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DRAFT
Transmitted by E-Mail

To: Joe Haake

From: Atul M. Salhotra, Ph.D.
Sungmi Moon, Ph.D.
Kendall L. Pickett

Date: November 1, 2010

RE: Risk Evaluation for Outdoor Inhalation of Vapors from Groundwater by Outdoor Worker in Sub-areas 2C and 6B
Boeing Tract 1 Facility, St. Louis, Missouri

This memo presents the updated non-carcinogenic risks (HIs) to outdoor worker in Sub-areas 2C and 6B at the Boeing Tract 1 Facility in St. Louis, Missouri. This update is necessary because in the *Final Risk Assessment* (Tetra Tech, March 2008) the representative groundwater concentrations were not capped at the constituent solubility levels. Also refer to the memo titled *Risk Evaluation of TPH for Indoor Inhalation Pathway* (RAM Group, January 12, 2010).

Table 1 compares the groundwater exposure point concentrations (EPCs) with the solubility values. The table also presents the updated hazard quotient (HQ) for EPCs capped at solubility values. Table 2 presents similar calculations for Sub-area 6B.

The results indicate that the HIs for outdoor worker are 0.34 and 0.07 for Sub-area 2C and Sub-area 6B, respectively, and hence are acceptable. Note that in these sub-areas the only complete exposure pathway for the outdoor worker is the outdoor inhalation of vapors from groundwater.

If you have any questions, please let us know.

References

Tetra Tech, March 2008. Final Risk Assessment, Boeing Tract 1 Facility, St. Louis, Missouri.

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Table 1
Updated Non-carcinogenic Risks by Outdoor Worker (2008 Risk Assessment by TetraTech) in Sub-areas 2C
Boeing Tract 1, St. Louis, Missouri

TPH Groups and Carbon Fractions	Solubility (mg/L)	Sub-area 2C			
		GW EPC (mg/L)	Ratio of GW EPC / Solubility	HQ in 2008 RA	Updated HQ
Benzene	1.75E+03	5.07E-01	2.90E-04	6.70E-04	6.70E-04
Ethylbenzene	1.69E+02	1.66E-01	9.82E-04	7.00E-06	7.00E-06
MTBE	4.80E+04	5.90E-02	1.23E-06	3.50E-07	3.50E-07
Toluene	5.26E+02	4.50E-02	8.56E-05	3.80E-07	3.80E-07
Xylene	1.85E+02	2.00E-02	1.08E-04	8.70E-06	8.70E-06
TPH-GRO Aliphatics >nC5 to nC8	1.10E+01	8.90E+01	8.09E+00	2.40E+00	2.97E-01
TPH-GRO Aliphatics >nC9 to nC18	1.00E-02	8.90E+01	8.90E+03	2.70E+00	3.03E-04
TPH-GRO Aromatics >nC9 to nC18	5.10E+01	8.90E+01	1.75E+00	7.90E-02	4.53E-02
TPH-DRO Aliphatics >nC9 to nC18	1.00E-02	3.06E-01	3.06E+01	9.30E-03	3.04E-04
TPH-DRO Aromatics >nC9 to nC18	5.80E+00	3.06E-01	5.28E-02	6.20E-05	6.20E-05
HI				**5.2E+00**	**3.4E-01**

Notes:
mg/L: Milligrams per liter
Ratio > 1: EPC higher than solubility and EPC has to be set equal to solubility
EPC: Exposure point concentration
GW: Groundwater
TPH: Total petroleum hydrocarbon
HQ: Hazard quotient for outdoor inhalation of vapors from groundwater by outdoor worker
HI: Hazard index

Table 2
Updated Non-carcinogenic Risks by Outdoor Worker (2008 Risk Assessment by TetraTech) in Sub-areas 6B
Boeing Tract 1, St. Louis, Missouri

TPH Groups and Carbon Fractions	Solubility (mg/L)	Sub-area 6B			
		GW EPC (mg/L)	Ratio of GW EPC / Solubility	HQ in 2008 RA	Updated HQ
1,1-Dichloroethane	5.06E+03	1.30E-02	2.57E-06	9.40E-07	9.40E-07
1,1-Dichloroethene	2.25E+03	1.30E-02	5.78E-06	9.20E-06	9.20E-06
1,1,2-Trichloro-1,2,2-trifluoroethane	2.00E+02	7.00E+00	3.50E-02	5.10E-04	5.10E-04
1,2,3-Trimethylbenzene	7.52E+01	3.00E-03	3.99E-05	1.10E-05	1.10E-05
1,2,4-Trimethylbenzene	5.68E+01	3.00E-03	5.28E-05	1.10E-05	1.10E-05
1,2-Dichlorobenzene	1.56E+02	4.10E-02	2.63E-04	3.50E-06	3.50E-06
1,2-Dichloroethene (total)	6.30E+03	4.36E+00	6.92E-04	3.80E-03	3.80E-03
1,2-Dichloropropane	2.80E+03	2.00E-03	7.14E-07	1.10E-05	1.10E-05
1,3-Dichlorobenzene	1.10E+02	3.00E-03	2.73E-05	--	--
1,4-Dichlorobenzene	7.38E+01	1.10E-02	1.49E-04	2.70E-07	2.70E-07
Acetone	1.00E+06	7.40E-02	7.40E-08	4.40E-09	4.40E-09
Benzene	1.75E+03	2.00E-02	1.14E-05	2.70E-05	2.70E-05
Bromodichloromethane	6.74E+03	2.00E-03	2.97E-07	--	--
Bromomethane	1.52E+04	2.30E-02	1.51E-06	3.30E-04	3.30E-04
Carbon disulfide	1.19E+03	1.00E-03	8.40E-07	1.30E-07	1.30E-07
Chlorform	7.92E+03	1.10E-02	1.39E-06	3.80E-06	3.80E-06
cis-1,2-Dichloroethene	3.50E+03	2.43E+00	6.93E-04	--	--
Dichlorodifluoromethane	1.26E+04	7.00E-01	5.56E-05	9.20E-05	9.20E-05
Ethylbenzene	1.69E+02	4.00E-03	2.37E-05	1.80E-07	1.80E-07
Isopropylbenzene	5.00E+01	5.00E-03	1.00E-04	6.80E-07	6.80E-07
Methyl ethyl ketone	2.40E+05	8.70E-02	3.63E-07	2.50E-08	2.50E-08
MTBE	4.80E+04	7.50E-02	1.56E-06	4.40E-07	4.40E-07
Methylene chloride	1.30E+04	5.10E-02	3.92E-06	4.60E-07	4.60E-07
n-Propylbenzene	4.20E+01	2.00E-03	4.76E-05	--	--
sec-Butylbenzene	1.81E+01	1.00E-03	5.52E-05	--	--
tert-Butylbenzene	1.51E+01	2.00E-03	1.32E-04	--	--
Tetrachloroethene	2.00E+02	2.90E-02	1.45E-04	8.80E-06	8.80E-06
Toluene	5.26E+02	3.60E-02	6.84E-05	3.10E-07	3.10E-07
trans-1,2-Dichloroethene	6.30E+03	9.30E-02	1.48E-05	8.10E-05	8.10E-05
Trichloroethene	1.10E+03	1.37E+00	1.25E-03	1.90E-03	1.90E-03
Trichlorofluoromethane	1.10E+03	1.00E-02	9.09E-06	6.50E-06	6.50E-06
Vinyl chloride	2.76E+03	6.17E-01	2.24E-04	1.00E-03	1.00E-03
Xylene	1.85E+02	1.20E-02	6.49E-05	5.20E-06	5.20E-06
Acenatphthene	4.24E+00	4.30E-02	1.01E-02	--	--
Benzo(a)anthracene	9.40E-03	2.50E-01	2.66E+01	--	--
Chrysene	1.60E-03	8.60E-02	5.38E+01	--	--
Aroclor 1254	5.55E-02	5.80E-01	1.05E+01	--	--
Arsenic	0.00E+00	1.70E-01	--	--	--
Barium	0.00E+00	1.01E+01	--	--	--
Cadmium	0.00E+00	4.20E-02	--	--	--
Chromium	0.00E+00	6.16E-01	--	--	--
Lead	0.00E+00	2.65E-01	--	--	--
Mercury	3.00E-02	1.60E-02	5.33E-01	1.50E-03	1.50E-03
Selenium	0.00E+00	3.60E-02	--	--	--
Silver	0.00E+00	1.00E-03	--	--	--
TPH-GRO Aliphatics >nC5 to nC8	1.10E+01	2.03E+00	1.85E-01	5.50E-02	5.50E-02
TPH-GRO Aliphatics >nC9 to nC18	1.00E-02	2.03E+00	2.03E+02	6.20E-02	3.05E-04
TPH-GRO Aromatics >nC9 to nC18	5.10E+01	2.03E+00	3.98E-02	1.80E-03	1.80E-03
TPH-DRO Aliphatics >nC9 to nC18	1.00E-02	9.96E+01	9.96E+03	3.00E+00	3.01E-04
TPH-DRO Aromatics >nC9 to nC18	5.80E+00	9.96E+01	1.72E+01	2.00E-02	1.16E-03
HI				**3.1E+00**	**6.8E-02**

Notes:
mg/L: Milligrams per liter
Ratio > 1: EPC higher than solubility
EPC: Exposure point concentration
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TPH: Total petroleum hydrocarbon
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Xylene	1.85E+02	2.00E-02	1.08E-04	8.70E-06	8.70E-06
TPH-GRO Aliphatics >nC5 to nC8	1.10E+01	8.90E+01	8.09E+00	2.40E+00	2.97E-01
TPH-GRO Aliphatics >nC9 to nC18	1.00E-02	8.90E+01	8.90E+03	2.70E+00	3.03E-04
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Updated Non-carcinogenic Risks by Outdoor Worker (2008 Risk Assessment by TetraTech) in Sub-areas 6B
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TPH Groups and Carbon Fractions	Solubility (mg/L)	Sub-area 6B			
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1,1-Dichloroethene	2.25E+03	1.30E-02	5.78E-06	9.20E-06	9.20E-06
1,1,2-Trichloro-1,2,2-trifluoroethane	2.00E+02	7.00E+00	3.50E-02	5.10E-04	5.10E-04
1,2,3-Trimethylbenzene	7.52E+01	3.00E-03	3.99E-05	1.10E-05	1.10E-05
1,2,4-Trimethylbenzene	5.68E+01	3.00E-03	5.28E-05	1.10E-05	1.10E-05
1,2-Dichlorobenzene	1.56E+02	4.10E-02	2.63E-04	3.50E-06	3.50E-06
1,2-Dichloroethene (total)	6.30E+03	4.36E+00	6.92E-04	3.80E-03	3.80E-03
1,2-Dichloropropane	2.80E+03	2.00E-03	7.14E-07	1.10E-05	1.10E-05
1,3-Dichlorobenzene	1.10E+02	3.00E-03	2.73E-05	--	--
1,4-Dichlorobenzene	7.38E+01	1.10E-02	1.49E-04	2.70E-07	2.70E-07
Acetone	1.00E+06	7.40E-02	7.40E-08	4.40E-09	4.40E-09
Benzene	1.75E+03	2.00E-02	1.14E-05	2.70E-05	2.70E-05
Bromodichloromethane	6.74E+03	2.00E-03	2.97E-07	--	--
Bromomethane	1.52E+04	2.30E-02	1.51E-06	3.30E-04	3.30E-04
Carbon disulfide	1.19E+03	1.00E-03	8.40E-07	1.30E-07	1.30E-07
Chlorform	7.92E+03	1.10E-02	1.39E-06	3.80E-06	3.80E-06
cis-1,2-Dichloroethene	3.50E+03	2.43E+00	6.93E-04	--	--
Dichlorodifluoromethane	1.26E+04	7.00E-01	5.56E-05	9.20E-05	9.20E-05
Ethylbenzene	1.69E+02	4.00E-03	2.37E-05	1.80E-07	1.80E-07
Isopropylbenzene	5.00E+01	5.00E-03	1.00E-04	6.80E-07	6.80E-07
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n-Propylbenzene	4.20E+01	2.00E-03	4.76E-05	--	--
sec-Butylbenzene	1.81E+01	1.00E-03	5.52E-05	--	--
tert-Butylbenzene	1.51E+01	2.00E-03	1.32E-04	--	--
Tetrachloroethene	2.00E+02	2.90E-02	1.45E-04	8.80E-06	8.80E-06
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Trichloroethene	1.10E+03	1.37E+00	1.25E-03	1.90E-03	1.90E-03
Trichlorofluoromethane	1.10E+03	1.00E-02	9.09E-06	6.50E-06	6.50E-06
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Xylene	1.85E+02	1.20E-02	6.49E-05	5.20E-06	5.20E-06
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Benzo(a)anthracene	9.40E-03	2.50E-01	2.66E+01	--	--
Chrysene	1.60E-03	8.60E-02	5.38E+01	--	--
Aroclor 1254	5.55E-02	5.80E-01	1.05E+01	--	--
Arsenic	0.00E+00	1.70E-01	--	--	--
Barium	0.00E+00	1.01E+01	--	--	--
Cadmium	0.00E+00	4.20E-02	--	--	--
Chromium	0.00E+00	6.16E-01	--	--	--
Lead	0.00E+00	2.65E-01	--	--	--
Mercury	3.00E-02	1.60E-02	5.33E-01	1.50E-03	1.50E-03
Selenium	0.00E+00	3.60E-02	--	--	--
Silver	0.00E+00	1.00E-03	--	--	--
TPH-GRO Aliphatics >nC5 to nC8	1.10E+01	2.03E+00	1.85E-01	5.50E-02	5.50E-02
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TPH-DRO Aliphatics >nC9 to nC18	1.00E-02	9.96E+01	9.96E+03	3.00E+00	3.01E-04
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