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NASJRB WILLOW GROVE
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LETTER AND U S NAVY RESPONSE TO U S EPA REGION III COMMENTS REGARDING HUMAN HEALTH RISK ASSESSMENT FOR THE DRAFT REMEDIAL INVESTIGATION REPORT FOR SITE 3 NASJRB WILLOW GROVE PA
07/28/2011
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PHIL-24414

July 28, 2011

Project Number 02014

Ms. Lisa Cunningham (3HS11)
United States Environmental Protection Agency (EPA)
1650 Arch Street
Philadelphia, Pennsylvania 19103

Reference: Contract No. N62470-08-D-1001
Contract Task Order (CTO) No. WE05

Subject: Response to EPA Comments
Remedial Investigation (RI) Report
Site 3 - Ninth Street Landfill
Naval Air Station Joint Reserve Base (NAS JRB) - Willow Grove
Philadelphia, Pennsylvania

Dear Ms. Cunningham:

Tetra Tech is pleased to submit the following response to EPA's comments dated May 26, 2011 regarding the human health risk assessment for the draft RI report for Site 3 – Ninth Street Landfill at NAS JRB Willow Grove. These responses are provided on behalf of the Navy Base Realignment and Closure (BRAC) Program Management Office (PMO).

EPA's May 26, 2011 comments provided a rebuttal to the Navy's prior response to EPA comments on the draft RI. The May 26, 2011 comments included two general comments and five comments specifically on the Risk Assessment Guidance for Superfund (RAGS) Part D Tables. On July 5, 2011, EPA indicated to the Navy that the two general comments were adequately addressed during the initial response and that only a response to the five comments on the RAGS D Tables was required. The EPA comments on the RAGS D tables have been included with the response in bold below each comment. Revised text and tables, where applicable, have also been attached.

RAGS D Table Rebuttal Response

1. Table 2.02. Soil to Groundwater. The identified Exposure Point column "Tap water Contact or Water Vapors at Showerhead" is incorrect. It should read "Soil impact to Groundwater."

   RESPONSE: This is a minor editorial change and can be made easily if desired by EPA. However, as it currently stands, the existing label for Exposure Point in Table 2.02 is consistent with the RAGS D instructions on EPA's website: http://www.epa.gov/oswer/riskassessment/ragsd/pdf/table2instructions.pdf.

   --According to the definition given in the instructions for RAGS Part D guidance, the Exposure Point is "An exact location of potential contact between a person and a chemical or radionuclide within an exposure medium." In this particular case, the location of contact is tap water and water vapors at the showerhead, as stated in Table 2.02. This is appropriate because the SSL is based on tap water exposure.

--If the Exposure Point were to be relabeled as "Soil impact to Groundwater", then it would be redundant with the information already stated under the headings for the Medium ("Soil") and the Exposure Medium ("Groundwater or Air") in Table 2.02.

Whether or not it is decided to make this change to Table 2.02, there should be no confusion, as the title of Table 2.02 already states "soil to groundwater".

2. Table 3.03. The reported statistics do not agree with the contaminant concentrations reported in Table 2.03. This table corresponds with Table 2.04. Please correct this error.

   RESPONSE: Table 3.03 was incorrectly filled in with the EPCs and maximum concentrations representing the data set for Hangar Area Surface Soil instead of Hangar Area Total Soil. Table 3.03 has been revised and is attached. Since the analysis of soil-to-groundwater was entirely qualitative, this does not affect any other risk assessment tables and no changes were necessary for the text.

3. Table 6.02. Although the IUR for carbon tetrachloride is reported correctly in the table, it is not used to calculate risk. See Table 7.02RME.

   RESPONSE: The IUR for carbon tetrachloride was revised on the EPA IRIS website on 3/31/2010 from the old value of 1.5E-5 $(ug/m^3)^{-1}$ to 6E-6 $(ug/m^3)^{-1}$. Note that the correct value was used on Table 6.02 and in the RAGS D Table 7.02 where cancer risk calculations were presented. A copy of Table 6.02 and Table 7.02 is attached. No additional changes to RAGS D Tables 7 through 10 are necessary.

4. Table 6.02. The IUR for aroclor-1254 has not been changed. The correct IUR should be 5.7E-04.

   RESPONSE: Table 6.02 has been edited to show the Aroclor-1254 IUR of 5.7E-4, and is attached. This error occurred because according to IRIS, different toxicity values apply depending on whether Aroclor-1254 is in dust or vapor form. Since Aroclor-1254 was not selected as a COPC for the inhalation pathway, this change will not affect calculated risks in other RAGS D tables.

5. Table 7.27RME, 7.28RME. Based on the most recent RSL table chromium is now identified as a mutagen and must be evaluated as such.

   The Navy's response to this comment could not be verified since page 6-33 was not included in the review submission.

   RESPONSE: Page 6-33 has been copied and attached. This page includes Section 6.4.8 of the Toxicity Assessment of the risk assessment, where a special note was made for the mutagenic properties of hexavalent chromium and PAHs:

   "EPA has categorized PAHs and hexavalent chromium as mutagens having enhanced carcinogenic potency during early life periods of exposure. Based upon EPA guidance (EPA, 2005b), cancer slope factors for carcinogenic PAHs and hexavalent chromium should be multiplied by a factor of 10 for those periods of exposure occurring between 0 and 2 years of age, and by a factor of 3 for periods of exposure occurring between 2 and 16 years of age. A multiplier of 1 (no correction) applies to cancer slope factors that are outside of these critical age ranges. A receptor-specific age dependent adjustment factor (ADAF) is calculated and multiplied by the daily intake and the slope factor for mutagens as shown below:"

Receptor	Medium	RME/CTE	ADAF for PAHs and Chromium
Recreational Child	Surface water, sediment, soil	RME	5.33 = [(10 x 2 yrs) + (3 x 4 yrs)] / (2 + 4 yrs)
Recreational Child	Surface water, sediment, soil	CTE	3.0 = [(10 x 0 yr) + (3 x 2 yr)] / (0 + 2 yrs)
Recreational Adult	Surface water, sediment, soil	RME	1.83 = [(3 x 10 yrs) + (1 x 14 yrs)] / (10+14 yrs)
Recreational Adult	Surface water, sediment, soil	CTE	1.0 = [(3 x 0 yrs) + (1 x 7 yrs)] / (0 + 7 yrs)
Residential Child	Soil, groundwater	RME	5.33 = [(10 x 2 yrs) + (3 x 4 yrs)] / (2 + 4 yrs)
Residential Child	Soil, groundwater	CTE	3.0 = [(10 x 0 yr) + (3 x 2 yr)] / (0 + 2 yrs)
Residential Adult	Soil, groundwater	RME	1.83 = [(3 x 10 yrs) + (1 x 14 yrs)] / (10+14 yrs)
Residential Adult	Soil, groundwater	CTE	1.0 = [(3 x 0 yrs) + (1 x 7 yrs)] / (0 + 7 yrs)
Construction Worker	All	RME	1.0 (adult age 18 years or older)
Construction Worker	All	CTE	1.0 (adult age 18 years or older)
Industrial worker	Soil	RME	1.0 (adult age 18 years or older)
Industrial worker	Soil	CTE	1.0 (adult age 18 years or older)

Tables 7.27 and 7.28 are also attached to confirm the correct use of mutagenic age-dependent adjustment factors (ADAFs) for chromium. The cancer risk for the residential child cited in Table 7.27 is illustrated using the intake equation from Table 4.04:

Intake = CS x IRS x CF3 x FI x EF x ED / (BW x AT)
= (39.4 mg/kg) x (200 mg/day) x (1E-6 kg/mg) x 1 x (350 days/year) x (6 years) / (15 kg x 25550 days)
= 4.32E-5 mg/kg/day
Cancer risk = Intake x CSF x ADAF = (4.32E-5) x (0.5) x (5.33) = 1.15E-4 (matches Table 7.27)

I hope this response adequately addresses EPA's comments. Please do not hesitate to contact me if you have any questions.

Sincerely,

Andrew Frebowitz
Project Manager

AF/nfs

Enclosure

c: Jeffrey Dale (Navy BRAC PMO)
Robert Lewandowski (Navy BRAC PMO)
Linda Watson (EPA Region 3)
Glenn Wagner (Tetra Tech)
Files

ATTACHMENTS

Comment No. 2

Revised Table 3.03

TABLE 3.03
EXPOSURE POINT CONCENTRATION SUMMARY - EXPOSURE TO SITE 3 HANGAR AREA SOIL-TO-GROUNDWATER
NAS JRB WILLOW GROVE, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Groundwater

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Tap Water Contact or Water Vapors at Showerhead	Benz(a)anthracene	ug/kg	2029	1398.3463	4200	4200	ug/kg	Maximum	Number of detects<5; n=13, max<=10xDL
	Benzo(a)pyrene	ug/kg	1675	1133.749	3200	3200	ug/kg	Maximum	Number of detects<5; n=13, max<=10xDL
	Benzo(b)fluoranthene	ug/kg	2067	1412.6795	4200	4200	ug/kg	Maximum	Number of detects<5; n=13, max<=10xDL
	Benzo(k)fluoranthene	ug/kg	377	NA*	1400	NA*			
	Chrysene	ug/kg	684	NA*	3400	NA*			
	Dibenz(a,h)anthracene	ug/kg	420	314.59	580 J	580	ug/kg	Maximum	Number of detects<5; n=13, max<=10xDL
	Indeno(1,2,3-cd)pyrene	ug/kg	1102	736.0795	2000	2000	ug/kg	Maximum	Number of detects<5; n=13, max<=10xDL

NA* - EPCs for soil-to-groundwater COPCs were not calculated separately because risk analysis was qualitative. (The only EPCs shown are those for substances also selected as COPCs for direct contact with soil exposure.)

Comment Nos. 3 and 4

Revised Tables 6.02 and 7.02

TABLE 6.2
CANCER TOXICITY DATA -- INHALATION
NAS JRB WILLOW GROVE, PENNSYLVANIA

Chemical of Potential Concern	Unit Risk		Inhalation Cancer Slope Factor (1)		Weight of Evidence/ Cancer Guideline Description	Unit Risk: Inhalation CSF	
	Value	Units	Value	Units		Sources(s) (2)	Date(s)
Total 2,3,7,8-TCDD Equiv.	3.80E+01	1/(ug/m3)	N/A	N/A	B2	Cal EPA	10/20/2010
Aluminum	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Antimony	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Arsenic	4.30E-03	1/(ug/m3)	N/A	N/A	A	IRIS	10/20/2010
Cadmium	1.80E-03	1/(ug/m3)	N/A	N/A	B1	IRIS	10/20/2010
Chromium	1.20E-02	1/(ug/m3)	N/A	N/A	A	IRIS	10/20/2010
Cobalt	9.00E-03	1/(ug/m3)	N/A	N/A		PPRTV	05/2010
Copper	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Iron	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Lead	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Manganese	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Mercury	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Nickel	2.60E-04	1/(ug/m3)	N/A	N/A	A	Cal EPA	10/20/2010
Silver	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Vanadium	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Zinc	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4,4'-DDD	6.90E-05	1/(ug/m3)	N/A	N/A	B2	Cal EPA	10/21/2010
4,4'-DDE	9.70E-05	1/(ug/m3)	N/A	N/A	B2	Cal EPA	10/21/2010
4,4'-DDT	9.70E-05	1/(ug/m3)	N/A	N/A	B2	IRIS	10/21/2010
Aroclor-1248	5.70E-04	1/(ug/m3)	N/A	N/A	B2	IRIS	10/21/2010
Aroclor-1254	5.70E-04	1/(ug/m3)	N/A	N/A	B2	IRIS	10/21/2010
Aroclor-1260	5.70E-04	1/(ug/m3)	N/A	N/A	B2	IRIS	10/21/2010
Dieldrin	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Heptachlor Epoxide	2.60E-03	1/(ug/m3)	N/A	N/A	B2	IRIS	10/21/2010
Benz(a)anthracene	1.10E-04	1/(ug/m3)	N/A	N/A	B2	Cal EPA	10/22/2010
Benzo(a)pyrene	1.10E-03	1/(ug/m3)	N/A	N/A	B2	Cal EPA	10/22/2010
Benzo(b)fluoranthene	1.10E-04	1/(ug/m3)	N/A	N/A	B2	Cal EPA	10/22/2010
Benzo(k)fluoranthene	1.10E-04	1/(ug/m3)	N/A	N/A	B2	Cal EPA	10/22/2010
Bis(2-ethylhexyl) Phthalate	2.40E-06	1/(ug/m3)	N/A	N/A		Cal EPA	10/22/2010
Chrysene	1.10E-05	1/(ug/m3)	N/A	N/A	B2	Cal EPA	10/22/2010
Dibenz(a,h)anthracene	1.20E-03	1/(ug/m3)	N/A	N/A	B2	Cal EPA	10/22/2010
Indeno(1,2,3-cd)pyrene	1.10E-04	1/(ug/m3)	N/A	N/A	B2	Cal EPA	10/22/2010
Naphthalene	3.40E-05	1/(ug/m3)	N/A	N/A	A	Cal EPA	10/22/2010
Phenanthrene	N/A	N/A	N/A	N/A	N/A	N/A	N/A
1,1-Dichloroethane	1.60E-06	1/(ug/m3)	N/A	N/A	C	Cal EPA	10/22/2010
Bromodichloromethane	3.70E-05	1/(ug/m3)	N/A	N/A	B2	Cal EPA	10/22/2010
Carbon Tetrachloride	6.00E-06	1/(ug/m3)	N/A	N/A	B2	IRIS	10/22/2010
Chloroform	2.30E-05	1/(ug/m3)	N/A	N/A	B2	IRIS	10/22/2010
Dibromochloromethane	2.70E-05	1/(ug/m3)	N/A	N/A	C	Cal EPA	10/22/2010
Ethylbenzene	2.50E-06	1/(ug/m3)	N/A	N/A		Cal EPA	10/22/2010
Tetrachloroethene	2.90E-06	1/(ug/m3)	N/A	N/A	B2-C	EPA-NCEA	04/2002
Trichloroethene	1.70E-06	1/(ug/m3)	N/A	N/A		EPA-NCEA	04/2002

N/A = Not Applicable
1 - RAGS Part F (EPA, 2009) requires use of the inhalation unit risk (IUR),
so the extrapolated Inhalation CSF is obsolete (CSFi = IUR * 70 kg / 20m3/day)
2 - IRIS - Integrated Risk Information System (EPA, 2006)
EPA - NCEA - EPA National Center for Exposure Assessment
Cal EPA - California Environmental Protection Agency Toxicity Value
PPRTV - Provisional Peer Reviewed Toxicity Value

EPA Group:
A - Human carcinogen.
B1 - Probable human carcinogen - indicates that limited human data are available.
B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans .
C - Possible human carcinogen.
D - Not classifiable as a human carcinogen.
E - Evidence of noncarcinogenicity.

TABLE 7.02.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS - RESIDENTIAL ADULT EXPOSURE TO GROUNDWATER

REASONABLE MAXIMUM EXPOSURES

NAS JRB WILLOW GROVE

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	Site 3 Tap Water Contact With Groundwater	Ingestion	Arsenic	4.52E+00	ug/l	4.25E-05	mg/kg-day	1.50E+00	mg/kg-day	6.37E-05	1.24E-04	mg/kg-day	3.00E-04	mg/kg-day	4.13E-01
				Cobalt	2.40E+00	ug/l	2.25E-05	mg/kg-day	--	mg/kg-day	--	6.58E-05	mg/kg-day	3.00E-04	mg/kg-day	2.19E-01
				Manganese	4.33E+01	ug/l	4.07E-04	mg/kg-day	--	mg/kg-day	--	1.19E-03	mg/kg-day	2.40E-02	mg/kg-day	4.94E-02
				Bis(2-ethylhexyl) Phthalate	1.10E+01	ug/l	1.03E-04	mg/kg-day	1.40E-02	mg/kg-day	1.45E-06	3.01E-04	mg/kg-day	2.00E-02	mg/kg-day	1.51E-02
				1,1-Dichloroethane	8.20E+00	ug/l	7.70E-05	mg/kg-day	5.70E-03	mg/kg-day	4.39E-07	2.25E-04	mg/kg-day	2.00E-01	mg/kg-day	1.12E-03
				Bromodichloromethane	1.10E+00	ug/l	1.03E-05	mg/kg-day	6.20E-02	mg/kg-day	6.41E-07	3.01E-05	mg/kg-day	2.00E-02	mg/kg-day	1.51E-03
				Carbon Tetrachloride	3.80E-01	ug/l	3.57E-06	mg/kg-day	7.00E-02	mg/kg-day	2.50E-07	1.04E-05	mg/kg-day	4.00E-03	mg/kg-day	2.60E-03
				Chloroform	5.23E-01	ug/l	4.91E-06	mg/kg-day	3.10E-02	mg/kg-day	1.52E-07	1.43E-05	mg/kg-day	1.00E-02	mg/kg-day	1.43E-03
				Dibromochloromethane	1.50E+00	ug/l	1.41E-05	mg/kg-day	8.40E-02	mg/kg-day	1.18E-06	4.11E-05	mg/kg-day	2.00E-02	mg/kg-day	2.05E-03
				Tetrachloroethene	5.26E+00	ug/l	4.94E-05	mg/kg-day	5.20E-02	mg/kg-day	2.57E-06	1.44E-04	mg/kg-day	1.00E-02	mg/kg-day	1.44E-02
				Trichloroethene	3.10E+00	ug/l	2.91E-05	mg/kg-day	1.10E-02	mg/kg-day	3.20E-07	8.49E-05	mg/kg-day	--	mg/kg-day	--
			Exp. Route Total								7.07E-05					7.20E-01
			Dermal	Arsenic	4.52E+00	ug/l	1.91E-07	mg/kg-day	1.50E+00	mg/kg-day	2.87E-07	5.57E-07	mg/kg-day	3.00E-04	mg/kg-day	1.86E-03
				Cobalt	2.40E+00	ug/l	4.06E-08	mg/kg-day	--	mg/kg-day	--	1.18E-07	mg/kg-day	3.00E-04	mg/kg-day	3.95E-04
				Manganese	4.33E+01	ug/l	1.83E-06	mg/kg-day	--	mg/kg-day	--	5.34E-06	mg/kg-day	9.60E-04	mg/kg-day	5.56E-03
				Bis(2-ethylhexyl) Phthalate	1.10E+01	ug/l	1.48E-04	mg/kg-day	1.40E-02	mg/kg-day	2.08E-06	4.32E-04	mg/kg-day	2.00E-02	mg/kg-day	2.16E-02
				1,1-Dichloroethane	8.20E+00	ug/l	4.83E-06	mg/kg-day	5.70E-03	mg/kg-day	2.75E-08	1.41E-05	mg/kg-day	2.00E-01	mg/kg-day	7.04E-05
				Bromodichloromethane	1.10E+00	ug/l	7.03E-07	mg/kg-day	6.20E-02	mg/kg-day	4.36E-08	2.05E-06	mg/kg-day	2.00E-02	mg/kg-day	1.03E-04
				Carbon Tetrachloride	3.80E-01	ug/l	7.87E-07	mg/kg-day	7.00E-02	mg/kg-day	5.51E-08	2.30E-06	mg/kg-day	4.00E-03	mg/kg-day	5.74E-04
				Chloroform	5.23E-01	ug/l	3.64E-07	mg/kg-day	3.10E-02	mg/kg-day	1.13E-08	1.06E-06	mg/kg-day	1.00E-02	mg/kg-day	1.06E-04
				Dibromochloromethane	1.50E+00	ug/l	9.06E-07	mg/kg-day	8.40E-02	mg/kg-day	7.61E-08	2.64E-06	mg/kg-day	2.00E-02	mg/kg-day	1.32E-04
				Tetrachloroethene	5.26E+00	ug/l	2.44E-05	mg/kg-day	5.20E-02	mg/kg-day	1.27E-06	7.11E-05	mg/kg-day	1.00E-02	mg/kg-day	7.11E-03
				Trichloroethene	3.10E+00	ug/l	4.11E-06	mg/kg-day	1.10E-02	mg/kg-day	4.53E-08	1.20E-05	mg/kg-day	--	mg/kg-day	--
			Exp. Route Total								3.89E-06					3.75E-02
		Exposure Point Total									7.46E-05					7.57E-01
	Exposure Medium Total										7.46E-05					7.57E-01
	Air	Site 3 Groundwater Vapors During Showering	Inhalation	Arsenic	4.52E+00	ug/l	NA	mg/m3	4.30E+00	1/(mg/m3)	NA	NA	mg/m3	1.50E-05	mg/m3	NA
				Cobalt	2.40E+00	ug/l	NA	mg/m3	9.00E+00	1/(mg/m3)	NA	NA	mg/m3	6.00E-06	mg/m3	NA
				Manganese	4.33E+01	ug/l	NA	mg/m3	--	1/(mg/m3)	--	NA	mg/m3	5.00E-05	mg/m3	NA
				Bis(2-ethylhexyl) Phthalate	1.10E+01	ug/l	NA	mg/m3	2.40E-03	1/(mg/m3)	NA	NA	mg/m3	--	mg/m3	--
				1,1-Dichloroethane	8.20E+00	ug/l	2.01E-04	mg/m3	1.60E-03	1/(mg/m3)	3.21E-07	5.85E-04	mg/m3	--	mg/m3	--
				Bromodichloromethane	1.10E+00	ug/l	2.04E-05	mg/m3	3.70E-02	1/(mg/m3)	7.56E-07	5.96E-05	mg/m3	--	mg/m3	--
				Carbon Tetrachloride	3.80E-01	ug/l	7.69E-06	mg/m3	6.00E-03	1/(mg/m3)	4.61E-08	2.24E-05	mg/m3	1.00E-01	mg/m3	2.24E-04
				Chloroform	5.23E-01	ug/l	1.16E-05	mg/m3	2.30E-02	1/(mg/m3)	2.67E-07	3.39E-05	mg/m3	9.80E-02	mg/m3	3.46E-04
				Dibromochloromethane	1.50E+00	ug/l	2.37E-05	mg/m3	2.70E-02	1/(mg/m3)	6.39E-07	6.90E-05	mg/m3	--	mg/m3	--
				Tetrachloroethene	5.26E+00	ug/l	1.03E-04	mg/m3	2.90E-03	1/(mg/m3)	2.98E-07	2.99E-04	mg/m3	2.70E-01	mg/m3	1.11E-03
				Trichloroethene	3.10E+00	ug/l	6.71E-05	mg/m3	1.70E-03	1/(mg/m3)	1.14E-07	1.96E-04	mg/m3	--	mg/m3	--
			Exp. Route Total								2.44E-06					1.68E-03
		Exposure Point Total									2.44E-06					1.68E-03
	Exposure Medium Total										2.44E-06					1.68E-03
Medium Total											7.70E-05					7.59E-01
										Total of Receptor Risks Across All Media	7.70E-05				Total of Receptor Hazards Across All Media	7.59E-01

Comment No. 5

Page 6-33, Table 7.27, and Table 7.28

- Benzo(a)pyrene (RPF = 1.0)
- Benz(a)anthracene (RPF = 0.1)
- Benzo(b)fluoranthene (RPF = 0.1)
- Benzo(k)fluoranthene (RPF = 0.01)
- Chrysene (RPF = 0.001)
- Dibenz(a,h)anthracene (RPF = 1.0)
- Indeno(1,2,3-cd)pyrene (RPF = 0.1)

6.4.8 Carcinogenicity of Chromium and PAHs

EPA has categorized PAHs and hexavalent chromium as mutagens having enhanced carcinogenic potency during early life periods of exposure. Based upon EPA guidance (EPA, 2005b), cancer slope factors for carcinogenic PAHs and hexavalent chromium should be multiplied by a factor of 10 for those periods of exposure occurring between 0 and 2 years of age, and by a factor of 3 for periods of exposure occurring between 2 and 16 years of age. A multiplier of 1 (no correction) applies to cancer slope factors that are outside of these critical age ranges. A receptor-specific age dependent adjustment factor (ADAF) is calculated and multiplied by the daily intake and the slope factor for mutagens as shown below:

Receptor	Medium	RME/CTE	ADAF for PAHs and Chromium
Recreational Child	Surface water, sediment, soil	RME	5.33 = [(10 x 2 yrs) + (3 x 4 yrs)] / (2 + 4 yrs)
Recreational Child	Surface water, sediment, soil	CTE	3.0 = [(10 x 0 yr) + (3 x 2 yr)] / (0 + 2 yrs)
Recreational Adult	Surface water, sediment, soil	RME	1.83 = [(3 x 10 yrs) + (1 x 14 yrs)] / (10+14 yrs)
Recreational Adult	Surface water, sediment, soil	CTE	1.0 = [(3 x 0 yrs) + (1 x 7 yrs)] / (0 + 7 yrs)
Residential Child	Soil, groundwater	RME	5.33 = [(10 x 2 yrs) + (3 x 4 yrs)] / (2 + 4 yrs)
Residential Child	Soil, groundwater	CTE	3.0 = [(10 x 0 yr) + (3 x 2 yr)] / (0 + 2 yrs)
Residential Adult	Soil, groundwater	RME	1.83 = [(3 x 10 yrs) + (1 x 14 yrs)] / (10+14 yrs)
Residential Adult	Soil, groundwater	CTE	1.0 = [(3 x 0 yrs) + (1 x 7 yrs)] / (0 + 7 yrs)
construction worker	All	RME	1.0 (adult age 18 years or older)
construction worker	All	CTE	1.0 (adult age 18 years or older)
Industrial worker	Soil	RME	1.0 (adult age 18 years or older)
Industrial worker	Soil	CTE	1.0 (adult age 18 years or older)

TABLE 7.27.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS - RESIDENTIAL CHILD EXPOSURE TO SITE 3 LANDFILL AREA SOIL

REASONABLE MAXIMUM EXPOSURES

NAS JRB WILLOW GROVE

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Soil	Site 3 Landfill Area Contact with Soil	Ingestion	Total 2,3,7,8-TCDD Equiv.	2.43E-01	ug/kg	2.66E-10	mg/kg-day	1.30E+05	mg/kg-day	3.46E-05	3.11E-09	mg/kg-day	1.00E-09	mg/kg-day	3.11E+00
				Aluminum	1.98E+04	mg/kg	2.17E-02	mg/kg-day	--	mg/kg-day	--	2.53E-01	mg/kg-day	1.00E+00	mg/kg-day	2.53E-01
				Antimony	2.50E+01	mg/kg	2.74E-05	mg/kg-day	--	mg/kg-day	--	3.20E-04	mg/kg-day	4.00E-04	mg/kg-day	7.99E-01
				Arsenic	6.21E+00	mg/kg	6.81E-06	mg/kg-day	1.50E+00	mg/kg-day	1.02E-05	7.94E-05	mg/kg-day	3.00E-04	mg/kg-day	2.65E-01
				Cadmium	4.71E+01	mg/kg	5.16E-05	mg/kg-day	--	mg/kg-day	--	6.02E-04	mg/kg-day	1.00E-03	mg/kg-day	6.02E-01
				Chromium	3.94E+01	mg/kg	4.32E-05	mg/kg-day	5.00E-01	mg/kg-day	1.15E-04	5.04E-04	mg/kg-day	3.00E-03	mg/kg-day	1.68E-01
				Cobalt	1.23E+01	mg/kg	1.35E-05	mg/kg-day	--	mg/kg-day	--	1.57E-04	mg/kg-day	3.00E-04	mg/kg-day	5.24E-01
				Copper	9.67E+02	mg/kg	1.06E-03	mg/kg-day	--	mg/kg-day	--	1.24E-02	mg/kg-day	4.00E-02	mg/kg-day	3.09E-01
				Iron	3.36E+04	mg/kg	3.68E-02	mg/kg-day	--	mg/kg-day	--	4.30E-01	mg/kg-day	7.00E-01	mg/kg-day	6.14E-01
				Lead	3.22E+02	mg/kg	3.53E-04	mg/kg-day	--	mg/kg-day	--	4.12E-03	mg/kg-day	--	mg/kg-day	--
				Manganese	1.32E+03	mg/kg	1.45E-03	mg/kg-day	--	mg/kg-day	--	1.69E-02	mg/kg-day	2.40E-02	mg/kg-day	7.03E-01
				Mercury	1.15E+00	mg/kg	1.26E-06	mg/kg-day	--	mg/kg-day	--	1.47E-05	mg/kg-day	1.00E-04	mg/kg-day	1.47E-01
				Nickel	3.74E+01	mg/kg	4.10E-05	mg/kg-day	--	mg/kg-day	--	4.78E-04	mg/kg-day	2.00E-02	mg/kg-day	2.39E-02
				Silver	1.60E+01	mg/kg	1.75E-05	mg/kg-day	--	mg/kg-day	--	2.05E-04	mg/kg-day	5.00E-03	mg/kg-day	4.09E-02
				Vanadium	4.45E+01	mg/kg	4.88E-05	mg/kg-day	--	mg/kg-day	--	5.69E-04	mg/kg-day	5.00E-03	mg/kg-day	1.14E-01
				Zinc	1.38E+03	mg/kg	1.51E-03	mg/kg-day	--	mg/kg-day	--	1.76E-02	mg/kg-day	3.00E-01	mg/kg-day	5.88E-02
				4,4'-DDD	4.63E+03	ug/kg	5.07E-06	mg/kg-day	2.40E-01	mg/kg-day	1.22E-06	5.92E-05	mg/kg-day	--	mg/kg-day	--
				4,4'-DDE	6.03E+02	ug/kg	6.61E-07	mg/kg-day	3.40E-01	mg/kg-day	2.25E-07	7.71E-06	mg/kg-day	--	mg/kg-day	--
				4,4'-DDT	1.73E+04	ug/kg	1.90E-05	mg/kg-day	3.40E-01	mg/kg-day	6.45E-06	2.21E-04	mg/kg-day	5.00E-04	mg/kg-day	4.42E-01
				Aroclor-1248	5.60E+02	ug/kg	6.14E-07	mg/kg-day	2.00E+00	mg/kg-day	1.23E-06	7.16E-06	mg/kg-day	--	mg/kg-day	--
				Aroclor-1254	1.34E+02	ug/kg	1.47E-07	mg/kg-day	2.00E+00	mg/kg-day	2.94E-07	1.71E-06	mg/kg-day	2.00E-05	mg/kg-day	8.57E-02
				Aroclor-1260	4.51E+01	ug/kg	4.94E-08	mg/kg-day	2.00E+00	mg/kg-day	9.88E-08	5.77E-07	mg/kg-day	--	mg/kg-day	--
				Dieldrin	7.01E+02	ug/kg	7.68E-07	mg/kg-day	1.60E+01	mg/kg-day	1.23E-05	8.96E-06	mg/kg-day	5.00E-05	mg/kg-day	1.79E-01
				Heptachlor Epoxide	1.28E+01	ug/kg	1.40E-08	mg/kg-day	9.10E+00	mg/kg-day	1.28E-07	1.64E-07	mg/kg-day	1.30E-05	mg/kg-day	1.26E-02
				Benz(a)anthracene	3.92E+03	ug/kg	4.30E-06	mg/kg-day	7.30E-01	mg/kg-day	1.67E-05	5.01E-05	mg/kg-day	--	mg/kg-day	--
				Benzo(a)pyrene	2.89E+03	ug/kg	3.17E-06	mg/kg-day	7.30E+00	mg/kg-day	1.23E-04	3.69E-05	mg/kg-day	--	mg/kg-day	--
				Benzo(b)fluoranthene	3.21E+03	ug/kg	3.52E-06	mg/kg-day	7.30E-01	mg/kg-day	1.37E-05	4.10E-05	mg/kg-day	--	mg/kg-day	--
				Benzo(k)fluoranthene	2.14E+03	ug/kg	2.35E-06	mg/kg-day	7.30E-02	mg/kg-day	9.13E-07	2.74E-05	mg/kg-day	--	mg/kg-day	--
				Chrysene	3.58E+03	ug/kg	3.92E-06	mg/kg-day	7.30E-03	mg/kg-day	1.53E-07	4.58E-05	mg/kg-day	--	mg/kg-day	--
				Dibenz(a,h)anthracene	2.80E+02	ug/kg	3.07E-07	mg/kg-day	7.30E+00	mg/kg-day	1.19E-05	3.58E-06	mg/kg-day	--	mg/kg-day	--
				Indeno(1,2,3-cd)pyrene	1.30E+03	ug/kg	1.42E-06	mg/kg-day	7.30E-01	mg/kg-day	5.55E-06	1.66E-05	mg/kg-day	--	mg/kg-day	--
				Naphthalene	7.76E+02	ug/kg	8.50E-07	mg/kg-day	--	mg/kg-day	--	9.92E-06	mg/kg-day	2.00E-02	mg/kg-day	4.96E-04
				Phenanthrene	1.25E+04	ug/kg	1.37E-05	mg/kg-day	--	mg/kg-day	--	1.60E-04	mg/kg-day	3.00E-02	mg/kg-day	5.33E-03
				Ethylbenzene	6.55E+02	ug/kg	7.18E-07	mg/kg-day	1.10E-02	mg/kg-day	7.90E-09	8.37E-06	mg/kg-day	1.00E-01	mg/kg-day	8.37E-05
			Exp. Route Total								3.54E-04					8.45E+00

TABLE 7.27.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS - RESIDENTIAL CHILD EXPOSURE TO SITE 3 LANDFILL AREA SOIL

REASONABLE MAXIMUM EXPOSURES

NAS JRB WILLOW GROVE

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
			Dermal	Total 2,3,7,8-TCDD Equiv.	2.43E-01	ug/kg	2.24E-11	mg/kg-day	1.30E+05	mg/kg-day	2.91E-06	2.61E-10	mg/kg-day	1.00E-09	mg/kg-day	2.61E-01
				Aluminum	1.98E+04	mg/kg	6.08E-04	mg/kg-day	--	mg/kg-day	--	7.09E-03	mg/kg-day	1.00E+00	mg/kg-day	7.09E-03
				Antimony	2.50E+01	mg/kg	7.67E-07	mg/kg-day	--	mg/kg-day	--	8.95E-06	mg/kg-day	6.00E-05	mg/kg-day	1.49E-01
				Arsenic	6.21E+00	mg/kg	5.72E-07	mg/kg-day	1.50E+00	mg/kg-day	8.57E-07	6.67E-06	mg/kg-day	3.00E-04	mg/kg-day	2.22E-02
				Cadmium	4.71E+01	mg/kg	1.45E-07	mg/kg-day	--	mg/kg-day	--	1.69E-06	mg/kg-day	2.50E-05	mg/kg-day	6.74E-02
				Chromium	3.94E+01	mg/kg	1.21E-06	mg/kg-day	2.00E+01	mg/kg-day	1.29E-04	1.41E-05	mg/kg-day	7.50E-05	mg/kg-day	1.88E-01
				Cobalt	1.23E+01	mg/kg	3.77E-07	mg/kg-day	--	mg/kg-day	--	4.40E-06	mg/kg-day	3.00E-04	mg/kg-day	1.47E-02
				Copper	9.67E+02	mg/kg	2.97E-05	mg/kg-day	--	mg/kg-day	--	3.46E-04	mg/kg-day	4.00E-02	mg/kg-day	8.65E-03
				Iron	3.36E+04	mg/kg	1.03E-03	mg/kg-day	--	mg/kg-day	--	1.20E-02	mg/kg-day	7.00E-01	mg/kg-day	1.72E-02
				Lead	3.22E+02	mg/kg	9.88E-06	mg/kg-day	--	mg/kg-day	--	1.15E-04	mg/kg-day	--	mg/kg-day	--
				Manganese	1.32E+03	mg/kg	4.05E-05	mg/kg-day	--	mg/kg-day	--	4.73E-04	mg/kg-day	9.60E-04	mg/kg-day	4.92E-01
				Mercury	1.15E+00	mg/kg	3.53E-08	mg/kg-day	--	mg/kg-day	--	4.12E-07	mg/kg-day	1.00E-04	mg/kg-day	4.12E-03
				Nickel	3.74E+01	mg/kg	1.15E-06	mg/kg-day	--	mg/kg-day	--	1.34E-05	mg/kg-day	8.00E-04	mg/kg-day	1.67E-02
				Silver	1.60E+01	mg/kg	4.91E-07	mg/kg-day	--	mg/kg-day	--	5.73E-06	mg/kg-day	2.00E-04	mg/kg-day	2.86E-02
				Vanadium	4.45E+01	mg/kg	1.37E-06	mg/kg-day	--	mg/kg-day	--	1.59E-05	mg/kg-day	1.30E-04	mg/kg-day	1.23E-01
				Zinc	1.38E+03	mg/kg	4.23E-05	mg/kg-day	--	mg/kg-day	--	4.94E-04	mg/kg-day	3.00E-01	mg/kg-day	1.65E-03
				4,4'-DDD	4.63E+03	ug/kg	4.26E-07	mg/kg-day	2.40E-01	mg/kg-day	1.02E-07	4.97E-06	mg/kg-day	--	mg/kg-day	--
				4,4'-DDE	6.03E+02	ug/kg	5.55E-08	mg/kg-day	3.40E-01	mg/kg-day	1.89E-08	6.48E-07	mg/kg-day	--	mg/kg-day	--
				4,4'-DDT	1.73E+04	ug/kg	1.59E-06	mg/kg-day	3.40E-01	mg/kg-day	5.41E-07	1.86E-05	mg/kg-day	5.00E-04	mg/kg-day	3.72E-02
				Aroclor-1248	5.60E+02	ug/kg	2.41E-07	mg/kg-day	2.00E+00	mg/kg-day	4.81E-07	2.81E-06	mg/kg-day	--	mg/kg-day	--
				Aroclor-1254	1.34E+02	ug/kg	5.76E-08	mg/kg-day	2.00E+00	mg/kg-day	1.15E-07	6.72E-07	mg/kg-day	2.00E-05	mg/kg-day	3.36E-02
				Aroclor-1260	4.51E+01	ug/kg	1.94E-08	mg/kg-day	2.00E+00	mg/kg-day	3.87E-08	2.26E-07	mg/kg-day	--	mg/kg-day	--
				Dieldrin	7.01E+02	ug/kg	2.15E-07	mg/kg-day	1.60E+01	mg/kg-day	3.44E-06	2.51E-06	mg/kg-day	5.00E-05	mg/kg-day	5.02E-02
				Heptachlor Epoxide	1.28E+01	ug/kg	3.93E-09	mg/kg-day	9.10E+00	mg/kg-day	3.57E-08	4.58E-08	mg/kg-day	1.30E-05	mg/kg-day	3.52E-03
				Benz(a)anthracene	3.92E+03	ug/kg	1.56E-06	mg/kg-day	7.30E-01	mg/kg-day	6.09E-06	1.82E-05	mg/kg-day	--	mg/kg-day	--
				Benzo(a)pyrene	2.89E+03	ug/kg	1.15E-06	mg/kg-day	7.30E+00	mg/kg-day	4.49E-05	1.34E-05	mg/kg-day	--	mg/kg-day	--
				Benzo(b)fluoranthene	3.21E+03	ug/kg	1.28E-06	mg/kg-day	7.30E-01	mg/kg-day	4.99E-06	1.49E-05	mg/kg-day	--	mg/kg-day	--
				Benzo(k)fluoranthene	2.14E+03	ug/kg	8.54E-07	mg/kg-day	7.30E-02	mg/kg-day	3.32E-07	9.96E-06	mg/kg-day	--	mg/kg-day	--
				Chrysene	3.58E+03	ug/kg	1.43E-06	mg/kg-day	7.30E-03	mg/kg-day	5.56E-08	1.67E-05	mg/kg-day	--	mg/kg-day	--
				Dibenz(a,h)anthracene	2.80E+02	ug/kg	1.12E-07	mg/kg-day	7.30E+00	mg/kg-day	4.35E-06	1.30E-06	mg/kg-day	--	mg/kg-day	--
				Indeno(1,2,3-cd)pyrene	1.30E+03	ug/kg	5.19E-07	mg/kg-day	7.30E-01	mg/kg-day	2.02E-06	6.05E-06	mg/kg-day	--	mg/kg-day	--
				Naphthalene	7.76E+02	ug/kg	3.10E-07	mg/kg-day	--	mg/kg-day	--	3.61E-06	mg/kg-day	2.00E-02	mg/kg-day	1.81E-04
				Phenanthrene	1.25E+04	ug/kg	4.99E-06	mg/kg-day	--	mg/kg-day	--	5.82E-05	mg/kg-day	3.00E-02	mg/kg-day	1.94E-03
				Ethylbenzene	6.55E+02	ug/kg	6.03E-08	mg/kg-day	1.10E-02	mg/kg-day	6.63E-10	7.03E-07	mg/kg-day	1.00E-01	mg/kg-day	7.03E-06
			Exp. Route Total								2.00E-04					1.53E+00
		Exposure Point Total									5.54E-04					9.98E+00
	Exposure Medium Total										5.54E-04					9.98E+00
	Air	Site 3 Landfill Area Outdoor Air, Volatilization from Soil	Inhalation	Naphthalene	7.76E+02	ug/kg	6.74E-06	mg/m3	3.40E-02	1/(mg/m3)	2.29E-07	7.87E-05	mg/m3	3.00E-03	mg/m3	2.62E-02
				Ethylbenzene	7.00E+03	ug/kg	2.38E-04	mg/m3	2.50E-03	1/(mg/m3)	5.94E-07	2.77E-03	mg/m3	1.00E+00	mg/m3	2.77E-03
			Exp. Route Total								8.24E-07					2.90E-02
		Exposure Point Total									8.24E-07					2.90E-02
	Exposure Medium Total										8.24E-07					2.90E-02
	Particulates	Site 3 Landfill Area Airborne Particulates, Emitted from Soil	Inhalation	Chromium	3.94E+01	mg/kg	5.00E-10	mg/m3	1.20E+01	1/(mg/m3)	3.20E-08	5.84E-09	mg/m3	1.00E-04	mg/m3	5.84E-05
				Manganese	1.32E+03	mg/kg	1.68E-08	mg/m3	--	1/(mg/m3)	--	1.96E-07	mg/m3	5.00E-05	mg/m3	3.91E-03
			Exp. Route Total								3.20E-08					3.97E-03
		Exposure Point Total									3.20E-08					3.97E-03
	Exposure Medium Total										3.20E-08					3.97E-03
Medium Total											5.55E-04					1.00E+01
										Total of Receptor Risks Across All Media	5.55E-04				Total of Receptor Hazards Across All Media	1.00E+01

TABLE 7.28.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS - RESIDENTIAL ADULT EXPOSURE TO SITE 3 LANDFILL AREA SOIL

REASONABLE MAXIMUM EXPOSURES

NAS JRB WILLOW GROVE

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Soil	Site 3 Landfill Area Contact with Soil	Ingestion	Total 2,3,7,8-TCDD Equiv.	2.43E-01	ug/kg	1.14E-10	mg/kg-day	1.30E+05	mg/kg-day	1.48E-05	3.33E-10	mg/kg-day	1.00E-09	mg/kg-day	3.33E-01
				Aluminum	1.98E+04	mg/kg	9.30E-03	mg/kg-day	--	mg/kg-day	--	2.71E-02	mg/kg-day	1.00E+00	mg/kg-day	2.71E-02
				Antimony	2.50E+01	mg/kg	1.17E-05	mg/kg-day	--	mg/kg-day	--	3.42E-05	mg/kg-day	4.00E-04	mg/kg-day	8.56E-02
				Arsenic	6.21E+00	mg/kg	2.92E-06	mg/kg-day	1.50E+00	mg/kg-day	4.37E-06	8.51E-06	mg/kg-day	3.00E-04	mg/kg-day	2.84E-02
				Cadmium	4.71E+01	mg/kg	2.21E-05	mg/kg-day	--	mg/kg-day	--	6.45E-05	mg/kg-day	1.00E-03	mg/kg-day	6.45E-02
				Chromium	3.94E+01	mg/kg	1.85E-05	mg/kg-day	5.00E-01	mg/kg-day	1.70E-05	5.40E-05	mg/kg-day	3.00E-03	mg/kg-day	1.80E-02
				Cobalt	1.23E+01	mg/kg	5.78E-06	mg/kg-day	--	mg/kg-day	--	1.68E-05	mg/kg-day	3.00E-04	mg/kg-day	5.62E-02
				Copper	9.67E+02	mg/kg	4.54E-04	mg/kg-day	--	mg/kg-day	--	1.32E-03	mg/kg-day	4.00E-02	mg/kg-day	3.31E-02
				Iron	3.36E+04	mg/kg	1.58E-02	mg/kg-day	--	mg/kg-day	--	4.60E-02	mg/kg-day	7.00E-01	mg/kg-day	6.58E-02
				Lead	3.22E+02	mg/kg	1.51E-04	mg/kg-day	--	mg/kg-day	--	4.41E-04	mg/kg-day	--	mg/kg-day	--
				Manganese	1.32E+03	mg/kg	6.20E-04	mg/kg-day	--	mg/kg-day	--	1.81E-03	mg/kg-day	2.40E-02	mg/kg-day	7.53E-02
				Mercury	1.15E+00	mg/kg	5.40E-07	mg/kg-day	--	mg/kg-day	--	1.58E-06	mg/kg-day	1.00E-04	mg/kg-day	1.58E-02
				Nickel	3.74E+01	mg/kg	1.76E-05	mg/kg-day	--	mg/kg-day	--	5.12E-05	mg/kg-day	2.00E-02	mg/kg-day	2.56E-03
				Silver	1.60E+01	mg/kg	7.51E-06	mg/kg-day	--	mg/kg-day	--	2.19E-05	mg/kg-day	5.00E-03	mg/kg-day	4.38E-03
				Vanadium	4.45E+01	mg/kg	2.09E-05	mg/kg-day	--	mg/kg-day	--	6.10E-05	mg/kg-day	5.00E-03	mg/kg-day	1.22E-02
				Zinc	1.38E+03	mg/kg	6.48E-04	mg/kg-day	--	mg/kg-day	--	1.89E-03	mg/kg-day	3.00E-01	mg/kg-day	6.30E-03
				4,4'-DDD	4.63E+03	ug/kg	2.17E-06	mg/kg-day	2.40E-01	mg/kg-day	5.22E-07	6.34E-06	mg/kg-day	--	mg/kg-day	--
				4,4'-DDE	6.03E+02	ug/kg	2.83E-07	mg/kg-day	3.40E-01	mg/kg-day	9.63E-08	8.26E-07	mg/kg-day	--	mg/kg-day	--
				4,4'-DDT	1.73E+04	ug/kg	8.13E-06	mg/kg-day	3.40E-01	mg/kg-day	2.76E-06	2.37E-05	mg/kg-day	5.00E-04	mg/kg-day	4.74E-02
				Aroclor-1248	5.60E+02	ug/kg	2.63E-07	mg/kg-day	2.00E+00	mg/kg-day	5.26E-07	7.67E-07	mg/kg-day	--	mg/kg-day	--
				Aroclor-1254	1.34E+02	ug/kg	6.29E-08	mg/kg-day	2.00E+00	mg/kg-day	1.26E-07	1.84E-07	mg/kg-day	2.00E-05	mg/kg-day	9.18E-03
				Aroclor-1260	4.51E+01	ug/kg	2.12E-08	mg/kg-day	2.00E+00	mg/kg-day	4.24E-08	6.18E-08	mg/kg-day	--	mg/kg-day	--
				Dieldrin	7.01E+02	ug/kg	3.29E-07	mg/kg-day	1.60E+01	mg/kg-day	5.27E-06	9.60E-07	mg/kg-day	5.00E-05	mg/kg-day	1.92E-02
				Heptachlor Epoxide	1.28E+01	ug/kg	6.01E-09	mg/kg-day	9.10E+00	mg/kg-day	5.47E-08	1.75E-08	mg/kg-day	1.30E-05	mg/kg-day	1.35E-03
				Benz(a)anthracene	3.92E+03	ug/kg	1.84E-06	mg/kg-day	7.30E-01	mg/kg-day	2.46E-06	5.37E-06	mg/kg-day	--	mg/kg-day	--
				Benzo(a)pyrene	2.89E+03	ug/kg	1.36E-06	mg/kg-day	7.30E+00	mg/kg-day	1.82E-05	3.96E-06	mg/kg-day	--	mg/kg-day	--
				Benzo(b)fluoranthene	3.21E+03	ug/kg	1.51E-06	mg/kg-day	7.30E-01	mg/kg-day	2.02E-06	4.40E-06	mg/kg-day	--	mg/kg-day	--
				Benzo(k)fluoranthene	2.14E+03	ug/kg	1.01E-06	mg/kg-day	7.30E-02	mg/kg-day	1.35E-07	2.93E-06	mg/kg-day	--	mg/kg-day	--
				Chrysene	3.58E+03	ug/kg	1.68E-06	mg/kg-day	7.30E-03	mg/kg-day	2.25E-08	4.90E-06	mg/kg-day	--	mg/kg-day	--
				Dibenz(a,h)anthracene	2.80E+02	ug/kg	1.32E-07	mg/kg-day	7.30E+00	mg/kg-day	1.76E-06	3.84E-07	mg/kg-day	--	mg/kg-day	--
				Indeno(1,2,3-cd)pyrene	1.30E+03	ug/kg	6.11E-07	mg/kg-day	7.30E-01	mg/kg-day	8.17E-07	1.78E-06	mg/kg-day	--	mg/kg-day	--
				Naphthalene	7.76E+02	ug/kg	3.64E-07	mg/kg-day	--	mg/kg-day	--	1.06E-06	mg/kg-day	2.00E-02	mg/kg-day	5.32E-05
				Phenanthrene	1.25E+04	ug/kg	5.87E-06	mg/kg-day	--	mg/kg-day	--	1.71E-05	mg/kg-day	3.00E-02	mg/kg-day	5.71E-04
				Ethylbenzene	6.55E+02	ug/kg	3.08E-07	mg/kg-day	1.10E-02	mg/kg-day	3.38E-09	8.97E-07	mg/kg-day	1.00E-01	mg/kg-day	8.97E-06
			Exp. Route Total								7.10E-05					9.06E-01

TABLE 7.28.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS - RESIDENTIAL ADULT EXPOSURE TO SITE 3 LANDFILL AREA SOIL

REASONABLE MAXIMUM EXPOSURES

NAS JRB WILLOW GROVE

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
			Dermal	Total 2,3,7,8-TCDD Equiv.	2.43E-01	ug/kg	1.37E-11	mg/kg-day	1.30E+05	mg/kg-day	1.78E-06	3.98E-11	mg/kg-day	1.00E-09	mg/kg-day	3.98E-02
				Aluminum	1.98E+04	mg/kg	3.71E-04	mg/kg-day	--	mg/kg-day	--	1.08E-03	mg/kg-day	1.00E+00	mg/kg-day	1.08E-03
				Antimony	2.50E+01	mg/kg	4.68E-07	mg/kg-day	--	mg/kg-day	--	1.37E-06	mg/kg-day	6.00E-05	mg/kg-day	2.28E-02
				Arsenic	6.21E+00	mg/kg	3.49E-07	mg/kg-day	1.50E+00	mg/kg-day	5.24E-07	1.02E-06	mg/kg-day	3.00E-04	mg/kg-day	3.39E-03
				Cadmium	4.71E+01	mg/kg	8.83E-08	mg/kg-day	--	mg/kg-day	--	2.57E-07	mg/kg-day	2.50E-05	mg/kg-day	1.03E-02
				Chromium	3.94E+01	mg/kg	7.38E-07	mg/kg-day	2.00E+01	mg/kg-day	2.71E-05	2.15E-06	mg/kg-day	7.50E-05	mg/kg-day	2.87E-02
				Cobalt	1.23E+01	mg/kg	2.30E-07	mg/kg-day	--	mg/kg-day	--	6.72E-07	mg/kg-day	3.00E-04	mg/kg-day	2.24E-03
				Copper	9.67E+02	mg/kg	1.81E-05	mg/kg-day	--	mg/kg-day	--	5.29E-05	mg/kg-day	4.00E-02	mg/kg-day	1.32E-03
				Iron	3.36E+04	mg/kg	6.30E-04	mg/kg-day	--	mg/kg-day	--	1.84E-03	mg/kg-day	7.00E-01	mg/kg-day	2.62E-03
				Lead	3.22E+02	mg/kg	6.03E-06	mg/kg-day	--	mg/kg-day	--	1.76E-05	mg/kg-day	--	mg/kg-day	--
				Manganese	1.32E+03	mg/kg	2.47E-05	mg/kg-day	--	mg/kg-day	--	7.21E-05	mg/kg-day	9.60E-04	mg/kg-day	7.52E-02
				Mercury	1.15E+00	mg/kg	2.16E-08	mg/kg-day	--	mg/kg-day	--	6.29E-08	mg/kg-day	1.00E-04	mg/kg-day	6.29E-04
				Nickel	3.74E+01	mg/kg	7.01E-07	mg/kg-day	--	mg/kg-day	--	2.04E-06	mg/kg-day	8.00E-04	mg/kg-day	2.56E-03
				Silver	1.60E+01	mg/kg	3.00E-07	mg/kg-day	--	mg/kg-day	--	8.75E-07	mg/kg-day	2.00E-04	mg/kg-day	4.37E-03
				Vanadium	4.45E+01	mg/kg	8.34E-07	mg/kg-day	--	mg/kg-day	--	2.43E-06	mg/kg-day	1.30E-04	mg/kg-day	1.87E-02
				Zinc	1.38E+03	mg/kg	2.59E-05	mg/kg-day	--	mg/kg-day	--	7.54E-05	mg/kg-day	3.00E-01	mg/kg-day	2.51E-04
				4,4'-DDD	4.63E+03	ug/kg	2.60E-07	mg/kg-day	2.40E-01	mg/kg-day	6.25E-08	7.59E-07	mg/kg-day	--	mg/kg-day	--
				4,4'-DDE	6.03E+02	ug/kg	3.39E-08	mg/kg-day	3.40E-01	mg/kg-day	1.15E-08	9.89E-08	mg/kg-day	--	mg/kg-day	--
				4,4'-DDT	1.73E+04	ug/kg	9.73E-07	mg/kg-day	3.40E-01	mg/kg-day	3.31E-07	2.84E-06	mg/kg-day	5.00E-04	mg/kg-day	5.67E-03
				Aroclor-1248	5.60E+02	ug/kg	1.47E-07	mg/kg-day	2.00E+00	mg/kg-day	2.94E-07	4.29E-07	mg/kg-day	--	mg/kg-day	--
				Aroclor-1254	1.34E+02	ug/kg	3.52E-08	mg/kg-day	2.00E+00	mg/kg-day	7.03E-08	1.03E-07	mg/kg-day	2.00E-05	mg/kg-day	5.13E-03
				Aroclor-1260	4.51E+01	ug/kg	1.18E-08	mg/kg-day	2.00E+00	mg/kg-day	2.37E-08	3.45E-08	mg/kg-day	--	mg/kg-day	--
				Dieldrin	7.01E+02	ug/kg	1.31E-07	mg/kg-day	1.60E+01	mg/kg-day	2.10E-06	3.83E-07	mg/kg-day	5.00E-05	mg/kg-day	7.66E-03
				Heptachlor Epoxide	1.28E+01	ug/kg	2.40E-09	mg/kg-day	9.10E+00	mg/kg-day	2.18E-08	7.00E-09	mg/kg-day	1.30E-05	mg/kg-day	5.38E-04
				Benz(a)anthracene	3.92E+03	ug/kg	9.55E-07	mg/kg-day	7.30E-01	mg/kg-day	1.28E-06	2.79E-06	mg/kg-day	--	mg/kg-day	--
				Benzo(a)pyrene	2.89E+03	ug/kg	7.04E-07	mg/kg-day	7.30E+00	mg/kg-day	9.42E-06	2.05E-06	mg/kg-day	--	mg/kg-day	--
				Benzo(b)fluoranthene	3.21E+03	ug/kg	7.82E-07	mg/kg-day	7.30E-01	mg/kg-day	1.05E-06	2.28E-06	mg/kg-day	--	mg/kg-day	--
				Benzo(k)fluoranthene	2.14E+03	ug/kg	5.21E-07	mg/kg-day	7.30E-02	mg/kg-day	6.98E-08	1.52E-06	mg/kg-day	--	mg/kg-day	--
				Chrysene	3.58E+03	ug/kg	8.72E-07	mg/kg-day	7.30E-03	mg/kg-day	1.17E-08	2.54E-06	mg/kg-day	--	mg/kg-day	--
				Dibenz(a,h)anthracene	2.80E+02	ug/kg	6.82E-08	mg/kg-day	7.30E+00	mg/kg-day	9.13E-07	1.99E-07	mg/kg-day	--	mg/kg-day	--
				Indeno(1,2,3-cd)pyrene	1.30E+03	ug/kg	3.17E-07	mg/kg-day	7.30E-01	mg/kg-day	4.24E-07	9.24E-07	mg/kg-day	--	mg/kg-day	--
				Naphthalene	7.76E+02	ug/kg	1.89E-07	mg/kg-day	--	mg/kg-day	--	5.51E-07	mg/kg-day	2.00E-02	mg/kg-day	2.76E-05
				Phenanthrene	1.25E+04	ug/kg	3.05E-06	mg/kg-day	--	mg/kg-day	--	8.88E-06	mg/kg-day	3.00E-02	mg/kg-day	2.96E-04
				Ethylbenzene	6.55E+02	ug/kg	3.68E-08	mg/kg-day	1.10E-02	mg/kg-day	4.05E-10	1.07E-07	mg/kg-day	1.00E-01	mg/kg-day	1.07E-06
			Exp. Route Total								4.55E-05					2.33E-01
		Exposure Point Total									1.16E-04					1.14E+00
	Exposure Medium Total										1.16E-04					1.14E+00
	Air	Site 3 Landfill Area Outdoor Air, Volatilization from Soil	Inhalation	Naphthalene	7.76E+02	ug/kg	2.70E-05	mg/m3	3.40E-02	1/(mg/m3)	9.17E-07	7.87E-05	mg/m3	3.00E-03	mg/m3	2.62E-02
				Ethylbenzene	7.00E+03	ug/kg	9.51E-04	mg/m3	2.50E-03	1/(mg/m3)	2.38E-06	2.77E-03	mg/m3	1.00E+00	mg/m3	2.77E-03
			Exp. Route Total								3.29E-06					2.90E-02
		Exposure Point Total									3.29E-06					2.90E-02
	Exposure Medium Total										3.29E-06					2.90E-02
	Particulates	Site 3 Landfill Area Airborne Particulates, Emitted from Soil	Inhalation	Chromium	3.94E+01	mg/kg	2.00E-09	mg/m3	1.20E+01	1/(mg/m3)	4.40E-08	5.84E-09	mg/m3	1.00E-04	mg/m3	5.84E-05
				Manganese	1.32E+03	mg/kg	6.71E-08	mg/m3	--	1/(mg/m3)	--	1.96E-07	mg/m3	5.00E-05	mg/m3	3.91E-03
			Exp. Route Total								4.40E-08					3.97E-03
		Exposure Point Total									4.40E-08					3.97E-03
	Exposure Medium Total										4.40E-08					3.97E-03
Medium Total											1.20E-04					1.17E+00
										Total of Receptor Risks Across All Media	1.20E-04				Total of Receptor Hazards Across All Media	1.17E+00