E+00
					Hazard Index =	3E+00

* Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis period

NAV - Not Available

TABLE A-2-63. CAMP THUNDEROCK

Non-Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TO1) - July 1991

	Concentration*	Outdoor Exposure ug/m ³	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Reference Conc. mg/kg-day	Hazard Quotient
Benzene	2.94E+01	1.40E-02	1.19E-03	1.52E-02	1.5E-03	1E+01
Toluene	5.41E+01	2.58E-02	2.19E-03	2.80E-02	1.1E-01	3E-01
Ethyl Benzene	3.18E+00	1.52E-03	1.29E-04	1.65E-03	2.9E-01	6E-03
m,p-Xylene	8.54E+00	4.08E-03	3.47E-04	4.42E-03	2.0E-01	2E-02
o-Xylene	2.78E+00	1.32E-03	1.13E-04	1.44E-03	2.0E-01	7E-03
Heptane	3.82E+01	1.82E-02	1.55E-03	1.98E-02	NAV	0E+00
n-Propyl Benzene	1.53E+00	7.28E-04	6.19E-05	7.90E-04	NAV	0E+00
					Hazard Index =	1E+01

• Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis period

NAV - Not Available

TABLE A-244. CAMP THUNDEROCK

Non-Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TOI) - August 1991

	Concentration*	Outdoor Exposure ug/m ³	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Reference Conc. mg/kg-day	Hazard Quotient
Benzene	NA	0.00E+00	0.00E+00	0.00E+00	1.5E-03	0E+00
Toluene	3.71E+00	1.77E-03	1.51E-04	1.92E-03	1.1E-01	2E-02
Ethyl Benzene	5.11E-01	2.44E-04	2.07E-05	2.65E-04	2.9E-01	9E-04
m,p-Xylene	9.98E-01	4.76E-04	4.05E-05	5.17E-04	2.0E-01	3E-03
o-Xylene	3.10E-01	1.43E-04	1.22E-05	1.55E-04	2.0E-01	8E-04
Heptane	6.48E-01	3.19E-04	2.71E-05	3.46E-04	NAV	0E+00
n-Propyl Benzene	9.31E-02	4.44E-05	3.78E-06	4.82E-05	NAV	0E+00
Hazard Index =						2E-02

* Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis period

NAV - Not Available

TABLE A-2-65. CAMP THUNDEROCK
Non-Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TOI) - September 1991

	Concentration* ug/m ³	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Reference Conc. mg/kg-day	Hazard Quotient
Benzene	6.03E+00	2.88E-03	2.45E-04	3.12E-03	1.5E-03	2E+00
Toluene	2.01E+01	9.59E-03	8.15E-04	1.04E-02	1.1E-01	9E-02
Ethyl Benzene	8.53E+00	4.07E-03	3.46E-04	4.41E-03	2.9E-01	2E-02
m,p-Xylene	1.56E+01	7.44E-03	6.33E-04	8.07E-03	2.0E-01	4E-02
o-Xylene	5.96E+00	2.84E-03	2.42E-04	3.08E-03	3.0E-01	2E-02
Heptane	1.61E+01	7.69E-03	6.54E-04	8.34E-03	NAV	0E+00
n-Propyl Benzene	1.14E+00	5.42E-04	4.61E-05	5.89E-04	N A V O E + O O	Hazard Index = 2E+00

- Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis period

NAV - Not Available

TABLE A-2-66. CAMP THUNDEROCK

Non-Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TOI) - October 1991

	Concentration*	Outdoor Exposure ug/m ³	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Reference Conc. mg/kg-day	Hazard Quotient
Benzene	6.08E+00	2.90E-03	2.47E-04	3.15E-03	1.5E-03	2EtO0
Toluene	8.35E+01	3.99E-02	3.39E-03	4.32E-02	1.1E-01	4E-01
Ethyl Benzene	6.06E+00	2.89E-03	2.46E-04	3.14E-03	2.9E-01	1E-02
m,p-Xylene	1.84E+01	8.80E-03	7.48E-04	9.54E-03	2.0E-01	SE-02
o-Xylene	7.83E+00	3.73E-03	3.18E-04	4.05E-03	2.0E-01	2E-02
Heptane	2.86E+01	1.37E-02	1.16E-03	1.48E-02	NAV	0E+00
n-Propyl Benzene	1.08E+00	5.17E-04	4.40E-05	5.61E-04	NAV	0E+00
					Hazard Index =	3E+00

* Concentrations are the 954 % upper bound of the sample data set

NA - No valid samples for analysis period

NAV - Not Available

TABLE A-Z-67. CAMP THUNDEROCK

Non-Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TOI) - November 1991

	Concentration* ug/m ³	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Reference Conc. mg/kg-day	Hazard Quotient
Benzene	1.06E+01	5.07E-03	4.31E-04	5.50E-03	1SE-03	4E+00
Toluene	3.39E+02	1.62E-01	1.38E-02	1.76E-01	1.1E-01	2E+00
Ethyl Benzene	3.61E+00	1.72E-03	1.46E-04	1.87E-03	2.9E-01	6E-03
m,p-Xylene	1.88E+01	8.97E-03	7.63E-04	9.73E-03	2.0E-01	5E-02
o-Xylene	1.71E+01	8.14E-03	6.92E-04	8.83E-03	2.0E-01	4E-02
Heptane	1.18E+02	5.61E-02	4.77E-03	6.09E-02	NAV	OE+00
n-Propyl Benzene	1.75E+00	8.36E-04	7.11E-05	9.07E-04	NAV	0E+00
					Hazard Index =	5E+00

* Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis period

NAV - Not Available

TABLE A-2-68. AL AHMADI HOSPITAL

Non-Carcinogenic Risk - Inhalation of Volatile Organic Compounds (TOI) - June 1991

	Concentration*	Outdoor Exposure ug/m ³	Indoor Exposure mg/kg-day	Total Exposure m & day	Reference Conc. mg/kg-day	Hazard Quotient
Benzene	1.31E+01	6.23E-03	5.30E-04	6.76E-03	1.5E-03	5E+00
Toluene	3.60E+01	1.72E-02	1.46E-03	1.86E-02	1E-011	2E-01
Ethyl Benzene	4.12E+01	1.97E-02	1.67E-03	2.13E-02	2.9E-01	7E-02
m,p-Xylene	1.16E+02	5.56E-02	4.73E-03	6.03E-02	2.0E-01	3E-01
o-Xylene	3.04E+01	1.45E-02	1.23E-03	1.57E-02	2.0E-01	8E-02
Heptane	1.27E+02	6.05E-02	5.15E-03	6.57E-02	NAV	0E+00
n-Propyl Benzene	4.40E+00	2.10E-03	1.79E-04	2.28E-03	NAV	0E+00
					Hazard Index =	5E+00

* Concentrations are the 95th % upper bound of the sample data set

NA - No valid samples for analysis period

NAV - Not Available

A-2-69

	Concentration' ug/m ³	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Aluminum	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Arsenic	NA	0.00E+00	0.00E+00	0.00E+00	1.5E+01	OEtOO
Beryllium	NA	0.00E+00	0.00E+00	0.00E+00	8.4E+00	OEtOO
Calcium	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	OEtOO
Cadmium	1.34E-02	7.76E-09	6.60E-10	8.42E-09	6.3E+00	SE-08
Chromium	8.50E-02	4.92E-08	4.18E-09	5.34E-08	4.2E+01	See Note
Iron	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	OEtOO
Magnesium	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	OEtOO
Sodium	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Nickel	1.15E-01	6.66E-08	5.67E-09	7.23E-08	8.4E-01	6E-08
Lead	6.61E-01	3.83E-07	3.25E-08	4.15E-07	0.0E+00	OEtOO
Vanadium	7.22E-01	4.18E-07	3.55E-08	4.54E-07	0.0E+00	OEtOO
Zinc	3.248-O 1	1.87E-07	1.59E-08	2.03E-07	0.0E+00	0E+00
					Total Risk =	1E-07

* Concentrations are the 95th % upper bound of the sample data set

Note - No carcinogenic risk was determined for chromium. All chromium was determined to be trivalent (Cr(III)), the non-carcinogenic form.

See discussion in Uncertainty Analysis section of the main report.

NA - No analysis performed for this analyte

TABLE A-2-70. KHOBAR TOWERS

Carcinogenic Risk - Inhalation of Particulates (PM10) - June 1991

	Concentration*	Outdoor Exposure ug/m ³	indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Aluminum	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Arsenic	NA	0.00E+00	0.00E+00	0.00E+00	1.5E+01	0E+00
Beryllium	NA	0.00E+00	0.00E+00	0.00E+00	8.4E+00	0E+00
Calcium	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Cadmium	4.04E-03	2.34E-09	1.99E-10	2.54E-09	6.3E+00	2E-08
Chromium	3.94E-02	2.28E-08	1.94E-09	2.47E-08	4.2E+01	See Note
Iron	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Magnesium	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Sodium	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Nickel	6.02E-02	3.49E-08	2.96E-09	3.78E-08	8.4E-01	3E-08
Lead	6.36E-01	3.68E-07	3.13E-08	4.00E-07	0.0E+00	0E+00
Vanadium	4.86E-02	2.81E-08	2.39E-09	3.05E-08	0.0E+00	0E+00
Zinc	2.11E-01	1.22E-07	1.04E-08	1.32E-07	0.0E+00	0E+00
					Total Risk =	5E-08

* Concentrations are the 95th upper bound of the sample data set

Note - No carcinogenic risk was determined for chromium. All chromium was determined to be trivalent (**Cr(III)**), the non-carcinogenic form.

See discussion in Uncertainty Analysis section of the main report.

NA - No analysis performed for this analyte

TABLE A-2-71. KHOBAR TOWERS

Carcinogenic Risk - Inhalation of Particulates (PM10) - July 1991

	Concentration+ ug/m ³	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Aluminum	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Arsenic	NA	0.00E+00	0.00E+00	0.00E+00	1.5E+01	0E+00
Beryllium	NA	0.00E+00	0.00E+00	0.00E+00	8.4E+00	0E+00
Calcium	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Cadmium	1.061	6.13E-09	5.21E-10	6.65E-09	6.3E+00	4E-08
Chromium	3.53E-02	2.04E-08	1.74E-09	2.22E-08	4.2E+01	See Note
Iron	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Magnesium	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Sodium	NA	0.00E+00	0.00E+00	0.001E+00	0.0E+00	0E+00
Nickel	1.87E-01	1.08E-07	9.22E-09	1.18E-07	8.4E-01	1E-07
Lead	8.65E-01	5.01E-07	4.26E-08	5.43E-07	0.0E+00	0E+00
Vanadium	9.10E-02	5.27E-08	4.48E-09	5.72E-08	0.0E+00	0E+00
Zinc	1.98E-01	1.15E-07	9.74E-09	1.24E-07	0.0E+00	0E+00
					Total Risk =	1E-07

* Concentrations are the 95th % upper bound of the sample data set

Note - No carcinogenic risk was determined for chromium. All chromium was determined to be trivalent (Cr(III)), the non-carcinogenic form.

See discussion in Uncertainty Analysis section of the main report.

NA - No analysis performed for this analyte

A-2-71

TABLE A-2-72, KHOBAR TOWERS

Carcinogenic Risk - Inhalation of Particulates (PM10) - August 1991

	Concentration*	Outdoor Exposure ug/m ³	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Aluminum	5.79E+00	3.35E-06	2.85E-07	3.64E-06	0.0E+00	0E+00
Arsenic	4.37E-03	2.53E-09	2.15E-10	2.75E-09	1.5E+01	4E-08
Beryllium	6.20E-03	3.59E-09	3.05E-10	3.89E-09	8.4E+00	3E-08
Calcium	4.59E+01	2.66E-05	2.26E-06	2.88E-05	0.0E+00	0E+00
Cadmium	3.61E-03	2.09E-09	1.78E-10	2.27E-09	6.3E+00	1E-08
Chromium	3.21E-02	1.86E-08	1.58E-09	2.02E-08	4.2E+01	See Note
Iron	6.16E+00	3.57E-06	3.03E-07	3.87E-06	0.0E+00	0E+00
Magnesium	1.01E+01	5.84E-06	4.97E-07	6.34E-06	0.0E+00	0E+00
Sodium	2.01E+01	1.16E-05	9.89E-07	1.26E-05	0.0E+00	0E+00
Nickel	7.82E-02	4.53E-08	3.85E-09	4.91E-08	8.4E-01	4E-08
Lead	7.67E-01	4.44E-07	3.78E-08	4.82E-07	0.0E+00	0E+00
Vanadium	3.16E-02	1.83E-08	1.56E-09	1.98E-08	0.0E+00	0E+00
Zinc	6.20E-01	3.59E-07	3.05E-08	3.90E-07	0.0E+00	0E+00
						Total Risk = 1E-07

* Concentrations are the 95th % upper bound of the sample data set

Note - No carcinogenic risk was determined for chromium. All chromium was determined to be trivalent (**Cr(III)**), the non-carcinogenic form.

See discussion in Uncertainty Analysis section of the main report.

NA - No analysis performed for **this analyte**

TABLE A-2-73. KHOBAR TOWERS

Carcinogenic Risk - Inhalation of Particulate-s (PM10) - September 1991

	Concentration* ug/m ³	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Aluminum	7.22E+00	4.18E-06	3.55E-07	4.54E-06	0.0E+00	0E+00
Arsenic	3.67E-03	2.12E-09	1.81E-10	2.31E-09	1.5E+01	3E-08
Beryllium	2.81E-03	1.63E-09	1.38E-10	1.77E-09	8.4E+00	1E-08
Calcium	4.96E+01	2.87E-05	2.44E-06	3.12E-05	0.0E+00	0E+00
Cadmium	6.71E-03	3.88E-09	3.30E-10	4.21E-09	6.3E+00	3E-08
Chromium	3.43E-02	1.99E-08	1.69E-09	2.15E-08	4.2E+01	See Note
Iron	8.52E+00	4.93E-06	4.19E-07	5.35E-06	0.0E+00	0E+00
Magnesium	1.29E+01	7.44E-06	6.33E-07	8.07E-06	0.0E+00	0E+00
Sodium	1.12E+01	6.48E-06	5.51E-07	7.04E-06	0.0E+00	0E+00
Nickel	1.63E-01	9.41E-08	8.00E-09	1.02E-07	8.4E-01	9E-08
Lead	7.54E-01	4.37E-07	3.71E-08	4.74E-07	0.0E+00	0E+00
Vanadium	3.58E-02	2.07E-08	1.76E-09	2.25E-08	0.0E+00	0E+00
Zinc	2.66E-01	1.54E-07	1.31 E-08	1.67E-07	0.0E+00	0E+00
				Total Risk =		2E-07

* Concentrations are the 95th % upper bound of the sampte data set

Note - No carcinogenic risk was determined for chromium. All chromium was determined to be trivalent (Cr(III)), the non-carcinogenic form.

See discussion in Uncertainty Analysis section of the main report.

NA - No analysis performed for this analyte

TABLE A-2-74. KHOBAR TOWERS

Carcinogenic Risk - Inhalation of Particulates (PM10) - October 1991

	Concentration*	Outdoor Exposure ug/m ³	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Aluminum	5.11E+00	2.96E-06	2.52E-07	3.21E-06	0.0E+00	0E+00
Arsenic	4.33E-03	2.51E-09	2.13E-10	2.72E-09	1.5E+01	4E-08
Beryllium	2.90E-04	1.68E-10	1.43E-11	1.82E-10	8.4E+00	2E-09
Calcium	3.39E+01	1.96E-05	1.67E-06	2.13E-05	0.0E+00	0E+00
Cadmium	2.50E-03	1.45E-09	1.23E-10	1.57E-09	6.3E+00	1E-08
Chromium	1.95E-02	1.13E-08	9.60E-10	1.22E-08	4.2E+01	See Note
Iron	5.53E+00	3.20E-06	2.72E-07	3.47E-06	0.0E+00	0E+00
Magnesium	7.67E+00	4.44E-06	3.78E-07	4.82E-06	0.0E+00	0E+00
Sodium	6.81E+00	3.94E-06	3.35E-07	4.28E-06	0.0E+00	0E+00
Nickel	3.45E-01	2.00E-07	1.70E-08	2.17E-07	8.4E-01	2E-07
Lead	8.05E-01	4.66E-07	3.96E-08	5.06E-07	0.0E+00	0E+00
Vanadium	1.61E-02	9.32E-09	7.93E-10	1.01E-08	0.0E+00	0E+00
Zinc	1.38E-01	8.01E-08	6.81E-09	8.69E-08	0.0E+00	0E+00
					Total Risk =	2E-07

* Concentrations are the 95th % upper bound of the sample data set

Note - No carcinogenic risk was determined for chromium. All chromium was determined to be trivalent (**Cr(III)**), the non-carcinogenic form.

See discussion in Uncertainty Analysis section of the main report.

NA - No analysis performed for this analyte

TABLE A-Z-75. KHOBAR TOWERS

Carcinogenic Risk - Inhalation of Particulates (PM10) - November 1991

A-2-75

	Concentration*	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
	ug/m3					
Aluminum	1.03E+00	5.96E-07	5.07E-08	6.47E-07	0.0E+00	0E+00
Arsenic	2.15E-03	1.24E-09	1.06E-10	1.35E-09	1.5E+01	2E-08
Beryllium	2.40E-04	1.39E-10	1.18E-11	1.51E-10	8.4E+00	1E-09
Calcium	1.39E+01	8.05E-06	6.84E-07	8.73E-06	0.0E+00	0E+00
Cadmium	1.47E-03	8.51E-10	7.24E-11	9.23E-10	6.3E+00	6E-09
Chromium	7.20E-03	4.17E-09	3.54E-10	4.52E-09	4.2E+01	See Note
Iron	1.36E+00	7.87E-07	6.69E-08	8.54E-07	0.0E+00	0E+00
Magnesium	2.45E+00	1.42E-06	1.21E-07	1.54E-06	0.0E+00	0E+00
Sodium	2.74E+00	1.59E-06	1.35E-07	1.72E-06	0.0E+00	0E+00
Nickel	5.74E-02	3.32E-08	2.83E-09	3.61E-08	8.4E-01	3E-08
Lead	6.69E-01	3.87E-07	3.29E-08	4.20E-07	0.0E+00	0E+00
Vanadium	4.80E-03	2.78E-09	2.36E-10	3.02E-09	0.0E+00	0E+00
Zinc	1.76E-01	1.02E-07	8.64E-09	1.10E-07	0.0E+00	0E+00
					Total Risk =	6E-08

* Concentrations are the 95th % upper bound of the sample data set

Note - No carcinogenic risk was determined for chromium. All chromium was determined to be trivalent (Cr(III)), the non-carcinogenic form.

See discussion in Uncertainty Analysis section of the main report.

NA - No analysis performed for this analyte

TABLE A-2-76. CAMP 1
Carcinogenic Risk - Inhalation of Particulates (PM10) - May 1991

	Concentration* ug/m³	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Aluminum	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	OEtOO
Arsenic	NA	0.00E+00	0.00E+00	0.00E+00	1.5E+01	0E+00
Beryllium	NA	0.00E+00	0.00E+00	0.00E+00	8.4E-00	0E+00
Calcium	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	OEtOO
Cadmium	1.24E-02	7.20E-09	6.12E-10	7.81E-09	6.3E+00	5E-08
Chromium	7.09E-02	4.10E-08	3.49E-09	4.45E-08	4.2E+01	See Note
Iron	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Magnesium	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	OEtOO
Sodium	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	OEtOO
Nickel	1.76E-01	1.02E-07	8.66E-09	1.11E-07	8.4E-01	9E-08
Lead	8.75E-01	5.07E-07	4.31E-08	5.50E-07	0.0E+00	OEtOO
Vanadium	8.98E-02	5.20E-08	4.42E-09	5.64E-08	0.0E+00	OEtOO
Zinc	1.93E-01	1.12E-07	9.50E-09	1.21E-07	0.0E+00	0E+00
					Total Risk =	1E-07

* Concentrations are the 95th percentile upper bound of the sample data set

Note - No carcinogenic risk was determined for chromium. All chromium was determined to be trivalent (**Cr(III)**), the non-carcinogenic form,

See discussion in Uncertainty Analysis section of the main report.

NA - No analysis performed for this analyte

TABLE A-2-77. CAMP 1

Carcinogenic Risk - Inhalation of Particulates (PM10) - June 1991

A-2-77

	Concentration*	Outdoor Exposure mg/kg-day	Zndour Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Aluminum	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	OEtOO
Arsenic	NA	0.00E+00	0.00E+00	0.00E+00	1.5E+01	0E+00
Beryllium	NA	0.00E+00	0.00E+00	0.00E+00	8.4E+00	0E+00
Calcium	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	OE+00
Cadmium	7.76E-03	4.49E-09	3.82E-10	4.87E-09	6.3E+00	3E-08
Chromium	1.38E-01	8.01E-08	6.81E-09	8.69E-08	4.2E+01	See Note
Iron	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Magnesium	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	OEtOO
Sodium	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Nickel	1.31E-01	7.59E-08	6.45E-09	8.24E-08	8.4E-01	7E-08
Lead	4.61E-01	2.67E-07	2.27E-08	2.90E-07	0.0E+00	0E+00
Vanadium	6.20E-02	3.59E-08	3.05E-09	3.89E-08	0.0Et00	0E+00
Zinc	1.31E-01	7.57E-08	6.43E-09	8.21E-08	0.0E+00	0E+00
					Total Risk =	1E-07

* Concentrations are the 95th % upper bound of the sample data set

Note - No carcinogenic risk was determined for chromium. All chromium was determined to be trivalent (Cr(III)), the non-carcinogenic form.

See discussion in Uncertainty Analysis section of the main report.

NA - No analysis performed for this analyte

TABLE A-2-78. CAMP 1
Carcinogenic Risk - Inhalation of Particulates (PM10) - July 1991

	Concentration* ug/m3	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Aluminum	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	OE+00
Arsenic	NA	0.00E+00	0.00E+00	0.00E+00	1.5E+01	OE+00
Beryllium	NA	0.00E+00	0.00E+00	0.00E+00	8.4E+00	OE+00
Calcium	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	OE+00
Cadmium	2.05E-03	1.19E-09	1.0tE-10	1.29E-09	6.3E+00	8E-09
Chromium	2.23E-02	1.29E-08	1.10E-09	1.40E-08	4.2E+01	See Note
Iron	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	OE+00
Magnesium	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	OE+00
Sodium	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	OE+00
Nickel	1.72E-01	9.95E-08	8.46E-09	1.08E-07	8.4E-01	9E-08
Lad	5.63E-01	3.26E-07	2.77E-08	3.54E-07	0.0E+00	OE+00
Vanadium	2.54E-02	1.47E-08	1.25E-09	1.60E-08	0.0E+00	OE+00
Zinc	3.85E-02	2.23E-08	1.90E-09	2.42E-08	0.0E+00	OE+00
					Total Risk =	1E-07

* Concentrations are the 95th % upper bound of the sample data set

Note - No carcinogenic risk was determined for chromium. All chromium was determined to be trivalent (**Cr(III)**), the non-carcinogenic form,
See discussion in Uncertainty Analysis section of the main report.

NA - No analysis performed for this analyte

TABLE A-2-79. CAMP 1

Carcinogenic Risk - Inhalation of Particulates (PM10) - August 1991

	Concentration*	Outdoor Exposure ug/m ³	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Aluminum	4.12E+00	2.39E-06	2.03E-07	2.598E-06	0.0E+00	OEtOO
Arsenic	2.38E-03	1.38E-09	1.17E-10	1.49E-09	1.5E+01	2E-08
Beryllium	3.81E-03	2.21E-09	1.88E-10	2.39E-09	8.4E+00	2E-08
Calcium	2.53E+01	1.46E-09	1.25E-06	1.59E-05	0.0E+00	OEtOO
Cadmium	2.74E-03	1.59E-09	1.35E-10	1.72E-09	6.3E+00	1E-08
Chromium	3.74E-02	2.17E-08	1.84E-09	3.35E-08	4.2E+01	See Note
Iron	5.37E-00	3.11E-06	2.64E-07	3.37E-06	0.0E+00	OE+00
Magnesium	4.69E+00	2.72E-06	2.31E-07	2.95E-06	0.0E+00	OEtOO
Sodium	2.45E+01	1.42E-05	1.20E-06	1.54E-05	0.0E+00	OEtOO
Nickel	2.14E-01	1.24E-07	1.05E-08	1.34E-07	8.4E-01	1E-07
L e a d	8.37E-01	4.85E-07	4.12E-08	5.26E-07	0.0E+00	OEtOO
Vanadium	2.32E-02	1.34E-08	1.14E-09	1.46E-08	0.0E+00	OEtOO
Zinc	1.48E-01	8.56E-08	7.28E-09	9.28E-08	0.0E+00	0E+00
					Total Risk =	2E-07

* Concentrations are the 95th % upper bound of the sample data set

Note - No carcinogenic risk was determined for chromium. All chromium was determined to be trivalent (Cr(III)), the non-carcinogenic form,

See discussion in Uncertainty Analysis section of the main report.

NA - No analysis performed for this analyte

TABLE A-2-80. ESKAN VILLAGE

Carcinogenic Risk - Inhalation of Particulates (PM10) - June 1991

	Concentration* ug/m ³	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Atuminum	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Arsenic	NA	0.00E+00	0.00E+00	0.00E+00	1.5E+01	0E+00
Beryllium	NA	0.00E+00	0.00E+00	0.00E+00	8.4E+00	0E+00
Calcium	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Cadmium	5.64E-03	3.27E-09	2.78E-10	3.54E-09	6.3E+00	2E-08
Chromium	4.53E-02	2.62E-08	2.23E-09	2.85E-08	4.2E+01	See Note
Iron	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Magnesium	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Sodium	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Nickel	5.66E-02	3.28E-08	2.79E-09	3.56E-08	8.4E-01	3E-08
Lead	1.60E+00	9.24E-07	7.86E-08	1.00E-06	0.0E+00	0E+00
Vanadium	4.26E-02	2.47E-08	2.10E-09	2.68E-08	0.0E+00	0E+00
Zinc	1.25E-01	7.25E-08	6.17E-09	7.87E-08	0.0E+00	0E+00
					Total Risk =	5E-08

* Concentrations are the 95th % upper bound of the sample data set

Note - No carcinogenic risk was determined for chromium. All chromium was determined to be trivalent (**Cr(III)**), the non-carcinogenic form,

See discussion in Uncertainty Analysis section of the main report.

NA - No analysis performed for this analyte

TABLE A-2-81. ESKAN VILLAGE

Carcinogenic Risk - Inhalation of Particulates (PM10) - July 1991

A-2-81

	Concentration* ug/m ³	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Aluminum	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Arsenic	NA	0.00E+00	0.00E+00	0.00E+00	1.5E+01	0E+00
Beryllium	NA	0.00E+00	0.00E+00	OBOE-I-00	8.4E+00	0E+00
Calcium	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Cadmium	1.30E-03	7.53E-10	6.40E-11	8.17E-10	6.3E+00	5E-09
Chromium	2.50E-02	1.45E-08	1.23E-09	1.57E-08	4.2E+01	See Note
Iron	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Magnesium	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Sodium	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Nickel	1.61E-01	9.32E-08	7.93E-09	1.01E-07	8.4E-01	8E-08
Lead	1.59E+00	9.18E-07	7.81E-08	9.96E-07	0.0E+00	0E+00
Vanadium	1.01E-02	5.85E-09	4.97E-10	6.34E-09	0.0E+00	0E+00
Zinc	82E-01	1.06E-07	8.97E-09	1.15E-07	0.0E+00	0E+00
TOTAL RISK =						9E-08

* Concentrations are the 95th % upper bound of the sample data set

Note - No carcinogenic risk was determined for chromium. All chromium was determined to be trivalent (Cr(III)), the non-carcinogenic form,

See discussion in Uncertainty Analysis section of the main report.

NA - No analysis performed for this analyte

TABLE A-2-82. ESKAN VILLAGE

Carcinogenic Risk - Inhalation of Particulates (PM10) - August 1991

	Concentration*	Outdoor Exposure ug/m ³	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Aluminum	5.88E+00	3.40E-06	2.89E-07	3.69E-06	0.0E+00	0E+00
Arsenic	2.35E-03	1.36E-09	1.16E-10	1.48E-09	1.5E+01	2E-08
Beryllium	4.30E-03	2.49E-09	2.12E-10	2.70E-09	8.4E+00	2E-08
Calcium	3.69E+01	2.14E-05	1.82E-06	2.32E-05	0.0E+00	0E+00
Cadmium	4.88E-03	2.83E-09	2.40E-10	3.07E-09	6.3E+00	2E-08
Chromium	2.11E-02	1.22E-08	1.04E-09	1.33E-08	4.2E+01	See Note
Iron	4.37E+00	2.53E-06	2.15E-07	2.75E-06	0.0E+00	0E+00
Magnesium	5.79E+00	3.35E-06	2.85E-07	3.64E-06	0.0E+00	0E+00
Sodium	1.66E+01	9.60E-06	8.17E-07	1.04E-05	0.0E+00	0E+00
Nickel	2.46E-02	1.42E-08	1.21E-09	1.55E-08	8.4E-01	1E-08
Lead	1.02E+00	5.88E-07	5.00E-08	6.38E-07	0.0E+00	0E+00
Vanadium	1.52E-02	8.80E-09	7.48E-10	9.55E-09	0.0E+00	0E+00
Zinc	2.56E-01	1.48E-07	1.26E-08	1.61E-07	0.0E+00	0E+00
					Total Risk =	8E-08

* Concentrations are the 95th % upper bound of the sample data set

Note - No carcinogenic risk was determined for chromium. All chromium was determined to be trivalent (**Cr(III)**), the non-carcinogenic form.

See discussion in Uncertainty Analysis section of the main report.

NA - No analysis performed for this analyte

TABLE A-2-83. KKMC

Carcinogenic Risk - Inhalation of Particulates (PM10) - May 1991

	Concentration@ ug/m ³	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Aluminum	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Arsenic	NA	0.00E+00	0.00E+00	0.00E+00	1.5E+01	0E+00
Beryllium	NA	0.00E+00	0.00E+00	0.00E+00	8.4E+00	0E+00
Calcium	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Cadmium	1.12E-02	6.50E-09	5.53E-10	7.05E-09	6.3E+00	4E-08
Chromium	3.01E-02	1.74E-08	1.48E-09	1.89E-08	4.2E+01	See Note
Iron	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Magnesium	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Sodium	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Nickel	7.29E-02	4.22E-08	3.59E-09	4.58E-08	8.4E-01	4E-08
Lead	3.42E-01	1.98E-07	1.68E-08	2.15E-07	0.0E+00	0E+00
Vanadium	4.95E-02	2.87E-08	2.44E-09	3.11E-08	0.0E+00	0E+00
Zinc	9.70E-02	5.62E-08	4.77E-09	6.09E-08	0.0E+00	0E+00
					Total Risk =	8E-08

* Concentrations are the 95th % upper bound of the sample data set

Note - No carcinogenic risk was determined for chromium. All chromium was determined to be trivalent (Cr(III)), the non-carcinogenic form.

See discussion in Uncertainty Analysis section of the main report.

NA - No analysis performed for this analyte

TABLE A-2-84. KKMC
Carcinogenic Risk - Inhalation of Particulates (PM10) - June 1991

	Concentration* ug/m³	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Aluminum	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Arsenic	NA	0.00E+00	0.00E+00	0.00E+00	1.5E+01	0E+00
Beryllium	NA	0.00E+00	0.00E+00	0.00E+00	8.4E+00	0E+00
Calcium	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Cadmium	5.09E-03	2.95E-09	2.51E-10	3.20E-09	6.3E+00	2E-08
Chromium	3.02E-02	1.75E-08	1.49E-09	1.90E-08	4.2E+01	See Note
Iron	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Magnesium	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Sodium	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Nickel	5.40E-02	3.13E-08	2.66E-09	3.39E-08	8.4E-01	3E-08
Lead	1.87E-01	1.08E-07	9.21E-09	1.17E-07	0.0E+00	0E+00
Vanadium	2.91E-02	1.68E-08	1.43E-09	1.83E-08	0.0E+00	0E+00
Zinc	5.59E-02	3.24E-08	2.75E-09	3.51E-08	0.0E+00	0E+00
					Total Risk =	5E-08

* Concentrations are the 95th % upper bound of the sample data set

Note - No carcinogenic risk was determined for chromium. AH chromium was determined to be trivalent (Cr(III)), the non-carcinogenic form,

See discussion in Uncertainty Analysis section of the main report.

NA - No analysis performed for this analyte

A-2-84

TABLE A-2-85, KKMC

Carcinogenic Risk - Inhalation of Particulate (PM10) - July 1991

A-2-85

	Concentration*	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Aluminum	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	OE+00
Arsenic	NA	0.00E+00	0.00E+00	0.00E+00	1.5E+01	OE+00
Beryllium	NA	0.00E+00	0.00E+00	0.00E+00	8.4E+00	OE+00
Calcium	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	OE+00
Cadmium	3.45E-03	2.00E-09	1.70E-10	2.17E-09	6.3E+00	1E-08
Chromium	1.94E-02	1.12E-08	9.55E-10	1.22E-08	4.2E+01	See Note
Iron	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	OE+00
Magnesium	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	OE+00
Sodium	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	OE+00
Nickel	1.52E-01	8.81E-08	7.49E-09	9.56E-08	8.4E-01	8E-08
Lead	1.77E-01	1.02E-07	8.71E-09	1.11E-07	0.0E+00	OE+00
Vanadium	1.14E-02	6.60E-09	5.61E-10	7.16E-09	0.0E+00	OE+00
Zinc	7.27E-02	4.21E-08	3.58E-09	4.57E-08	0.0E+00	OE+00
					Total Risk =	9E-08

* Concentrations are the 95th % upper bound of the sample data set

Note - No carcinogenic risk was determined for chromium. All chromium was determined to be trivalent (Cr(III)), the non-carcinogenic form.

See discussion in Uncertainty Analysis section of the main report.

NA - No analysis performed for this analyte

TABLE A-2-86. KKMC
Carcinogenic Risk - Inhalation of Particulates (PM10) - August 1991

	Concentration	Outdoor Exposure ug/m ³	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Aluminum	2.89E+00	1.67E-06	1.42E-07	1.82E-06	0.0E+00	0E+00
Arsenic	1.43E-03	8.28E-10	7.04E-11	8.98E-10	1.5E+01	1E-08
Beryllium	3.00E-03	1.74E-09	1.48E-10	1.88E-09	8.4E+00	2E-08
Calcium	2.13E+01	1.23E-05	1.05E-06	1.34E-05	0.0E+00	0E+00
Cadmium	1.86E-03	1.08E-09	9.16E-11	1.17E-09	6.3E+00	7E-09
Chromium	1.53E-02	8.86E-09	7.53E-10	9.61E-09	4.2E+01	See Note
Iron	3.18E+00	1.84E-06	1.57E-07	2.00E-06	0.0E+00	0E+00
Magnesium	3.77E+00	2.18E-06	1.86E-07	2.37E-06	0.0E+00	0E+00
Sodium	1.44E+01	8.31E-06	7.06E-07	9.01E-06	0.0E+00	0E+00
Nickel	2.80E-02	1.62E-08	1.38E-09	1.76E-08	8.4E-01	1E-08
Lead	2.93E-01	1.70E-07	1.44E-08	1.84E-07	0.0E+00	0E+00
Vanadium	9.50E-03	5.50E-09	4.68E-10	5.97E-09	0.0E+00	0E+00
Zinc	3.19E-01	1.85E-07	1.57E-08	2.00E-07	0.0E+00	0E+00
					Total Risk =	5E-08

* Concentrations are the 95th % upper bound of the sample data set

Note - No carcinogenic risk was determined for chromium. All chromium was determined to be trivalent (**Cr(III)**), the non-carcinogenic form.

See discussion in Uncertainty Analysis section of the main report.

NA - No analysis performed for this analyte

TABLE A-2-87. MILITARY HOSPITAL/CAMP FREEDOM
Carcinogenic Risk - Inhalation of Particulates (PM10) - May 1991

A-2-87

	Concentration*	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
	ug/m3					
Aluminum	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	OE+00
Arsenic	NA	0.00E+00	0.00E+00	0.00E+00	1.5E+01	OE+00
Beryllium	NA	0.00E+00	0.00E+00	0.00E+00	8.4E+00	0E+00
Calcium	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Cadmium	1.07E-02	6.17E-09	5.24E-10	6.69E-09	6.3E+00	4E-08
Chromium	6.32E-02	3.66E-08	3.11E-09	3.97E-08	4.2E+01	See Note
Iron	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Magnesium	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Sodium	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Nickel	9.72E-02	5.63E-08	4.78E-09	6.11E-08	8.4E-01	5E-08
Lead	3.80E-01	2.20E-07	1.87E-08	2.39E-07	0.0E+00	OE+00
Vanadium	8.53E-02	4.94E-08	4.20E-09	5.36E-08	0.0E+00	0E+00
Zinc	1.03E-01	5.98E-08	5.09E-09	6.49E-08	0.0E+00	0E+00
					Total Risk =	9E-08

* Concentrations are the 95th % upper bound of the sample data set

Note - No carcinogenic risk was determined for chromium. AH chromium was determined to be trivalent (Cr(III)), the non-carcinogenic form.

See discussion in Uncertainty Analysis section of the main report.

NA - No analysis performed for this analyte

TABLE A-2-88. MILITARY HOSPITAL/CAMP FREEDOM
Carcinogenic Risk - Inhalation of Particulates (PM10) - June 1991

	Concentration* ug/m ³	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Aluminum	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Arsenic	NA	0.00E+00	0.00E+00	0.00E+00	1.5E+01	0E+00
Beryllium	NA	0.00E+00	0.00E+00	0.00E+00	8.4E+00	0E+00
Calcium	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Cadmium	7.76E-03	4.49E-09	3.82E-10	4.87E-09	6.3E+00	3E-08
Chromium	7.91E-02	4.58E-08	3.89E-09	4.97E-08	4.2E+01	See Note
Iron	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Magnesium	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Sodium	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Nickel	1.29E-01	7.44E-08	6.33E-09	8.08E-08	8.4E-01	7E-08
Lead	5.98E-01	3.46E-07	2.94E-08	3.76E-07	0.0E+00	0E+00
Vanadium	5.34E-02	3.09E-08	2.63E-09	3.35E-08	0.0E+00	0E+00
Zinc	8.21E-02	4.75E-08	4.04E-09	5.16E-08	0.0E+00	0E+00
					Total Risk =	1E-07

* Concentrations are the 95th % upper bound of the sample data set

Note - No carcinogenic risk was determined for chromium. All chromium was determined to be trivalent (**Cr(III)**), the non-carcinogenic form.

See discussion in Uncertainty Analysis section of the main report.

NA - No analysis performed for this analyte

TABLE A-2-89. MILITARY HOSPITAL/CAMP FREEDOM
Carcinogenic Risk - Inhalation of Particulates (PM10) - July 1991

A-2-89

	Concentration+ ug/m ³	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Aluminum	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Arsenic	NA	0.00E+00	0.00E+00	0.00E+00	1.5E+01	0E+00
Beryllium	NA	0.00E+00	0.00E+00	0.00E+00	8.4E+00	0E+00
Cakium	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Cadmium	5.48E-03	3.17E-09	2.70E-10	3.44E-09	6.3E+00	2E-08
Chromium .	4.14E-02	2.40E-08	2.04E-09	2.60E-08	4.2E+01	See Note
Iron	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Magnesium	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Sodium	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Nickel	1.50E-01	8.68E-08	7.38E-09	9.42E-08	8.4E-01	8E-08
Lead	5.55E-01	3.21E-07	2.73E-08	3.49E-07	0.0E+00	0E+00
Vanadium	2.89E-02	1.67E-08	1.42E-09	1.82E-08	0.0E+00	0E+00
Zinc	7.45E-02	4.31E-08	3.67E-09	4.68E-08	0.0E+00	0E+00
					Total Risk =	1E-07

* Concentrations are the 95th % upper bound of the sample data set

Note - No carcinogenic risk was determined for chromium. All chromium was determined to be trivalent (Cr(III)), the non-carcinogenic form.

See discussion in Uncertainty Analysis section of the main report.

NA - No analysis performed for this analyte

TABLE A-2-90. MJLTARY HOSPITAL/CAMP FREEDOM
Carcinogenic Risk - Jnhatation of Particulates (PM10) - August 1991

	Concentration*	Outdoor Exposure ug/m ³	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Aluminum	7.43E+00	4.30E-06	3.66E-07	4.67E-06	0.0E+00	0E+00
Arsenic	2.76E-03	1.60E-09	1.36E-10	1.73E-09	1.5E+01	3E-08
Beryllium	1.83E-02	1.06E-08	9.02E-10	1.15E-08	8.4E+00	1E-07
Calcium	5.01E+01	2.90E-05	2.47E-06	3.15E-05	0.0E+00	0E+00
Cadmium	4.03E-03	2.33E-09	1.98E-10	2.53E-09	6.3E+00	2E-08
Chromium	8.82E-02	5.11E-08	4.34E-09	5.54E-08	4.2E+01	See Note
Iron	8.58E+00	4.97E-06	4.22E-07	5.39E-06	0.0E+00	0E+00
Magnesium	1.14E+01	6.61E-06	5.62E-07	7.17E-06	0.0E+00	0E+00
Sodium	1.73E+01	1.00E-05	8.54E-07	1.09E-05	0.0E+00	0E+00
Nickel	1.68E-01	9.73E-08	8.27E-09	1.06E-07	8.4E-01	9E-08
Lead	4.12E-01	2.39E-07	2.03E-08	2.59E-07	0.0E+00	0E+00
V a n a d i u m	3.20E-02	1.85E-08	1.58E-09	2.01E-08	0.0E+00	0E+00
Zinc	2.05E-01	1.18E-07	1.01E-08	1.28E-07	0.0E+00	0E+00
					Total Risk =	2E-07

* Concentrations are the 95th % upper bound of the sample data set

Note - No carcinogenic risk was determined for chromium. All chromium was determined to be trivalent (**Cr(III)**), the non-carcinogenic form.

See discussion in Uncertainty Analysis section of the main report.

NA - No analysis performed for this analyte

TABLE A-2-91. MILITARY HOSPITAL/CAMP FREEDOM
Carcinogenic Risk - Inhalation of Particulates (PM10) - September 1991

A-2-91

	Concentration*	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
	ug/m ³					
Aluminum	9.10E+00	5.27E-06	4.48E-07	5.72E-06	0.0E+00	0E+00
Arsenic	3.99E-03	2.31E-09	1.96E-10	2.51E-09	1.5E+01	4E-08
Beryllium	6.08E-03	3.52E-09	2.99E-10	3.82E-09	8.4E+00	3E-08
Calcium	4.93E+01	2.85E-05	2.43E-06	3.10E-05	0.0E+00	0E+00
Cadmium	4.50E-03	2.84E-09	2.41E-10	3.08E-09	6.3E+00	2E-08
Chromium	4.60E-02	2.66E-08	2.26E-09	2.89E-08	4.2E+01	See Note
Iron	1.14E+01	6.58E-06	5.59E-07	7.14E-06	0.0E+00	0E+00
Magnesium	1.15E+01	6.68E-06	5.68E-07	7.25E-06	0.0E+00	0E+00
Sodium	2.71E+01	1.57E-05	1.34E-06	1.70E-05	0.0E+00	0E+00
Nickel	1.75E-01	1.01E-07	8.61E-09	1.10E-07	8.4E-01	9E-08
Lead	6.82E-01	3.95E-07	3.36E-08	4.28E-07	0.0E+00	0E+00
Vanadium	4.13E-02	2.39E-08	2.03E-09	2.59E-08	0.0E+00	0E+00
Zinc	8.17E-02	4.73E-08	4.02E-09	5.13E-08	0.0E+00	0E+00
					Total Risk =	2E-07

* Concentrations are the 95th % upper bound of the sample data set

Note - No carcinogenic risk was determined for chromium. All chromium was-determined to be trivalent (Cr(III)), the non-carcinogenic form.

See discussion in Uncertainty Analysis section of the main report.

NA - No analysis performed for this analyte

TABLE A-2-92. MILITARY HOSPITAL/CAMP FREEDOM
Carcinogenic Risk - Inhalation of Particulates (PM10) - October 1991

A-2-92

	Concentration*	Out door Exposure ug/m ³	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slow Factor (mg/kg-day)-1	Risk
Aluminum	3.63E+00	2.10E-06	1.79E-07	2.28E-06	0.0E+00	0E+00
Arsenic	1.45E-03	8.391E-10	7.14E-11	9.11E-10	1.5E+01	1E-08
Beryllium	5.20E-04	3.01E-10	2.56E-11	3.27E-10	8.4E+00	3E-09
Calcium	1.68E+01	9.73E-06	8.27E-07	1.06E-05	0.0E+00	0E+00
Cadmium	1.48E-03	8.57E-10	7.29E-11	9.30E-10	6.3E+00	6E-09
Chromium	1.65E-02	9.55E-09	8.12E-10	1.04E-08	4.2E+01	See Note
Iron	4.06E+00	2.35E-06	2.00E-07	2.55E-06	0.0E+00	0E+00
Magnesium	3.85E+00	2.23E-06	1.90E-07	2.42E-06	0.0E+00	0E+00
Sodium	8.17E+00	4.73E-06	4.02E-07	5.13E-06	0.0E+00	0E+00
Nickel	3.49E-01	2.02E-07	1.72E-08	2.19E-07	8.4E-01	2E-07
Lead	8.17E-01	4.73E-07	4.02E-08	5.13E-07	0.0E+00	0E+00
Vanadium	1.56E-02	9.03E-09	7.68E-10	9.80E-09	0.0E+00	0E+00
Zinc	8.93E-02	5.17E-08	4.40E-09	5.61E-08	0.0E+00	0E+00
					Total Risk =	2E-07

* Concentrations are the 95th % upper bound of the sample data set

Note - No carcinogenic risk was determined for chromium. All chromium was determined to be trivalent (**Cr(III)**), the non-carcinogenic form.

See discussion in Uncertainty Analysis section of the main report.

NA - No analysis performed for this analyte

TABLE A-Z-93. MILITARY HOSPITAL/CAMP FREEDOM
Carcinogenic Risk - Inhalation of Particulates (PM10) - November 1991

A-2-93

	Concentration* ug/m ³	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Aluminum	2.12E+00	1.23E-06	1.04E-07	1.33E-06	0.0E+00	OE00
Arsenic	1.66E-03	9.61E-10	8.17E-11	1.04E-09	1.5E+01	2E-08
Beryllium	1.80E-04	1.04E-10	8.86E-12	1.13E-10	8.4E+00	9E-10
Calcium	1.20E+01	6.95E-06	5.91E-07	7.54E-06	0.0E+00	0E+00
Cadmium	8.90E-04	5.15E-10	4.38E-11	5.59E-10	6.3E+00	4E-09
Chromium	1.18E-02	6.83E-09	5.81E-10	7.41E-09	4.2E+01	See Note
Iron	2.85E+00	1.65E-06	1.40E-07	1.79E-06	0.0E+00	0E+00
Magnesium	3.14E+00	1.82E-06	1.55E-07	1.97E-06	0.0E+00	0E+00
Sodium	2.04E+00	1.18E-06	1.00E-07	1.28E-06	0.0E+00	0E+00
Nickel	6.68E-02	3.87E-08	3.29E-09	4.20E-08	8.4E-01	4E-08
Lead	6.51E-01	3.77E-07	3.20E-08	4.09E-07	0.0E+00	0E+00
Vanadium	7.80E-03	4.52E-09	3.84E-10	4.90E-09	0.0E+00	0E+00
Zinc	5.35E-02	3.10E-08	2.63E-09	3.36E-08	0.0E+00	OE00
					Total Risk =	6E-08

* Concentrations are the 95th % upper bound of the sample data set

Note - No carcinogenic risk was determined for chromium. All chromium was determined to be trivalent (Cr(III)), the non-carcinogenic form.

See discussion in Uncertainty Analysis section of the main report.

NA - No analysis performed for this analyte

TABLE A-2-94. U.S. EMBASSY, KUWAIT
Carcinogenic Risk - Inhalation of Particulates (PM10) - May 1991

	Concentration* ug/m3	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Aluminum	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Arsenic	NA	0.00E+00	0.00E+00	0.00E+00	1.5E+01	0Et00
Beryllium	MA	0.00E+00	0.00E+00	0.00E+00	8.4E+00	0E+00
Calcium	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Cadmium	1.1ME-02	6.11E-09	5.20E-10	6.63E-09	6.3E+00	4E-08
Chromium	7.tME-02	4.45E-08	3.78E-09	4.82E-08	4.2E+01	See Note
Iron	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Magnesium	NA	0.100E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Sodium	NA	59E-01	0.923E-08	0.0058E-00	0.0E+00	0E+00
Nickel	1.4E-01	--	--	0.00E-07	8.4E-01	8E-08
Lead	8.26E-01	4.78E-07	4.07E-08	--	1.1E+00	0Et00
Vanadium	1.18E-01	6.85E-08	5.83E-09	5.19E-08	7.44E-08	0.0E+00
Zinc	1.47E-01	8.48E-08	7.21E-09	9.20E-08	0.0E+00	0Et00
					Total Risk =	1E-07

* Concentrations are the 95th % upper bound of the sample data set

Note - No carcinogenic risk was determined for chromium. All chromium was determined to be trivalent (Cr(III)), the non-carcinogenic form.

See discussion in Uncertainty Analysis section of the main report,

NA - No analysis performed for this analyte

TABLE A-2-95. U.S. EMBASSY, KUWAIT
Carcinogenic Risk - Inhalation of Particulates (PM10) - June 1991

	Concentration*	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk	
Aluminum	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00	
Arsenic	NA	0.00E+00	0.00E+00	0.00E+00	1.5E+01	0E+00	
Beryllium	NA	0.00E+00	0.00E+00	0.00E+00	8.4E+00	0E+00	
Calcium	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00	
A-2-95	Cadmium	6.83E-03	3.95E-09	3.36E-10	4.29E-09	6.3E+00	3E-08
Chromium	6.13E-02	3.55E-08	3.02E-09	3.85E-08	4.2E+01	See Note	
Iron	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00	
Magnesium	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00	
Sodium	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00	
Nickel	9.87E-02	5.71E-08	4.86E-09	6.20E-08	8.4E-01	5E-08	
Lead	1.12E+00	6.46E-07	5.49E-08	7.01E-07	0.0E+00	0E+00	
Vanadium	5.10E-02	2.95E-08	2.51E-09	3.20E-08	0.0E+00	0E+00	
Zinc	1.08E-01	6.22E-08	5.29E-09	6.75E-08	0.0E+00	0E+00	
					Total Risk =	8E-08	

* Concentrations are the 95th % upper bound of the sample data set

Note - No carcinogenic risk was determined for chromium. All chromium was determined to be trivalent (Cr(III)), the non-carcinogenic form.

See discussion in Uncertainty Analysis section of the main report.

NA - No analysis performed for this analyte

TABLE A-2-96. U.S. EMBASSY, KUWAIT

Carcinogenic Risk - Inhalation of Particulates (PM10) - July 1991

A-2-96

	Concentration*	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Aluminum	N A	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Arsenic	N A	0.00E+00	0.00E+00	0.00E+00	1.5E+01	0E+00
Beryllium	N A	0.00E+00	0.00E+00	0.00E+00	8.4E+00	0E+00
Calcium	N A	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Cadmium	7.80E-03	4.52E-09	3.84E-10	4.90E-09	6.3E+00	3E-08
Chromium	8.98E-02	5.20E-08	4.42E-09	5.64E-08	4.2E+01	See Note
Iron	N A	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Magnesium	N A	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Sodium	N A	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Nickel	2.67E-01	1.55E-07	1.32E-08	1.68E-07	8.4E-01	1E-07
Lead	2.19E-01	1.27E-07	1.08E-08	1.38E-07	0.0E+00	0E+00
Vanadium	6.77E-02	3.92E-08	3.33E-09	4.25E-08	0.0E+00	0E+00
Zinc	1.19E-01	6.91E-08	5.87E-09	7.49E-08	0.0E+00	0E+00
Total Risk =						2E-07

* Concentrations are the 95th % upper bound of the sample data set

Note - No carcinogenic risk was determined for chromium. All chromium was determined to be trivalent (Cr(III)), the non-carcinogenic form.

See discussion in Uncertainty Analysis section of the main report. .

NA - No analysis performed for this analyte

TABLE A-2-97. CAMP THUNDEROCK

Carcinogenic Risk - Inhalation of Particulates (PM10) - June 1991

A-2-97

	Concentration* ug/m ³	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Aluminum	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Arsenic	NA	0.00E+00	0.00E+00	0.00E+00	1.5E+01	0E+00
Beryllium	NA	0.00E+00	0.00E+00	0.00E+00	8.4E+00	0E+00
Calcium	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Cadmium	7.91E-03	4.58E-09	3.89E-10	4.97E-09	6.3E+00	3E-08
Chromium	3.98E-02	2.30E-08	1.96E-09	2.50E-08	4.2E+01	See Note
Iron	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Magnesium	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Sodium	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Nickel	6.89E-02	3.99E-08	3.39E-09	4.33E-08	8.4E-01	4E-08
Lead	4.43E-01	2.56E-07	2.18E-08	2.78E-07	0.0E+00	0E+00
Vanadium	6.14E-02	3.55E-08	3.02E-09	3.86E-08	0.0E+00	0E+00
Zinc	1.43E-01	8.28E-08	7.04E-09	8.98E-08	0.0E+00	0E+00
					Total Risk =	7E-08

* Concentrations are the 95th % upper bound of the sample data set

Note - No carcinogenic risk was determined for chromium. All chromium was determined to be trivalent (Cr(III)), the non-carcinogenic form.

See discussion in Uncertainty Analysis section of the main report.

NA - No analysis performed for this analyte

TABLE A-2-98. CAMP THUNDEROCK

Carcinogenic Risk - Inhalation of Particulates (PM10) - July 1991

	Concentration* ug/m ³	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Aluminum	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	OE+00
Arsenic	NA	0.00E+00	0.00E+00	0.00E+00	1.5E+01	0E+00
Beryllium	NA	0.00E+00	0.00E+00	0.00E+00	8.4E+00	0E+00
Calcium	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	OE+00
Cadmium	7.71E-03	4.47E-09	3.80E-10	4.85E-09	6.3E+00	3E-08
Chromium	8.51E-02	4.92E-08	4.18E-09	5.34E-08	4.2E+01	See Note
Iron	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Magnesium	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Sodium	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	OE+00
Nickel	1.80E-01	1.04E-07	8.88E-09	1.13E-07	8.4E-01	1E-07
Lead	1.93E-01	1.12E-07	9.50E-09	1.21E-07	0.0E+00	OE+00
Vanadium	4.56E-02	2.64E-08	2.24E-09	2.86E-08	0.0E+00	OE+00
Zinc	1.80E-01	1.04E-07	8.86E-09	1.13E-07	0.0E+00	0E+00
					Total Risk =	1E-07

* Concentrations are the 95th % upper bound of the sample data set

Note - No carcinogenic risk was determined for chromium. All chromium was determined to be trivalent (Cr(III)), the non-carcinogenic form.

See discussion in Uncertainty Analysis section of the main report,

NA - No analysis performed for this analyte

TABLE A-2-99. CAMP THUNDEROCK

Carcinogenic Risk - Inhalation of Particulates (PM10) - August 1991

	Concentration* ug/m ³	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day) ⁻¹	Risk
Aluminum	6.93E+00	4.01E-06	3.41E-07	4.35E-06	0.0E+00	0E+00
Arsenic	4.25E-03	2.46E-09	2.09E-10	2.67E-09	1.5E+01	4E-08
Beryllium	1.25E-02	7.23E-09	6.15E-10	7.85E-09	8.4E+00	7E-08
Calcium	5.12E+01	2.96E-05	2.52E-06	3.22E-05	0.0E+00	0E+00
Cadmium	4.30E-03	2.49E-09	2.12E-10	2.70E-09	6.3E+00	2E-08
Chromium	4.40E-02	2.55E-08	2.17E-09	2.76E-08	4.2E+01	See Note
Iron	8.39E+00	4.86E-06	4.13E-07	5.27E-06	0.0E+00	0E+00
Magnesium	1.21E+01	7.02E-06	5.97E-07	7.61E-06	0.0E+00	0E+00
Sodium,	2.03E+01	1.18E-05	1.00E-06	1.28E-05	0.0E+00	0E+00
Nickel	1.36E-01	7.87E-08	6.69E-09	8.54E-08	8.4E-01	7E-08
Lead	5.87E-01	3.40E-07	2.89E-08	3.69E-07	0.0E+00	0E+00
Vanadium	3.88E-02	2.25E-08	1.91E-09	2.44E-08	0.0E+00	0E+00
Zinc	1.07E-01	6.19E-08	5.27E-09	6.72E-08	0.0E+00	0E+00
					Total Risk =	2E-07

* Concentrations are the 95th % upper bound of the sample data set

Note - No carcinogenic risk was determined for chromium. All chromium was determined to be trivalent (Cr(III)), the non-carcinogenic form,

See discussion in Uncertainty Analysis section of the main report.

NA - No analysis performed for this analyte

TABLE A-2-100. CAMP THUNDEROCK
Carcinogenic Risk - Inhalation of Particulates (PM10) - September 1991

	Concentration*	Outdoor Exposure ug/m ³	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day) ⁻¹	Risk
Aluminum	1.35E+01	7.80E-06	6.63E-07	8.46E-06	0.0E+00	0E+00
Arsenic	5.83E-03	3.38E-09	2.87E-10	3.66E-09	1.5E+01	6E-08
Beryllium	4.63E-03	2.68E-09	2.28E-10	2.91E-09	8.4E+00	2E-08
Calcium	8.34E+01	4.83E-05	4.11E-06	5.24E-05	0.0E+00	0E+00
Cadmium	7.17E-03	4.15E-09	3.53E-10	4.50E-09	6.3E+00	3E-08
Chromium	6.31E-02	3.65E-08	3.11E-09	3.96E-08	4.2E+01	See Note
Iron	1.62E+01	9.39E-06	7.98E-07	1.02E-05	0.0E+00	0E+00
Magnesium	8.1E+01	1.05E-05	8.89E-07	1.13E-05	0.0E+00	0E+00
Sodium	4.08E+01	2.36E-05	2.01E-06	2.56E-05	0.0E+00	0E+00
Nickel	2.55E-01	1.48E-07	1.26E-08	1.60E-07	8.4E-01	1E-07
Lead	7.72E-01	4.47E-07	3.80E-08	4.85E-07	0.0E+00	0E+00
Vanadium	7.38E-02	4.27E-08	3.63E-09	4.64E-08	0.0E+00	0E+00
Zinc	1.68E-01	9.74E-08	8.28E-09	1.06E-07	0.0E+00	0E+00
				Total Risk =		2E-07

* Concentrations are the 95th % upper bound of the sample data set

Note - No carcinogenic risk was determined for chromium. All chromium was determined to be trivalent (Cr(III)), the non-carcinogenic form.

See discussion In Uncertainty Analysis section of the main report.

NA - No analysis performed for this analyte

TABLE A-2-101. CAMP THUNDEROCK

Carcinogenic Risk - Inhalation of Particulates (PM10) - October 1991

A-2-101

	Concentration*	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
	ug/m ³					
Aluminum	4.41E+00	2.55E-06	2.17E-07	2.77E-06	0.0E+00	0E+00
Arsenic	2.02E-03	1.17E-09	9.94E-11	1.27E-09	1.5E+01	2E-08
Beryllium	8.10E-04	4.69E-10	3.99E-11	5.09E-10	8.4E+00	4E-09
Calcium	2.07E+01	1.20E-05	1.02E-06	1.30E-05	0.0E+00	0E+00
Cadmium	1.76E-03	1.02E-09	8.66E-11	1.11E-09	6.3E+00	7E-09
Chromium	2.77E-02	1.60E-08	1.36E-09	1.74E-08	4.2E+01	See Note
Iron	4.66E+00	2.70E-06	2.29E-07	2.93E-06	0.0E+00	0E+00
Magnesium	5.07E+00	2.94E-06	2.50E-07	3.18E-06	0.0E+00	0E+00
Sodium	1.83E+01	1.06E-05	9.02E-07	1.15E-05	0.0E+00	0E+00
Nickel	5.46E-01	3.16E-07	2.69E-08	3.43E-07	8.4E-01	3E-07
Lead	8.02E-01	4.64E-07	3.95E-08	5.04E-07	0.0E+00	0E+00
Vanadium	2.67E-02	1.55E-08	1.31E-09	1.68E-08	0.0E+00	0E+00
Zinc	9.62E-02	5.57E-08	4.74E-09	6.04E-08	0.0E+00	0E+00
					Total Risk =	3E-07

* Concentrations are the 95th % upper bound of the sample data set

Note - No carcinogenic risk was determined for chromium. All chromium was determined to be trivalent (Cr(III)), the non-carcinogenic form.

See discussion in Uncertainty Analysis section of the main report.

NA - No analysis performed for this analyte

TABLE A-2-102. CAMP THUNDEROCK
Carcinogenic Risk - Inhalation of Particulates (PM10) - November 1991

	Coneentrat ion*	Outdoor Exposure ug/m ³	Indoor Exposure mg/kg-day	T _c mg/kg-day ⁻¹	Slope Factor (mg/kg-day) ⁻¹	Risk
Aluminum	2.98E+00	1.73E-06	1.47E-07	1.87E-06	0.0E+00	0E+00
Arsenic	2.68E-03	1.55E-09	1.32E-10	1.68E-09	1.5E+01	3E-08
Beryllium	3.10E-04	1.79E-10	1.53E-11	1.95E-10	8.4E+00	2E-09
Calcium	1.54E+01	8.92E-06	7.58E-07	9.67E-06	0.0E+00	0E+00
Cadmium	1.23E-03	7.12E-10	6.05E-11	7.73E-10	6.3E+00	5E-09
Chromium	1.74E-02	1.01E-08	8.57E-10	1.09E-08	4.2E+01	See Note
Iron	4.16E+00	2.41E-06	2.05E-07	2.61E-06	0.0E+00	0E+00
Magnesium	6.12E+00	3.54E-06	3.01E-07	3.84E-06	0.0E+00	0E+00
Sodium	2.73E+00	1.58E-06	1.34E-07	1.71E-06	0.0E+00	0E+00
Nickel	1.33E-01	7.69E-08	6.54E-09	8.35E-08	8.4E-01	7E-08
Lead	1.13E+00	6.56E-07	5.58E-08	7.12E-07	0.0E+00	0E+00
Vanadium	1.30E-02	7.53E-09	6.40E-10	8.17E-09	0.0E+00	0E+00
Zinc	1.44E-01	8.32E-08	7.08E-09	9.03E-08	0.0E+00	0E+00
				Total Risk =		1E-07

* Concentrations are the 95th % upper bound of the sample data set

Note - No carcinogenic risk was determined for chromium. All chromium was determined to be trivalent (Cr(III)), the non-carcinogenic form.

See discussion in Uncertainty Analysis section of the mak report.

NA - No analysis performed for this analyte

A-2-102

TABLE A-2-103. AL AHMADI HOSPITAL

Carcinogenic Risk - Inhalation of Particulates (PM10) - June 1991

	Concentration*	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk	
Aluminum	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00	
Arsenic	NA	0.00E+00	0.00E+00	0.00E+00	1.5E+01	0E+00	
Beryllium	NA	0.00E+00	0.00E+00	0.00E+00	8.4E+00	0E+00	
Calcium	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00	
A-2-103	Cadmium	6.56E-03	3.80E-09	3.23E-10	4.12E-09	6.3E+00	3E-08
Chromium		3.64E-02	2.11E-08	1.79E-09	2.29E-08	4.2E+01	See Note
Iron	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00	
Magnesium	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00	
Sodium	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00	
Nickel		5.11E-02	2.96E-08	2.52E-09	3.21E-08	8.4E-01	3E-08
Lead		2.98E-01	1.73E-07	1.47E-08	1.87E-07	0.0E+00	0E+00
Vanadium		5.97E-02	3.46E-08	2.94E-09	3.75E-08	0.0E+00	0E+00
Zinc		1.20E-01	6.96E-08	5.92E-09	7.55E-08	0.0E+00	0E+00
					Total Risk =	5E-08	

* Concentrations are the 95th % upper bound of the sample data set

Note - No carcinogenic risk was determined for chromium. All chromium was determined to be trivalent (Cr(III)), the non-carcinogenic form.

See discussion in Uncertainty Analysis section of the main report.

NA - No analysis performed for this analyte

TABLE A-2-104. AL AHMADI HOSPITAL
Carcinogenic Risk - Inhalation of Particulates (PM10) - July 1991

	Concentration* ug/m3	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Aluminum	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Arsenic	NA	0.00E+00	0.00E+00	0.00E+00	1.5E+01	0E+00
Beryllium	NA	0.00E+00	0.00E+00	0.00E+00	8.4E+00	0E+00
Calcium	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Cadmium	7.22E-03	4.18E-09	3.55E-10	4.54E-09	6.3E+00	3E-08
Chromium	5.05E-02	2.92E-08	2.49E-09	3.17E-08	4.2E+01	See Note
Iron	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Magnesium	NA	0.00E+00	0.00E+00	0.00E+00	0.0E+00	0E+00
Sodium	NA	0.00E+00	0.00E+00	0.00E+00	0 . O E t O O	0E+00
Nickel	9.83E-02	5.69E-08	4.84E-09	6.17E-08	8.4E-01	5E-08
Lead	1.36E-01	7.87E-08	6.69E-09	8.54E-08	0.0E+00	0E+00
Vanadium	3.98E-02	2.30E-08	1.96E-09	2.50E-08	0.0E+00	0E+00
Zinc	6.57E-02	3.80E-08	3.23E-09	4.13E-08	0.0E+00	0E+00
					Total Risk =	RE-0R

* Concentrations are the 95th % upper bound of the sample data set

Note - No carcinogenic risk was determined for chromium. All chromium was determined to be trivalent (Cr(III)), the non-carcinogenic form, See discussion in Uncertainty Analysis section of the main report.

NA - No analysis performed for this analyte

TABLE A-2-105. KHOBAR TOWERS
Carcinogenic Risk - Inhalation of Polycyclic Aromatic Hydrocarbons (PAH)

	Concentration*	outdoor Exposure ug/m ³	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Rbk
Naphthalene	1.09E+00	6.29E-07	5.35E-08	6.83E-07	NAV	0E+00
2-Methyl Naphthalene	2.13E-01	1.23E-07	1.05E-08	1.34E-07	NAV	0E+00
1-Methyl Naphthalene	3.47E-01	2.01E-07	1.71E-08	2.18E-07	NAV	0E+00
Biphenyl	6.66E-02	3.86E-07	3.28E-09	4.18E-08	NAV	0E+00
Dimethyl Naphthalene	7.13E-02	4.13E-08	3.51E-09	4.48E-08	NAV	0E+00
Acenaphthylene	4.78E-01	2.01E-07	2.35E-08	3.00E-07	NAV	0E+00
Acenaphthene	2.79E-02	1.61E-08	1.37E-09	1.75E-08	NAV	0E+00
Dibenzofuran	1.72E-01	9.96E-08	8.47E-09	1.08E-07	NAV	0E+00
Fluorene	2.50E-02	1.45E-08	1.23E-09	1.57E-08	NAV	0E+00
Phenanthrene	3.63E-02	2.11E-08	1.80E-09	2.29E-08	NAV	0E+00
Anthracene	2.30E-02	1.33E-08	1.13E-09	1.44E-08	NAV	0E+00
Carbazole	4.69E-02	2.72E-08	2.31E-09	2.95E-08	NAV	0E+00
Fluoranthene	1.12E-01	8.23E-08	6.99E-09	8.93E-08	NAV	0E+00
Pyrene	5.49E-02	3.18E-08	2.70E-09	3.45E-08	NAV	0E+00
Benzo(a)Anthracene	1.1BE-03	7.96E-10	6.77E-11	8.64E-10	6.1E-01	5E-10
Chrysene	2.17E-03	1.26E-09	1.07E-10	1.36E-09	6.1E-02	8E-11
Benzo(b)Fluoranthene	2.44E-03	1.41E-09	1.20E-10	1.53E-09	6.1E-01	9E-10
Benzo(k)Fluoranthene	2.3DE-03	1.56E-09	1.33E-10	1.69E-09	6.1E-01	1E-09
Benzo(e)Pyrene	1.10E-04	5.79E-11	4.92E-12	6.28E-11	NAV	0E+00
Benzo(s)Pyrene	2.412E-03	1.40E-09	1.19E-10	1.52E-09	6.1E+00	9E-09
Iproto(1,2,3-cd)Pyrene	2.31E-03	1.33E-09	1.13E-10	1.45E-09	6.1E-01	9E-10
Dibenzo(ab)Anthracene	1.30E-03	7.50E-10	6.37E-11	8.13E-10	NAV	0E+00
Benzo(ghi)Perylene	2.66E-03	1.54E-09	1.31E-10	1.67E-09	NAV	0E+00
Total Risk =						1E-08

* Concentrations are the average of maximum detected concentration hum TO15 rod Hi-Vol PM10 reference method or maximum for one method below the detection limit.

NAV - Not Available

TABLE A-2-106. CAMP 1
Carcinogenic Risk - Inhalation of Polycyclic Aromatic Hydrocarbons (PAH)

	Concentration* ug/m ³	outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Naphthalene	BDL	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
2-Methyl Naphthalene	BDL	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
1-Methyl Naphthalene	BDL	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
Biphenyl	BDL	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
Dimethyl Naphthalene	BDL	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
Acenaphthylene	BDL	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
Acenaphthene	1.38E-03	7.99E-10	6.79E-11	8.67E-10	NAV	0E+00
Dibenzofuran	2.70E-03	1.56E-09	1.33E-10	1.70E-09	NAV	0E+00
Fluorene	2.50E-04	1.45E-10	1.23E-11	1.57E-10	NAV	0E+00
Phenanthrene	4.70E-04	2.72E-10	2.31E-11	2.93E-10	NAV	0E+00
Anthracene	BDL	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
Carbazole	BDL	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
Fluoranthene	9.30E-04	5.38E-10	4.58E-11	5.84E-10	NAV	0E+00
Pyrene	1.43E-03	8.28E-10	7.04E-11	8.98E-10	NAV	0E+00
Benzo(a)Anthracene	6.90E-04	3.99E-10	3.40E-11	4.33E-10	6.1E-01	3E-10
Chrysene	3.80E-04	2.20E-10	1.87E-11	2.39E-10	6.1E-02	1E-11
Benzo(b)Fluoranthene	3.80E-04	2.20E-10	1.87E-11	2.39E-10	6.1E-01	1E-10
Benzo(b)Fluoranthene	BDL	0.00E+00	0.00E+00	0.00E+00	6.1E-01	0E+00
Benzo(e)Pyrene	BDL	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
Benzo(a)Pyrene	BDL	0.00E+00	0.00E+00	0.00E+00	6.1E+00	0E+00
Indeno(1,2,3-cd)Pyrene	BDL	0.00E+00	0.00E+00	0.00E+00	6.1E-01	0E+00
Dibenzo(ah)Anthracene	BDL	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
Benzog(hi)Perylene	BDL	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
				Total Risk =		4E-10

- Concentrations are the maximum detected

NAV - Not Available

TABLE A-2-107. ESKAN VILLAGE
Carcinogenic Risk - Inhalation of Polycyclic Aromatic Hydrocarbons (PAH)

	Concentration* ug/m ³	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Naphthalene	BDL	0.00E+00	0.00E+00	0.00E+00	NAV	OE+00
2-Methyl Naphthalene	BDL	0.00E+00	0.00E+00	0.00E+00	NAV	OE+00
1-Methyl Naphthalene	BDL	0.00E+00	0.00E+00	0.00E+00	NAV	OE+00
Biphenyl	1.91E-02	1.10E-08	9.39E-10	1.20E-08	NAV	OE+00
Dimethyl Naphthalene	BDL	0.00E+00	0.00E+00	0.00E+00	NAV	OE+00
Acenaphthylene	BDL	0.00E+00	0.00E+00	0.00E+00	NAV	OE+00
Acenaphthene	2.25E-03	1.30E-09	1.11E-10	1.41E-09	NAV	OE+00
Dibenzofuran	3.90E-03	2.26E-09	1.92E-10	2.45E-09	NAV	OE+00
Fluorene	1.75E-03	1.01E-09	8.61E-11	1.10E-09	NAV	OE+00
Phenanthrene	1.17E-03	6.77E-10	5.76E-11	7.35E-10	NAV	OE+00
Anthracene	1.37E-03	7.93E-10	6.74E-11	8.61E-10	NAV	OE+00
Carbazole	BDL	0.00E+00	0.00E+00	0.00E+00	NAV	OE+00
Fluoranthene	5.14E-03	2.98E-09	2.53E-10	3.23E-09	NAV	OE+00
Pyrene	3.54E-03	2.05E-09	1.74E-10	2.22E-09	NAV	OE+00
Benzo(a)Anthracene	2.23E-03	1.29E-09	1.10E-10	1.40E-09	6.1E-01	9E-10
Chrysene	2.25E-03	1.30E-09	1.11E-10	1.41E-09	6.1E-02	9E-11
Benzo(b)Fluoranthene	1.27E-03	7.35E-10	6.25E-11	7.98E-10	6.1E-01	5E-10
Benzo(k)Fluoranthene	BDL	0.00E+00	0.00E+00	0.00E+00	6.1E-01	OE+00
Benzo(e)Pyrene	2.00E-04	1.16E-10	9.85E-12	1.26E-10	NAV	OE+00
Benzo(a)Pyrene	BDL	0.00E+00	0.00E+00	0.00E+00	6.1E+00	OE+00
Ieno(1,2,3-cd)Pyrene	BDL	0.00E+00	0.00E+00	0.00E+00	6.1E-01	OE+00
Dibenzo(ab)Anthracene	BDL	0.00E+00	0.00E+00	0.00E+00	NAV	OE+00
Benzo(ghi)Perylene	BDL	0.00E+00	0.00E+00	0.00E+00	NAV	OE+00
					Total Risk =	1E-09

• Concentrations are tbt maximum detected

NAV - Not Available

TABLE A-2-106. KKMC
Carcinogenic Risk - Inhalation of Polycyclic Aromatic Hydrocarbons (PAH)

	Concentration* ug/m ³	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Naphthalene	BDL	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
2-Methyl Naphthalene	BDL	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
1-Methyl Naphthalene	BDL	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
Biphenyl	BDL	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
Dimethyl Naphthalene	BDL	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
Acenaphthylene	BDL	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
Acenaphthene	BDL	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
Dibenzofuran	BDL	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
Fluorene	BDL	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
Phenanthrene	6.30E-04	3.65E-10	3.10E-11	3.96E-10	NAV	0E+00
Anthracene	BDL	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
Carbazole	BDL	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
Fluoranthene	2.23E-03	1.29E-09	1.10E-10	1.40E-09	NAV	0E+00
Pyrene	7.80E-04	4.52E-10	3.84E-11	4.90E-10	NAV	0E+00
Benzo(a)Anthracene	3.00E-04	1.74E-10	1.48E-11	1.88E-10	6.1E-01	1E-10
Chrysene	2.90E-04	1.68E-10	1.43E-11	1.82E-10	6.1E-02	1E-11
Benzo(b)Fluoranthene	BDL	0.00E+00	0.00E+00	0.00E+00	6.1E-01	0E+00
Benzo(k)Fluoranthene	BDL	0.00E+00	0.00E+00	0.00E+00	6.1E-01	0E+00
Benzo(e)Pyrene	BDL	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
Benzo(a)Pyrene	BDL	0.00E+00	0.00E+00	0.00E+00	6.1E+00	0E+00
Indeno(1,2,3-cd)Pyrene	2.50E-04	1.45E-10	1.23E-11	1.57E-10	6.1E-01	1E-10
Dibenzo(ab)Anthracene	BDL	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
Benzo(ghi)Perylene	BDL	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
					Total Risk =	2E-10

- Concentrations are the maximum detected
- NAV - Not Available

TABLE A-2-109. MILITARY HOSPITAL/CAMP FREEDOM
Carcinogenic Risk - Inhalation of Polycyclic Aromatic Hydrocarbons (PAH)

	Concentration* ug/m ³	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Sbpt Factor (mg/kg-day)-1	Rbk
Naphthalene	2.03E+00	1.18E-06	1.00E-07	1.28E-06	NAV	0E+00
2-Methyl Naphthalene	1.89E-01	1.10E-07	3.2E-09	1.19E-07	NAV	0E+00
1-Methyl Naphthalene	3.65E-01	2.23E-07	1.90E-08	2.42E-07	NAV	0E+00
Biphenyl	6.21E-02	3.60E-08	3.06E-09	3.90E-08	NAV	0E+00
Dimethyl Naphthalene	2.24E-01	1.30E-07	1.10E-08	1.41E-07	NAV	0E+00
Acenaphthylene	2.74E+00	1.59E-06	1.45E-07	1.72E-06	NAV	0E+00
Actaarpbtot	6.50E-04	3.76E-10	3.20E-11	4.08E-10	NAV	0E+00
Dibenzofuran	1.00E-01	5.82E-08	4.94E-09	6.31E-08	NAV	0E+00
Fluorene	3.66E-02	2.12E-08	1.80E-09	2.30E-08	NAV	0E+00
Phenanthrene	7.74E-03	4.48E-09	3.81E-10	4.86E-09	NAV	0E+00
Antracene	BDL	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
Carbazole	BDL	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
Fluoranthene	7.05E-03	4.08E-09	3.47E-10	4.43E-09	NAV	0E+00
Pyrene	6.08E-03	3.52E-09	2.99E-10	3.82E-09	NAV	0E+00
Benzo(a)Anthracene	BDL	0.00E+00	0.00E+00	0.00E+00	6.1E-01	0E+00
Chrysene	2.39E-03	1.38E-09	1.17E-10	1.50E-09	6.1E-02	9E-11
Benzo(b)Fluoranthene	1.10E-03	6.37E-10	5.41E-11	6.91E-10	6.1E-01	4E-10
Benzo(k)Fluoranthene	BDL	0.00E+00	0.00E+00	0.00E+00	6.1E-01	0E+00
Benzo(e)Pyrene	1.00E-04	5.79E-11	4.92E-12	6.28E-11	NAV	0E+00
Benzo(a)Pyrene	BDL	0.00E+00	0.00E+00	0.00E+00	6.1E+00	0E+00
Indeno(1,2,3-cd)Pyrene	3.00E-04	1.74E-10	1.48E-11	1.88E-10	6.1E-01	1E-10
Dibenzo(ab)Anthracene	BDL	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
Benzo(ghi)Perylene	1.20E-04	6.95E-11	5.91E-12	7.54E-11	NAV	0E+00
					Total Risk =	6E-10

* Concentrations are the average of maximum detected concentration from TO13 and HI-Vol PM10 reference method or maximum if maximum for one method is below the detection limit.

NAV - Not Available

TABLE A-2410. U.S. EMBASSY, KUWAIT
Carcinogenic Risk - Inhalation of Polycyclic Aromatic Hydrocarbons (PAH)

	Concentration* ug/m ³	Outdoor Exposure mg/kg-day	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Naphthalene	BDL	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
2-Methyl Naphthalene	NA	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
1-Methyl Naphthalene	NA	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
Biphenyl	NA	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
Dimethyl Naphthalene	NA	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
Acenaphthylene	BDL	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
Acenaphthene	BDL	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
Dibenzofuran	NA	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
Fluorene	BDL	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
Phenanthrene	1.78E-03	1.03E-09	8.76E-11	1.12E-09	NAV	0E+00
Antracene	BDL	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
Carbazole	NA	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
Fluoranthene	2.35E-03	1.36E-09	1.16E-10	1.48E-09	NAV	0E+00
Pyrene	BDL	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
Benzo(a)Anthracene	BDL	0.00E+00	0.00E+00	0.00E+00	6.1E-01	0E+00
Chrysene	BDL	0.00E+00	0.00E+00	0.00E+00	6.1E-02	0E+00
Benzo(b)Fluoranthene	BDL	0.00E+00	0.00E+00	0.00E+00	6.1E-01	0E+00
Benzo(k)Fluoranthene	BDL	0.00E+00	0.00E+00	0.00E+00	6.1E-01	0E+00
Benzo(e)Pyrene	NA	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
Benzo(a)Pyrene	BDL	0.00E+00	0.00E+00	0.00E+00	6.1E+00	0E+00
Indeno(1,2,3-cd)Pyrene	BDL	0.00E+00	0.00E+00	0.00E+00	6.1E-01	0E+00
Dibenzo(ah)Anthracene	BDL	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
Benzo(ghi)Perylene	BDL	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
					Total Risk =	0E+00

* Concentrations are the maximum detected

NAV - Not Available

TABLE A-2-I t 1. CAMP THUNDEROCK
Carcinogenic Risk - Inhalation 01 Polycyclic Aromatic Hydrocarbons (PAH)

	Concentration*	Outdoor Exposure ug/m ³	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Naphthalene	2.14E+00	1.24E-06	1.05E-07	1.34E-06	NAV	0E+00
Z-Methyl Naphthalene	2.42E-01	1.40E-07	1.19E-08	1.52E-07	NAV	0E+00
1-Methyl Naphthalene	5.46E-01	3.16E-07	2.69E-08	3.43E-07	NAV	0E+00
Biphenyl	2.65E-01	1.53E-07	1.30E-08	1.66E-07	NAV	0E+00
Dimethyl Naphthalene	2.38E-01	1.38E-07	1.17E-08	1.49E-07	NAV	0E+00
Acenaphthylene	3.67E+00	2.13E-06	1.81E-07	2.31E-06	NAV	0E+00
Acenaphthene	1.67E-03	9.67E-10	8.22E-11	1.05E-09	NAV	0E+00
Dibenzofuran	1.31E-01	7.60E-08	6.46E-09	8.24E-08	NAV	0E+00
Fluorene	1.10E-01	6.39E-08	5.43E-09	6.93E-08	NAV	0E+00
Phenanthrene	1.96E-02	1.14E-08	9.65E-10	1.23E-08	NAV	0E+00
Anthracene	BDL	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
Carbazole	BDL	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
Fluoranthene	1.29E-02	7.47E-09	6.35E-10	8.10E-09	NAV	0E+00
Pyrene	7.37E-03	4.26E-09	3.63E-10	4.63E-09	NAV	0E+00
Benzo(a)Anthracene	BDL	0.00E+00	0.00E+00	0.00E+00	6.1E-01	0E+00
Chrysene	1.42E-03	8.22E-10	6.99E-11	8.92E-10	6.1E-02	5E-11
Benzo(b)Fluoranthene	9.90E-04	5.73E-10	4.87E-11	6.22E-10	6.1E-01	4E-10
Benzo(k)Fluoranthene	2.60E-04	1.51E-10	1.28E-11	1.63E-10	6.1E-01	1E-10
Benzo(e)Pyrene	BDL	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
Benzo(a)Pyrene	BDL	0.00E+00	0.00E+00	0.00E+00	6.1E+00	0E+00
Indeno(1,2,3-cd)Pyrene	6.00E-04	3.47E-10	2.95E-11	3.77E-10	6.1E-01	2E-10
Dibenzo(ah)Anthracene	BDL	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
Benzo(ghi)Perylene	BDL	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
					Total Risk =	8E-10

* Concentrations are the average of maximum detected concentration from TO13 and III-Vol PM10 reference method or maximum if maximum for one method is below the detection limit.

NAV - Not Available

TABLE A-2-t 12. AL AHMADI HOSPITAL
Carcinogenic Risk - Inhalation of Polycyclic Aromatic Hydrocarbons (PAH)

	Concentration*	Outdoor Exposure ug/m ³	Indoor Exposure mg/kg-day	Total Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Naphthalene	BDL	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
2-Methyl Naphthalene	N/A	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
1-Methyl Naphthalene	N/A	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
Biphenyl	N/A	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
Dimethyl Naphthalene	N/A	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
Acenaphthylene	BDL	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
Acenaphthene	2.50E-04	1.45E-10	1.23E-11	1.57E-10	NAV	0E+00
Dibenzofuran	N/A	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
Fluorene	BDL	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
Phenanthrene	1.84E-03	1.07E-09	9.06E-11	1.16E-09	NAV	0E+00
Anthracene	BDL	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
Carbazole	N/A	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
Fluoranthene	1.70E-03	9.84E-10	8.37E-11	1.07E-09	NAV	0E+00
Pyrene	BDL	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
Benzo(a)Anthracene	BDL	0.00E+00	0.00E+00	0.00E+00	6.1E-01	0E+00
Chrysene	BDL	0.00E+00	0.00E+00	0.00E+00	6.1E-02	0E+00
Benzo(b)Fluoranthene	1.43E-02	8.25E-09	7.01E-10	8.95E-09	6.1E-01	5E-09
Benzo(k)Fluoranthene	1.43E-02	8.25E-09	7.01E-10	8.95E-09	6.1E-01	5E-09
Benzo(e)Pyrene	N/A	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
Benzo(a)Pyrene	BDL	0.00E+00	0.00E+00	0.00E+00	6.1E+00	0E+00
Indeno(1,2,3-cd)Pyrene	BDL	0.00E+00	0.00E+00	0.00E+00	6.1E-01	0E+00
Dibenzo(ah)Anthracene	BDL	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
Benzo(ghi)Perylene	BDL	0.00E+00	0.00E+00	0.00E+00	NAV	0E+00
				Total Risk =		1E-08

* Concentrations are the maximum detected

NAV - Not Available

TABLE A-2-113. KHOBAR TOWERS
Carcinogenic Risk - Ingestion of Soils

	Concentration*	Exposure	Slope Factor	Risk
	mg/kg	mg/kg-day	(mg/kg-day)-1	
Aluminum	2.57E+03	1.34E-05	NA	0E+00
Arsenic	1.51E+00	7.85E-09	1.7E+00	1E-08
Beryllium	3.18E-01	1.65E-09	4.3E+00	7E-09
Calcium	1.03E+05	5.36E-04	NA	0E+00
Cadmium	2.56E+00	1.33E-08	NA	0E+00
Chromium	2.23E+01	1.16E-07	NA	0E+00
Iron	3.36E+03	1.07SE-05	NA	0E+00
Mercury	3.88E-02	2.02E-10	NA	0E+00
Magnesium	1.18E+04	6.14E-05	NA	0E+00
Sodium	4.57E+03	2.38E-05	NA	0E+00
Nickel	2.33E+01	1.21E-07	NA	0E+00
Lead	1.00E+01	5.20E-08	NA	0E+00
Vanadium	1.09E+01	5.67E-08	NA	0E+00
Zinc	3.09E+01	1.61E-07	N/A	0E+00
Total Risk =				2E-08

* Concentrations are the 95th % upper bound of the sample data set

N/A - Not Available

TABLE A-2-114. CAMP 1
Carcinogenic Risk - ingestion of Soils

	Concentration*	Exposure	Slope Factor	Risk
	mg/kg	mg/kg-day	(mg/kg-day)-1	
Aluminum	2.32E+03	1.21E-05	NA	0E+00
Arsenic	1.27E+00	6.60E-09	1.7E+00	1E-08
Beryllium	1.37E+00	7.12E-09	4.3E+00	3E-08
Calcium	5.17E+04	2.69E-04	NA	0E+00
cadmium	3.88E+00	2.02E-08	NA	0E+00
Chromium	1.61E+01	8.37E-08	NA	0E+00
Iron	3.11E+03	1.62E-05	NA	0E+00
Mercury	2.48E-02	1.29E-10	NA	0E+00
Magnesium	8.90E+03	4.63E-05	NA	0E+00
Sodium	4.08E+03	2.12E-05	NA	0E+00
Nickel	1.58E+01	8.22E-08	NA	0E+00
Lead	2.18E+01	1.13E-07	NA	0E+00
Vanadium	1.22E+01	6.34E-08	NA	0E+00
Zinc	2.92E+01	1.52E-07	NA	0E+00
Total Risk =				4E-08

* Concentrations are the 95th % upper bound of the sample data set

N/A - Not Available

**TABLE A-2-115. ESKAN VILLAGE
Carcinogenic Risk - Ingestion of Solis**

	Concentration*	Exposure	Slope Factor	Risk
	mg/kg	mg/kg-day	(mg/kg-day)-1	
Aluminum	3.53E+03	1.84E-05	NA	0E+00
Arsenic	2.56E+00	1.33E-08	1.7E+00	2E-08
Beryllium	6.59E-01	3.43E-09	4.3E+00	1E-08
Calcium	1.46E+05	7.59E-04	NA	0E+00
Cadmium	2.61E+00	1.36E-08	NA	0E+00
Chromium	1.80E+01	9.36E-08	NA	0E+00
Iron	5.13E+03	2.67E-05	NA	0E+00
Mercury	3.09E-02	1.61E-10	NA	0E+00
Magnesium	3.35E+03	1.74E-05	NA	0E+00
Sodium	4.12E+03	2.14E-05	NA	0E+00
Nickel	1.89E+01	9.83E-08	NA	0E+00
Lead	1.23E+01	6.40E-08	NA	0E+00
Vanadium	1.77E+01	9.20E-08	NA	0E+00
Zinc	6.65E+01	3.46E-07	NA	0E+00
Total Risk =				4E-08

* Concentrations are the 95th % upper bound of the sample data set

N/A - Not Available

TABLE A-2-116. KKMC
Carcinogenic Risk - Ingestion of Soils

	Concentration* mg/kg	Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Aluminum	7.09E+03	3.69E-05	NA	0E+00
Arsenic	3.32E+00	1.73E-08	1.7E+00	3E-08
Beryllium	1.07E+00	5.56E-09	4.3E+00	2E-08
Calcium	9.80E+04	5.10E-04	NA	0E+00
Cadmium	3.938 too	2.04E-08	NA	0E+00
Chromium	2.78E+01	1.45E-07	NA	0E+00
Iron	9.216E+03	4.82E-05	NA	0E+00
Mercury	4.14E-02	2.15E-10	NA	0E+00
Magnesium	7.46E+03	3.88E-05	NA	0E+00
Sodium	5.57E+02	2.90E-06	NA	0E+00
Nickel	3.41E+01	1.77E-07	NA	0E+00
Lead	2.23E+01	1.16E-07	NA	0E+00
Vanadium	2.61E+01	1.36E-07	NA	0E+00
Zinc	4.64E+01	2.41E-07	N A	0E+00
Total Risk =				5E-08

* Concentrations **are** the 95th % upper bound of the sample data set
 N/A - Not Available

TABLE A-2-117. MILITARY HOSPITAL CAMP FREEDOM
Carcinogenic Risk - Ingestion of Soils

	Concentration*	Exposure	Slope Factor	Risk
	mg/kg	mg/kg-day	(mg/kg-day)-1	
Aluminum	4.77E+03	2.48E-05	NA	OE+00
Arsenic	4.73E+00	2.46E-08	1.7E+00	4E-08
Beryllium	2.57E+00	1.34E-08	4.3E+00	6E-08
Calcium	3.90E+04	2.03E-04	NA	OE+00
Cadmium	5.65E+00	2.94E-08	NA	OE+00
Chromium	3.24E+01	1.68E-07	NA	OE+00
Iron	6.09E+03	3.17E-05	NA	OE+00
Mercury	6.77E-00	3.52E-08	NA	OE+00
Magnesium	5.85E+03	3.04E-05	NA	OE+00
Sodium	2.56E+02	1.33E-06	NA	OE+00
Nickel	3.51E+01	1.83E-07	NA	OE+00
Lead	4.33E+01	2.25E-07	NA	OE+00
Vanadium	2.04E+01	1.06E-07	NA	OE+00
Zinc	1.97E+02	1.02E-06	NA	OE+00
Total Risk =				1E-07

* Concentrations are the 95th% upper bound of the sample data set

N/A - Not Available

TABLE A-2-110. U.S. EMBASSY, KUWAIT
Carcinogenic Risk - Ingestion of Soils

	Concentration+ mg/kg	Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Aluminum	5.31E+03	2.76E-05	NA	0E+00
Arsenic	2.15E+00	1.12E-08	1.7E+00	2E-08
Beryllium	7.47E-01	3.88E-09	4.3E+00	2E-08
Calcium	9.84E+04	5.12E-04	NA	0E+00
Cadmium	2.77E+00	1.44E-08	NA	0E+00
Chromium	5.47E+01	2.84E-07	NA	0E+00
Iron	6.45E+03	3.35E-05	NA	0E+00
Mercury	3.71E-02	1.93E-10	NA	0E+00
Magnesium	7.48E+03	3.89E-05	NA	0E+00
Sodium	1.18E+03	6.14E-06	NA	0E+00
Nickel	3.97E+01	2.06E-07	NA	0E+00
Lead	3.10E+01	1.61E-07	NA	0E+00
Vanadium	2.03E+01	1.06E-07	NA	0E+00
Zinc	8.33E+01	4.33E-07	NA	0E+00
Total Risk =				4E-08

* Concentrations are the 95th % upper bound of the sample data set
 N/A - Not Available

TABLE A-2-119. CAMP THUNDEROCK
Carcinogenic Risk - Ingestion of Soils

	Concentration+ mg/kg	Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Aluminum	4.75E+03	2.47E-05	NA	0E+00
Arsenic	3.10E+00	1.61E-08	1.7E+00	3E-08
Beryllium	5.50E-01	2.86E-09	4.3E+00	1E-08
Calcium	1.65E+05	8.58E-04	NA	0E+00
Cadmium	2.83E+00	1.47E-08	NA	0E+00
Chromium	6.91E+01	3.59E-07	NA	0E+00
Iron	5.94E+03	3.09E-05	NA	0E+00
Mercury	2.60E-02	1.35E-10	NA	0E+00
Magnesium	1.06E+04	5.51E-05	NA	0E+00
Sodium	2.62E+04	1.36E-04	NA	0E+00
Nickel	4.95E+01	2.57E-07	NA	0E+00
Lead	4.97E+00	2.58E-08	NA	0E+00
Vanadium	2.76E+01	1.44E-07	NA	0E+00
Zinc	4.03E+01	2.10E-07	NA	0E+00
Total Risk =				4E-08

* Concentrations **are** the 95th % upper bound of the sample data set

N/A - Not Available

**TABLE A-2-120. AL AHMADI HOSPITAL,
Carcinogenic Risk - Ingestion of Soils**

	Concentration* mg/kg	Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Aluminum	4.26E+03	2.22E-05	NA	0E+00
Arsenic	2.22E+00	1.15E-08	1.7E+00	2E-08
Beryllium	7.77E-01	4.04E-09	4.3E+00	2E-08
Calcium	3.37E+04	1.75E-04	NA	0E+00
Cadmium	9.69E-01	5.04E-09	NA	0E+00
Chromium	3.41E+01	1.77E-07	NA	0E+00
Iron	6.95E+03	3.61E-05	NA	0E+00
Mercury	6.47E-02	3.36E-10	NA	0E+00
Magnesium	6.96E+03	3.62E-05	NA	0E+00
Sodium	2.23E+03	1.16E-05	NA	0E+00
Nickel	3.27E+01	1.70E-07	NA	0E+00
Lead	3.70E+01	1.92E-07	NA	0E+00
Vanadium	2.61E+01	1.36E-07	NA	0E+00
Zinc	5.49E+01	2.85E-07	NA	0E+00
Total Risk =				4E-08

* Concentrations are the 95th % upper bound of the sample data set
N/A - Not Available

TABLE A-2-121.. KHOBAR TOWERS
Non-Carcinogenic Risk - Ingestion of Soils

	Concentration* mg/kg	Exposure mglkg-day	Reference Dose mglkg-day	Hazard Quotient
Atuminuui	2.57E+03	1.10E-02	2.9E+00	4E-03
Arsenic	1.51E+00	6.47E-06	3.0E-04	2E-02
Beryllium	3.18E-01	1.36E-06	5.0E-03	3E-04
Calcium	1.03E+05	4.41E-01	NA	0E+00
Cadmium	2.56E+00	1.10E-05	5.0E-04	2E-02
Chromium	2.23E+01	9.56E-05	1.0E+01	1E-05
Iron	3.36E+03	1.44E-02	NA	0E+00
Mercury	3.88E-02	1.66E-07	3.0E-04	6E-04
Magnesium	1.18E+04	5.06E-02	NA	0E+00
Sodium	4.57E+03	1.96E-02	NA	0E+00
Nickel	2.33E+01	9.99E-05	2.0E-02	SE-03
Lead	1.00E+01	4.29E-05	NA	0E+00
Vanadium	1.09E+01	4.67E-05	7.0E-03	7E-03
Zinc	3.09E+01	1.32E-04	.. 3.0E-01	4E-04
			Hazard Index =I	6E-02

* Concentrations are the 95th % upper bound of the **sample** data set

N/A - Not Available

TABLE A-2-122.; CAMP 1
Non-Carcinogenic. Risk - Ingestion of Soils

	Concentration* mg/kg	Exposure mg/kg-day	Reference Dose mg/kg-day	Hazard Quotient
Aluminum	2.32E+03	9.94E-03	2.9E+00	3E-03
Arsenic	1.27E+00	5.44E-06	3.0E-04	2E-02
Beryllium	1.37E-00	5.87E-06	5.0E-03	1E-03
Calcium	5.17E+04	2.22E-01	NA	0E+00
Cadmium	3.88E+00	1.66E-05	5.0E-04	3E-02
Chromium	1.61E+01	6.90E-05	1.0E+01	7E-06
Iron	3.11E+03	1.33E-02	NA	0E+00
Mercury	2.48E-02	1.06E-07	3.0E-04	4E-04
Magnesium	8.90E+03	3.81E-02	NA	0E+00
Sodium	-4.08E+03	1.75E-02	NA	0E+00
Nickel	1.58E+01	6.77E-05	2.0E-02	3E-03
Lead	2.18E+01	9.34E-05	NA	0E+00
Vanadium	1.22E+01	5.23E-05	7.0E-03	7E-03
Zinc	2.92E+01	1.25E-04	3.0E-01	4E-04
		Hazard Index =		7E-02

* Concentrations are the 95th %upper bound of the sample data set

N/A- Not Available

**TABLE A-2-123, ESKAN VILLAGE
Non-Carcinogenic Risk - Ingestion of Soils**

	Concentration*	Exposure	Reference Dose	Hazard Quotient
	mg/kg	mg/kg-day	mg/kg-day	
Aluminum	3.53E+03	1.51E-02	2.9E+00	5E-03
Arsenic	2.56E+00	1.10E-05	3.0E-04	4E-02
Beryllium	6.59E-01	2.82E-06	5.0E-03	6E-04
Calcium	1.46E+05	6.26E-01	NA	0E+00
Cadmium	2.61E+00	1.12E-05	5.0E-04	2E-02
Chromium	1.80E+01	7.71E-05	1.0E+01	8E-06
Iron	5.13E+03	2.20E-02	NA	0E+00
Mercury	3.09E-02	1.32E-07	3.0E-04	4E-04
Magnesium	3.35E+03	1.44E-02	NA	0E+00
Sodium	4.12E+03	1.77E-02	NA	0E+00
Nickel	1.89E+01	8.10E-05	2.0E-02	4E-03
Lead	1.23E+01	5.27E-05	NA	0E+00
Vanadium	1.77E+01	7.59E-05	7.0E-03	1E-02
Zinc	6.65E+01	2.85E-04	3.0E-01	1E-03
Hazard Index =				8E-02

* Concentrations are the 95th % upperbound of the sampled data set

N/A - Not Available

**TABLE A-2-124. KKMC
Non-Carcinogenic Risk - Ingestion of Soils**

	Concentration* mg/kg	Exposure mg/kg-day	Reference Dose mg/kg-day	Hazard Quotient
Aluminum	7.09E+03	3.04E-02	2.9E+00	1E-02
Arsenic	3.32E+00	1.42E-05	3.0E-04	5E-02
Beryllium	1.07E+00	4.59E-06	5.0E-03	9E-04
Calcium	9.80E+04	4.20E-01	NA	0E+00
Cadmium	3.93E+00	1.68E-05	5.0E-04	3E-02
Chromium	2.78E+01	1.19E-04	1.0E+01	1E-05
Iron	9.26E+03	3.97E-02	NA	0E+00
Mercury	4.14E-02	1.77E-07	3.0E-04	6E-04
Magnesium	7.46E+03	3.20E-02	NA	0E+00
Sodium	5.57E+02	2.39E-03	NA	0E+00
Nickel	3.41E+01	1.46E-04	2.0E-02	7E-03
Lead	2.23E+01	9.56E-05	NA	0E+00
Vanadium	2.61E+01	1.12E-04	7.0E-03	2E-02
Zinc	4.64E+01	1.99E-04	3.0E-01	7E-04
Hazard Index =				1E-01

* Concentrations are the 95th % upperbound of the sample data set

N/A - Not Available

TABLE A-2-125. MILITARY HOSPITAL/CAMP FREEDOM
 Non-Carcinogenic Risk - ingestion of Soils

	Concentration*	Exposure	Reference Dose	Hazard Quotient
	mg/kg	mg/kg-day	mg/kg-day	
Aluminum	4.77E+03	2.04E-02	2.9E+00	7E-03
Arsenic	4.73E+00	2.03E-05	3.0E-04	7E-02
Beryllium	2.57E+00	1.10E-05	5.0E-03	2E-03
Calcium	3.90E+04	1.67E-01	N/A	0E+00
Cadmium	5.658E-00	2.42E-05	5.0E-04	5E-02
Chromium	3.24E+01	1.39E-04	1.0E+01	1E-05
Iron	6.09E+03	2.61E-02	NA	0E+00
Mercury	6.778E-00	2.90E-05	3.0E-04	1E-01
Magnesium	5.85E+03	2.51E-02	NA	0E+00
Sodium	2.56E+02	1.10E-03	NA	0E+00
Nickel	3.51E+01	1.50E-04	2.0E-02	8E-03
Lead	4.33E+01	1.86E-04	NA	0E+00
Vanadium	2.04E+01	8.74E-05	7.0E-03	1E-02
Zinc	1.97E+02	8.44E-04	3.0E-01	3E-03
			Hazard Index =	2E-01

* Concentrations are the 95th % upper bound of the sample data set

N/A - Not Available

TABLE A-2-126, U.S. EMBASSY, KUWAIT
Non-Carcinogenic Risk - Ingestion of Soils

	Concentration* mg/kg	Exposure mg/kg-day	Reference Dose mg/kg-day	Hazard Quotient
Aluminum	5.31E+03	2.28E-02	2.9E+00	8E-03
Arsenic	2.15E+00	9.21E-06	3.0E-04	3E-02
Beryllium	7.47E-01	3.20E-06	8.0E-03	6E-04
Calcium	9.84E+04	4.22E-01	NA	0E+00
Cadmium	2.77E-00	1.19E-05	5.0E-04	2E-02
Chromium	5.47E+01	2.34E-04	1.0E+01	2E-05
Iron	6.45E+03	2.76E-02	NA	0E+00
Mercury	3.71E-02	1.59E-07	3.0E-04	5E-04
Magnesium	7.48E+03	3.21E-02	NA	0E+00
Sodium	1.18E+03	5.06E-03	NA	0E+00
Nickel	3.97E+01	1.70E-04	2.0E-02	9E-03
Lead	3.10E+01	1.33E-04	NA	0E+00
Vanadium	2.03E+01	8.70E-05	7.0E-03	1E-02
z i n c	8.33E+01	3.57E-04	3.0E-01	1E-03
Hazard Index =				9E-02

* Concentrations are the 95th % upperbound of the sample data set
N/A - Not Available

**TABLE A-2-127. CAMP THUNDEROCK
Non-Carcinogenic Risk - Ingestion of Soils**

	Concentration*	Exposure	Reference Dose	Hazard Quotient
	mg/kg	mg/kg-day	mg/kg-day	
Aluminum	4.75E+03	2.04E-02	2.9E+00	7E-03
Arsenic	3.10E+00	1.33E-05	3.0E-04	4E-02
Beryllium	5.50E-01	2.36E-06	5.0E-03	5E-04
Calcium	1.65E+05	7.07E-01	NA	0E+00
Cadmium	2.83E+00	1.21E-05	5.0E-04	2E-02
Chromium	6.91E+01	2.96E-04	1.0E+01	3E-05
Iron	5.94E+03	2.55E-02	NA	0E+00
Mercury	2.60E-02	1.11E-07	3.0E-04	4E-04
Magnesium	1.06E+04	4.54E-02	NA	0E+00
Sodium	2.62E+04	1.12E-01	NA	0E+00
Nickel	4.95E+01	2.12E-04	2.0E-02	1E-02
Lead	4.97E+00	2.13E-05	NA	0E+00
Vanadium	2.76E+01	1.18E-04	7.0E-03	2E-02
Zinc	4.03E+01	1.73E-04	3.0E-01	6E-04
Hazard Index =				1E-01

* Concentrations are the 95th % upper bound of the sample data set

N/A - Not Available

**TABLE A-2-128. AL AHMADI HOSPITAL
Non-Carcinogenic Risk - ingestion of Soils**

	Concentration+ mg/kg	Exposure mg/kg-day	Reference Dose mg/kg-day	Hazard Quotient
Aluminum	4.26E+03	1.83E-02	2.9E+00I	6E-03
Arsenic	2.21E+00	9.51E-06	3.0E-04	3E-02
Beryllium	7.77E-01	3.33E-06	5.0E-03	7E-04
Calcium	3.37E+04	1.44E-01	NA	0E+00
Cadmium	9.69E-01	4.15E-06	5.0E-04	8E-03
Chromium	3.41E+01	1.46E-04	1.0E+01	1E-05
Iron	6.95E+03	2.98E-02	NA	0E+00
Mercury	6.47E-02	2.77E-07	3.0E-04	9E-04
Magnesium	6.96E+03	2.98E-02	NA	0E+00
Sodium	2.23E+03	9.56E-03	NA	0E+00
Nickel	3.27E+01	1.40E-04	2.0E-02	7E-03
Lead	3.70E+01	1.59E-04	NA	0E+00
Vanadium	2.61E+01	1.12E-04	7.0E-03	2E-02
Zinc	5.49E+01	2.35E-04	3.0E-01	8E-04
Hazard Index =				7E-02

* Concentrations are the 95th % upper bound of the sample data set
N/A - Not Available

TABLE A-2-129. **KHOBAR TOWERS**
Carcinogenic Risk - Dermal Contact with Soils

	Concentration*	Exposure	Slope Factor	Risk
	mg/kg	mg/kg-day	(mg/kg-day)-1	
Aluminum	2.57E+03	9.51E-06	NA	0E+00
Arsenic	1.51E+00	5.59E-09	1.7E+00	1E-08
Beryllium	3.18E-01	1.18E-09	4.3E+00	SE-09
Calcium	1.03E+05	3.81E-04	NA	0E+00
Cadmium	2.56E+00	1.89E-09	NA	0E+00
Chromium	2.23E+01	8.25E-08	NA	0E+00
Iron	3.36E+03	1.24E-05	NA	0E+00
Mercury	3.88E-02	1.44E-10	NA	0E+00
Magnesium	1.18E+04	4.37E-05	NA	0E+00
Sodium	4.57E+03	1.69E-05	NA	0E+00
Nickel	2.33E+01	8.62E-08	NA	0E+00
Lead	1.00E+01	3.70E-08	NA	0E+00
Vanadium	1.09E+01	4.03E-08	NA	0E+00
Zinc	3.09E+01	1.14E-07	NA	0E+00
Total Risk =				1E-08

* Concentrations are the 95th % upper bound of the **sample** data set

N/A - Not Available

TABLE A-2-130. CAMP 1
Carcinogenic Risk - Dermal Contact with Soils

	Concentration* mg/kg	Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Aluminum	2.32E+03	8.59E-06	NA	0E+00
Arsenic	1.27E+00	4.70E-09	1.7E+00	8E-09
Beryllium	1.37E+00	5.07E-09	4.3E+00	2E-08
Calcium	5.17E+04	1.91E-04	NA	0E+00
Cadmium	3.88E+00	2.87E-09	NA	0E+00
Chromium	1.61E+01	5.96E-08	NA	0E+00
Iron	3.11E+03	1.15E-05	NA	0E+00
Mercury	2.48E-02	9.18E-11	NA	0E+00
Magnesium	8.90E+03	3.29E-05	NA	0E+00
Sodium	4.08E+03	1.51E-05	NA	0E+00
Nickel	1.58E+01	5.85E-08	NA	0E+00
Lead	2.18E+01	8.07E-08	NA	0E+00
Vanadium	1.22E+01	4.51E-08	NA	0E+00
Zinc	2.92E+01	1.08E-07	NA	0E+00
			Total Risk =	3E-08

*Concentrations are the 95th% upper bound of the sample data set
N/A - Not Available

TABLE A-2-131, ESKAN VILLAGE
Carcinogenic Risk - Derma Contact with Soils

	Concentration*	Exposure	Slope Factor	Risk
	mg/kg	mg/kg-day	(mg/kg-day)-1	
Aluminum	3.53E+03	1.31E-05	NA	0E+00
Arsenic	2.56E+00	9.47E-09	1.7E+00	2E-08
Beryllium	6.59E-01	2.44E-09	4.3E+00	1E-08
Calcium	1.46E+05	5.40E-04	NA	0E+00
Cadmium	2.61E+00	1.93E-09	NA	0E+00
Chromium	1.80E+01	6.66E-08	NA	0E+00
Iron	5.13E+03	1.90E-05	NA	0E+00
Mercury	3.09E-02	1.14E-10	NA	0E+00
Magnesium	3.35E+03	1.24E-05	NA	0E+00
Sodium	4.12E+03	1.52E-05	NA	0E+00
Nickel	1.89E+01	6.99E-08	NA	0E+00
Lead	1.23E+01	4.55E-08	NA	0E+00
Vsnadlum	1.77E+01	6.55E-08	NA	0E+00
Zinc	6.65E+01	2.46E-07	NA	0E+00
Total Risk =				3E-08

* Concentrations are the 95th % upper bound of the sample data set

N/A - Not Available

TABLE A-2-I 32, KKMC
Carcinogen: I - Dermal Contact with Soils

	Concentration* mg/kg	Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Aluminum	7.09E+03	2.62E-05	NA	0E+00
Arsenic	3.32E+00	1.23E-08	1.7E+00	2E-08
Beryllium	1.07E+00	3.96E-09	4.3E+00	2E-08
Calcium	9.80E+04	3.63E-04	NA	0E+00
Cadmium	3.93E+00	2.91E-09	NA	0E+00
Chromium	2.78E+01	1.03E-07	NA	0E+00
Iron	9.26E+03	3.43E-05	NA	0E+00
Mercury	4.14E-02	1.53E-10	NA	0E+00
Magnesium	7.46E+03	2.76E-05	NA	0E+00
Sodium	5.57E+02	2.06E-06	NA	0E+00
Nickel	3.41E+01	1.26E-07	NA	0E+00
Lead	2.23E+01	8.25E-08	NA	0E+00
Vanadium	2.61E+01	9.66E-08	NA	0E+00
Zinc	4.64E+01	1.72E-07	NA	0E+00
Total Risk =				4E-08

* Concentrations are the 95th % upper bound of the **sample** data set
 N/A - Not Available

TABLE A-2-133. MILITARY HOSPITAL CAMP FREEDOM
Carcinogenic Risk - Dermal Contact with Soils

	Concentration+ mg/kg	Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Aluminum	4.77E+03	1.77E-05	NA	0E+00
Arsenic'	4.738-I-00	1 • 75E-08	1.7E+00	3E-08
Beryllium	2.57E+00	9.51E-09	4.3E+00	4E-08
Calcium	3.90E+04	1.44E-04	NA	0E+00
Cadmium	5.65E+00	4.18E-09	NA	0E+00
Chromium	3.24E+01	1.20E-07	NA	0E+00
Iron	6.09E+03	2.25E-05	NA	0E+00
Mercury	6.77E+00	2.51E-08	NA	0E+00
Magnesium	5.85E+03	2.16E-05	NA	0E+00
Sodium	2.56E+02	9.47E-07	NA	0E+00
Nickel	3.51E+01	1.30E-07	NA	0E+00
Lead	4.33E+01	1.60E-07	NA	0E+00
Vanadium	2.04E+01	7.55E-08	NA	0E+00
Zinc	1.97E+02	7.29E-07	NA	0E+00
Total Risk =				7E-08

* Concentrations are the 95th % upper bound of the sample data set

N/A - Not Available

TABLE A - 2 1.34. U.S. EMBASSY, KUWAIT
Carcinogenic Risk - Dermal Contact with Soils

	Concentration* mg/kg	Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Aluminum	5.31E+03	1.97E-05	NA	0E+00
Arsenic	2.15E+00	7.96E-09	1.7E+00	1E-08
Beryllium	7.47E-01	2.76E-09	4.3E+00	1E-08
Calcium	9.84E+04	3.64E-04	NA	0E+00
Cadmium	2.77E+00	2.05E-09	NA	0E+00
Chromium	5.47E+01	2.02E-07	NA	0E+00
Iron	6.45E+03	2.39E-05	NA	0E+00
Mercury	3.71E-02	1.37E-10	NA	0E+00
Magnesium	7.48E+03	2.77E-05	NA	0E+00
Sodium	1.18E+03	4.37E-06	NA	0E+00
Nickel	3.97E+01	1.47E-07	NA	0E+00
Lead	3.10E+01	1.15E-07	NA	0E+00
Vanadium	2.03E+01	7.51E-08	NA	0E+00
Zinc	8.33E+01	3.08E-07	NA	0E+00
			Total Risk =	3E-08

* Concentrations are the 95th % upper bound of the sample data set
 N/A - Not Available

TABLE A-2-135. CAMP THUNDEROCK
Carcinogenic Risk - Dermal Contact with Soils

	Concentration* mg/kg	Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Aluminum	4.75E+03	1.76E-05	NA	0E+00
Arsenic	3.10E+00	1.15E-08	1.7E+00	2E-08
Beryllium	5.50E-01	2.04E-09	4.3E+00	9E-09
Calcium	1.65E+05	6.11E-04	NA	0E+00
Cadmium	2.83E+00	2.09E-09	NA	0E+00
Chromium	6.91E+01	2.56E-07	NA	0E+00
Iron	5.94E+03	2.20E-05	NA	0E+00
Mercury	2.60E-02	9.628E-11	NA	0E+00
Magnesium	1.06E+04	3.928E-05	NA	0E+00
Sodium	2.62E+04	9.70E-05	NA	0E+00
Nickel	4.95E+01	1.1E-07	NA	0E+00
Lead	4.97E+00	1.84E-08	NA	0E+00
Vanadium	2.76E+01	1.02E-07	NA	0E+00
Zinc	4.03E+01	1.49E-07	NA	0E+00
			Total Risk =	3E-08

* **Concentrations** are the 95th % upper bound of the sample data set

N/A - Not Available

TABLE A-2-136. AL AHMADI HOSPITAL
Carcinogenic Risk - Dermal Contact with Soils

	Concentration* mg/kg	Exposure mg/kg-day	Slope Factor (mg/kg-day)-1	Risk
Aluminum	4.26E+03	1.58E-05	NA	0E+00
Arsenic	2.22E+00	8.22E-W	1.7E+00	1E-08
Beryllium	.77E-01	2.88E-09	4.3E+00	1E-08
Calcium	2.37E+04	1.25E-04	NA	0E+00
Cadmium	9.69E-01	7.17E-10	NA	0E+00
Chromium	3.41E+01	1.26E-07	NA	0E+00
Iron	6.95E+03	2.57E-115	NA	0E+00
Mercury	6.47E-02	2.39E-10	NA	0E+00
Magnesium	6.96E+03	2.58E-05	NA	0E+00
Sodium	2.23E+03	8.25E-06	NA	0E+00
Nickel	2.27E+01	1.21E-07	NA	0E+00
Lead	3.70E+01	1.37E-07	NA	0E+00
Vanadium	2.61E+01	9.66E-08	NA	0E+00
Zinc	5.11E-01	2.03E-07	NA	0E+00
			Total Risk =	3E-08

* Concentrations are the 95th % upperbound of the sampled data set

N/A - Not Available

TABLE A-2-137. KHOBAR TOWERS
Non-Carcinogenic Risk - Dermal Contact with Soils

	Concentration* mg/kg	Exposure mg/kg-day	Reference Dose mg/kg-day	Hazard Quotient
Aluminum	2.57E+03	7.84E-03	2.9E+00	3E-03
Arsenic	1.51E+00	4.61E-06	3.0E-04	2E-02
Beryllium	3.18E-01	9.70E-07	5.0E-03	2E-04
Calcium	1.03E+05	3.14E-01	NA	0E+00
Cadmium	2.56E+00	1.56E-06	5.0E-04	3E-03
Chromium	2.23E+01	6.80E-05	1.0E+01	7E-06
Iron	3.36E+03	1.02E-02	NA	0E+00
Mercury	3.88E-02	1.18E-07	3.0E-04	4E-04
Magnesium	1.18E+04	3.60E-02	NA	0E+00
Sodium	4.57E+03	1.39E-02	NA	0E+00
Nickel	2.33E+01	7.11E-05	2.0E-02	4E-03
Lead	1.00E+01	3.05E-05	NA	0E+00
Vanadium	1.09E+01	3.32E-05	1.0E-03	5 E-03
Zinc	3.09E+01	9.42E-05	3.0E-01	3E-04
Hazard Index				3E-02

* Concentrations are the 95th 96 upper bound of the sample data set

N/A - Not Available

TABLE A-2-138. CAMP 1

Non-Carcinogenic Risk - Dermal Contact with Soib

	Concentration* mg/kg	Exposure mg/kg-day	Reference Dose mg/kg-day	Hazard Quotient
Aluminum	^ 32E+03	7.08E-03	2.9E+00	2E-03
Arsenic	1.27E+00	3.87E-06	3.0E-04	1E-02
Beryllium	1.37E+00	4.18E-06	5.0E-03	8E-04
Calcium	5.17E+04	1.58E-01	NA	0E+00
Cadmium	3.88E+00	2.37E-06	5.0E-04	5E-03
Chromium	1.61E+01	4.91E-05	1.0E+01	SE-06
Iron	3.11E+03	9.49E-03	NA	0E+00
Mercury	2.48E-02	7.56E-08	3.0E-04	3E-04
Magnesium	8.90E+03	2.71E-02	NA	0E+00
Sodium	4.08E+03	1.24E-02	NA	0E+00
Nickel	1.58E+01	4.82E-05	2.0E-02	2E-03
Lead	2.18E+01	6.65E-05	NA	0E+00
Vanadium	1.22E+01	^ 72E-05	7.0E-03	5E-03
Zinc	2.92E+01I	8.91 E-05	3.0E-01	3E-04
Hazard Index =				3E-02

* Concentrations are the 95th % upper bound of the sample data set
 N/A - Not Available

TABLE A-2-139. ESKAN VILLAGE
Non-Carcinogenic **Risk-Dermal** Contact with Soils

A-2-1w9

	Concentration*	Exposure	Reference Dose	Hazard Quotient
	mg/kg	mg/kg-day	mg/kg-day	
Aluminum	3.53E+03	1.08E-02	2.9E+00	4E-03
Arsenic	2.56E+00	7.81E-06	3.0E-04	3E-02
Beryllium	6.59E-01	2.01E-06	5.0E-03	4E-04
Calcium	1.46E+05	4.45E-01	NA	0E+00
Cadmium	2.61E+00	1.59E-06	5.0E-04	3E-03
Chromium	1.80E+01	5.49E-05	1.0E+01	5E-06
Iron	5.13E+03	1.56E-02	NA	0E+00
Mercury	3.09E-02	9.42E-08	3.0E-04	3E-04
Magnesium	3.35E+03	1.02E-02	NA	0E+00
Sodium	4.12E+03	1.26E-02	NA	0E+00
Nickel	1.89E+01	5.76E-05	2.0E-02	3E-03
Lead	1.23E+01	3.75E-05	NA	0E+00
Vanadium	1.77E+01	5.40E-05	7.0E-03	8E-03
Zinc	6.65E+01	2.03E-04	3.0E-01	7E-04
Hazard Index =				4E-02

* Concentrations are the 95th % upper bound of the sample data set

N/A - Not Available

**TABLE A-2-140. KKMC
Non-Carcinogenic Risk - Dermal Contact with Soils**

	Concentration* mg/kg	Exposure mg/kg-day	Reference Dose mg/kg-day	Hazard Quotient
Aluminum	7.09E+03	2.16E-02	2.9E+00	7E-03
Arsenic	3.32E+00	1.01E-05	3.0E-04	3E-02
Beryllium	1.07E+00	3.26E-06	5.0E-03	7E-04
Calcium	9.80E+04	2.99E-01	NA	0E+00
Cadmium	3.93E+00	2.40E-06	5.0E-04	5E-03
Chromium	2.78E+01	8.48E-05	1.0E+01	8E-06
Iron	9.26E+03	2.82E-02	NA	0E+00
Mercury	4.14E-02	1.26E-07	3.0E-04	4E-04
Magnesium	7.46E+03	2.28E-02	NA	0E+00
Sodium	5.57E+02	1.70E-03	NA	0E+00
Nickel	3.41E+01	1.04E-04	2.0E-02	5E-03
Lead	2.23E+01	6.80E-05	NA	0E+00
Vanadium	2.61E+01	7.96E-05	7.0E-03	1E-02
Zinc	4.64E+01	1.42E-04	3.0E-01	SE-04
Hazard Index =				6E-02

* Concentrations are the 95th % upper bound of the sample data set
N/A - Not Available

**TABLE A-2-141. MILITARY HOSPITAL CAMP FREEDOM
Non-Carcinogenic Risk - Dermal Contact with Soils**

	Concentration*	Exposure	Reference Dose	Hazard Quotient
	mg/kg	mg/kg-day	mg/kg-day	
Aluminum	4.77E+03	1.45E-02	2.9E+00	5 E-03
Arsenic	4.73E+00	1.44E-05	3.0E-04	SE-02
Beryllium	2.57E+00	7.84E-06	5.0E-03	2E-03
Calcium	3.90E+04	1.19E-01	NA	0E+00
Cadmium	5.65E+00	3.45E-06	5.0E-04	7E-03
Chromium	3.24E+01	9.88E-05	1.0E+01	1 E-05
Iron	6.09E+03	1.86E-02	NA	0E+00
Mercury	6.77E+00	2.06E-05	3.0E-04	7E-02
Magnesium	5.85E+03	1.78E-02	NA	0E+00
Sodium	2.56E+02	7.81E-04	NA	0E+00
Nickel	7.51E+01	1.07E-04	2.0E-02	5E-03
Lead	4.33E+01	1.32E-04	NA	0E+00
Vanadium	2.04E+01	6.22E-05	7.0E-03	9E-03
Zinc	1.97E+02	6.01 E-04	3.0E-01	2E-03
Hazard Index =				1E-01

* Concentrations are the 95th % upper bound of the sample data set

N/A - Not Available

TABLE A-2-142. U.S. EMBASSY, KUWAIT
Non-Carcinogenic Risk - Dermal Contact with Soils

	Concentration* mg/kg	Exposure mg/kg:g-day	Reference Dose mg/kg-day	Hazard Quotient
Aluminum	5.31E+03	1.62E-02	2.9E+00	6E-03
Arsenic	2.15E+00	6.56E-06	3.0E-04	2E-02
Beryllium	7.47E-01	2.28E-06	5.0E-03	5E-04
Calcium	9.84E+04	3.00E-01	NA	0E+00
Cadmium	2.77E+00	1.69E-06	5.0E-04	3E-03
Chromium	5.47E+01	1.67E-04	1.0E+01	2E-05
Iron	6.45E+03	1.97E-02	NA	0E+00
Mercury	3.71E-02	1.13E-07	3.1DE-04	4E-04
Magnesium	7.48E+03	2.28E-02	NA	0E+00
Sodium	1.18E+03	3.60E-03	NA	0E+00
Nickel	3.97E+01	1.21E-04	2.0E-02	6E-03
Lead	3.10E+01	9.46E-05	NA	0E+00
Vanadium	2.03E+01	6.19E-05	7.0E-03	9E-03
Zinc	8.33E+01	2.54E-04	3.0E-01	8E-04
Hazard Quotient =				5E-02

* Concentrations are the 95th % upper bound of the sample data set

N/A - Not Available

TABLE A-2-143. CAMP THUNDEROCK
Non-Carcinogenic Risk - Dermal Contact with Soils

	Concentration* mg/kg	Exposure mg/kg-day	Reference Dose mg/kg-day	Hazard Quotient
Aluminum	4.75E+03	1.45E-02	2.9E+00	5E-03
Arsenic	3.10E+00	9.46E-06	3.0E-04	3E-02
Beryllium	5.50E-01	1.68E-06	5.0E-03	3E-04
Calcium	1.65E+05	5.03E-01	NA	0E+00
Cadmium	2.83E+00	1.73E-06	5.0E-04	3E-03
Chromium	6.91E+01	2.11E-04	1.0E+01	2E-05
Iron	5.94E+03	1.81E-02	NA	0E+00
Mercury	2.60E-02	7.93E-08	3.0E-04	3E-04
Magnesium	1.06E+04	3.23E-02	NA	0E+00
Sodium	2.628E-04	7.99E-02	NA	0E+00
Nickel	4.95E+01	1.51E-04	2.0E-02	8E-03
Lead	4.97E+00	1.52E-05	NA	0E+00
Vanadium	2.76E+01	8.42E-05	7.0E-03	1E-02
Zinc	4.03E+01	1.23E-04	3.0E-01	4E-04
Hazard Index =				6E-02

* Concentrations are the 95th % upper bound of the sample data set

N/A - Not Available

**TABLE A-2-144. AL AHMADI HOSPITAL
Non-Carcinogenic Risk - Dermal Contact with Soils**

	Concentration* mg/kg	Exposure mg/kg-day	Reference Dose mg/kg-day	Hazard Quotient
Aluminum	4.26E+03	1.30E-02	2.9E+00	4E-03
Arsenic	2.22E+00	6.77E-06	3.0E-04	2E-02
Beryllium	7.77E-01	2.37E-06	5.0E-03	5E-04
Calcium	3.37E+04	1.03E-01	NA	0E+00
Cadmium	9.69E-01	5.91E-07	5.0E-04	1E-03
Chromium	3.41E+01	1.04E-04	1.0E+01	1E-05
Iron	6.95E+03	2.12E-02	NA	0E+00
Mercury	6.47E-02	1.97E-07	3.0E-04	7E-04
Magnesium	6.96E+03	2.12E-02	NA	0E+00
Sodium	2.23E+03	6.80E-03	NA	0E+00
Nickel	3.27E+01	9.97E-05	2.0E-02	5E-03
Lead	3.70E+01	1.13E-04	NA	0E+00
Vanadium	2.61E+01	7.96E-05	7.0E-03	1E-02
Zinc	5.49E+01	1.67E-04	3.0E-01	6E-04
Hazard Index =				5E-02

* Concentrations are the 95th % upper bound of the sample data set

N/A - Not Available

APPENDIX A-3

**CARCINOGENIC SLOPE FACTORS,
NONCARCINOGENIC REFERENCE D O S E S - C E CONCENTRATIONS,
TOXICITY PROFILES, AND HEALTH EFFECTS OF
INHALED PARTICULATES**

I. CARCINOGENIC SLOPE FACTORS AND NONCARCINOGENIC **REFERENCE** DOSES AND REFERENCE CONCENTRATIONS. Table A-3-1 summarizes the **toxicological** data available for the **chemicals** sampled during the environmental monitoring efforts in Saudi **Arabia** and Kuwait. Table A-3-1 presents carcinogenic **slope** factors and **noncarcinogenic** reference **doses/reference concentrations**.

TABLE A-3-I. REFERENCE VALUES (mg/kg-day) AND SLOPE FACTORS (mg/kg-day)⁻¹

	ORAL RfD	INH. RfC	W.O.E.	ORAL SF	INH. SF
Aluminum	2.9E+0	*	*	*	*
Arsenic	3.0E-4	N/A	A	1.75E+0	5.0E+1a/1.51E+1
Beryllium	5E-3	N/A	B2	4.3E+0	8.4E+0
Calcium	N/A	N/A	-	N/A	N/A
Cadmium	1E-3/5.0E-4b	N/A	B1	N/A	6.3E+0
Chromium (VI)	2E-2s/5E-3	N/A	A	N/A	4.2E+1
Chromium (III)	1E+0s	5.71E-7c	-	N/A	N/A
Iron	*	*	*	*	*
Mercury	3E-4a	8.57E-5a	-	N/A	N/A
Magnesium	N/A	N/A	D	N/A	N/A
Sodium	N/A	N/A	-	N/A	N/A
Nickel	2E-2	N/A	A	N/A	8.4E-1
Lead	N/A	N/A	B2	N/A	N/A
Vanadium	7E-3a	N/A	-	N/A	N/A
Zinc	3E-1	N/A	D	N/A	N/A
Chlorine	N/A	N/A	-	N/A	N/A
Nitrates	N/A	N/A	-	N/A	N/A
Sulfates			-		
Benzene	N/A	1.43E-4d	A	2.9E-2	2.91E-2
Toluene	2E-1	2E+0s/1.14E-1c	D	N/A	N/A
Ethyl Benzene	1E-1	2.86E-1	D	N/A	N/A
m-Xylene	2E+0a	2E-1c	D	N/A	N/A
p-Xylene	N/A	8.57E-2c	D	N/A	N/A
o-Xylene	2E+0a	2E-1c	D	N/A	N/A
Heptane	*	*	*	*	*
n-Propyl Benzene	*	*	*	*	*

RfD Oral Reference Dose.

RfC Inhalation Reference Concentration.

SF Slope Factor.

INH. Inhalation.

W.O.E. Weight of Evidence.

* Data Inadequate.

a Value Obtained from HEAST.

b Value for Food/Value for Drinking Water.

s Sub&ironic Value.

c Value Withdrawn from HEAST.

d Value Obtained from EPA-ECAO.

TABLE A-3-1. REFERENCE VALUES (mg/kg-day) AND SLOPE FACTORS (mg/kg-day)⁻¹
(continued)

	ORAL RFD	INH. RFC	W.O.E.	ORAL SF	INH. SF
Acenaphthalene	N/A	N/A	D	N/A	N/A
Fluorene	4.0E-1s/4.0E-2	N/A	D	N/A	N/A
Phenanthrene	*	*	D	*	*
Fluoranthene	4E-1s/4E-2	N/A	D	N/A	N/A
Pyrene	3E-1s/3E-2	N/A	D	N/A	N/A
Chrysene	*	*	B2	7.3E-3e	6.1E-3e
Benzo(a)anthracene	N/A	N/A	B2	7.3E-1e	6.1E-1e
Benzo(b)fluoranthene	N/A	N/A	B2	7.3E-1e	6.1E-1e
Benzo(k)fluoranthene	N/A	N/A	B2	7.3E-2e	6.1E-2e
Benzo(a)pyrene	N/A	N/A	B2	7.3E+0	6.1E+0
Benzo(e)pyrene					
Indeno(1,2,3-cd)pyrene	N/A	N/A	B2	7.3E-1e	6.1E-1e
Benzo(g,h,i)perylene	N/A	N/A	D	2.5E-1	N/A
1-Methylnaphthalene	N/A	N/A		N/A	N/A
2-Methylnaphthalene	N/A	N/A	D	N/A	N/A
Biphenyl	5E-2	N/A	D	N/A	N/A
2,6-Dimethylnaphthalene	N/A	N/A		N/A	N/A
Dibenzofuran (TCDD Eq.)	*	*	D	*	*
Carbazole				2E-2a	

RfD Oral Reference Dose.

RfC Inhalation Reference Concentration.

SF Slope Factor.

INH. Inhalation.

W.O.E. Weight of Evidence.

a Data Inadequate.

b Value Obtained from HEAST.

c Value for Food/Value for Drinking Water.

s Subchronic Value.

d Value Withdrawn from HEAST.

e Value Obtained from EPA-ECAO.

f Value Derived using a Benzo(a)pyrene CEF.

CEF Carcinogenic Equivalency Factor.

II. TOXICITY PROFILES. Toxicity profiles have been prepared for the chemicals that were detected during the environmental monitoring efforts in Kuwait and Saudi Arabia. The following summaries are intended to express primary effects of the contaminants in this document. These summaries are not intended to be comprehensive literature reviews, but rather general human toxicological effects with supporting values.

ARSENIC

Inorganic arsenic has been given a weight-of-evidence classification as a human carcinogen. This was based on observations of increased lung cancer mortality in populations exposed primarily through inhalation and on increased skin cancer incidence in populations consuming drinking water with high arsenic concentrations. There has not been consistent demonstration of arsenic carcinogenicity in test animals for various forms administered by different routes in several species. Potential carcinogenicity has been supported by studies in which sodium arsenite has been shown to transform Syrian hamster embryo cells. Arsenic has not been shown to be mutagenic to bacteria. For inhalation exposure the slope factor is 5E+1(mg/kg-d)⁻¹. The Maximum Contaminant Level (MCL) for drinking water is 0.05 mg/L. Recommended water quality criteria for water and fish consumption is 2.2E-3 µg/L. Arsenic has the ability to bioaccumulate in tissues of aquatic and marine organisms and can potentially concentrate in the food chain.

BENZENE

Benzene is a clear, colorless, naturally occurring liquid. Industry utilizes this compound in the production of other chemicals such as detergents and pesticides, and it is a component of gasoline. The most likely route of human exposure to benzene is through inhalation. Acute dose related effects can range from dizziness, headache, nausea and tightness of chest, to more severe effects such as tremors, ventricular irregularities, paralysis, unconsciousness and possible death. The effects of a chronic inhalation exposure to benzene can effect the central nervous system and gastrointestinal tract. Although the major health concern of benzene exposure is its cancer causing effect. Human and animal studies indicate that benzene causes leukemia; a cancer of the tissues that form white blood cells. Human and animal studies also indicate the possibility of genotoxicity. Based on positive human and animal data, the EPA has classified Benzene as a known carcinogen, Group A, and given it a slope factor of 2.9E-2 (mg/kg-d)⁻¹. The American Conference of Governmental Industrial Hygienists (ACGIH) recommends a workplace Threshold Limit Value-Time Weighted Average (TLV-TWA) of 10 ppm.

BERYLLIUM

Beryllium is a naturally occurring, grayish-white, hard-light, odorless metal. Beryllium is used in the production of missile parts, aerospace guidance systems, x-ray windows and in the production of brass. Beryllium enters the environment largely as a result of coal combustion. Beryllium alloy manufacturers, ceramic plants and beryllium extraction plants are the major industrial processes which release beryllium into the environment.

The major health effects observed with beryllium exposure are seen in the lungs. The most common effect is shortness of breath. Acute, high-dose short-duration, inhalation exposures can result in a range of other symptoms that may include coughing, fever, eye/nose/throat irritation, nasal discharge, cyanosis, acute pneumonitis, chest pain, bronchial spasm and possible heart failure. Chronic, long term, exposure to beryllium can lead to heart enlargement, congestive heart failure and enlarged liver and spleen. A restrictive lung disease can occur known as berylliosis, or chronic granulomatous pulmonary disease; the first symptom is usually shortness of breath. Skin contact with beryllium, or compound containing beryllium, can cause a dermatitis which may appear ulcerative. In some cases this dermatitis reaction can result in a hypersensitivity to beryllium containing compounds. Acute skin contact to high concentrations of beryllium may result in first and/or second degree burns. Beryllium is classified by the EPA as a B2, probable human carcinogen. This classification is based on sufficient carcinogenicity evidence in animals, though limited evidence in humans. The greatest potential for human exposure to a high dose of beryllium occurs in an occupational setting; individuals working in plants using beryllium. The evidence of excess cancer incidence among this occupational population is conflicting. Occupational standards have been established with regard to beryllium exposure. The Occupational Safety and Health Administration (OSHA) will permit 2 micrograms of beryllium per cubic meter of air in an 8-hour per day, 40-hour work week. The National Institute for Occupational Safety and Health (NIOSH) recommends 0.5 micrograms of beryllium per cubic meter of air in a 10-hour per day, 40-hour work week.

CADMIUM

Cadmium exists in nature in small quantities with no known nutritive value. It is a general cytotoxic agent and a potent inhibitor of some enzyme systems. Mineral loss from bone and renal damage result from chronic cadmium poisoning. Excretion occurs in narrow limits and every increase in intake results in increased accumulation. The oral RfD for water is 0.0005 mg Cd/kg/day. The RfD's are based on the highest level of cadmium in the renal cortex not associated with significant proteinuria. No RfDs for inhalation have been established. Cadmium has been classified as a B1 probable human carcinogen through inhalation. This is based on several studies of workers exposed to cadmium. Rats exposed to cadmium chloride developed lung tumors and cadmium oxide produced tumors at multiple sites. Mutagenicity tests in bacteria and yeast have been inconclusive. Mutation assays in hamster cells, mouse

lymphoma cells and chicken embryos have been positive. Insufficient data exist to classify cadmium as carcinogenic to humans by the oral route. The inhalation slope factor is 6.3 E+0/mg/kg/day for air concentrations not exceeding 6 $\mu\text{g}/\text{m}^3$.

CARBON MONOXIDE

Carbon monoxide is a colorless and odorless gas. It is not considered to be an irritant. Inhaled carbon monoxide is rapidly absorbed by the lungs and binds with hemoglobin reducing the blood's oxygen carrying capacity. The magnitude of the health effect is dependent upon the dose and overall condition of the individual. Human effects of carbon monoxide exposure are: headaches, nausea, vomiting, vertigo, muscular collapse, coma, and death. A healthy individual will compensate at low level exposure by increasing cardiac output; however, for individuals with already impaired cardiac function low levels could be detrimental. Once removed from an acute exposure, carbon monoxide can be eliminated from the lungs and the blood's oxygen carrying capacity will revert to normal. The NIOSH recommends a carbon monoxide time-weighted average (TWA) of 35 ppm, with a 200 ppm ceiling. The ACGIH recommends a carbon monoxide TWA of 50 ppm; this level should not result in blood carbon monoxide levels above 10 percent. They have also recommended a short-term exposure limit (STEL) of 400 ppm.

CHROMIUM

The toxicity of chromium varies with the valence state of the compound. Toxic hematological effects were observed in animal studies using Cr⁺³. In bacterial systems Cr⁺⁶ but not Cr⁺³ is mutagenic. Cr⁺³ is not a carcinogen and there is a lack of data on orally administered Cr⁺⁶ which precludes an assessment of carcinogenic risk. The MCL for total chromium in drinking water is set at 0.050 mg/L by the EPA. The EPA has classified Cr⁺⁶ as class A, human carcinogen, by the inhalation route with a slope factor of 4.2E+1 (mg/kg-d)⁻¹. This slope factor is based on a number of epidemiological studies in chromate facilities. The EPA has also given Cr⁺⁶ an oral RfD of 5E-3 mg/kg-d (chronic) and 2E-2 mg/kg-d (subchronic).

HYDROGEN SULFIDE

Hydrogen sulfide is a colorless, flammable gas with an odor of "rotten eggs." Odor detection is an inefficient warning for the presence of hydrogen sulfide. Human health data indicates that hydrogen sulfide causes adverse effects on the respiratory system. Low air concentrations (SO-500 ppm) of hydrogen sulfide act primarily as a respiratory irritant. While high levels (500-100 ppm) create systemic poisoning causing unconsciousness and death, through respiratory paralysis. Studies of chronic hydrogen sulfide exposures exceeding 250 ppm lead to pulmonary edema and bronchial pneumonia. Eye irritation occurs

at levels of 20 ppm or less. Short-term (few hours), low Level exposures produce symptoms such as h&aches, insomnia, nervousness, and nausea. Hydrogen sulfide has not been evaluated by the EPA with regard to carcinogenicity. The NIOSH recommends a 10 minute ceiling for hydrogen sulfide at 10 ppm. This is based on reports of low hydrogen sulfide levels displaying signs and symptoms which are suggestive of brain damage. They have also determined a level of 300 ppm to be immediately dangerous to life-lethal. The ACGIH recommends a TWA of 10 ppm and a STEL of 15 ppm with regard to hydrogen sulfide concentrations.

LEAD

The absorption of lead from the gastrointestinal tract is dependant on a number of factors including age and nutritional state. Adults absorb between 5-15 percent of an ingested dose and retain less than 5 percent of the absorbed dose. Children may absorb and retain as much as 42 percent of an ingested dose. Absorption of inhaled lead is relatively complete. Target organs for the toxic actions of lead include the central nervous system, blood forming tissues, the gastrointestinal system and the reproductive system. Of these, the CNS effects are the most important blood lead concentrations have been used as an indicator of exposure and a number of toxic endpoints have been correlated with blood lead levels. Children appear to be particularly susceptible to the neurotoxic effects of lead. A number of the neurobehavioral development endpoints occur at such low blood lead levels that there may not be a threshold for these effects. Several of the soluble lead salts have been shown to produce renal tumors in rodent bioassays. Epidemiological evidence from human occupational exposures was inadequate to demonstrate a clear association between lead exposures and cancer. Based on these data, the EPA has classified lead as a B2 carcinogen. Because of the uncertainties associated with the lead carcinogen risk assessment, the EPA recommended that numerical estimates of risk from lead exposure be avoided. The EPA is currently developing guidelines for performing environmental risk assessments involving lead. As an interim measure, they are suggesting the use of a Centers for Disease Control (CDC) document which recommended that soil lead levels between 500-1,000 ppm were safe levels, protective of the neurological effects in children. This value only addresses exposures from soil ingestion; probably the most important pathway when dealing with contaminated soil. In terms of air lead, the EPA promulgated a National Ambient Air Quality Standard (NAAQS) of 1.5 $\mu\text{g}/\text{m}^3$. This level is also undergoing extensive review. In the absence of toxicity values, the CDC recommendations concerning soil lead concentrations and the NAAQS primary air standard will be used to partially quantify health risks in the current evaluation.

MERCURY

Inorganic mercury **salts** are poorly absorbed from the **gastro-intestinal** tract. The kidneys show the highest concentration of mercury following exposure to inorganic salts and mercury vapor. In **contrast**, the CNS is the **primary** target organ for organic mercury **compounds**. **Chronic occupational exposures** to mercury **compounds** have **been** associated with **mental disturbances, tremors, and gingivitis**. The **EPA established a 1-hour RfD of 3E-4** for methyl mercury. This value was based on several human studies and includes an uncertainty factor of 10. Mercury was classified by the EPA as category D, not classifiable as to human carcinogenicity. The OSHA has recommended a **workplace exposure** level of 0.1 mg/m^3 for both **aryl** and **inorganic** mercury **compounds**, and an &hour **TWA** of 0.01 mg/m^3 for **alkyl** mercury **compounds**.

NITROGEN DIOXIDE

Nitrogen dioxide is a reddish-brown gas which is produced as an intermediate in the formation of nitric acid. Nitrogen dioxide is a deep lung irritant which, if in sufficient concentration, can produce pulmonary edema.

Reports of human workers **exposed** to nitrogen dioxide for short durations have not displayed adverse effects at 25-38 ppm (parts per million). At an air concentration of 80 ppm tightness of the chest occurred within 3-5 minutes. Another study of workers reported no adverse effects after working for several years at nitrogen dioxide exposure concentrations of 30-35 ppm. Nitrogen dioxide **exposures** of 10-20 ppm can cause irritation to eyes, nose, and upper respiratory tract. An air concentration at 5 ppm of nitrogen dioxide has a distinct odor, though most individuals can detect it at 0.22 ppm. Animal studies suggest that long or short-term nitrogen dioxide exposures can increase susceptibility to respiratory infection from bacterial pneumonia or **influenza** virus. Nitrogen dioxide atmosphere levels of greater than 0.25 ppm can threaten all plant species. Nitrogen dioxide in water forms nitric acid. Nitrates can persist for a long period of time in natural waters. The potential result is a change in water ph and subsequent adverse effects on aquatic **species**. Nitrogen dioxide has not been evaluated for **carcinogenicity** by the **EPA**. The NIOSH has determined nitrogen dioxide to be dangerous to life and health at 100 ppm and lethal at 200 ppm. The NIOSH recommends a 1 ppm ceiling value. The ACGIH recommends a TWA of 3 ppm and a STEL of 5 ppm.

SULFUR DIOXIDE

The result of burning fossil fuels and smelting of **metals** leads to the production of sulfur dioxide and various **particulates**. It is the metal **enriched particles** which promote the conversion of sulfur dioxide to sulfuric acid. Sulfur dioxide is the source of sulfate **aerosols** which can be transported long **distances in** the atmosphere. Aerosols such as sulfuric acid,

ammonium sulfate, and ammonium bisulfate pose a **direct** health **hazard** and contribute to the production of acid **rain**. Animal studies of chronic exposure to sulfur dioxide indicate a condition which **pathologically** resembles chronic bronchitis. Exposure **produces** a **thickening** of the mucous layer of the trachea with **hypertrophy** of goblet **cells** and mucous glands. The **magnitude of the response is dose related**.

Human studies indicate that inhaled sulfur dioxide is removed by the upper respiratory tract. Therefore most adverse effects occur in this area. Some of the effects are: dry throat and nose, sneezing, coughing, thoracic pain, burning sensation of the esophagus and stomach, and nausea. Inhaled sulfur dioxide which enters the deep lung is readily absorbed and distributed throughout the body. These studies have shown that lung penetration of sulfur dioxide is greater during mouth breathing as opposed to nose breathing. Sulfur dioxide uptake is also increased during exercise.

Brief human exposure periods have **demonstrated** respiratory **airflow resistance** in a majority of the subjects exposed to sulfur dioxide at air concentrations of 5 ppm or higher and 1 ppm for the more sensitive individual such as an asthmatic. Exposure levels of 1-3 ppm of sulfur dioxide induces airflow resistance in individuals engaged in exercise. No noticeable airflow resistance was observed in individuals exposed to sulfur dioxide at air concentrations of 0.5 ppm.

The following are some general sensations with regard to air concentrations:

- | | |
|-----------------|---|
| a . 0.47 ppm | Recognition of pungent atmospheric odor. |
| b . 6-10 ppm | Immediate nose and throat irritation. |
| c . 10-20 ppm | e y e - |
| d . 400-500 ppm | Immediately dangerous to life. |
| e . 1000 ppm | Death (suffocation, pulmonary edema, or systemic acidosis.) |

There is no evidence to support that sulfur dioxide alone is a carcinogen.

Wet and **dry deposition** will remove atmospheric sulfur dioxide.
Sulfur dioxide polluted waters will undergo a slow oxidation of sulfurous--> sulfuric acid;
natural alkalinity will neutralize slowly over time.

The NIOSH has **established** a **sulfur dioxide TWA** of 0.5 **ppm based on a 10-hour/day, 40-hour/week**. The NIOSH has **also determined** sulfur dioxide to be immediately **dangerous to life or health** at 100 ppm. The ACGIH has established a **sulfur dioxide TWA** of 2 ppm and a **STEL** of 5 ppm.

TOLUENE

Toluene is a clear, colorless **naturally** occurring compound. It is found in crude oil. **Toluene** is produced **from petroleum refining** and as a byproduct in the production of styrenes and coke oven **manufacturing**. Industry uses it in refining gasoline and in the **manufacturing** of paints, lacquers and **adhesives**. Human exposure to toluene is likely to occur via **inhalation** from many **sources** such as automobile exhaust, solvents, gasoline, **paints** and cigarette smoke.

Acute exposure effects to **toluene generally** target the **central nervous** system. **Acute** effects may range from **fatigue**, confusion, memory loss, **nausea** to **dizziness, unconsciousness** and **death**. Though if the **exposure** to **toluene ceases**, before **death occurs**, the symptoms will also **cease**. **Low** dose chronic exposure to toluene has **displayed questionable** mild effects on the kidneys. **Studies** in individuals who intentionally exposed **themselves** to high doses of toluene (**intended** abuse), over a **period** of time, have displayed **permanent brain damage**; effects on speech, vision, **hearing**, muscle **control** and memory. Animal **studies** do not indicate toluene to **be** a **carcinogen**.

The **ACGIH** has **established** a **TLV-TWA** of 100 ppm for toluene.

ZINC

Zinc is an essential trace element involved in enzyme functions, protein synthesis, and metabolism of carbohydrates. Zinc, when ingested in large amounts, can cause fever, vomiting, and stomach cramps. Metal fume fever can occur with high concentration exposures to zinc oxide fumes. Respiratory and gastrointestinal tracts may be irritated by inhalation of zinc chloride fumes/mist. Skin and eye irritation may also be associated with zinc chloride exposure. Animal studies have shown growth retardation, hypochromic anemia, and defective bone mineralization with a dietary zinc level of greater than 0.25 percent. Toxicity was not observed at dietary levels below 0.25 percent. Zinc oxide fumes are given a TWA of 5 mg/m³ and a STEL of 10 mg/m³. The EPA has established chronic and subchronic oral reference dose values of 3E-1 mg/kg-d.

ALUMINUM

Aluminum metal dusts have been shown to exhibit very little potential for causing adverse health effects. Other forms of Al are toxic at high concentrations. Bauxite fumes can produce pulmonary fibrosis, and there is information implicating Al in some neurological disorders. The EPA has not developed toxicity values for use in quantitative risk assessment; it is not thought to pose a carcinogenic hazard. The ACGIH TLV values for Al compounds range from, 2 mg/m³ for soluble salts and alkyls of Al to 10 mg/m³ for Al dust and Al oxide.

CALCIUM

Calcium is an essential nutrient required by the body for proper growth and development. **Calcium cyanide** is the only Ca compound for which an RfD has been developed. A 2-year rodent feeding study using this compound indicated thyroid effects and myelin degeneration; the oral RfD value recommended by the EPA is 4E-2 mg/kg-day.

IRON

Iron is also an essential nutrient. However, toxic effects have occurred following accidental overdoses; toxic actions include both liver and renal effects. Chronic iron toxicity is manifest by alterations in liver function, diabetes, endocrine disturbances and cardiovascular effects (reference 1). The EPA has not developed toxicity values appropriate for use in risk assessment; however, the ACGIH recommends an 8-hour TLV of 1 mg/m³ for the workplace (reference 2).

MAGNESIUM

Magnesium is another essential element and is required for proper neuromuscular function. Several magnesium compounds including the citrate, oxide, hydroxide, sulfite and carbonate are used widely in antacid formulations (reference 1). High concentrations of magnesium oxide can produce metal fume fever. There are no toxicity values for use in risk assessment; however, the ACGIH TLV is 10 mg/m³ for magnesium oxide (reference 2).

NICKEL

Nickel is also an essential element and deficiencies have been shown to cause decreased growth and anemia. Occupational exposures to nickel have been associated with lung and nasal cancer (reference 1). The EPA has developed an inhalation slope factor of 8.4E-1 (mg/kg-day)⁻¹ (reference 3). It does not appear to be a carcinogen by the oral route and the EPA has developed an oral RfD of 2E-2 mg/kg-day (reference 3).

VANADIUM

Vanadium is a by product of petroleum refining. It is also found in a variety of food products including milk, cereal and vegetables. Vanadium dust is a skin and eye irritant and workplace exposures have been linked to a number of systemic effects (reference 1). The EPA has developed an oral RfD of 7E-3 mg/kg-day (reference 3).

ETHYLBENZENE

Ethylbenzene is a fairly volatile liquid which is soluble in organic solvents. Toxicity data from animals **indicate** the liver, kidney and central nervous system as target organs; however, the **reproductive** system **appears** to be most sensitive. **Ethylbenzene** has a chronic oral **RfD** of **1E-1 mg/kg-day** and an **inhalation RfC** of **2.86E-1** (reference 3).

HEPTANE

Heptane is a volatile, flammable liquid; it is **insoluble** in water but dissolves in non-polar organic solvents. The primary toxic **effect** of high **airborne** concentrations is **CNS depression**. Chronic exposures have also been **associated** with neural effects (reference 1). The **EPA has not established toxicity values for use in quantitative risk assessment**; however, the **ACGIH TLV** is **1640 mg/m³** (reference 2).

XYLENE

Xylene can exist in one of three isomeric states and most environmental contamination includes a mixture of the three (**ortho**, **meta** and **para**) isomers. High concentrations of xylene cause CNS **depression**. Chronic **toxicity** also **produces** CNS **effects as** well as **decreased growth** in **experimental animals** (reference 1). The EPA recommends an oral **RfD** of **2E+0 mg/kg-day** and an inhalation **RfC** of **2E-1 mg/m³** (reference 3).

POLYNUCLEAR AROMATIC HYDROCARBONS (PAH's)

The **PAH's** may be formed when any organic matter is burned. These compounds may combine with dust particles in the **air** and **be carried into** water and soil. Soot, tar, tobacco smoke and petroleum products typically contain **mixtures** of many different **PAH's**. These compounds were isolated from coal tar and **identified** as the **carcinogenic** component of this substance. This **finding lead to a great deal of experimental** work to investigate the structure activity relationships among **this** class of **chemicals**. Based on **these studies**, the following **PAH's** were found to exhibit some degree of **carcinogenic** potential: **benzo-(a)-pyrene**, **chrysene**, **benzo-(b)-fluoranthene**, **benzo-(k)-fluoranthene**, **benzo-a-anthracene**, **indeno(1,2,3)cd-pyrene**, **dibenzo-(a,h)-anthracene** and **benzo-(g,h,i)perylene**. Carcinogenic slope factors have been derived for **benzo-a-pyrene**: **7.3E+0 (mg/kg-day)⁻¹** (oral) and **6.1 (mg/kg-day)⁻¹ (inhalation)**; none of the **remaining** carcinogenic **PAH's** have slope factors (reference 3). A number of **PAH's** are considered to be **noncarcinogens**; **these** include **naphthalene**, **fluorene**, **phenanthrene**, **acenaphthylene**, **acenaphthene**, **anthracene**, **fluoranthene** and **pyrene**. Toxic actions of these **chemicals include** effects on the liver, kidneys and blood. Oral **RfD** values range from **3E-1** to **4E-2** (reference 3).

REF~~T~~ ~~E~~NCE~~S~~

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2. American Conference of Government Industrial Hygienists (ACGIH), 1990-1991, Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices, ACGIH, Cincinnati Ohio (Source for TLV values).
- 3 . Department of Labor, 29 CFR Part 1910, Air C_____ , Final Rule (Source for OSHA PEL values).
4. Health Effects Assessment Summary Tables (HEAST), Environmental Protection Agency, NTIS No. PB91-921199, March 1993 and July 1993 Supplement (Source for Reference doses and carcinogen Slope Factors).

III. ADDITIONAL PAH INFORMATION.

Pure polycyclic aromatic hydrocarbons (PAH's) are colorless, white or pale yellow-green solid compounds. These compounds are typically found as a mixture. PAH's are formed from the incomplete burning of organic matter. These compounds may combine, with dust particles in the air and be carried to water and soil. Soot, tar, tobacco smoke, vehicle exhaust, petroleum products, even char-grilled foods contain mixtures of different PAH's (reference 1). There are no known uses for most PAH's, however anthracene and naphthalene are used by industry in the manufacture of plastics, dyes, moth repellents and air fresheners (reference 2).

Exposure to PAH's may occur through inhalation, dermal contact and/or ingestion. The largest amount of exposure occurs in the occupational setting. PAH's are readily absorbed by the body and stored in the liver, kidney and fat. However, they are usually excreted within a few days (reference 1).

Acute exposure to high concentrations of PAH's has reportedly caused skin and eye irritation (reference 2).

Experimental investigations of chronic PAH exposure has revealed varying degrees of carcinogenic potential of the following compounds: benzo(a)pyrene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)anthracene, indeno(1,2,3)cd-pyrene, dibenzo-(a,h)-anthracene and benzo(g,h,i)perylene. These compounds have displayed cancer in animals and have suggested carcinogenic potential in humans exposed by the inhalation and dermal routes. The EPA has developed slope factors for benzo(a)pyrene: 7.3E+0 (mg/kg-d)-1 oral and 6.1 (mg/kg-d)-1 inhalation (reference 3).

The following compounds are considered to be noncarcinogenic: naphthalene, fluorene, phenanthrene, acenaphthylene, acenaphthene, anthracene, fluoranthene and pyrene. Toxic actions of these chemicals include liver, kidney and blood effects. Oral RfD (reference dose) values range from 3E-1 to 4E-2 (mg/kg-d) (reference 3). Humans in occupationally related exposures to high doses of naphthalene have complained of headache, nausea and vomiting. While accidental ingestion of naphthalene produced hemolytic anemia. Contact dermatitis has also been reported (reference 2).

The following paragraphs will individually address some of the above mentioned PAH compounds (data is limited):

A. ACENAPHTHALENE

Currently, the EPA has determined acenaphthylene a class D, not classifiable, carcinogen. This classification is based on the absence of human data and inadequate animal data. Presently, an oral RfD (reference dose) is pending review by the EPA (reference 4).

B. BENZO(a)ANTHRACENE

The EPA has classified benzo(a)anthracene as a B2, probable human carcinogen. This classification is based on the absence of human data but sufficient evidence of carcinogenicity in animals. Studies in mice have revealed lung and liver tumors following intraperitoneal, intramuscular or subcutaneous injection and dermal exposure of this compound. Though there is no direct evidence of benzo(a)anthracene causing cancer in humans it is suggested, as this compound is contained in PAH mixtures which have displayed human carcinogenesis (such as soot, coal tar and cigarette smoke). Positive mutagenicity studies have been reported in bacteria and [REDACTED] cells for this PAH compound. Currently, there is no available data regarding a RfD for benzo(a)anthracene (reference 4).

C. BENZO(b)FLUORANTHENE

The EPA has classified benzo(b)fluoranthene as a B2, probable human carcinogen. This classification is based on the absence of human data but sufficient evidence of carcinogenicity in animals. Studies in mice have revealed tumors following lung implantation, intraperitoneal or subcutaneous injection and dermal exposure of this compound. Though there is no direct evidence of benzo(b)fluoranthene causing cancer in humans it is suggested, as this compound is contained in PAH mixtures which have displayed human carcinogenesis (such as soot, coal tar and cigarette smoke). Positive [REDACTED]icity studies have been reported. Currently, there is no available data regarding a RfD for benzo(b)fluoranthene (reference 4).

D. BENZO(k)FLUORANTHENE

The EPA has classified benzo(k)fluoranthene as a B2, probable human carcinogen. This classification is based on the absence of human data but sufficient evidence of carcinogenicity in animals. Animal studies have revealed tumors following lung implantation and dermal exposure of this compound. Though there is no direct evidence of benzo(b)fluoranthene causing cancer in humans it is suggested, as this compound is contained in PAH mixtures which have display& human carcinogenesis (such as soot, coal tar and cigarette smoke). Positive mutagenicity studies have been reported in bacteria. Currently, there is no available data regarding a RfD for benzo(k)fluoranthene (reference 4).

E. BENZO(g,h,i)PERYLENE

The EPA has determined benzo(g,h,i)perylene to be a class D carcinogen; not classifiable with regard to carcinogenicity. This classification is based on the absence of human data and inadequate animal data. Benzo(g,h,i)perylene has produced positive mutagenicity studies as well as showing compound related DNA damage in hams&r ovarian cells. There is no available data regarding a RfD for benzo(g,h,i)perylene (reference 4).

F. BENZO(e)PYRENE

Research is currently underway to determine if there is an association between benzo(e)pyrene and tumor production in rat conjunctiva. Presently, animal studies have not produced adequate evidence of carcinogenicity from benzo(e)pyrene exposure. There is no human data reporting effects of this compound. On the basis of this extremely limited data, the International Agency of Research on Cancer (IARC) has determined benzo(e)pyrene as not yet classifiable with regard to carcinogenicity. Presently, the EPA has not developed toxicity value for benzo(e)pyrene (reference 5).

G. CHRYSENE

The EPA has determined chrysene to be a B2, probable human carcinogen. This classification was based on an absence of human data but with evidence of skin cancer and liver and lung tumors in mice exposed to chrysene. Though there is no direct evidence of chrysene causing cancer in humans it is suggested, as this compound is contained in PAH mixtures which have displayed human carcinogenesis (such as soot, coal tar and cigarette smoke). Studies have shown that chrysene has induced mutagenic response in bacteria and chromosomal abnormalities in rodent cells. Currently, the EPA has not developed toxicity values for chrysene (reference 4).

H. FLUORANTHENE

The EPA has determined an oral RfD of 4E-2 (mg/kg-d) with regard to the noncarcinogenic effects of fluoranthene. This RfD is based on the potential of fluoranthene to adversely effect the kidneys, hematological and clinical findings and increase liver weights in mice. The uncertainty factor associated with this RfD is 3,000. Inhalation studies are not available in the literature. The EPA has classified fluoranthene as a class D, not classifiable, carcinogen. This classification is based on the absence of human data and inadequate animal data. Mutagenicity studies on fluoranthene are uncertain (reference 4).

I* FLUORENE

The EPA has determined an oral RfD of 4E-2 (mg/kg-d) with regard to the noncarcinogenic effects of fluorene. This RfD is based on a decrease in red blood cells of exposed mice. The uncertainty factor associated with this RfD is 3000. The EPA has also determined fluorene to be a class D, not classifiable, carcinogen. This classification is based on an absence of human data and inadequate animal data. Positive mutagenicity studies have been reported on fluorene (reference 4).

J. PHENANTHRENE

The EPA has also determined phenanthrene to be a class D, not classifiable, carcinogen. This classification is based on an absence of human data and inadequate animal data. Presently there is no available data with regard to phenanthrene RfD (reference 4).

K. PYRENE

Pyrene is a colorless, solid PAH which is currently undergoing research. Pyrene can be absorbed through the skin and is considered to be a skin irritant. One study has suggested possible teratogenic effects of exposed workers. The EPA has established an oral RfD for pyrene of 3E-2 (mg/kg-d) based on adverse kidney effects in mice. An uncertainty factor of 3000 is associated with this RfD. The EPA has also determined pyrene to be a class D, not classifiable, carcinogen. This classification is based on an absence of human data and inadequate animal data. Results from mutagenicity studies are equivocal (reference 4).

The following paragraphs will address additional PAH's revealed through sampling efforts:

A. BIPHENYL

The EPA has established an oral biphenyl RfD of 5E-2 (mg/kg-d). This RfD is based on adverse kidney effects seen in rats. An ~~uncertainty~~ factor of 100 is associated with this RfD. Current inhalation data is inadequate to determine a RfC (reference concentration). The EPA has also determined biphenyl to be a class D, not classifiable, carcinogen. This classification is based on an absence of human data and inadequate rodent data. Current available test data indicates that biphenyl is not genotoxic or mutagenic (reference 4). The ACGIH recommends a time-weighted average threshold limit value of 0.2 ppm for biphenyl (reference 6).

B. CARBAZOLE

Carbazole is a white crystalline compound which is used commercially as a dye intermediate and in the manufacture of photographic plates. It is also used in the production of some explosives.

Toxicity data is extremely limited on carbazole. A rat study has reported an oral LD₅₀ (lethal dose killing 50 percent of test animals) greater than 5,000 mg/kg of carbazole. According to IARC, carbazole is not yet classifiable as to carcinogenic potential due to the absence of human data and limited evidence in animal studies. Presently the EPA has not developed toxicity values for carbazole (f&fence 5).

C. 1,6-DIMETHYLNAPHTHALENE

1,6-Dimethylnaphthalene is a **methylated** form of **naphthalene**. This component of crude oil is used in the **manufacture** of polyester resins, dyes, pigments, **pharmaceuticals** and insecticides. Environmental **contamination of this PAH also occurs from forest fires**, volcanic activities, municipal waste incinerators, petroleum **refining** and tobacco smoke (reference 5).

Human exposure to 1,6-dimethylnaphthalene **may occur through dermal contact and/or the inhalation route.** The only reported effects from exposure to methylated forms of naphthalene **are** skin **irritation** and photo **sensitization**. Mutagenicity studies conducted on this PAH have reported negative results. The **odor** threshold for 1,6-dimethylnaphthalene is 0.428 **mg/m³** (reference 5).

1,6-Dimethylnaphthalene has the potential to be a persistent contaminant in the aquatic environment. This PAH is **resistant** to hydrolysis therefore bioaccumulating in aquatic systems. However 1,6-dimethylnaphthalene will undergo **photolytic degradation** (reference 5).

Presently, the EPA has not developed toxicity values for 1,6-dimethylnaphthalene.

D. 1-METHYLNAPHTHALENE

1-Methylnaphthalene is a colorless liquid used by industry in the manufacture of resins, dyes, pigments, **pharmaceuticals** and **insecticides** (reference 5).

Human exposure may occur via **inhalation, ingestion** and/or **dermal** routes. The only reported effects of human exposure to methylated naphthalene **are** skin irritation and photosensitization. The odor threshold of 1-methylnaphthalene is 0.02 ppm. Reports of eye irritation have been noted at ambient air concentrations of 15 ppm 1-methylnaphthalene. The NIOSH reports the minimum lethal dose of 1-methylnaphthalene is 50 mg/kg for humans. Measurement of urinary metabolites, 1-naphthol or mercapturic acid, may be an indication of 1-methylnaphthalene exposure (reference 5).

The following adverse health effects have been reported in cases of naphthalene exposure. Though most of these effects have not been reported in methylnaphthalene exposures, they are noted in the literature due to structural similarity to the parent compound. These effects include: flushing, **headaches**, restlessness, fever, **nausea**, anorexia, **diarrhea**, skin **irritation**, corneal damage, **respiratory irritation**, **hemolytic anemia**, **oliguria**, liver damage, convulsions and coma (reference 5).

Current data does not show genotoxic effects resulting from 1-methylnaphthalene exposure (reference 5).

Environmental contamination of **1-methylnaphthalene** is expected to undergo photolytic degradation. **Bioconcentration** of **1-methyl-naphthalene** in aquatic systems is not anticipated (reference 5).

Presently, the EPA has not **developed** toxicity values for **1-methylnaphthalene**.

E. **2-METHYLNAPHTHALENE**

2-Methylnaphthalene is a solid crystalline compound used by industry in the manufacture of dyes, resins, pigments, pharmaceuticals and insecticides. Pure **2-methylnaphthalene** is used in vitamin K production.

Human exposure may occur via inhalation, ingestion and/or dermal routes. The only reported effects of human exposure to methylated naphthalene are skin irritation and phototoxication. The odor threshold of **2-methylnaphthalene** is 0.02-0.05 ppm. Reports of eye irritation have been noted at ambient air concentrations of 15 ppm **2-methylnaphthalene**. The NIOSH reports the minimum lethal dose of **2-methylnaphthalene** is 50 mg/kg for humans.

Adverse health effects have been reported in cases of naphthalene exposure. Though most of these effects have not been reported in methylnaphthalene exposures, they are noted in the literature due to structural similarity to the parent compound. These effects include: flushing, headaches, restlessness, fever, nausea, anorexia, diarrhea, skin irritation, corneal damage, respiratory irritation, hemolytic anemia, oliguria, liver damage, convulsions and coma (reference 5).

2-Methylnaphthalene has shown negative **mutagenicity** results (reference 5). Presently, the EPA has not developed **toxicity** values for **2-methylnaphthalene**.

REFERENCES

1. **Toxicological Profile for Polycyclic Aromatic Hydrocarbons.** Agency for Toxic Substances and Disease Registry U.S. Public Health Service.
2. **LaDou, Joseph; Occupational Medicine.** Appleton and Lange, East Norwalk, Connecticut, 1990.
3. **EPA, 1984. Health Effects Assessment. Final Draft. Environmental Criteria and Assessment Office,** Cincinnati, Ohio. **September 1984.**
4. **IRIS, EPA Integrated Risk Information System, On line.**

5. HSDB, **Hazardous** Substance Data Base, On line.

6. **ACGIH**, American Conference of Governmental Industrial Hygienists 1990-91 Threshold Limit values.

IV. ADDITIONAL TOXICITY PROFILES.

DIBENZOFURAN

There are several isomers of **polychlorinated dibenzofurans**. Yet the major isomer of concern is **2,3,7,8-tetrachloro-dibenzofuran (TCDBF)**. TCBDF is inadvertently produced as an impurity in technical grades of commercial pentachlorophenol and PCB mixtures.

Human data with regard to TCDBF is very limited. It has been suggested the TCBDF may be immunotoxic. Though this determination was made on the basis of structural similarities with a dioxin isomer.

Animal studies have noted offspring **malformations resulting** from TCBDF exposure; there is **no evidence of this in humans**.

TCBDF released into the atmosphere in a gas phase will react photochemically at an estimated half-life of 7 days. There are no estimates of degradation rates of the particulate phase. The particulate phase can be removed from the atmosphere by wet and dry deposition. A release of TCBDF to water will result in partitioning to sediment and a release to soil will result in strong adsorption.

There are no current federal regulations regarding TCDBF air standards.

REFERENCE

Hazardous Substance Data Base (**HSDB**), On-line data base.

HEALTH EFFECTS OF INHALED PARTICULATES

A. Definition of Particulates.

"Particulate matter" is the generic term for a broad class of chemically and physically diverse substances that exist as discrete particles (liquid droplets or solids) over a wide range of sizes. Particles originate from a variety of stationary and mobile sources. They may be emitted directly or formed in the atmosphere by transformation of gaseous emissions such as sulfur oxides, nitrogen oxides, and volatile organic substances. The chemical and physical properties of particulate matter vary greatly with time, region, meteorology and source category, thus complicating the assessment of health and welfare effects.

B. Indicator for the Use of PM₁₀ as the Size-Specific

1. In 1971, EPA promulgated primary and secondary national ambient air quality standards for particulate matter, measured as "total suspended particulate matter" or TSP. The primary standards were set at $260 \mu\text{g}/\text{m}^3$, 24-hour average not to be exceeded more than once per year, and $75 \mu\text{g}/\text{m}^3$, annual geometric mean. The secondary standard, also measured as TSP, was set at $150 \mu\text{g}/\text{m}^3$, 24-hour average not to be exceeded more than once per year. The 1 July 1987 Final Rule, Revisions to the National Ambient Air Quality Standards for Particulate Matter, replaced TSP as the indicator for particulate matter for the ambient standards with a new indicator that included only those particles with an aerodynamic diameter less than or equal to a nominal 10 micrometers (PM₁₀). The 24-hour primary TSP standard was replaced with a 24-hour PM₁₀ standard of $150 \mu\text{g}/\text{m}^3$ with no more than one expected exceedance per year, and the annual primary TSP standard was replaced by a PM₁₀ standard of $50 \mu\text{g}/\text{m}^3$ expected annual arithmetic mean. The secondary standards for PM₁₀ are identical in all respects to the primary standards.

2. Health risks posed by inhaled particles are influenced by the penetration and deposition of particles in the various regions of the respiratory tract, and by the biological responses to these deposited materials. Smaller particles penetrate furthest in the respiratory tract. The largest particles are deposited in the extrathoracic (head) region with somewhat smaller particles depositing in the tracheobronchial region. Still smaller particles can reach the deepest portion of the lung, the alveolar region. The risks of adverse health effects associated with deposition of typical ambient fine and coarse particles in the thorax (tracheobronchial and alveolar regions of the respiratory tract) are markedly greater than those associated with depositions in the extrathoracic (head) region. Maximum particle penetration to the thoracic region occurs during oronasal or mouth breathing. The size-specific indicator for the primary standard was chosen to represent those particles small enough to penetrate to the thoracic region (both the tracheobronchial and alveolar regions.) The risks of adverse health effects from extrathoracic deposition of typical ambient particulate matter are sufficiently low that particles depositing only in that region can safely be excluded from the indicator.

C. pollutant Responsible for Health Effects.

1. Although **PM₁₀** was chosen by the **EPA** as the **indicator** for monitoring, the **precise measure** of the pollutant **responsible** for **health effects**-total **suspended** particles, **PM₁₀**, fine particles, **sulfates**, acid aerosols, sulfur dioxide, or some as yet **unmeasured** pollutant is **unclear based on current available evidence**. Studies which have associated health effects in humans to some measure of particulates have varied in the indicator measured depending on the country of origin, and particularly prior to the 1987 EPA standard. Interpretation of these studies during the drafting of the standard attempted to quantify an equivalent **PM₁₀** level for the actual particulate measured. The EPA further acknowledged that even the quantitative studies were conducted in times and places where **pollutant compositions** may have varied considerably from U.S. atmospheres, for which the standard was written.

2. A recent article by Ostro, in the *Archives of Environmental Health*, points out an additional complicating factor. "Thus far, the biological mechanism, typically deduced from animal studies, is unclear, rendering it difficult to assign the effects to any one constituent. In part, this is a result of the heterogeneous mix of chemicals that constitute particulate matter, making it difficult to test for a mechanism in a clinical or experimental setting. However, current evidence indicates that small particles can penetrate deeply into the lung and result in bronchoconstriction and an alteration in respiratory mechanics. In addition, constituents of particulate matter, such as acid sulfates, may irritate the upper airway and deep lung, reduce bronchial clearance, and modify the lung's resistance to infection." Preexisting respiratory infection may also be an important part of the mechanism for some of the associations seen between particulates and increased mortality. Various respiratory viruses cause prolonged bronchial hyper-responsiveness via multiple mechanisms involving epithelial cell damage and inflammation. In this setting, exposure to pollution represents an additional burden of inflammation, which may exacerbate the conditions of individuals already compromised with respiratory infections.

D. Short Term Exposures.

1. Analysis of effects of exposure to elevated particulates of less than 2 weeks duration during discrete air pollution episodes led the EPA to determine that a continuum of health effects occur. At equivalent **PM₁₀** levels of 350-600 $\mu\text{g}/\text{m}^3$, effects such as increased mortality and aggravation of bronchitis were determined to be "likely." At equivalent **PM₁₀** levels of 140-350 $\mu\text{g}/\text{m}^3$, aggravation of bronchitis in adults and small, reversible declines in lung function in children were considered possible, while at equivalent **PM₁₀** levels of < 125 $\mu\text{g}/\text{m}^3$ no effects were noted.

2. Three studies which reported significant decreases in pulmonary function in predominantly healthy school children during wintertime air pollution episodes with TSP concentrations of 200-250 $\mu\text{g}/\text{m}^3$ daily (equivalent PM, of 140-350 $\mu\text{g}/\text{m}^3$) also reported a

persistence of this decrement several weeks later. A recent study in the Netherlands found **significant** but non-persistent decreases in forced vital **capacity** and forced **expiratory** volume in one second during **episodes** where **PM₁₀** ranged from **30-144 µg/m³**.

E. Long Term Exposures.

1. **Exposures lasting longer than 2 to 6 weeks have been associated with health effects at lower levels of PM₁₀. At equivalent PM₁₀ levels of > 80-90 µg/m³, increased respiratory disease, symptoms, and decreased lung function in children (with a smaller reduction in function in adults) was determined to be "likely."** At equivalent **PM₁₀** levels of **40-80 µg/m³**, **increased respiratory symptoms and reductions in lung function in children and adults were considered "possible."** At **PM₁₀** equivalent levels of **< 40 µg/m³**, no detectable decreases in pulmonary function are **expected** in children or adults.
2. **A newly published cohort study attempted to quantify the long-term risks associated with particulates. As this study was started in 1977, the original measure was TSP. Ten-year followup data significantly associates new onset airway obstructive disease, chronic bronchitis, and asthma to particulates after adjustment for smoking history, living with a Smoker, and other pollutant indicators among other variables. The relative risk associated with a 1,000 hour/year exceedance of a TSP level of 200 µg/m³ ranged from 1.33 for new onset chronic bronchitis to 1.74 for asthma (all significant). Results of precise PM₁₀ level associations are said to be forthcoming.**

F. Mortality.

A recent review article transformed alternative measures of particulate matter (British smoke, sulfate, TSP, coefficient of haze) from previous studies into PM₁₀ equivalents and examined the relationship to daily mortality. Estimated % changes in daily mortality due to a 10 µg/m³ change in PM₁₀ in the range of 37-80 µg/m³ were 0.31 to 1.49%. While some studies examined only all-cause mortality, others were large enough to explore the association between particulates and respiratory and cardiovascular mortality, which were found to be positively associated, while no significant association to cancer, accidents or other causes of mortality were seen. Such increases in mortality would be expected only among sensitive subsets of the population, such as the chronically ill or the elderly. While there are some important caveats to this finding, the article states that "despite problems in measurement of exposure, and control for all potential confounders, when the outdoor fixed site monitor measures a higher concentration of particulate matter, higher levels of mortality are consistently observed."

G. Cancer.

1. **The EPA also considered the results of qualitative data from a number of other animal and epidemiologic studies, which suggest concern for effects not directly evaluated in the studies used to develop the ranges. Such effects include damage to lung tissues contributing**

to **cancer**. The available **scientific** data do not suggest major risks for these effects at current ambient particle levels **in** most U.S. areas, and is at present **unquantitated**. However, the EPA **states** that "the risk that both **fine** and **coarse** particles may produce these **responses** supports the need to **limit long-term** levels of **PM₁₀** for a variety of aerosol **compositions**."

2. An additional concern is that *most polycyclic organic* compounds in ambient air are associated with particulate matter. Specific classes of organic compounds identified with airborne particulate matter include polycyclic aromatic hydrocarbons (PAH), aromatic and aliphatic hydrocarbons, aza-arenes, aliphatic and aromatic aldehydes and ketones, quinones, phenols, phthalic acid esters, aryl and alkyl halides, chlorophenols, nitro compounds, and alkylating agents. Of these, the **polycyclic organic matter compounds**—particularly the **polycyclic aromatic hydrocarbons (PAHs)**—have received the most attention. Many of these compounds are potent carcinogens in animals. Benzo[a]pyrene is the most commonly measured surrogate of airborne organic pollutants. It is important to distinguish however, that although airborne organic pollutants associate with particles, they have essentially separate health effects and can be measured separately.