Click Here to Return to Main Document

Appendix F.8

Sample Calculations

TETRA TECH NUS, INC. **CALCULATION WORKSHEET**

CLIENT Raymark - Ferry Creek	JOB NUMBER 7491
SUBJECT Incidental Ingestion of Soil - Commercial Worker (	DRAWING NUMBER
BASED ON RAGs 1989	APPROVED BY / DATE 3/24/00
BY JMM / CHECKED BY NJF	

Purpose: To calculate Noncarcinogenic and Carcinogenic risk for the commercial worker via incidental ingestion of site soil

Relevant Equations:

$$\text{Intake (mg/kg day)} = \frac{Cs \times IR \times CF \times FI \times EF \times ED}{BW \times AT}$$

where:

Cs = Concentration in soil (mg/kg)
IR = Soil ingestion Rate (mg/day)
CF = Conversion Factor (Kg/mg)
FI = Fraction of soil from contaminated source (unitless)
EF = Exposure Frequency (days/year)
ED = Exposure Duration (years)
BW = Body weight (Kg)
AT_N = Averaging Time for noncarcinogenic exposures (days)
AT_C = Averaging Time for carcinogenic exposures (days)

and

RME - Reasonable Maximum Exposure		CTE - Central Tendency Exposure	
Cs	Chemical specific	Cs	Chemical specific
IR	100 (mg/day)	IR	50 (mg/day)
CF	$1.0 E^{-6}$ (Kg/mg)	CF	$1.0 E^{-6}$ (Kg/mg)
FI	1 (unitless)	FI	1 (unitless)
EF	250 (days/year)	EF	250 (days/year)
ED	25 years	ED	9 years
BW	70 Kg	BW	70 Kg
AT_C	25,550 (days)	AT_C	25,550 days
AT_N	9,125 (days)	AT_N	3,285 days

TETRA TECH NUS, INC. CALCULATION WORKSHEET

CLIENT Raymark - Ferry Creek		JOB NUMBER 7491	PAGE 2 OF 3
SUBJECT Incidental Ingestion of soil - Commercial Worker (soil)			
BASED ON RAGs 1989		DRAWING NUMBER	
BY JMM	CHECKED BY RJV	APPROVED BY	DATE 3/24/00

Intake of arsenic at a concentration of 7.9 mg/kg in surface soil in Area B under the RME assumptions.

RME Noncarcinogenic Intake (mg/kg-day) of Arsenic

$$= \frac{7.9\,mg/kg \times 100\,mg/day \times 1E^{-6}\,kg/mg \times 1 \times 250\,days/yr \times 25\,yrs}{70\,kg \times 9{,}125\,days}$$

$$= 7.73\,E^{-6}\,mg/kg\text{-}day$$ ✓

RME Carcinogenic Intake (mg/kg-day) of Arsenic

$$= \frac{7.9\,mg/kg \times 100\,mg/day \times 1E^{-6}\,kg/mg \times 1 \times 250\,days/yr \times 25\,yrs}{70\,kg \times 25{,}550\,days}$$

$$= 2.76\,E^{-6}\,mg/kg\text{-}day$$ ✓

Then Incremental Cancer Risk (ICR) and Hazard Quotient (HQ) are calculated using the following equations:

ICR = Carcinogenic Intake × Cancer Slope Factor (CSF)
(unitless) (mg/kg-day) (kg/mg-day)

HQ = $\frac{\text{noncarcinogenic intake } mg/kg\text{-}day}{\text{Reference Dose (RFD) } mg/kg\text{-}day}$
(unitless)

where the CSF for arsenic = $1.5E^{+0}$ and the RFD for arsenic = $3.0E^{-4}$

ICR arsenic = $2.76E^{-6}$ (mg/kg-day) × $1.5E^{+0}$ kg/mg-day = $4.1\,E^{-6}$ under RME ✓
(unitless)

HQ arsenic = $\frac{7.73E^{-6}\,mg/kg\text{-}day}{3.0E^{-4}\,mg/kg\text{-}day}$ = $2.6\,E^{-2}$ under RME ✓
(unitless)

CLIENT Raymark-Ferry Creek	JOB NUMBER
SUBJECT Incidental Ingestion of Soil - Commercial Worker (Soil)	
BASED ON RAGs 1989	DRAWING NUMBER
BY JMM / CHECKED BY RJR	APPROVED BY / DATE 3/24/00

Intake of Arsenic at a concentration of 4.8 mg/kg in Area B surface soil under the CTE assumptions.

CTE Noncarcinogenic Intake (mg/kg-day) $= \frac{4.8\,mg/kg \times 50\,mg/day \times 1E^{-6}\,kg/mg \times 1 \times 250\,days/yr \times 9\,yrs}{70\,kg \times 3{,}285\,days}$

$= \boxed{2.35\,E^{-6}\,mg/kg\text{-}day}$ ✓

CTE Carcinogenic Intake (mg/kg-day) $= \frac{4.8\,mg/kg \times 50\,mg/day \times 1E^{-6}\,kg/mg \times 1 \times 250\,days/yr \times 9\,yrs}{70\,kg \times 25{,}550\,days}$

$= \boxed{3.02\,E^{-7}\,mg/kg\text{-}day}$ ✓

then ICR and HQ are calculated for arsenic where the

ICR arsenic (unitless) $= 3.02E^{-7}\,mg/kg\text{-}day \times 1.5\,E^{+0}\,kg/mg\text{-}day = \boxed{4.5\,E^{-7}}$ ✓ under CTE

HQ arsenic (unitless) $= \frac{2.35E^{-6}\,mg/kg\text{-}day}{3.00\,E^{-4}\,mg/kg\text{-}day} = \boxed{7.8\,E^{-3}}$ under CTE ✓

References

U.S. EPA Dec. 1989. Risk Assessment Guidance for Superfund Volume I Human Health Evaluation Manual (Part A) Interim Final. OSWER EPA/540/1-89/002.

RISK ASSESSMENT SPREADSHEET - INCIDENTAL INGESTION OF SOIL

-1-

SITE NAME: AREA B, DELBUONO WETLANDS
LOCATION: FERRY CREEK, STRATFORD, CT
EXPOSURE SCENARIO: CURRENT/FUTURE COMMERCIAL/INDUSTRIAL WORKER - RME ✓
MEDIA: SURFACE SOIL
DATE: FEBRUARY 9, 2000

HAZARD INDICES AND INCREMENTAL CANCER RISKS ARE CALCULATED BY THIS SPREADSHEET.
EXPOSURES THROUGH INCIDENTAL INGESTION OF SOIL ARE CONSIDERED.
ASSUMPTIONS ARE OUTLINED BELOW.

RELEVANT EQUATION: $\text{Intake} = \frac{Cs \times IR \times CF \times FI \times EF \times ED}{BW \times AT}$

WHERE:

Cs = :		Concentration in soil (mg/kg)
IR = :	100	Soil Ingestion Rate (mg/day) ✓
CF = :	1.0E-06	Conversion Factor (kg/mg)
FI = :	1	Fraction from contaminated source (unitless)
EF = :	250	Exposure Frequency (days/year)
ED = :	25	Exposure Duration (years)
BW = :	70	Body Weight (kg)
ATc = :	25,550	Averaging time for carcinogenic exposures (days)
ATn = :	9,125	Averaging time for noncarcinogenic exposures (days)

Unit Dose
Lifetime Chronic Daily Int: 3.5E-07 kg-soil/kg-wt/day
Chronic Daily Intake = : 9.8E-07 kg-soil/kg-wt/day

RISK ASSESSMENT SPREADSHEET - INCIDENTAL INGESTION OF SOIL (PAGE TWO)

SITE NAME: AREA B, DELBUONO WETLANDS
LOCATION: FERRY CREEK, STRATFORD, CT
EXPOSURE SCENARIO: CURRENT/FUTURE COMMERCIAL/INDUSTRIAL WORKER - RME
MEDIA: SURFACE SOIL
DATE: FEBRUARY 9, 2000

CHEMICAL	Cs (mg/kg)	Lifetime Chronic Daily Intake (mg/kg/day)	Chronic Daily Intake (mg/kg/day)	Cancer Slope Factor $(mg/kg/day)^{-1}$	Reference Dose (mg/kg/day)	Lifetime Cancer Risk	Percent Cancer Risk	Hazard Quotient	Percent Hazard Quotient
Benzo(a)anthracene	0.19✓	6.6E-08	1.9E-07	7.30E-01	NA	4.8E-08	0.4%	NA	NA
Benzo(a)pyrene	0.18✓	6.3E-08	1.8E-07	7.30E+00	NA	4.6E-07	3.5%	NA	NA
Benzo(b)fluoranthene	0.34✓	1.2E-07	3.3E-07	7.30E-01	NA	8.7E-08	0.7%	NA	NA
Indeno(1,2,3-cd)pyrene	0.12✓	4.2E-08	1.2E-07	7.30E-01	NA	3.1E-08	0.2%	NA	NA
Aroclor, total	3.9✓	1.4E-06	3.8E-06	2.00E+00	NA	2.7E-06	20.7%	NA	NA
Dieldrin	0.08✓	2.8E-08	7.8E-08	1.60E+01	5.00E-05	4.5E-07	3.4%	1.6E-03	3.4%
Arsenic	7.9✓	2.8E-06	7.7E-06	1.50E+00	3.00E-04	4.1E-06	31.4%	2.6E-02	56.1%
Barium	75✓	2.6E-05	7.3E-05	NA	7.00E-02	NA	NA	1.0E-03	2.3%
Chromium (total)	21.2✓	7.4E-06	2.1E-05	NA	3.00E-03	NA	NA	6.9E-03	15.1%
Manganese	373✓	1.3E-04	3.6E-04	NA	1.40E-01	NA	NA	2.6E-03	5.7%
Mercury	0.71✓	2.5E-07	6.9E-07	NA	3.00E-04	NA	NA	2.3E-03	5.0%
Nickel	16.7✓	5.8E-06	1.6E-05	NA	2.00E-02	NA	NA	8.2E-04	1.8%
Vanadium	34.8✓	1.2E-05	3.4E-05	NA	7.00E-03	NA	NA	4.9E-03	10.6%
TEQ - Dioxins/Furans	0.0001✓	3.5E-11	9.8E-11	1.50E+05	NA	5.2E-06	39.8%	NA	NA
					Total	1.3E-05	100.0%	4.6E-02	100.0%

RISK ASSESSMENT SPREADSHEET - INCIDENTAL INGESTION OF SOIL

SITE NAME: AREA B, DELBUONO WETLANDS
LOCATION: FERRY CREEK, STRATFORD, CT
EXPOSURE SCENARIO: CURRENT/FUTURE COMMERCIAL/INDUSTRIAL WORKER - CTE ✓
MEDIA: SURFACE SOIL
DATE: FEBRUARY 8, 2000 ✓

HAZARD INDICES AND INCREMENTAL CANCER RISKS ARE CALCULATED BY THIS SPREADSHEET.
EXPOSURES THROUGH INCIDENTAL INGESTION OF SOIL ARE CONSIDERED.
ASSUMPTIONS ARE OUTLINED BELOW.

RELEVANT EQUATION: $\text{Intake} = \frac{Cs \times IR \times CF \times FI \times EF \times ED}{BW \times AT}$

WHERE:

Cs = :		Concentration in soil (mg/kg)
IR = :	50	Soil Ingestion Rate (mg/day) ✓
CF = :	1.0E-06	Conversion Factor (kg/mg)
FI = :	1	Fraction from contaminated source (unitless)
EF = :	250	Exposure Frequency (days/year)
ED = :	9	Exposure Duration (years)
BW = :	70	Body Weight (kg)
ATc = :	25,550	Averaging time for carcinogenic exposures (days)
ATn = :	3,285	Averaging time for noncarcinogenic exposures (days)

Unit Dose		
Lifetime Chronic Daily Int	6.3E-08	kg-soil/kg-wt/day
Chronic Daily Intake = :	4.9E-07	kg-soil/kg-wt/day

RISK ASSESSMENT SPREADSHEET - INCIDENTAL INGESTION OF SOIL (PAGE TWO)

SITE NAME: AREA B, DELBUONO WETLANDS
LOCATION: FERRY CREEK, STRATFORD, CT
EXPOSURE SCENARIO: CURRENT/FUTURE COMMERCIAL/INDUSTRIAL WORKER - CTE
MEDIA: SURFACE SOIL
DATE: FEBRUARY 8, 2000

CHEMICAL	Cs (mg/kg)	Lifetime Chronic Daily Intake (mg/kg/day)	Chronic Daily Intake (mg/kg/day)	Cancer Slope Factor $(mg/kg/day)^{-1}$	Reference Dose (mg/kg/day)	Lifetime Cancer Risk	Percent Cancer Risk	Hazard Quotient	Percent Hazard Quotient
Benzo(a)anthracene	0.19 ✓	1.2E-08	9.3E-08	7.30E-01	NA	8.7E-09	0.7%	NA	NA
Benzo(a)pyrene	0.18 ✓	1.1E-08	8.8E-08	7.30E+00	NA	8.3E-08	6.7%	NA	NA
Benzo(b)fluoranthene	0.2 ✓	1.3E-08	9.8E-08	7.30E-01	NA	9.2E-09	0.7%	NA	NA
Indeno(1,2,3-cd)pyrene	0.12 ✓	7.5E-09	5.9E-08	7.30E-01	NA	5.5E-09	0.4%	NA	NA
Aroclor, total	1.1 ✓	6.9E-08	5.4E-07	1.00E+00	NA	6.9E-08	5.6%	NA	NA
Dieldrin	0.021 ✓	1.3E-09	1.0E-08	1.60E+01	5.00E-05	2.1E-08	1.7%	2.1E-04	1.5%
Arsenic	4.8 ✓	3.0E-07	2.3E-06	1.50E+00	3.00E-04	4.5E-07	36.7%	7.8E-03	56.5%
Barium	44.4 ✓	2.8E-06	2.2E-05	NA	7.00E-02	NA	NA	3.1E-04	2.2%
Chromium (total)	12.9 ✓	8.1E-07	6.3E-06	NA	3.00E-03	NA	NA	2.1E-03	15.2%
Manganese	254 ✓	1.6E-05	1.2E-04	NA	1.40E-01	NA	NA	8.9E-04	6.4%
Mercury	0.33 ✓	2.1E-08	1.6E-07	NA	3.00E-04	NA	NA	5.4E-04	3.9%
Nickel	14.8 ✓	9.3E-07	7.2E-06	NA	2.00E-02	NA	NA	3.6E-04	2.6%
Vanadium	23.3 ✓	1.5E-06	1.1E-05	NA	7.00E-03	NA	NA	1.6E-03	11.7%
TEQ - Dioxins/Furans	0.000062 ✓	3.9E-12	3.0E-11	1.50E+05	NA	5.8E-07	47.4%	NA	NA
					Total	1.2E-06	100.0%	1.4E-02	100.0%

TETRA TECH NUS, INC. **CALCULATION WORKSHEET**

CLIENT: Raymark-Ferry Creek	JOB NUMBER: 7491
SUBJECT: Direct Dermal Contact with Soil - Commercial Worker (Soil)	
BASED ON: RAGs 1989	DRAWING NUMBER:
BY: JMM / CHECKED BY: RJV	APPROVED BY: / DATE: 3/24/00

Purpose: To calculate carcinogenic and noncarcinogenic risk for the commercial worker via direct dermal contact with site soils.

Relevant equation:

$$\text{Absorbed dose (mg/Kg-day)} = \frac{Cs \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT}$$

where:

Cs = Chemical concentration in Soil (mg/Kg)
CF = Conversion Factor (Kg/mg)
SA = Skin Surface available for contact (cm^2/event)
AF = Soil to Skin adherence factor (mg/cm^2)
ABS = Absorption factor (unitless)
EF = Exposure Frequency (events/year)
ED = Exposure Duration (years)
BW = Body Weight (Kg)
AT_N = Averaging Time for noncarcinogenic exposures (days)
AT_C = Averaging Time for carcinogenic exposures (days)

and

RME - Reasonable Maximum Exposure		CTE - Central Tendency Exposure	
Cs	chemical specific (mg/Kg)	Cs	chemical specific (mg/Kg)
CF	$1.0E^{-6}$ (Kg/mg)	CF	$1.0E^{-6}$ (Kg/mg)
SA	2,500 (cm^2/event)	SA	2,500 (cm^2/event)
AF	0.20 (mg/cm^2)	AF	0.03 (mg/cm^2)
ABS	chemical specific (unitless)	ABS	chemical specific (unitless)
EF	250 events/year	EF	250 events/year
ED	25 years	ED	9 years
BW	70 Kg	BW	70 Kg
AT_N	9,125 days	AT_N	3,285 days
AT_C	26,550 days	AT_C	25,550 days

CLIENT Raymark - Ferry Creek	JOB NUMBER 7491
SUBJECT Direct Dermal Contact with Soil - Commercial Worker (Soil)	
BASED ON RAGs 1989	DRAWING NUMBER
BY JMM / CHECKED BY RJV	APPROVED BY / DATE 3/24/00

Absorbed dose of arsine at a concentration of 7.9 mg/Kg in Area B A#1, all soil, under RME assumptions is calculated:

RME Noncarcinogenic Absorbed Dose (mg/Kg-day)

$$= \frac{7.9\,mg/Kg \times 1.0E^{-6}\,Kg/mg \times 2500\,cm^2/event \times 0.20\,mg/cm^2 \times 0.03 \times 250\,events/yr \times 25}{70\,Kg \times 9{,}125\,days}$$

$$= \boxed{1.16\,E^{-6}\,mg/Kg/day} \checkmark$$

RME Carcinogenic Absorbed dose mg/Kg-day

$$= \frac{7.9\,mg/Kg \times 1.0E^{-6}\,Kg/mg \times 2500\,cm^2/event \times 0.20\,mg/cm^2 \times .03 \times 250\,events/yr \times 25\,years}{70\,Kg \times 25{,}550\,days}$$

$$= \boxed{4.14\,E^{-7}\,mg/Kg\text{-}day} \checkmark$$

Then incremental Cancer Risk (ICR) and Hazard Quotient (HQ) are calculated via the following equations:

ICR (unitless) = Carcinogenic Absorbed Dose (mg/Kg-day) × Cancer Slope Factor (CSF) (Kg/mg-day)

HQ (unitless) = $\frac{\text{noncarcinogenic absorbed Dose (mg/Kg-day)}}{\text{Reference Dose (RfD) (mg/Kg-day)}}$

Where the CSF of As = 1.5 E+0 and the RfD = 3.0 E^{-4}

$$ICR = 4.14E^{-7}\,(mg/Kg\text{-}day) \times 1.5E^{+0}\,(Kg/mg\text{-}day) = \boxed{6.2\,E^{-7}}\ \text{RME} \checkmark$$

$$HQ = \frac{1.16E^{-6}\,mg/Kg\text{-}day}{3.0E^{-4}\,mg/Kg\text{-}day} = \boxed{3.9\,E^{-3}}\ \text{RME} \checkmark$$

TETRA TECH NUS, INC. **CALCULATION WORKSHEET**

CLIENT: Raymark - Ferry Creek	JOB NUMBER:
SUBJECT: Direct Dermal Contact with soil - Commercial worker	
BASED ON:	DRAWING NUMBER:
BY: JMM	CHECKED BY: R/P
APPROVED BY:	DATE: 3-24-00

Absorbed dose of Arsenic at a concentration of 4.5 mg/kg in Area B, A#1, all soil under CTE assumption is calculated

CTE Noncarcinogenic Absorbed dose (mg/kg-day)

$$= \frac{4.5\,mg/kg \times 1.0E^{-6}\,kg/mg \times 2500\,cm^2/event \times 0.02\,mg/cm^2 \times .03 \times 250\,events/yr \times 9\,yrs}{70\,kg \times 3{,}285\,days}$$

$$= \boxed{6.61\,E^{-8}\ mg/kg\text{-}day}$$ ✓

CTE Carcinogenic Absorbed Dose (mg/kg-day)

$$= \frac{4.5\,mg/kg \times 1.0E^{-6}\,kg/mg \times 2{,}500\,cm^2/event \times 0.02\,mg/cm^2 \times .03 \times 250\,events/yr \times 9\,yrs}{70\,kg \times 25{,}550\,days}$$

$$= \boxed{8.49\,E^{-9}\ mg/kg\text{-}day}$$ ✓

ICR Arsenic CTE (unitless) $= 8.49E^{-9}\,(mg/kg\text{-}day) \times 1.5\,E^{+0}\,(kg/mg\text{-}day) = \boxed{1.3\,E^{-8}}$ CTE ✓

HQ Arsenic CTE (unitless) $= \dfrac{6.61\,E^{-8}\,mg/kg\text{-}day}{3.0\,E^{-4}\,mg/kg\text{-}day} = \boxed{2.2\,E^{-4}}$ CTE ✓

Reference

USEPA 1989. Risk Assessment Guidance for Superfund Volume 1. Human Health Evaluation Manual (Part A) Interim Final OSWER EPA/540/1-89/002.

RISK ASSESSMENT SPREADSHEET - DIRECT DERMAL CONTACT WITH SOIL

SITE NAME: AREA B, DELBUONO WETLANDS
LOCATION: FERRY CREEK, STRATFORD, CT
EXPOSURE SCENARIO: FUTURE COMMERCIAL/INDUSTRIAL WORKER - RME - AREA #1
MEDIA: ALL SOIL
DATE: FEBRUARY 9, 2000

HAZARD INDICES AND INCREMENTAL CANCER RISKS ARE CALCULATED BY THIS SPREADSHEET.
EXPOSURES THROUGH DERMAL CONTACT WITH SOIL ARE CONSIDERED.
ASSUMPTIONS ARE OUTLINED BELOW.

RELEVANT EQUATION: $\text{AbsorbedDose} = \frac{Cs \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT}$

Where:			
	Cs = :		Concentration in soil (mg/kg)
	CF = :	1.0E-06	Conversion factor (kg/mg)
	SA = :	2,500	Skin surface available for contact (cm^2/event) ✓
	AF = :	0.20	Soil to skin adherence factor (mg/cm^2) ✓
	ABS = :		Absorption factor (unitless)
	EF = :	250	Exposure frequency (events/year)
	ED = :	25	Exposure duration (years)
	BW = :	70	Body weight (kg)
	ATc = :	25,550	Averaging time for carcinogenic exposures (days)
	ATn = :	9,125	Averaging time for noncarcinogenic exposures (days)

Unit Dose
Lifetime Chronic Daily Inta 1.7E-06 kg-soil/kg-wt/day
Chronic Daily Intake = : 4.9E-06 kg-soil/kg-wt/day

RISK ASSESSMENT SPREADSHEET - DIRECT DERMAL CONTACT WITH SOIL (PAGE TWO)

SITE NAME: AREA B, DELBUONO WETLANDS
LOCATION: FERRY CREEK, STRATFORD, CT
EXPOSURE SCENARIO: FUTURE COMMERCIAL/INDUSTRIAL WORKER - RME - AREA #1
MEDIA: ALL SOIL
DATE: FEBRUARY 9, 2000

CHEMICAL	Cs (mg/kg)	ABS (unitless)	Lifetime Chronic Daily Intake (mg/kg/day)	Chronic Daily Intake (mg/kg/day)	Cancer Slope Factor $(mg/kg/day)^{-1}$	Reference Dose (mg/kg/day)	Lifetime Cancer Risk	Percent Cancer Risk	Hazard Quotient	Percent Hazard Quotient
Benzo(a)anthracene	0.78 ✓	0.13	1.77E-07	4.96E-07	7.30E-01	NA	1.3E-07	2.8%	NA	NA
Benzo(a)pyrene	0.49 ✓	0.13	1.11E-07	3.12E-07	7.30E+00	NA	8.1E-07	17.7%	NA	NA
Benzo(b)fluoranthene	1 ✓	0.13	2.27E-07	6.36E-07	7.30E-01	NA	1.7E-07	3.6%	NA	NA
Bis(2-ethylhexyl)phthalate	0.06 ✓	NA	NA	NA	1.40E-02	2.00E-02	NA	NA	NA	NA
Dibenzo(a,h)anthracene	0.072 ✓	0.13	1.64E-08	4.58E-08	7.30E+00	NA	1.2E-07	2.6%	NA	NA
Indeno(1,2,3-cd)pyrene	0.28 ✓	0.13	6.36E-08	1.78E-07	7.30E-01	NA	4.6E-08	1.0%	NA	NA
Aroclor, total	3.9 ✓	0.14	9.54E-07	2.67E-06	2.00E+00	NA	1.9E-06	41.6%	NA	NA
Alpha-chlordane	0.016 ✓	0.04	1.12E-09	3.13E-09	3.50E-01	5.00E-04	3.9E-10	0.0%	6.3E-06	0.1%
Dieldrin	0.08	NA	NA	NA	1.60E+01	5.00E-05	NA	NA	NA	NA
Arsenic	7.9	0.03	4.14E-07	1.16E-06	1.50E+00	3.00E-04	6.2E-07	13.5%	3.9E-03	85.8%
Barium	164	NA	NA	NA	NA	4.90E-03	NA	NA	NA	NA
Cadmium	0.65	0.01	1.14E-08	3.18E-08	NA	5.00E-05	NA	NA	6.4E-04	14.1%
Chromium (total)	38.5	NA	NA	NA	NA	7.50E-05	NA	NA	NA	NA
Manganese	373	NA	NA	NA	NA	8.40E-03	NA	NA	NA	NA
Mercury	0.71	NA	NA	NA	NA	2.10E-05	NA	NA	NA	NA
Nickel	24.2	NA	NA	NA	NA	8.00E-04	NA	NA	NA	NA
Vanadium	38.3	NA	NA	NA	NA	1.80E-04	NA	NA	NA	NA
Zinc	264	NA	NA	NA	NA	3.00E-01	NA	NA	NA	NA
TEQ - Dioxins/Furans	0.0001	0.03	5.24E-12	1.47E-11	1.50E+05	NA	7.9E-07	17.1%	NA	NA
						Total	4.6E-06	100.0%	4.5E-03	100.0%

RISK ASSESSMENT SPREADSHEET - DIRECT DERMAL CONTACT WITH SOIL

SITE NAME: AREA B, DELBUONO WETLANDS
LOCATION: FERRY CREEK, STRATFORD, CT
EXPOSURE SCENARIO: FUTURE COMMERCIAL/INDUSTRIAL WORKER - CTE - AREA #1
MEDIA: ALL SOIL
DATE: FEBRUARY 9, 2000

HAZARD INDICES AND INCREMENTAL CANCER RISKS ARE CALCULATED BY THIS SPREADSHEET.
EXPOSURES THROUGH DERMAL CONTACT WITH SOIL ARE CONSIDERED.
ASSUMPTIONS ARE OUTLINED BELOW.

RELEVANT EQUATION: $\text{Absorbed Dose} = \frac{Cs \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT}$

Where:			
	Cs = :		Concentration in soil (mg/kg)
	CF = :	1.0E-06	Conversion factor (kg/mg)
	SA = :	2,500	Skin surface available for contact (cm^2/event) ✓
	AF = :	0.02	Soil to skin adherence factor (mg/cm^2) ✓
	ABS = :		Absorption factor (unitless)
	EF = :	250	Exposure frequency (events/year)
	ED = :	9	Exposure duration (years)
	BW = :	70	Body weight (kg)
	ATc = :	25,550	Averaging time for carcinogenic exposures (days)
	ATn = :	3,285	Averaging time for noncarcinogenic exposures (days)

Unit Dose		
Lifetime Chronic Daily Inta	6.3E-08	kg-soil/kg-wt/day
Chronic Daily Intake = :	4.9E-07	kg-soil/kg-wt/day

RISK ASSESSMENT SPREADSHEET - DIRECT DERMAL CONTACT WITH SOIL (PAGE TWO)

SITE NAME: AREA B, DELBUONO WETLANDS
LOCATION: FERRY CREEK, STRATFORD, CT
EXPOSURE SCENARIO: FUTURE COMMERCIAL/INDUSTRIAL WORKER - CTE - AREA #1
MEDIA: ALL SOIL
DATE: FEBRUARY 9, 2000

CHEMICAL	Cs (mg/kg)	ABS (unitless)	Lifetime Chronic Daily Intake (mg/kg/day)	Chronic Daily Intake (mg/kg/day)	Cancer Slope Factor $(mg/kg/day)^{-1}$	Reference Dose (mg/kg/day)	Lifetime Cancer Risk	Percent Cancer Risk	Hazard Quotient	Percent Hazard Quotient
Benzo(a)anthracene	0.26 ✓	0.13	2.13E-09	1.65E-08	7.30E-01	NA	1.6E-09	3.1%	NA	NA
Benzo(a)pyrene	0.2 ✓	0.13	1.64E-09	1.27E-08	7.30E+00	NA	1.2E-08	24.1%	NA	NA
Benzo(b)fluoranthene	0.29 ✓	0.13	2.37E-09	1.84E-08	7.30E-01	NA	1.7E-09	3.5%	NA	NA
Bis(2-ethylhexyl)phthalate	0.06 ✓	NA	NA	NA	1.40E-02	2.00E-02	NA	NA	NA	NA
Dibenzo(a,h)anthracene	0.072 ✓	0.13	5.89E-10	4.58E-09	7.30E+00	NA	4.3E-09	8.7%	NA	NA
Indeno(1,2,3-cd)pyrene	0.17 ✓	0.13	1.39E-09	1.08E-08	7.30E-01	NA	1.0E-09	2.0%	NA	NA
Aroclor, total	0.63 ✓	0.14	5.55E-09	4.32E-08	1.00E+00	NA	5.5E-09	11.2%	NA	NA
Alpha-chlordane	0.003 ✓	0.04	7.55E-12	5.87E-11	3.50E-01	5.00E-04	2.6E-12	0.0%	1.2E-07	0.0%
Dieldrin	0.012 ✓	NA	NA	NA	1.60E+01	5.00E-05	NA	NA	NA	NA
Arsenic	4.5 ✓	0.03	8.49E-09	6.60E-08	1.50E+00	3.00E-04	1.3E-08	25.7%	2.2E-04	87.2%
Barium	61.7 ✓	NA	NA	NA	NA	4.90E-03	NA	NA	NA	NA
Cadmium	0.33 ✓	0.01	2.08E-10	1.61E-09	NA	5.00E-05	NA	NA	3.2E-05	12.8%
Chromium (total)	18.5 ✓	NA	NA	NA	NA	7.50E-05	NA	NA	NA	NA
Manganese	235 ✓	NA	NA	NA	NA	8.40E-03	NA	NA	NA	NA
Mercury	0.25 ✓	NA	NA	NA	NA	2.10E-05	NA	NA	NA	NA
Nickel	14.8 ✓	NA	NA	NA	NA	8.00E-04	NA	NA	NA	NA
Vanadium	24.1 ✓	NA	NA	NA	NA	1.80E-04	NA	NA	NA	NA
Zinc	138 ✓	NA	NA	NA	NA	3.00E-01	NA	NA	NA	NA
TEQ - Dioxins/Furans	0.000038 ✓	0.03	7.17E-14	5.58E-13	1.50E+05	NA	1.1E-08	21.7%	NA	NA
						Total	5.0E-08	100.0%	2.5E-04	100.0%

TETRA TECH NUS, INC. **CALCULATION WORKSHEET**

CLIENT Raymark - Ferry Creek		JOB NUMBER 7491	
SUBJECT Incidental Ingestion of Soil - Adolescent Trespasser			
BASED ON Rags 1989		DRAWING NUMBER	
BY JMM	CHECKED BY RJF	APPROVED BY	DATE 3/27/00

Purpose: To calculate noncarcinogenic and carcinogenic risk for the adolescent trespasser for exposure via incidental ingestion of soil.

Relevant equation:

$$\text{Intake (mg/kg-day)} = \frac{Cs \times IR \times CF \times FI \times EF \times ED}{BW \times AT}$$

where

Cs = Concentration in soil (mg/kg)
IR = Soil ingestion Rate (mg/day)
CF = Conversion Factor (Kg/mg)
FI = Fraction of soil from contaminated source (unitless)
EF = Exposure frequency (days/year)
ED = Exposure duration (years)
BW = Body weight (Kg)
ATn = Averaging time for noncarcinogenic exposures (days)
ATc = Averaging time for carcinogenic exposures (days)
and

Reasonable Maximum Exposure (RME)		Central Tendency Exposure (CTE	
Cs	chemical specific	Cs	chemical specific
IR	100 (mg/day)	IR	50 (mg/day)
CF	1.0E-6 (Kg/mg)	CF	1.0E-6 (Kg/mg)
FI	1 (unitless)	FI	1 (unitless)
EF	52 (days/year)	EF	52 (days/year)
ED	10 (years)	ED	5 (years)
BW	51 (Kg)	BW	51 (Kg)
ATc	25,550 (days)	ATc	25,550 (days)
ATn	3,650 (days)	ATn	1,825 (days)

TETRA TECH NUS, INC. CALCULATION WORKSHEET

CLIENT: Raymark - Ferry Creek	JOB NUMBER: 7491
SUBJECT: Incidental Ingestion of soil - Adolescent Trespasser	
BASED ON: RAGs 1989	DRAWING NUMBER:
BY: gmm / CHECKED BY: AJJ	APPROVED BY: / DATE: 3/27/00

Intake of arsenic at a concentration of 11.2 mg/kg in Area B, Surface Soil under RME assumption is calculated:

RME Noncarcinogenic Intake (mg/kg-day) of arsenic

$$= \frac{11.2(mg/kg) \times 100(mg/day) \times 1.0E^{-6}(kg/mg) \times 1 \times 52\ days/year \times 10\ years}{51(kg) \times 3{,}650(days)}$$

$$= \boxed{3.13\ E^{-6}\ mg/kg\text{-}day}$$ ✓

RME Carcinogenic Intake (mg/kg-day) of arsenic

$$= \frac{11.2(mg/kg) \times 100(mg/day) \times 1.0E^{-6}(kg/mg) \times 1 \times 52(days/year) \times 10(years)}{51\ kg \times 25{,}550(days)}$$

$$= \boxed{4.47\ E^{-7}\ mg/kg\text{-}day}$$ ✓

Then incremental Cancer Risk (ICR) and Hazard Quotient (HQ) are calculated with the following equations:

ICR (unitless) = Carcinogenic Intake (mg/kg-day) x Cancer Slope Factor (CSF) (kg/mg-day)

HQ (unitless) = $\frac{\text{Noncarcinogenic intake}}{\text{Reference Dose}}$ $\frac{mg/kg\text{-}day}{mg/kg\text{-}day}$

where the CSF for arsenic = $1.5E^{+0}$ and RFD for arsenic = $3.0E^{-4}$

ICR arsenic (unitless) = $4.47E^{-7}(mg/kg\text{-}day) \times 1.5E^{+0}(kg/mg\text{-}day) = \boxed{6.7\ E^{-7}}$ RME ✓

HQ arsenic (unitless) = $\frac{3.13E^{-6}\ mg/kg\text{-}day}{3.0\ E^{-4}\ mg/kg\text{-}day} = \boxed{1.0\ E^{-2}}$ RME ✓

CLIENT Raymark - Ferry creek	JOB NUMBER 7491
SUBJECT Incidental Ingestion of soil - Adolescent Trespasser	
BASED ON RAGs 1989	DRAWING NUMBER
BY JMM / CHECKED BY RJP	APPROVED BY / DATE 3/27/00

Intake of arsenic at a concentration of 11.2 mg/kg in Area B surface soil under CTE assumptions is calculated:

CTE Noncarcinogenic Intake (mg/kg-day)

$$= \frac{11.2(mg/kg) \times 50(mg/day) \times 1.0E^{-6}(kg/mg) \times 1 \times 52(days/yr) \times 5 years}{51(kg) \times 1,825 (days)}$$

$$= \boxed{1.56\ E^{-6}\ mg/kg\text{-}day}$$ ✓

CTE Carcinogenic Intake (mg/kg-day)

$$= \frac{11.2(mg/kg) \times 50(mg/day) \times 1.0E^{-6}(kg/mg) \times 1 \times 52 days/yr \times 5 years}{51(kg) \times 25,550 days}$$

$$= \boxed{1.11\ E^{-7}\ mg/kg\text{-}day}$$ ✓

Then ICR and HQ are calculated for arsenic where the

ICR arsenic (unitless) $= 1.11E^{-7}(mg/kg\text{-}day) \times 1.5\ E^{+1}(kg/mg\text{-}day) = \boxed{1.7\ E^{-7}}$ CTE ✓

HQ arsenic (unitless) $= \frac{1.56\ E^{-6}\ mg/kg\text{-}day}{3.0\ E^{-4}\ mg/kg\text{-}day} = \boxed{5.2\ E^{-3}}$ CTE ✓

References

USEPA Dec. 1989. Risk Assessment Guidance for Superfund Volume 1 Human Health Evaluation Manual (Part A) Interim Final. OSWER EPA/540/1-89/002.

RISK ASSESSMENT SPREADSHEET - INCIDENTAL INGESTION OF SOIL

SITE NAME: AREA B, DELBUONO WETLANDS
LOCATION: FERRY CREEK, STRATFORD, CT
EXPOSURE SCENARIO: ADOLESCENT TRESPASSER - RME
MEDIA: SURFACE SOIL
DATE: FEBRUARY 9, 2000

HAZARD INDICES AND INCREMENTAL CANCER RISKS ARE CALCULATED BY THIS SPREADSHEET.
EXPOSURES THROUGH INCIDENTAL INGESTION OF SOIL ARE CONSIDERED.
ASSUMPTIONS ARE OUTLINED BELOW.

RELEVANT EQUATION: $\text{Intake} = \frac{Cs \times IR \times CF \times FI \times EF \times ED}{BW \times AT}$

WHERE:

Cs = :		Concentration in soil (mg/kg)
IR = :	100	Soil Ingestion Rate (mg/day)
CF = :	1.0E-06	Conversion Factor (kg/mg)
FI = :	1	Fraction from contaminated source (unitless)
EF = :	52	Exposure Frequency (days/year)
ED = :	10	Exposure Duration (years)
BW = :	51	Body Weight (kg)
ATc = :	25,550	Averaging time for carcinogenic exposures (days)
ATn = :	3,650	Averaging time for noncarcinogenic exposures (days)

Unit Dose		
Lifetime Chronic Daily Int	4.0E-08	kg-soil/kg-wt/day
Chronic Daily Intake = :	2.8E-07	kg-soil/kg-wt/day

RISK ASSESSMENT SPREADSHEET - INCIDENTAL INGESTION OF SOIL (PAGE TWO)

SITE NAME: AREA B, DELBUONO WETLANDS
LOCATION: FERRY CREEK, STRATFORD, CT
EXPOSURE SCENARIO: ADOLESCENT TRESPASSER - RME
MEDIA: SURFACE SOIL
DATE: FEBRUARY 9, 2000

CHEMICAL	Cs (mg/kg)	Lifetime Chronic Daily Intake (mg/kg/day)	Chronic Daily Intake (mg/kg/day)	Cancer Slope Factor $(mg/kg/day)^{-1}$	Reference Dose (mg/kg/day)	Lifetime Cancer Risk	Percent Cancer Risk	Hazard Quotient	Percent Hazard Quotient
Benzo(a)anthracene	6.1	2.4E-07	1.7E-06	7.30E-01	NA	1.8E-07	3.6%	NA	NA
Benzo(a)pyrene	4	1.6E-07	1.1E-06	7.30E+00	NA	1.2E-06	23.4%	NA	NA
Benzo(b)fluoranthene	10	4.0E-07	2.8E-06	7.30E-01	NA	2.9E-07	5.8%	NA	NA
Bis(2-ethylhexyl)phthalate	5.1	2.0E-07	1.4E-06	1.40E-02	2.00E-02	2.8E-09	0.1%	7.1E-05	0.1%
Dibenzo(a,h)anthracene	0.73	2.9E-08	2.0E-07	7.30E+00	NA	2.1E-07	4.3%	NA	NA
Indeno(1,2,3-cd)pyrene	1.7	6.8E-08	4.7E-07	7.30E-01	NA	5.0E-08	1.0%	NA	NA
Aroclor 1254	0.19	7.6E-09	5.3E-08	NA	2.00E-05	NA	NA	2.7E-03	5.0%
Aroclor, total	4	1.6E-07	1.1E-06	2.00E+00	NA	3.2E-07	6.4%	NA	NA
Dieldrin	0.0061	2.4E-10	1.7E-09	1.60E+01	5.00E-05	3.9E-09	0.1%	3.4E-05	0.1%
Antimony	8.3	3.3E-07	2.3E-06	NA	4.00E-04	NA	NA	5.8E-03	11.0%
Arsenic	11.2	4.5E-07	3.1E-06	1.50E+00	3.00E-04	6.7E-07	13.4%	1.0E-02	19.7%
Barium	1010	4.0E-05	2.8E-04	NA	7.00E-02	NA	NA	4.0E-03	7.6%
Cadmium	1.8	7.2E-08	5.0E-07	NA	1.00E-03	NA	NA	5.0E-04	1.0%
Chromium (total)	270	1.1E-05	7.5E-05	NA	3.00E-03	NA	NA	2.5E-02	47.6%
Manganese	239	9.5E-06	6.7E-05	NA	1.40E-01	NA	NA	4.8E-04	0.9%
Mercury	0.95	3.8E-08	2.7E-07	NA	3.00E-04	NA	NA	8.8E-04	1.7%
Nickel	44.9	1.8E-06	1.3E-05	NA	2.00E-02	NA	NA	6.3E-04	1.2%
Vanadium	55.6	2.2E-06	1.6E-05	NA	7.00E-03	NA	NA	2.2E-03	4.2%
TEQ - Dioxins/Furans	0.00035	1.4E-11	9.8E-11	1.50E+05	NA	2.1E-06	42.0%	NA	NA
					Total	**5.0E-06**	**100.0%**	**5.3E-02**	**100.0%**

RISK ASSESSMENT SPREADSHEET - INCIDENTAL INGESTION OF SOIL

SITE NAME: AREA B, DELBUONO WETLANDS
LOCATION: FERRY CREEK, STRATFORD, CT
EXPOSURE SCENARIO: ADOLESCENT TRESPASSER - CTE
MEDIA: SURFACE SOIL
DATE: FEBRUARY 9, 2000

HAZARD INDICES AND INCREMENTAL CANCER RISKS ARE CALCULATED BY THIS SPREADSHEET.
EXPOSURES THROUGH INCIDENTAL INGESTION OF SOIL ARE CONSIDERED.
ASSUMPTIONS ARE OUTLINED BELOW.

RELEVANT EQUATION: $\text{Intake} = \frac{Cs \times IR \times CF \times FI \times EF \times ED}{BW \times AT}$

WHERE:			
	Cs = :		Concentration in soil (mg/kg)
	IR = :	50	Soil Ingestion Rate (mg/day)
	CF = :	1.0E-06	Conversion Factor (kg/mg)
	FI = :	1	Fraction from contaminated source (unitless)
	EF = :	52	Exposure Frequency (days/year)
	ED = :	5	Exposure Duration (years)
	BW = :	51	Body Weight (kg)
	ATc = :	25,550	Averaging time for carcinogenic exposures (days)
	ATn = :	1,825	Averaging time for noncarcinogenic exposures (days)

Unit Dose		
Lifetime Chronic Daily Int	1.0E-08	kg-soil/kg-wt/day
Chronic Daily Intake = :	1.4E-07	kg-soil/kg-wt/day

RISK ASSESSMENT SPREADSHEET - INCIDENTAL INGESTION OF SOIL (PAGE TWO)

SITE NAME: AREA B, DELBUONO WETLANDS
LOCATION: FERRY CREEK, STRATFORD, CT
EXPOSURE SCENARIO: ADOLESCENT TRESPASSER - CTE
MEDIA: SURFACE SOIL
DATE: FEBRUARY 9, 2000

CHEMICAL	Cs (mg/kg)	Lifetime Chronic Daily Intake (mg/kg/day)	Chronic Daily Intake (mg/kg/day)	Cancer Slope Factor $(mg/kg/day)^{-1}$	Reference Dose (mg/kg/day)	Lifetime Cancer Risk	Percent Cancer Risk	Hazard Quotient	Percent Hazard Quotient
Benzo(a)anthracene	6.1	6.1E-08	8.5E-07	7.30E-01	NA	4.4E-08	6.0%	NA	NA
Benzo(a)pyrene	4	4.0E-08	5.6E-07	7.30E+00	NA	2.9E-07	39.4%	NA	NA
Benzo(b)fluoranthene	2.5	2.5E-08	3.5E-07	7.30E-01	NA	1.8E-08	2.5%	NA	NA
Bis(2-ethylhexyl)phthalate	5.1	5.1E-08	7.1E-07	1.40E-02	2.00E-02	7.1E-10	0.1%	3.6E-05	0.2%
Dibenzo(a,h)anthracene	0.73	7.3E-09	1.0E-07	7.30E+00	NA	5.3E-08	7.2%	NA	NA
Indeno(1,2,3-cd)pyrene	0.65	6.5E-09	9.1E-08	7.30E-01	NA	4.7E-09	0.6%	NA	NA
Aroclor 1254	0.19	1.9E-09	2.7E-08	NA	2.00E-05	NA	NA	1.3E-03	8.6%
Aroclor, total	4	4.0E-08	5.6E-07	1.00E+00	NA	4.0E-08	5.4%	NA	NA
Dieldrin	0.0061	6.1E-11	8.5E-10	1.60E+01	5.00E-05	9.7E-10	0.1%	1.7E-05	0.1%
Antimony	8.3	8.3E-08	1.2E-06	NA	4.00E-04	NA	NA	2.9E-03	18.9%
Arsenic	11.2	1.1E-07	1.6E-06	1.50E+00	3.00E-04	1.7E-07	22.7%	5.2E-03	34.0%
Barium	1010	1.0E-05	1.4E-04	NA	7.00E-02	NA	NA	2.0E-03	13.1%
Cadmium	1.8	1.8E-08	2.5E-07	NA	1.00E-03	NA	NA	2.5E-04	1.6%
Chromium (total)	270	2.7E-06	3.8E-05	NA	2.00E-02	NA	NA	1.9E-03	12.3%
Manganese	239	2.4E-06	3.3E-05	NA	1.40E-01	NA	NA	2.4E-04	1.6%
Mercury	0.95	9.5E-09	1.3E-07	NA	3.00E-03	NA	NA	4.4E-05	0.3%
Nickel	44.9	4.5E-07	6.3E-06	NA	2.00E-02	NA	NA	3.1E-04	2.0%
Vanadium	55.6	5.5E-07	7.8E-06	NA	7.00E-03	NA	NA	1.1E-03	7.2%
TEQ - Dioxins/Furans	0.000079	7.9E-13	1.1E-11	1.50E+05	NA	1.2E-07	16.0%	NA	NA
					Total	**7.4E-07**	**100.0%**	**1.5E-02**	**100.0%**

TETRA TECH NUS, INC. **CALCULATION WORKSHEET**

CLIENT: Raymark - Ferry Creek	JOB NUMBER:
SUBJECT: Direct Dermal Contact with Soil - Adolescent Trespasser	
BASED ON: RAGs 1989	DRAWING NUMBER:
BY: JMM / CHECKED BY: MJ	APPROVED BY: / DATE: 3/27/00

Purpose: To calculate carcinogenic and noncarcinogenic risk for the adolescent trespasser with exposure via direct dermal contact with soil

Relevant equation:

$$\text{Absorbed dose (mg/kg-day)} = \frac{Cs \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT}$$

where:

Cs = Chemical concentration in soil (mg/kg)
CF = Conversion Factor (kg/mg)
SA = Skin surface available for contact (cm²/event)
AF = Soil to skin adherence factor (mg/cm²)
ABS = Absorption factor (unitless)
EF = Exposure Frequency (events/year)
ED = Exposure Duration (years)
BW = Bodyweight (kg)
ATN = Averaging Time for noncarcinogenic exposures (days)
ATc = Averaging Time for carcinogenic exposures (days)

and

Reasonable Maximum Exposure (RME)		Central Tendency Exposure CTE	
Cs	chemical specific (mg/kg)	Cs	chemical specific (mg/kg)
CF	1.0E-6 (kg/mg)	CF	1.0E-6 (kg/mg)
SA	3,500 (cm²/event)	SA	3,500 cm²/event)
AF	0.07 (mg/cm²)	AF	0.01 mg/cm²
ABS	chemical specific (unitless)	ABS	chemical specific (unitless)
EF	52 (events/year)	EF	52 (events/year)
ED	10 (years)	ED	5 (years)
BW	51 (kg)	BW	51 (kg)
ATN	3650 (days)	ATN	1825 (days)
ATc	25,550 (days)	ATc	25,550 (days)

CLIENT Raymark - Ferry Creek	JOB NUMBER 7491
SUBJECT Direct Dermal Contact with Soil - Adolescent Trespasser	
BASED ON RAGs 1989	DRAWING NUMBER
BY JMM / CHECKED BY RJV	APPROVED BY / DATE 3/27/00

Absorbed dose of arsenic at a concentration of 11.2 mg/Kg for Area B, surface soil, under the RME assumptions is calculated:

RME Noncarcinogenic Absorbed Dose (mg/Kg-day)

$$= \frac{11.2\left(\frac{mg}{Kg}\right) \times 1.0E^{-6}\left(\frac{Kg}{mg}\right) \times 3500\left(\frac{cm^2}{event}\right) \times .07\left(\frac{mg}{cm^2}\right) \times .03 \times 52\ \frac{events}{year} \times 10\ years}{51(Kg) \times 3{,}650\ days}$$

$$= \boxed{2.30\ E^{-7}\ (mg/Kg\text{-}day)}$$ ✓

RME Carcinogenic Absorbed Dose (mg/Kg-day)

$$= \frac{11.2\left(\frac{mg}{Kg}\right) \times 1.0E^{-6}\left(\frac{Kg}{mg}\right) \times 3500\left(\frac{cm^2}{event}\right) \times .07\left(\frac{mg}{cm^2}\right) \times .03 \times 52\ \frac{events}{year} \times 10\ years}{51(Kg) \times 25{,}550\ (days)}$$

$$= \boxed{3.29\ E^{-8}\ mg/Kg\text{-}day}$$ ✓

Then incremental Cancer Risk (ICR) and Hazard Quotient (HQ) are calculated via the following equations:

ICR (unitless) = Carcinogenic Absorbed Dose (mg/Kg-day) x Cancer Slope Factor (CSF) (Kg/mg-day)

HQ (unitless) = Noncarcinogenic Absorbed Dose (mg/Kg-day) / Reference Dose (RfD) (mg/Kg-day)

Where the CSF of Arsenic = $1.5\ E^{+0}$ and the RfD of arsenic = $3.0E^{-4}$

ICR Arsenic (unitless) $3.29E^{-8}$ (mg/Kg-day) x $1.5\ E^{+0}$ (Kg/mg-day) = $\boxed{4.9\ E^{-8}}$ RME ✓

HQ arsenic (unitless) $\frac{2.30\ E^{-7}\ (mg/Kg\text{-}day)}{3.0\ E^{-4}\ (mg/Kg\text{-}day)} = \boxed{7.7\ E^{-4}}$ RME ✓

TETRA TECH NUS, INC. **CALCULATION WORKSHEET**

CLIENT: Raymark - Ferry Creek	JOB NUMBER: 7491
SUBJECT: Direct Dermal Contact with Soil - Adolescent Trespasser	
BASED ON:	DRAWING NUMBER:
BY: JMM	CHECKED BY: KK
APPROVED BY:	DATE: 3/27/00

Absorbed dose of arsenic at a concentration of 11.2 mg/kg in Area B, surface soil under the CTE assumptions is calculated:

CTE Noncarcinogenic Absorbed Dose (mg/kg-day)

$$= \frac{11.2\left(\frac{mg}{kg}\right) \times 1.0E^{-6}\left(\frac{kg}{mg}\right) \times 3500\left(\frac{cm^2}{event}\right) \times .01\left(\frac{mg}{cm^2}\right) \times 0.03 \times 52\left(\frac{events}{year}\right) \times 5\,years}{51(kg) \times 1825(days)}$$

$$= \boxed{3.29E^{-8}\ mg/kg\text{-}day}$$ ✓

CTE Carcinogenic Absorbed Dose (mg/kg-day)

$$= \frac{11.2\left(\frac{mg}{kg}\right) \times 1.0E^{-6}\left(\frac{kg}{mg}\right) \times 3500\left(\frac{cm^2}{event}\right) \times 0.01\left(\frac{mg}{cm^2}\right) \times 0.03 \times 52\left(\frac{events}{year}\right) \times 5\,years}{51(kg) \times 25{,}550\,days}$$

$$= \boxed{2.35E^{-9}\ mg/kg\text{-}day}$$ ✓

ICR arsenic (unitless) $= 2.35E^{-9}(mg/kg\text{-}day) \times 1.5E^{+0}\ kg/mg\text{-}day = \boxed{3.5E^{-9}}$ CTE ✓

HQ arsenic (unitless) $\frac{3.29E^{-8}\ mg/kg\text{-}day}{3.0E^{-4}\ mg/kg\text{-}day} = \boxed{1.1E^{-4}}$ CTE ✓

Reference

USEPA 1989. Risk Assessment Guidance for Superfund Volume I Human Health Evaluation Manual (PART A) Interim Final OSWER EPA/540/1-89/002.

RISK ASSESSMENT SPREADSHEET - DIRECT DERMAL CONTACT WITH SOIL

SITE NAME: AREA B, DELBUONO WETLANDS
LOCATION: FERRY CREEK, STRATFORD, CT
EXPOSURE SCENARIO: ADOLESCENT TRESPASSER - RME
MEDIA: SURFACE SOIL
DATE: FEBRUARY 9, 2000

HAZARD INDICES AND INCREMENTAL CANCER RISKS ARE CALCULATED BY THIS SPREADSHEET.
EXPOSURES THROUGH DERMAL CONTACT WITH SOIL ARE CONSIDERED.
ASSUMPTIONS ARE OUTLINED BELOW.

RELEVANT EQUATION:

$$\text{AbsorbedDose} = \frac{Cs \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT}$$

Where:			
	Cs = :		Concentration in soil (mg/kg)
	CF = :	1.0E-06	Conversion factor (kg/mg)
	SA = :	3,500	Skin surface available for contact (cm^2/event) ✓
	AF = :	0.07	Soil to skin adherence factor (mg/cm^2) ✓
	ABS = :		Absorption factor (unitless)
	EF = :	52	Exposure frequency (events/year)
	ED = :	10	Exposure duration (years)
	BW = :	51	Body weight (kg)
	ATc = :	25,550	Averaging time for carcinogenic exposures (days)
	ATn = :	3,650	Averaging time for noncarcinogenic exposures (days)

Unit Dose
Lifetime Chronic Daily Intake = 9.8E-08 kg-soil/kg-wt/day
Chronic Daily Intake = : 6.8E-07 kg-soil/kg-wt/day

RISK ASSESSMENT SPREADSHEET - DIRECT DERMAL CONTACT WITH SOIL (PAGE TWO)

SITE NAME: AREA B, DELBUONO WETLANDS
LOCATION: FERRY CREEK, STRATFORD, CT
EXPOSURE SCENARIO: ADOLESCENT TRESPASSER - RME
MEDIA: SURFACE SOIL
DATE: FEBRUARY 9, 2000

CHEMICAL	Cs (mg/kg)	ABS (unitless)	Lifetime Chronic Daily Intake (mg/kg/day)	Chronic Daily Intake (mg/kg/day)	Cancer Slope Factor $(mg/kg/day)^{-1}$	Reference Dose (mg/kg/day)	Lifetime Cancer Risk	Percent Cancer Risk	Hazard Quotient	Percent Hazard Quotient
Benzo(a)anthracene	6.1	0.13	7.75E-08	5.43E-07	7.30E-01	NA	5.7E-08	6.2%	NA	NA
Benzo(a)pyrene	4	0.13	5.08E-08	3.56E-07	7.30E+00	NA	3.7E-07	40.5%	NA	NA
Benzo(b)fluoranthene	10	0.13	1.27E-07	8.90E-07	7.30E-01	NA	9.3E-08	10.1%	NA	NA
Bis(2-ethylhexyl)phthalate	5.1	NA	NA	NA	1.40E-02	2.00E-02	NA	NA	NA	NA
Dibenzo(a,h)anthracene	0.73	0.13	9.28E-09	6.49E-08	7.30E+00	NA	6.8E-08	7.4%	NA	NA
Indeno(1,2,3-cd)pyrene	1.7	0.13	2.16E-08	1.51E-07	7.30E-01	NA	1.6E-08	1.7%	NA	NA
Aroclor 1254	0.19	0.14	2.60E-09	1.82E-08	NA	2.00E-05	NA	NA	9.1E-04	47.3%
Aroclor, total	4	0.14	5.48E-08	3.83E-07	2.00E+00	NA	1.1E-07	11.9%	NA	NA
Dieldrin	0.0061	NA	NA	NA	1.60E+01	5.00E-05	NA	NA	NA	NA
Antimony	8.3	NA	NA	NA	NA	6.00E-05	NA	NA	NA	NA
Arsenic	11.2	0.03	3.29E-08	2.30E-07	1.50E+00	3.00E-04	4.9E-08	5.4%	7.7E-04	39.9%
Barium	1010	NA	NA	NA	NA	4.90E-03	NA	NA	NA	NA
Cadmium	1.8	0.01	1.76E-09	1.23E-08	NA	5.00E-05	NA	NA	2.5E-04	12.8%
Chromium (total)	270	NA	NA	NA	NA	7.50E-05	NA	NA	NA	NA
Manganese	239	NA	NA	NA	NA	8.40E-03	NA	NA	NA	NA
Mercury	0.95	NA	NA	NA	NA	2.10E-05	NA	NA	NA	NA
Nickel	44.9	NA	NA	NA	NA	8.00E-04	NA	NA	NA	NA
Vanadium	55.6	NA	NA	NA	NA	1.80E-04	NA	NA	NA	NA
TEQ - Dioxins/Furans	0.00035	0.03	1.03E-12	7.19E-12	1.50E+05	NA	1.5E-07	16.8%	NA	NA
						Total	**9.2E-07**	**100.0%**	**1.9E-03**	**100.0%**

RISK ASSESSMENT SPREADSHEET - DIRECT DERMAL CONTACT WITH SOIL

SITE NAME: AREA B, DELBUONO WETLANDS
LOCATION: FERRY CREEK, STRATFORD, CT
EXPOSURE SCENARIO: ADOLESCENT TRESPASSER - CTE
MEDIA: SURFACE SOIL
DATE: FEBRUARY 9, 2000

HAZARD INDICES AND INCREMENTAL CANCER RISKS ARE CALCULATED BY THIS SPREADSHEET.
EXPOSURES THROUGH DERMAL CONTACT WITH SOIL ARE CONSIDERED.
ASSUMPTIONS ARE OUTLINED BELOW.

RELEVANT EQUATION:

$$\text{Absorbed Dose} = \frac{Cs \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT}$$

Where:	Cs = :		Concentration in soil (mg/kg)
	CF = :	1.0E-06	Conversion factor (kg/mg)
	SA = :	3,500	Skin surface available for contact (cm^2/event)
	AF = :	0.01	Soil to skin adherence factor (mg/cm^2)
	ABS = :		Absorption factor (unitless)
	EF = :	52	Exposure frequency (events/year)
	ED = :	5	Exposure duration (years)
	BW = :	51	Body weight (kg)
	ATc = :	25,550	Averaging time for carcinogenic exposures (days)
	ATn = :	1,825	Averaging time for noncarcinogenic exposures (days)

Unit Dose
Lifetime Chronic Daily Intake = 7.0E-09 kg-soil/kg-wt/day
Chronic Daily Intake = : 9.8E-08 kg-soil/kg-wt/day

RISK ASSESSMENT SPREADSHEET - DIRECT DERMAL CONTACT WITH SOIL (PAGE TWO)

SITE NAME: AREA B, DELBUONO WETLANDS
LOCATION: FERRY CREEK, STRATFORD, CT
EXPOSURE SCENARIO: ADOLESCENT TRESPASSER - CTE
MEDIA: SURFACE SOIL
DATE: FEBRUARY 9, 2000

CHEMICAL	Cs (mg/kg)	ABS (unitless)	Lifetime Chronic Daily Intake (mg/kg/day)	Chronic Daily Intake (mg/kg/day)	Cancer Slope Factor $(mg/kg/day)^{-1}$	Reference Dose (mg/kg/day)	Lifetime Cancer Risk	Percent Cancer Risk	Hazard Quotient	Percent Hazard Quotient
Benzo(a)anthracene	6.1	0.13	5.54E-09	7.75E-08	7.30E-01	NA	4.0E-09	8.5%	NA	NA
Benzo(a)pyrene	4	0.13	3.63E-09	5.08E-08	7.30E+00	NA	2.7E-08	55.9%	NA	NA
Benzo(b)fluoranthene	2.5	0.13	2.27E-09	3.18E-08	7.30E-01	NA	1.7E-09	3.5%	NA	NA
Bis(2-ethylhexyl)phthalate	5.1	NA	NA	NA	1.40E-02	2.00E-02	NA	NA	NA	NA
Dibenzo(a,h)anthracene	0.73	0.13	6.63E-10	9.28E-09	7.30E+00	NA	4.8E-09	10.2%	NA	NA
Indeno(1,2,3-cd)pyrene	0.65	0.13	5.90E-10	8.26E-09	7.30E-01	NA	4.3E-10	0.9%	NA	NA
Aroclor 1254	0.19	0.14	1.86E-10	2.60E-09	NA	2.00E-05	NA	NA	1.3E-04	47.3%
Aroclor, total	4	0.14	3.91E-09	5.48E-08	1.00E+00	NA	3.9E-09	8.3%	NA	NA
Dieldrin	0.0061	NA	NA	NA	1.60E+01	5.00E-05	NA	NA	NA	NA
Antimony	8.3	NA	NA	NA	NA	6.00E-05	NA	NA	NA	NA
Arsenic	11.2	0.03	2.35E-09	3.29E-08	1.50E+00	3.00E-04	3.5E-09	7.4%	1.1E-04	39.9%
Barium	1010	NA	NA	NA	NA	4.90E-03	NA	NA	NA	NA
Cadmium	1.8	0.01	1.26E-10	1.76E-09	NA	5.00E-05	NA	NA	3.5E-05	12.8%
Chromium (total)	270	NA	NA	NA	NA	5.00E-04	NA	NA	NA	NA
Manganese	239	NA	NA	NA	NA	8.40E-03	NA	NA	NA	NA
Mercury	0.95	NA	NA	NA	NA	2.10E-04	NA	NA	NA	NA
Nickel	44.9	NA	NA	NA	NA	8.00E-04	NA	NA	NA	NA
Vanadium	55.6	NA	NA	NA	NA	1.80E-04	NA	NA	NA	NA
TEQ - Dioxins/Furans	0.000079	0.03	1.66E-14	2.32E-13	1.50E+05	NA	2.5E-09	5.2%	NA	NA
						Total	4.7E-08	100.0%	2.7E-04	100.0%

TETRA TECH NUS, INC. **CALCULATION WORKSHEET**

CLIENT Raymark - Ferry Creek		JOB NUMBER 7491	
SUBJECT Direct Dermal Contact with Surface Water - Wetland Marsh Receptor (Pre-Adolescent)			
BASED ON RAGs and Draft Dermal Guidance		DRAWING NUMBER	
BY JMM	CHECKED BY RJF	APPROVED BY	DATE 3/28/00

Purpose: To calculate carcinogenic and noncarcinogenic risk via dermal exposure to surface water

Relevant equation:

$$\text{Absorbed Dose} = \frac{DA_{event} \times EV \times EF \times ED \times SA}{BW \times AT}$$

For Inorganic Compounds:

$$DA_{event} = Kp \times Cw \times t_{event} \times CF$$

For Organic Compounds:

If $t_{event} \leq t^*$ then,

$$DA_{event} = 2 \times Kp \times Cw \times CF \times \sqrt{\frac{6 \times tau \times t_{event}}{\pi}}$$

If $t_{event} > t^*$ then,

$$DA_{event} = Kp \times Cw \times CF \times \left[\frac{t_{event}}{1+B} + 2 \times tau \times \left(\frac{1+3B+3B^2}{(1+B)^2} \right) \right]$$

where: If $B \leq 0.6$ then $t^* = 2.4 \times tau$

but If $B > 0.6$ then $t^* = \frac{(b - \sqrt{b^2 - c^2} \times 0.000001)}{Dsc}$

where: $B = Kp \times \frac{\sqrt{MW}}{2.6}$ $\qquad C = \frac{1+3B+3B^2}{3(1+B)}$

$b = \left(\frac{2(1+B)^2}{\pi} \right) - C$ $\qquad Dsc = 0.001 \times 10^{(-2.8 - 0.0056 \times MW)}$

$tau = 0.105 \times 10^{(0.0056 \times MW)}$

TETRA TECH NUS, INC. **CALCULATION WORKSHEET** PAGE 2 OF 4

CLIENT Raymark Ferry Creek	JOB NUMBER 7491
SUBJECT Direct Dermal Contact with Surface Water - Wetland Marsh Receptor (Pre-adolescent)	
BASED ON RAGs + Draft Dermal Guidance	DRAWING NUMBER
BY JMM / CHECKED BY RJF	APPROVED BY / DATE 3/08/00

Values for the organic compound Trichloroethene in surface water at Area B for the Wetland Marsh Receptor, the following exposure assumptions are true.

Where: SA = :	2,500	Skin surface available for contact (cm^2)
DAevent = :		Chemical specific absorbed dose per event (mg/cm^2-event)
EV = :	1	Event frequency (events/days)
EF = :	20	Exposure frequency (days/year)
ED = :	6	Exposure duration (years)
BW = :	31	Body weight (kg)
ATc = :	25,550	Averaging time for carcinogenic exposures (days)
ATn = :	2,190	Averaging time for noncarcinogenic exposures (days)
CF = :	0.001	Conversion Factor (L/m^3)
Kp =:	$1.2E^{-2}$	Chemical specific permeability coefficient (cm/hr) (Trichloroethene)
Cw = :	0.006	Concentration of chemical in water (mg/L) (Trichloroethene)
tevent = :	1	duration of event (hr/event)
tau = :		Chemical specific lag time (hr)
t* = :		Chemical specific time it takes to reach steady state (hr)
B = :		Chemical specific dimensionless constant
Dsc = :		Effective diffusivity for chemical transfer through skin (cm^2/hr)
b, c = :		chemical specific constants
MW =		Trichloroethene = 131.4

$$tau = 0.105 \times 10^{(0.0056 \times 131.4)} = \boxed{5.72E^{-1}\ hr} \checkmark$$

$$B = \frac{1.2E^{-2} \times \sqrt{131.4}}{2.6} = \boxed{5.29E^{-2}} \checkmark$$

$$C = \frac{1 + 3(5.29E^{-2}) + 3(5.29E^{-2})^2}{3(1 + 5.29E^{-2})} = \boxed{3.69E^{-1}} \checkmark$$

$$b = \left(\frac{2(1+5.29E^{-2})^2}{\pi}\right) - 3.69E^{-1} = \boxed{3.36E^{-1}} \checkmark$$

$$Dsc = 0.001 \times 10^{(-2.8 - 0.0056 \times 131.4)} = \boxed{2.91E^{-7}\ cm^2/hr} \checkmark$$

And $B = 5.29E^{-2}$ which is less than 0.6 hence

$$t^* = 2.4 \times tau; \quad t^* = 2.4 \times 5.72E^{-1} = \boxed{1.37\ hr} \checkmark$$

CLIENT Baymark - Ferry Creek	JOB NUMBER 7491
SUBJECT Direct Dermal Contact with Surface Water - Wetland Marsh Receptor (Pre-adolescent)	
BASED ON RAGs + Draft Dermal Guidance	DRAWING NUMBER
BY JMM / CHECKED BY RJV	APPROVED BY / DATE 3/28/00

and t^* (1.37) is greater than t_{event} (1.0) therefore

$$DA_{event} = 2 \times 1.2E^{-2}\left(\frac{cm}{hr}\right) \times 0.004\left(\frac{mg}{L}\right) \times .001\ \frac{L}{m^3} \times \sqrt{\frac{6 \times 5.72E^{-1}\ hr \times 1.0\left(\frac{hr}{event}\right)}{\pi}}$$

DA_{event} trichloroethene $= \boxed{1.50E^{-7}\ mg/cm^2\text{-}event}$ ✓

Absorbed dose noncarcinogen $= \dfrac{1.5E^{-7}\ mg/cm^2\text{-}event \times 1\ \frac{event}{day} \times 20\ \frac{days}{year} \times 6\ years \times 2{,}500\ cm^2}{31\ kg \times 2{,}190\ days}$

$= \boxed{6.6SE^{-7}\ mg/kg\text{-}day}$ ✓

Absorbed dose Carcinogen $= \dfrac{1.5E^{-7}\ mg/cm^2\text{-}event \times 1\ \frac{event}{day} \times 20\ \frac{days}{year} \times 6\ years \times 2{,}500\ cm^2}{31\ kg \times 25{,}550\ days}$

$= \boxed{5.70E^{-8}\ mg/kg\text{-}day}$ ✓

The cancer slope factor (CSF) for Trichloroethene $= 1.1E^{-2}\ kg/mg\text{-}day$
The reference dose (RfD) for trichloroethene $= 6.0E^{-3}\ mg/kg\text{-}day$

Lifetime Cancer Risk (unitless) = CSF × absorbed dose carcinogens
$1.1E^{-2}\ kg/mg\text{-}day \times 5.70E^{-8}\ mg/kg\text{-}day = \boxed{6.3E^{-10}}$ ✓

Hazard Quotient (unitless) $= \dfrac{\text{absorbed dose noncarcinogen}}{\text{Rfd}} = \dfrac{6.6SE^{-7}\ mg/kg\text{-}day}{6.0E^{-3}\ mg/kg\text{-}day}$

$= \boxed{1.1E^{-4}}$ ✓

CLIENT Raymark - Ferry Creek	JOB NUMBER 7491
SUBJECT Direct Dermal Contact with Surface Water - Wetland Marsh Receptor	
BASED ON PAGs + Draft Dermal Guidance	DRAWING NUMBER (Pre-adolescent)
BY JMO / CHECKED BY RJK	APPROVED BY / DATE 3/28/00

Values for the inorganic compound Arsenic in surface water at area B for the Wetland/Marsh Receptor were also calculated for which the following assumptions are true:

K_p = 1.0 E^{-3} cm/hr permeability coefficient for arsenic
C_w = 0.0659 mg/L concentration of arsenic in surface water
CF = 0.001 L/m^3 Conversion factor
t_{event} = 1.0 hr/event duration of event

For inorganics $DA_{event} = K_p \times C_w \times CF \times t_{event}$

DA_{event} arsenic = 1.0E^{-3} cm/hr × .0659 mg/L × 0.001 L/m^3 × 1.0 hr/event

= **6.6 E^{-8} mg/cm^{2}event** ✓

Absorbed dose nonarcinogen = $\frac{6.6E^{-8}\,\frac{mg}{cm^2 event} \times 1\,\frac{event}{year} \times 6\,years \times 2500\,cm^2 \times 20\,\frac{days}{year}}{31\,Kg \times 2190\,days}$

= **2.91 E^{-7} mg/kg-day** ✓

Absorbed dose Carcinogen = $\frac{6.6E^{-8}\,\frac{mg}{cm^2 event} \times 1\,\frac{event}{year} \times 6\,years \times 2500\,cm^2 \times 20\,\frac{days}{year}}{31\,Kg \times 26{,}550\,days}$

= **2.50 E^{-8} mg/kg-day** ✓

The cancer slope factor for arsenic = 1.5 kg/mg-day
The Reference dose (RfD) for arsenic = 3.0E^{-4} mg/kg-day

Lifetime Cancer Risk (unitless) = 1.5 kg/mg-day × 2.5E^{-8} mg/kg-day = **3.7 E^{-8}**

Hazard Quotient (unitless) = $\frac{2.91E^{-7}\,mg/kg\text{-}day}{3.0E^{-4}\,mg/kg\text{-}day}$ = **9.7 E-4** ✓

RISK ASSESSMENT SPREADSHEET - DIRECT DERMAL CONTACT WITH WATER

SITE NAME: AREA B, DELBUONO WETLANDS
LOCATION: FERRY CREEK, STRATFORD, CT
EXPOSURE SCENARIO: WETLAND/MARSH RECEPTOR -PRE-ADOLESCENT - RME
MEDIA: SURFACE WATER
DATE: JULY 27, 2000

HAZARD INDICES AND INCREMENTAL CANCER RISKS ARE CALCULATED BY THIS SPREADSHEET.
EXPOSURES THROUGH DERMAL CONTACT WITH WATER ARE CONSIDERED. ASSUMPTIONS ARE OUTLINED BELOW.

RELEVANT EQUATIONS:

$$\text{Absorbed Dose} = \frac{DAevent \times EV \times EF \times ED \times SA}{BW \times AT}$$

For Inorganics DAevent = Kp x Cw x CF x tevent

For Organics If tevent $\leq t^*$, then : $DAevent = 2 \times Kp \times Cw \times CF \times \sqrt{\frac{6 \times tau \times tevent}{\pi}}$

If tevent $> t^*$, then : $DAevent = Kp \times Cw \times CF \times \left[\frac{tevent}{1+B} + 2 \times tau \times \left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]$

Where:	SA = :	2,500	Skin surface available for contact (cm^2)
	DAevent = :		Chemical specific absorbed dose per event (mg/cm^2-event)
	EV = :	1	Event frequency (events/days)
	EF = :	20	Exposure frequency (days/year)
	ED = :	6	Exposure duration (years)
	BW = :	31	Body weight (kg)
	ATc = :	25,550	Averaging time for carcinogenic exposures (days)
	ATn = :	2,190	Averaging time for noncarcinogenic exposures (days)
	CF = :	0.001	Conversion Factor (L/m^3)
	Kp =:		Chemical specific permeability coefficient (cm/hr)
	Cw = :		Concentration of chemical in water (mg/L)
	tevent = :	1	duration of event (hr/event)
	tau = :		Chemical specific lag time (hr)
	t* = :		Chemical specific time it takes to reach steady state (hr)
	B = :		Chemical specific dimensionless constant
	Dsc = :		Effective diffusivity for chemical transfer through skin (cm^2/hr)
	b, c = :		chemical specific constants

Unit Dose

Lifetime Chronic Daily Intake =	3.8E-01	cm^2-event/(kg-day)
Chronic Daily Intake = :	4.4E+00	cm^2-event/(kg-day)

RISK ASSESSMENT SPREADSHEET - DIRECT DERMAL CONTACT WITH WATER (PAGE TWO)

SITE NAME: AREA B, DELBUONO WETLANDS
LOCATION: FERRY CREEK, STRATFORD, CT
EXPOSURE SCENARIO: WETLAND/MARSH RECEPTOR -PRE-ADOLESCENT - RME
MEDIA: SURFACE WATER
DATE: JULY 27, 2000

CHEMICAL	Cw (mg/L)	Organic or Inorganic	Molecular Weight	Estimated Kp (cm/hr)	tau-event (hr)	B	b	c	Dsc (cm^2/hr)	t* (hr)	DAevent (mg/cm^2 - event)
1,1,1-Trichloroethane	0.016	O	133.4	1.30E-02	5.86E-01	5.77E-02	3.39E-01	3.73E-01	2.84E-07	1.41E+00	4.40E-07
1,1-Dichloroethene	0.008	O	96.9	1.20E-02	3.66E-01	4.54E-02	3.32E-01	3.64E-01	4.54E-07	8.79E-01	1.65E-07
1,2-Dichloroethene (total)	0.011	O	96.9	7.80E-03	3.66E-01	2.95E-02	3.21E-01	3.53E-01	4.54E-07	8.79E-01	1.48E-07
Trichloroethene	0.006	O	131.4	1.20E-02	5.72E-01	5.29E-02	3.36E-01	3.69E-01	2.91E-07	1.37E+00	1.50E-07
Vinyl Chloride	0.005	O	62.5	5.60E-03	2.35E-01	1.70E-02	3.14E-01	3.45E-01	7.08E-07	5.64E-01	4.09E-08
Bis (2-ethylhexyl) phthalate	0.011	O	391	4.56E-02	1.62E+01	3.47E-01	5.60E-01	5.94E-01	1.02E-08	3.90E+01	5.59E-06
Antimony	0.0274	I	121.8	1.00E-03	5.05E-01	4.24E-03	3.06E-01	3.36E-01	3.30E-07	1.21E+00	2.74E-08
Arsenic	0.0057	I	74.9	1.00E-03	2.76E-01	3.33E-03	3.05E-01	3.36E-01	6.03E-07	6.62E-01	5.70E-09
Chromium	0.0138	I	51.9	1.00E-03	2.05E-01	2.77E-03	3.05E-01	3.35E-01	8.12E-07	4.92E-01	1.38E-08
Manganese	0.289	I	54.9	1.00E-03	2.13E-01	2.85E-03	3.05E-01	3.35E-01	7.81E-07	5.11E-01	2.89E-07
Mercury	0.0019	I	200.6	1.00E-03	1.39E+00	5.45E-03	3.07E-01	3.37E-01	1.19E-07	3.35E+00	1.90E-09
Thallium	0.0044	I	204.4	1.00E-03	1.46E+00	5.50E-03	3.07E-01	3.37E-01	1.14E-07	3.52E+00	4.40E-09

RISK ASSESSMENT SPREADSHEET - DIRECT DERMAL CONTACT WITH WATER (PAGE THREE)

SITE NAME: AREA B, DELBUONO WETLANDS
LOCATION: FERRY CREEK, STRATFORD, CT
EXPOSURE SCENARIO: WETLAND/MARSH RECEPTOR -PRE-ADOLESCENT - RME
MEDIA: SURFACE WATER
DATE: JULY 27, 2000

CHEMICAL	DAevent (mg/cm^2 - event)	Lifetime Chronic Daily Intake (mg/kg/day)	Chronic Daily Intake (mg/kg/day)	Cancer Slope Factor $(mg/kg/day)^{-1}$	Reference Dose (mg/kg/day)	Lifetime Cancer Risk	Percent Cancer Risk	Hazard Quotient	Percent Hazard Quotient
1,1,1-Trichloroethane	4.40E-07	1.67E-07	1.95E-06	NA	2.00E-02	NA	NA	9.7E-05	2.0%
1,1-Dichloroethene	1.65E-07	6.26E-08	7.31E-07	6.00E-01	9.00E-03	3.8E-08	37.4%	8.1E-05	1.7%
1,2-Dichloroethene (total)	1.48E-07	5.61E-08	6.54E-07	NA	9.00E-03	NA	NA	7.3E-05	1.5%
Trichloroethene	1.50E-07	5.70E-08	6.65E-07	1.10E-02	6.00E-03	6.3E-10	0.6%	1.1E-04	2.3%
Vinyl Chloride	4.09E-08	1.55E-08	1.81E-07	1.90E+00	NA	2.9E-08	29.3%	NA	NA
Bis (2-ethylhexyl) phthalate	5.59E-06	2.12E-06	2.47E-05	1.40E-02	2.00E-02	3.0E-08	29.5%	1.2E-03	25.7%
Antimony	2.74E-08	1.04E-08	1.21E-07	NA	6.00E-05	NA	NA	2.0E-03	42.0%
Arsenic	5.70E-09	2.16E-09	2.52E-08	1.50E+00	3.00E-04	3.2E-09	3.2%	8.4E-05	1.7%
Chromium	1.38E-08	5.23E-09	6.10E-08	NA	5.00E-04	NA	NA	1.2E-04	2.5%
Manganese	2.89E-07	1.09E-07	1.28E-06	NA	1.40E-03	NA	NA	9.1E-04	19.0%
Mercury	1.90E-09	7.20E-10	8.40E-09	NA	2.10E-04	NA	NA	4.0E-05	0.8%
Thallium	4.40E-09	1.67E-09	1.94E-08	NA	6.60E-04	NA	NA	2.9E-05	0.6%
					Total	**1.0E-07**	**100.0%**	**4.8E-03**	**100.0%**

TETRA TECH NUS, INC. **CALCULATION WORKSHEET**

CLIENT: Raymark - Ferry Creek		JOB NUMBER: 7491	
SUBJECT: Incidental Ingestion of Soil - Wetland/Marsh Receptor (Pre-adolescent)			
BASED ON: Rags 1989		DRAWING NUMBER:	
BY: JMM	CHECKED BY: RH	APPROVED BY:	DATE: 3/27/00

Purpose: To calculate noncarcinogenic and carcinogenic risk for the Pre-adolescent Wetland/Marsh Receptor via the ingestion of silt soil.

Relevant equation:

$$\text{Intake (mg/Kg-day)} = \frac{Cs \times IR \times CF \times FI \times EF \times ED}{BW \times AT}$$

where

Cs = Concentration in soil (mg/kg)
IR = Soil ingestion Rate (mg/day)
CF = Conversion Factor (Kg/mg)
FI = Fraction of soil from contaminated source (unitless)
EF = Exposure frequency (days/year)
ED = Exposure duration (years)
BW = Body weight (Kg)
ATn = Averaging time for noncarcinogenic exposures (days)
ATc = Averaging time for carcinogenic exposures (days)
and

Reasonable Maximum Exposure (RME)		Central Tendency Exposure (CTE)	
Cs	chemical specific (mg/Kg)	Cs	chemical specific (mg/Kg)
IR	100 (mg/day)	IR	50 (mg/day)
CF	1.0E-6 (Kg/mg)	CF	1.0E-6 (Kg/mg)
FI	1 (unitless)	FI	1 (unitless)
EF	20 (days/year)	EF	20 (days/year)
ED	6 (years)	ED	2 (years)
BW	31 (Kg)	BW	31 (Kg)
ATc	25,550 (days)	ATc	25,550 (days)
ATn	2,190 (days)	ATn	730 (days)

TETRA TECH NUS, INC. **CALCULATION WORKSHEET** PAGE 2 OF 3

CLIENT: Raymark - Ferry Creek	JOB NUMBER: 7491
SUBJECT: Incidental Ingestion of soil - Wetland Marsh Receptor (Pre-Adolescent)	
BASED ON: RAGs 1989	DRAWING NUMBER:
BY: gmm / CHECKED BY: RJJ	APPROVED BY: / DATE: 3/27/00

Intake of arsenic at a concentration of 9.5 mg/kg in area C for surface soil under RME assumptions:

RME Noncarcinogenic Intake (mg/kg-day) of arsenic

$$= \frac{9.5\,(mg/kg) \times 100\,(mg/day) \times 1.0E^{-6}\,(kg/mg) \times 1 \times 20\,(days/year) \times 6\,(years)}{31\,(kg) \times 2{,}190\,(days)}$$

$$= \boxed{1.68\,E^{-6}\ mg/kg\text{-}day}$$ ✓

RME Carcinogenic Intake (mg/kg-day) of arsenic

$$= \frac{9.5\,(mg/kg) \times 100\,(mg/day) \times 1.0E^{-6}\,(kg/mg) \times 1 \times 20\,(days/year) \times 6\,(years)}{31\,(kg) \times 25{,}550\,(days)}$$

$$= \boxed{1.44\,E^{-7}\ mg/kg\text{-}day}$$ ✓

Then incremental Cancer Risk (ICR) and Hazard Quotient (HQ) are calculated with the following equations:

ICR (unitless) = Carcinogenic Intake (mg/kg-day) x Cancer Slope Factor (CSF) (kg/mg-day)

HQ (unitless) = $\frac{\text{Noncarcinogenic intake}}{\text{Reference Dose}}$ $\frac{mg/kg\text{-}day}{mg/kg\text{-}day}$

where the CSF for arsenic = $1.5E^{+0}$ and RFD for arsenic = $3.0E^{-4}$

ICR arsenic (unitless) = $1.44E^{-7}$ (mg/kg-day) x $1.5E^{+0}$ kg/mg-day = $\boxed{2.16\,E^{-7}}$ RME ✓

HQ arsenic (unitless) = $\frac{1.68E^{-6}\ mg/kg\text{-}day}{3.0E^{-4}\ mg/kg\text{-}day}$ = $\boxed{5.6\,E^{-3}}$ RME ✓

TETRA TECH NUS, INC. **CALCULATION WORKSHEET**

CLIENT Raymark - Ferry creek	JOB NUMBER 7491
SUBJECT Incidental Ingestion of soil - Lowland Inland Receptor - Pre-Adolescent	
BASED ON RAGs 1989	DRAWING NUMBER
BY JMM / CHECKED BY RJK	APPROVED BY / DATE 3/27/00

Intake of arsenic at a concentration of 9.5 mg/kg in area C for surface soil under CTE assumptions.

CTE Noncarcinogenic Intake (mg/kg-day) $= \frac{9.5\,mg/kg \times 50\,mg/day \times 1.0E^{-6}\,kg/mg \times 1 \times 20\,days/year \times 2\,years}{31\,kg \times 730\,days}$

$= \boxed{8.4\,E^{-}\ mg/kg\text{-}day}$ ✓

CTE Carcinogenic Intake (mg/kg-day) $= \frac{9.5\,mg/kg \times 50\,mg/day \times 1.0E^{-6}\,kg/mg \times 1 \times 20\,days/year \times 2\,years}{31\,kg \times 25{,}550\,days}$

$= \boxed{2.40\,E^{-8}\ mg/kg\text{-}day}$ ✓

Then ICR and HQ are calculated for arsenic where the ✓

ICR arsenic (unitless) $= 2.40E^{-8}\,mg/kg\text{-}day \times 1.5E^{+0}\,kg/mg\text{-}day = \boxed{3.6E^{-8}}$ CTE

HQ arsenic (unitless) $= \frac{8.4\,E^{-7}\,mg/kg\text{-}day}{3.0\,E^{-4}\,mg/kg\text{-}day} = \boxed{2.8\,E^{-3}}$ CTE ✓

References

USEPA Dec. 1989. Risk Assessment Guidance for Superfund Volume 1 Human Health Evaluation Manual (Part A) Interim Final. OSWER EPA/540/1-89/002.

RISK ASSESSMENT SPREADSHEET - INCIDENTAL INGESTION OF SOIL

SITE NAME: AREA C, HOUSATONIC BOAT CLUB
LOCATION: FERRY CREEK, STRATFORD, CT
EXPOSURE SCENARIO: WETLAND/MARSH RECEPTOR - PRE-ADOLESCENT RME
MEDIA: SURFACE SOIL
DATE: AUGUST 3, 2000

HAZARD INDICES AND INCREMENTAL CANCER RISKS ARE CALCULATED BY THIS SPREADSHEET.
EXPOSURES THROUGH INCIDENTAL INGESTION OF SOIL ARE CONSIDERED.
ASSUMPTIONS ARE OUTLINED BELOW.

RELEVANT EQUATION: $\text{Intake} = \frac{Cs \times IR \times CF \times FI \times EF \times ED}{BW \times AT}$

WHERE:			
	Cs = :		Concentration in soil (mg/kg)
	IR = :	100	Soil Ingestion Rate (mg/day)
	CF = :	1.0E-06	Conversion Factor (kg/mg)
	FI = :	1	Fraction from contaminated source (unitless)
	EF = :	20	Exposure Frequency (days/year)
	ED = :	6	Exposure Duration (years)
	BW = :	31	Body Weight (kg)
	ATc = :	25,550	Averaging time for carcinogenic exposures (days)
	ATn = :	2,190	Averaging time for noncarcinogenic exposures (days)

Unit Dose		
Lifetime Chronic Daily Int	1.5E-08	kg-soil/kg-wt/day
Chronic Daily Intake = :	1.8E-07	kg-soil/kg-wt/day

RISK ASSESSMENT SPREADSHEET - INCIDENTAL INGESTION OF SOIL (PAGE TWO)

SITE NAME: AREA C, HOUSATONIC BOAT CLUB
LOCATION: FERRY CREEK, STRATFORD, CT
EXPOSURE SCENARIO: WETLAND/MARSH RECEPTOR - PRE-ADOLESCENT RME
MEDIA: SURFACE SOIL
DATE: AUGUST 3, 2000

CHEMICAL	Cs (mg/kg)	Lifetime Chronic Daily Intake (mg/kg/day)	Chronic Daily Intake (mg/kg/day)	Cancer Slope Factor $(mg/kg/day)^{-1}$	Reference Dose (mg/kg/day)	Lifetime Cancer Risk	Percent Cancer Risk	Hazard Quotient	Percent Hazard Quotient
Benzo(a)anthracene	1.7	2.6E-08	3.0E-07	7.30E-01	NA	1.9E-08	1.1%	NA	NA
Benzo(b)fluoranthene	2.3	3.5E-08	4.1E-07	7.30E-01	NA	2.5E-08	1.5%	NA	NA
Benzo(a)pyrene	1.7	2.6E-08	3.0E-07	7.30E+00	NA	1.9E-07	11.1%	NA	NA
Dibenzo(a,h)anthracene	0.5	7.6E-09	8.8E-08	7.30E+00	NA	5.5E-08	3.3%	NA	NA
Indeno(1,2,3-cd)pyrene	1.4	2.1E-08	2.5E-07	7.30E-01	NA	1.5E-08	0.9%	NA	NA
Aroclor, total	11	1.7E-07	1.9E-06	2.00E+00	2.00E-05	3.3E-07	19.7%	9.7E-02	85.0%
Antimony	3.7	5.6E-08	6.5E-07	NA	4.00E-04	NA	NA	1.6E-03	1.4%
Arsenic	9.5	1.4E-07	1.7E-06	1.50E+00	3.00E-04	2.2E-07	12.8%	5.6E-03	4.9%
Barium	1700	2.6E-05	3.0E-04	NA	7.00E-02	NA	NA	4.3E-03	3.8%
Chromium (total)	516	7.8E-06	9.1E-05	NA	2.00E-02	NA	NA	4.6E-03	4.0%
Nickel	62.1	9.4E-07	1.1E-05	NA	2.00E-02	NA	NA	5.5E-04	0.5%
Thallium	2.1	3.2E-08	3.7E-07	NA	6.60E-04	NA	NA	5.6E-04	0.5%
TEQ-Dioxin/Furans	0.00037	5.6E-12	6.5E-11	1.50E+05	NA	8.4E-07	49.7%	NA	NA
					Total	1.7E-06	100%	1.1E-01	100%

RISK ASSESSMENT SPREADSHEET - INCIDENTAL INGESTION OF SOIL

SITE NAME: AREA C, HOUSATONIC BOAT CLUB
LOCATION: FERRY CREEK, STRATFORD, CT
EXPOSURE SCENARIO: WETLAND/MARSH RECEPTOR - PRE-ADOLESCENT CTE
MEDIA: SURFACE SOIL
DATE: AUGUST 3, 2000

HAZARD INDICES AND INCREMENTAL CANCER RISKS ARE CALCULATED BY THIS SPREADSHEET.
EXPOSURES THROUGH INCIDENTAL INGESTION OF SOIL ARE CONSIDERED.
ASSUMPTIONS ARE OUTLINED BELOW.

RELEVANT EQUATION: $\text{Intake} = \frac{Cs \times IR \times CF \times FI \times EF \times ED}{BW \times AT}$

WHERE:			
	Cs = :		Concentration in soil (mg/kg)
	IR = :	50	Soil Ingestion Rate (mg/day)
	CF = :	1.0E-06	Conversion Factor (kg/mg)
	FI = :	1	Fraction from contaminated source (unitless)
	EF = :	20	Exposure Frequency (days/year)
	ED = :	2	Exposure Duration (years)
	BW = :	31	Body Weight (kg)
	ATc = :	25,550	Averaging time for carcinogenic exposures (days)
	ATn = :	730	Averaging time for noncarcinogenic exposures (days)

Unit Dose
Lifetime Chronic Daily Int: 2.5E-09 kg-soil/kg-wt/day
Chronic Daily Intake = : 8.8E-08 kg-soil/kg-wt/day

RISK ASSESSMENT SPREADSHEET - INCIDENTAL INGESTION OF SOIL (PAGE TWO)

SITE NAME: AREA C, HOUSATONIC BOAT CLUB
LOCATION: FERRY CREEK, STRATFORD, CT
EXPOSURE SCENARIO: WETLAND/MARSH RECEPTOR - PRE-ADOLESCENT CTE
MEDIA: SURFACE SOIL
DATE: AUGUST 3, 2000

CHEMICAL	Cs (mg/kg)	Lifetime Chronic Daily Intake (mg/kg/day)	Chronic Daily Intake (mg/kg/day)	Cancer Slope Factor $(mg/kg/day)^{-1}$	Reference Dose (mg/kg/day)	Lifetime Cancer Risk	Percent Cancer Risk	Hazard Quotient	Percent Hazard Quotient
Benzo(a)anthracene	1.7	4.3E-09	1.5E-07	7.30E-01	NA	3.1E-09	1.2%	NA	NA
Benzo(b)fluoranthene	2.3	5.8E-09	2.0E-07	7.30E-01	NA	4.2E-09	1.7%	NA	NA
Benzo(a)pyrene	1.7	4.3E-09	1.5E-07	7.30E+00	NA	3.1E-08	12.3%	NA	NA
Dibenzo(a,h)anthracene	0.5	1.3E-09	4.4E-08	7.30E+00	NA	9.2E-09	3.6%	NA	NA
Indeno(1,2,3-cd)pyrene	1.4	3.5E-09	1.2E-07	7.30E-01	NA	2.6E-09	1.0%	NA	NA
Aroclor, total	11	2.8E-08	9.7E-07	1.00E+00	2.00E-05	2.8E-08	10.9%	4.9E-02	85.0%
Antimony	3.7	9.3E-09	3.3E-07	NA	4.00E-04	NA	NA	8.2E-04	1.4%
Arsenic	9.5	2.4E-08	8.4E-07	1.50E+00	3.00E-04	3.6E-08	14.1%	2.8E-03	4.9%
Barium	1700	4.3E-06	1.5E-04	NA	7.00E-02	NA	NA	2.1E-03	3.8%
Chromium (total)	516	1.3E-06	4.6E-05	NA	2.00E-02	NA	NA	2.3E-03	4.0%
Nickel	62.1	1.6E-07	5.5E-06	NA	2.00E-02	NA	NA	2.7E-04	0.5%
Thallium	2.1	5.3E-09	1.9E-07	NA	6.60E-04	NA	NA	2.8E-04	0.5%
TEQ-Dioxin/Furans	0.00037	9.3E-13	3.3E-11	1.50E+05	NA	1.4E-07	55.1%	NA	NA
					Total	2.5E-07	100%	5.7E-02	100%

TETRA TECH NUS, INC. CALCULATION WORKSHEET

CLIENT: Raymark - Ferry Creek	JOB NUMBER: 7491
SUBJECT: Direct Dermal Contact with Soil - Wetland/Marsh Receptor (Pre-Adolescent)	
BASED ON: RAGs 1989	DRAWING NUMBER:
BY: JMM / CHECKED BY: RJK	APPROVED BY: / DATE: 3/27/00

Purpose: To calculate carcinogenic and noncarcinogenic risk for the Pre-adolescent Wetland/Marsh Receptor via direct dermal contact with site soil.

Relevant equation:

$$\text{Absorbed dose} \; (\text{mg/kg-day}) = \frac{Cs \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT}$$

where:

Cs = Chemical concentration in soil (mg/kg)
CF = Conversion Factor (kg/mg)
SA = Skin surface available for contact (cm^2/event)
AF = Soil to skin adherence factor (mg/cm^2)
ABS = Absorption factor (unitless)
EF = Exposure Frequency (events/year)
ED = Exposure Duration (years)
BW = Bodyweight (kg)
ATN = Averaging Time for noncarcinogenic exposures (days)
ATc = Averaging Time for carcinogenic exposures (days)

and

Reasonable Maximum Exposure (RME)		Central Tendency Exposure CTE	
Cs	chemical specific (mg/kg)	Cs	chemical specific (mg/kg)
CF	1.0E-6 (kg/mg)	CF	1.0E-6 (kg/mg)
SA	3,200 (cm^2/event)	SA	3,200 cm^2/event
AF	1.0 (mg/cm^2)	AF	0.20 mg/cm^2
ABS	chemical specific (unitless)	ABS	chemical specific (unitless)
EF	20 (events/year)	EF	20 (events/year)
ED	6 (years)	ED	2 (years)
BW	31 (kg)	BW	31 (kg)
ATN	2,190 (days)	ATN	730 (days)
ATc	25,550 (days)	ATc	25,550 (days)

CLIENT Raymark - Ferry Creek		JOB NUMBER 7491	
SUBJECT Direct Dermal Contact with Soil-Wetland/Marsh Receptor			
BASED ON RAGs 1989		DRAWING NUMBER (Pre-Adolescent)	
BY JMM	CHECKED BY RJK	APPROVED BY	DATE 3/27/00

Absorbed dose of arsenic at a concentration of 9.5 mg/Kg in Area C, surface soil under RME assumptions:

RME Noncarcinogenic Absorbed Dose (mg/Kg-day)

$$= \frac{9.5\,\frac{mg}{Kg} \times 1.0E^{-6}\,\frac{Kg}{mg} \times 3{,}200\,\frac{cm^2}{event} \times 1.0\,\frac{mg}{cm^2} \times 0.03 \times 20\,\frac{events}{yr} \times 6\,years}{31\,Kg \times 2{,}190\,days}$$

$$= \boxed{1.61\,E^{-6}\ mg/Kg\text{-}day}$$ ✓

RME Carcinogenic Absorbed Dose (mg/Kg-day)

$$= \frac{9.5\,\frac{mg}{Kg} \times 1.0E^{-6}\,\frac{Kg}{mg} \times 3{,}200\,\frac{cm^2}{event} \times 1.0\,\frac{mg}{cm^2} \times 0.03 \times 20\,\frac{events}{year} \times 6\,years}{31\,Kg \times 25{,}550\,days}$$

$$= \boxed{1.38\,E^{-7}\ mg/Kg\text{-}day}$$ ✓

Then incremental Cancer Risk (ICR) and Hazard Quotient (HQ) are calculated via the following equations:

ICR (unitless) = Carcinogenic Absorbed Dose (mg/Kg-day) x Cancer Slope Factor (CSF) (Kg/mg-day)

HQ (unitless) = $\frac{\text{noncarcinogenic Absorbed Dose (mg/Kg-day)}}{\text{Reference Dose (RfD) (mg/Kg-day)}}$

Where the CSF of Arsenic = $1.5\,E^{+0}$ and the RfD of arsenic = $3.0E^{-4}$ ✓

ICR Arsenic (unitless) = $1.38E^{-7}$ (mg/Kg-day) x $1.5E^{+0}$ Kg/mg-day = $\boxed{2.1\,E^{-7}}$ RME

HQ arsenic (unitless) = $\frac{1.61\,E^{-6}\ mg/Kg\text{-}day}{3.0\,E^{-4}\ mg/Kg\text{-}day}$ = $\boxed{5.4\,E^{-3}}$ RME ✓

TETRA TECH NUS, INC. **CALCULATION WORKSHEET** PAGE 3 OF 3

CLIENT Raymark - Ferry Creek	JOB NUMBER 7491
SUBJECT Direct Dermal Contact with Soil - Wetland/Marsh Receptor (Pre-Adolescent)	
BASED ON	DRAWING NUMBER
BY JMM / CHECKED BY RJP	APPROVED BY / DATE 3/27/00

Absorbed dose of arsenic at a concentration of 9.5 mg/kg in Area C, surface soil, under CTE assumption:

CTE Nonmarcinogenic Absorbed Dose (mg/kg-day)

$$= \frac{9.5\,\frac{mg}{kg} \times 1.0E^{-6}\,\frac{kg}{mg} \times 3200\,\frac{cm^2}{event} \times 0.20\,\frac{mg}{cm^2} \times .03 \times 20\,\frac{events}{year} \times 2\,years}{31\,kg \times 730\,days}$$

$$= \boxed{3.22\,E^{-7}\,mg/kg\text{-}day}$$ ✓

CTE Carcinogenic Absorbed Dose (mg/kg-day)

$$= \frac{9.5\,\frac{mg}{kg} \times 1.0E^{-6}\,\frac{kg}{mg} \times 3,200\,\frac{cm^2}{event} \times 0.20\,\frac{mg}{cm^2} \times .03 \times 20\,\frac{events}{year} \times 2\,years}{31\,kg \times 25,550\,days}$$

$$= \boxed{9.21\,E^{-9}\,mg/kg\text{-}day}$$ ✓

ICR arsenic (unitless) $= 9.21E^{-9}\,mg/kg\text{-}day \times 1.5E^{10}\,kg/mg\text{-}day = \boxed{1.4\,E^{-8}}$ CTE ✓

HQ arsenic (unitless) $= \frac{3.22\,E^{-7}\,mg/kg\text{-}day}{3.0\,E^{-4}\,mg/kg\text{-}day} = \boxed{1.1\,E^{-3}}$ CTE ✓

Reference

USEPA 1989. Risk Assessment Guidance for Superfund Volume I Human Health Evaluation Manual (PART A) Interim Final OSWER EPA/540/1-89/002.

RISK ASSESSMENT SPREADSHEET - DIRECT DERMAL CONTACT WITH SOIL

SITE NAME: AREA C, HOUSATONIC BOAT CLUB
LOCATION: FERRY CREEK, STRATFORD, CT
EXPOSURE SCENARIO: WETLAND/MARSH RECEPTOR - PRE-ADOLESCENT RME
MEDIA: SURFACE SOIL
DATE: FEBRUARY 25, 2000

HAZARD INDICES AND INCREMENTAL CANCER RISKS ARE CALCULATED BY THIS SPREADSHEET.
EXPOSURES THROUGH DERMAL CONTACT WITH SOIL ARE CONSIDERED.
ASSUMPTIONS ARE OUTLINED BELOW.

RELEVANT EQUATION: $$\text{AbsorbedDose} = \frac{Cs \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT}$$

Where:			
	Cs = :		Mean concentration in soil (mg/kg)
	CF = :	1.0E-06	Conversion factor (kg/mg)
	SA = :	3,200	Skin surface available for contact (cm^2/event)
	AF = :	1.0	Soil to skin adherence factor (mg/cm^2)
	ABS = :		Absorption factor (unitless)
	EF = :	20	Exposure frequency (events/year)
	ED = :	6	Exposure duration (years)
	BW = :	31	Body weight (kg)
	ATc = :	25,550	Averaging time for carcinogenic exposures (days)
	ATn = :	2,190	Averaging time for noncarcinogenic exposures (days)

Unit Dose
Lifetime Chronic Daily Intake 4.8E-07 kg-soil/kg-wt/day
Chronic Daily Intake = : 5.7E-06 kg-soil/kg-wt/day

RISK ASSESSMENT SPREADSHEET - DIRECT DERMAL CONTACT WITH SOIL (PAGE TWO)

SITE NAME: AREA C, HOUSATONIC BOAT CLUB
LOCATION: FERRY CREEK, STRATFORD, CT
EXPOSURE SCENARIO: WETLAND/MARSH RECEPTOR - PRE-ADOLESCENT RME
MEDIA: SURFACE SOIL
DATE: FEBRUARY 25, 2000

CHEMICAL	Cs (mg/kg)	ABS (unitless)	Lifetime Chronic Daily Intake (mg/kg/day)	Chronic Daily Intake (mg/kg/day)	Cancer Slope Factor $(mg/kg/day)^{-1}$	Reference Dose (mg/kg/day)	Lifetime Cancer Risk	Percent Cancer Risk	Hazard Quotient	Percent Hazard Quotient
Benzo(a)anthracene	1.7	0.13	1.07E-07	1.25E-06	7.30E-01	NA	7.8E-08	2.1%	NA	NA
Benzo(b)fluoranthene	2.3	0.13	1.45E-07	1.69E-06	7.30E-01	NA	1.1E-07	2.8%	NA	NA
Benzo(a)pyrene	1.7	0.13	1.07E-07	1.25E-06	7.30E+00	NA	7.8E-07	20.8%	NA	NA
Dibenzo(a,h)anthracene	0.5	0.13	3.15E-08	3.68E-07	7.30E+00	NA	2.3E-07	6.1%	NA	NA
Indeno(1,2,3-cd)pyrene	1.4	0.13	8.82E-08	1.03E-06	7.30E-01	NA	6.4E-08	1.7%	NA	NA
Aroclor, total	11	0.14	7.47E-07	8.71E-06	2.00E+00	NA	1.5E-06	39.6%	NA	NA
Antimony	3.7	NA	NA	NA	NA	6.00E-05	NA	NA	NA	NA
Arsenic	9.5	0.03	1.38E-07	1.61E-06	1.50E+00	3.00E-04	2.1E-07	5.5%	5.4E-03	100.0%
Barium	1700	NA	NA	NA	NA	4.90E-03	NA	NA	NA	NA
Chromium (total)	516	NA	NA	NA	NA	5.00E-04	NA	NA	NA	NA
Manganese	320	NA	NA	NA	NA	8.40E-03	NA	NA	NA	NA
Nickel	62.1	NA	NA	NA	NA	8.00E-04	NA	NA	NA	NA
Thallium	2.1	NA	NA	NA	NA	6.60E-04	NA	NA	NA	NA
TEQ-Dioxin/Furans	0.00037	0.03	5.38E-12	6.28E-11	1.50E+05	NA	8.1E-07	21.4%	NA	NA
						Total	3.8E-06	100%	5.4E-03	100%

RISK ASSESSMENT SPREADSHEET - DIRECT DERMAL CONTACT WITH SOIL

SITE NAME: AREA C, HOUSATONIC BOAT CLUB
LOCATION: FERRY CREEK, STRATFORD, CT
EXPOSURE SCENARIO: WETLAND/MARSH RECEPTOR - PRE-ADOLESCENT CTE
MEDIA: SURFACE SOIL
DATE: FEBRUARY 25, 2000

HAZARD INDICES AND INCREMENTAL CANCER RISKS ARE CALCULATED BY THIS SPREADSHEET.
EXPOSURES THROUGH DERMAL CONTACT WITH SOIL ARE CONSIDERED.
ASSUMPTIONS ARE OUTLINED BELOW.

RELEVANT EQUATION:

$$\text{AbsorbedDose} = \frac{Cs \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT}$$

Where:

Cs = :		Mean concentration in soil (mg/kg)
CF = :	1.0E-06	Conversion factor (kg/mg)
SA = :	3,200	Skin surface available for contact (cm^2/event)
AF = :	0.2	Soil to skin adherence factor (mg/cm^2)
ABS = :		Absorption factor (unitless)
EF = :	20	Exposure frequency (events/year)
ED = :	2	Exposure duration (years)
BW = :	31	Body weight (kg)
ATc = :	25,550	Averaging time for carcinogenic exposures (days)
ATn = :	730	Averaging time for noncarcinogenic exposures (days)

Unit Dose
Lifetime Chronic Daily Intake 3.2E-08 kg-soil/kg-wt/day
Chronic Daily Intake = : 1.1E-06 kg-soil/kg-wt/day

RISK ASSESSMENT SPREADSHEET - DIRECT DERMAL CONTACT WITH SOIL (PAGE TWO)

SITE NAME: AREA C, HOUSATONIC BOAT CLUB
LOCATION: FERRY CREEK, STRATFORD, CT
EXPOSURE SCENARIO: WETLAND/MARSH RECEPTOR - PRE-ADOLESCENT CTE
MEDIA: SURFACE SOIL
DATE: FEBRUARY 25, 2000

CHEMICAL	Cs (mg/kg)	ABS (unitless)	Lifetime Chronic Daily Intake (mg/kg/day)	Chronic Daily Intake (mg/kg/day)	Cancer Slope Factor $(mg/kg/day)^{-1}$	Reference Dose (mg/kg/day)	Lifetime Cancer Risk	Percent Cancer Risk	Hazard Quotient	Percent Hazard Quotient
Benzo(a)anthracene	1.7	0.13	7.14E-09	2.50E-07	7.30E-01	NA	5.2E-09	2.6%	NA	NA
Benzo(b)fluoranthene	2.3	0.13	9.66E-09	3.38E-07	7.30E-01	NA	7.1E-09	3.5%	NA	NA
Benzo(a)pyrene	1.7	0.13	7.14E-09	2.50E-07	7.30E+00	NA	5.2E-08	25.9%	NA	NA
Dibenzo(a,h)anthracene	0.5	0.13	2.10E-09	7.35E-08	7.30E+00	NA	1.5E-08	7.6%	NA	NA
Indeno(1,2,3-cd)pyrene	1.4	0.13	5.88E-09	2.06E-07	7.30E-01	NA	4.3E-09	2.1%	NA	NA
Aroclor, total	11	0.14	4.98E-08	1.74E-06	1.00E+00	NA	5.0E-08	24.7%	NA	NA
Antimony	3.7	NA	NA	NA	NA	6.00E-05	NA	NA	NA	NA
Arsenic	9.5	0.03	9.21E-09	3.22E-07	1.50E+00	3.00E-04	1.4E-08	6.9%	1.1E-03	100.0%
Barium	1700	NA	NA	NA	NA	4.90E-03	NA	NA	NA	NA
Chromium (total)	516	NA	NA	NA	NA	5.00E-04	NA	NA	NA	NA
Manganese	320	NA	NA	NA	NA	8.40E-03	NA	NA	NA	NA
Nickel	62.1	NA	NA	NA	NA	8.00E-04	NA	NA	NA	NA
Thallium	2.1	NA	NA	NA	NA	6.60E-04	NA	NA	NA	NA
TEQ-Dioxin/Furans	0.00037	0.03	3.59E-13	1.26E-11	1.50E+05	NA	5.4E-08	26.7%	NA	NA
						Total	2.0E-07	100%	1.1E-03	100%

TETRA TECH NUS, INC. **CALCULATION WORKSHEET**

CLIENT: Raymark - Ferry Creek	JOB NUMBER: 7491
SUBJECT: Incidental Ingestion of soil - Wetland/Marsh Receptor (adult)	
BASED ON: Rags 1989	DRAWING NUMBER:
BY: JMM / CHECKED BY: RJK	APPROVED BY: / DATE: 3/27/00

Purpose: To calculate noncarcinogenic and carcinogenic risk for the wetland Marsh Receptor - adult via incidental ingestion of site soil.

Relevant equation:

$$\text{Intake (mg/kg-day)} = \frac{Cs \times IR \times CF \times FI \times EF \times ED}{BW \times AT}$$

where

Cs = Concentration in soil (mg/kg)
IR = Soil ingestion Rate (mg/day)
CF = Conversion Factor (Kg/mg)
FI = Fraction of soil from contaminated source (unitless)
EF = Exposure frequency (days/year)
ED = Exposure duration (years)
BW = Body weight (Kg)
ATn = Averaging time for noncarcinogenic exposures (days)
ATc = Averaging time for carcinogenic exposures (days)
and

Reasonable Maximum Exposure (RME)		Central Tendency Exposure (CTE)	
Cs	chemical specific	Cs	chemical specific
IR	100 mg/day	IR	50 (mg/day)
CF	1.0E-6 (Kg/mg)	CF	1.0E-6 (Kg/mg)
FI	1 (unitless)	FI	1 (unitless)
EF	20 (days/year)	EF	20 (days/year)
ED	24 (years)	ED	7 (years)
BW	70 Kg	BW	70 (Kg)
ATc	25,550 days	ATc	25,550 (days)
ATn	8760 days	ATn	2,555 (days)

TETRA TECH NUS, INC. **CALCULATION WORKSHEET**

CLIENT: Raymark - Ferry Creek	JOB NUMBER: 7491
SUBJECT: Incidental Ingestion of soil - (wetland/marsh Receptor)	
BASED ON: RAGs 1989	DRAWING NUMBER: (adult)
BY: gmm / CHECKED BY: RJP	APPROVED BY: / DATE: 3/27/00

Intake of arsenic at a concentration of 9.5 mg/kg in Area C, surface soil under the RME assumptions:

$$\text{RME Noncarcinogenic Intake (mg/kg-day) of arsenic} = \frac{9.5\,(mg/kg) \times 100\,(mg/day) \times 1.0E^{-6}\,(kg/mg) \times 1 \times 20\,days/year \times 24\,years}{70\,(kg) \times 8{,}760\,days}$$

$$= \boxed{7.44E^{-7}\ mg/kg\text{-}day} \checkmark$$

$$\text{RME Carcinogenic Intake (mg/kg-day) of arsenic} = \frac{9.5\,mg/kg \times 100\,(mg/day) \times 1.0E^{-6}\,(kg/mg) \times 1 \times 20\,days/year \times 24\,years}{70\,(kg) \times 25{,}550\,days}$$

$$= \boxed{2.55E^{-7}\ mg/kg\text{-}day} \checkmark$$

Then incremental Cancer Risk (ICR) and Hazard Quotient (HQ) are calculated with the following equations:

$$\underset{\text{(unitless)}}{ICR} = \underset{(mg/kg\text{-}day)}{\text{Carcinogenic Intake}} \times \underset{(kg/mg\text{-}day)}{\text{Cancer Slope Factor (CSF)}}$$

$$\underset{\text{(unitless)}}{HQ} = \frac{\text{Noncarcinogenic intake}}{\text{Reference Dose}} \quad \frac{mg/kg\text{-}day}{mg/kg\text{-}day}$$

where the CSF for arsenic = $1.5E^{+0}$ and RFD for arsenic = $3.0E^{-4}$

$$\underset{\text{(unitless)}}{ICR\ arsenic} = 2.55E^{-7}\,(mg/kg\text{-}day) \times 1.5E^{+0}\,(kg/mg\text{-}day) = \boxed{3.8E^{-7}}\ \text{RME} \checkmark$$

$$\underset{\text{(unitless)}}{HQ\ arsenic} = \frac{7.44E^{-7}\ mg/kg\text{-}day}{3.0E^{-4}\ mg/kg\text{-}day} = \boxed{2.5E^{-3}}\ \text{RME} \checkmark$$

CLIENT Raymark - Ferry creek		JOB NUMBER	
SUBJECT Incidental Ingestion of soil - wetland/Marsh Receptor (adult)			
BASED ON RAGs 1989		DRAWING NUMBER	
BY JMM	CHECKED BY RJJ	APPROVED BY	DATE 3/27/00

Intake of arsenic at a concentration of 9.5 mg/kg in Area C, surface soil under C & E assumptions:

CTE Noncarcinogenic Intake (mg/kg-day) $= \frac{9.5\,mg/kg \times 50\,(mg/day) \times 1.0E^{-6}\,(kg/mg) \times 1 \times 20\,days/year \times 7\,years}{70\,(kg) \times 2555\,(days)}$

$= \boxed{3.72\,E^{-7}\,(mg/kg\text{-}day)}$ ✓

CTE Carcinogenic Intake (mg/kg-day) $= \frac{9.5\,mg/kg \times 50\,(mg/day) \times 1.0E^{-6}\,(kg/mg) \times 1 \times 20\,days/year \times 7\,years}{70\,(kg) \times 25{,}550\,(days)}$

$= \boxed{3.72\,E^{-8}\,mg/kg\text{-}day}$ ✓

Then ICR and HQ are calculated for arsenic where the

ICR arsenic (unitless) $= 3.72E^{-8}\,(mg/kg\text{-}day) \times 1.5E^{+0}\,(kg/mg\text{-}day) = \boxed{5.6\,E^{-8}}$ CTE ✓

HQ arsenic (unitless) $= \frac{3.72E^{-7}\,mg/kg\text{-}day}{3.0E^{-4}\,mg/kg\text{-}day} = \boxed{1.2\,E^{-3}}$ CTE ✓

References

USEPA Dec. 1989. Risk Assessment Guidance for Superfund Volume 1 Human Health Evaluation Manual (Part A) Interim Final. OSWER EPA/540/1-89/002.

RISK ASSESSMENT SPREADSHEET - INCIDENTAL INGESTION OF SOIL

SITE NAME: AREA C, HOUSATONIC BOAT CLUB
LOCATION: FERRY CREEK, STRATFORD, CT
EXPOSURE SCENARIO: WETLAND/MARSH RECEPTOR - ADULT RME
MEDIA: SURFACE SOIL
DATE: FEBRUARY 25, 2000

all WMR

HAZARD INDICES AND INCREMENTAL CANCER RISKS ARE CALCULATED BY THIS SPREADSHEET.
EXPOSURES THROUGH INCIDENTAL INGESTION OF SOIL ARE CONSIDERED.
ASSUMPTIONS ARE OUTLINED BELOW.

RELEVANT EQUATION: $\text{Intake} = \frac{Cs \times IR \times CF \times FI \times EF \times ED}{BW \times AT}$

WHERE:

Cs = :		Concentration in soil (mg/kg)
IR = :	100	Soil Ingestion Rate (mg/day)
CF = :	1.0E-06	Conversion Factor (kg/mg)
FI = :	1	Fraction from contaminated source (unitless)
EF = :	20	Exposure Frequency (days/year) ✓
ED = :	24	Exposure Duration (years)
BW = :	70	Body Weight (kg)
ATc = :	25,550	Averaging time for carcinogenic exposures (days)
ATn = :	8,760	Averaging time for noncarcinogenic exposures (days)

Unit Dose
Lifetime Chronic Daily Int: 2.7E-08 kg-soil/kg-wt/day
Chronic Daily Intake = : 7.8E-08 kg-soil/kg-wt/day

RISK ASSESSMENT SPREADSHEET - INCIDENTAL INGESTION OF SOIL (PAGE TWO)

SITE NAME: AREA C, HOUSATONIC BOAT CLUB
LOCATION: FERRY CREEK, STRATFORD, CT
EXPOSURE SCENARIO: WETLAND/MARSH RECEPTOR - ADULT RME
MEDIA: SURFACE SOIL
DATE: FEBRUARY 25, 2000

CHEMICAL	Cs (mg/kg)	Lifetime Chronic Daily Intake (mg/kg/day)	Chronic Daily Intake (mg/kg/day)	Cancer Slope Factor $(mg/kg/day)^{-1}$	Reference Dose (mg/kg/day)	Lifetime Cancer Risk	Percent Cancer Risk	Hazard Quotient	Percent Hazard Quotient
Benzo(a)anthracene	1.7	4.6E-08	1.3E-07	7.30E-01	NA	3.3E-08	1.1%	NA	NA
Benzo(b) fluoranthene	2.3	6.2E-08	1.8E-07	7.30E-01	NA	4.5E-08	1.5%	NA	NA
Benzo(a)pyrene	1.7	4.6E-08	1.3E-07	7.30E+00	NA	3.3E-07	11.1%	NA	NA
Dibenzo(a,h)anthracene	0.5	1.3E-08	3.9E-08	7.30E+00	NA	9.8E-08	3.3%	NA	NA
Indeno(1,2,3-cd)pyrene	1.4	3.8E-08	1.1E-07	7.30E-01	NA	2.7E-08	0.9%	NA	NA
Aroclor, total	11	3.0E-07	8.6E-07	2.00E+00	NA	5.9E-07	19.7%	NA	NA
Antimony	3.7	9.9E-08	2.9E-07	NA	4.00E-04	NA	NA	7.2E-04	3.4%
Arsenic	9.5	2.5E-07	7.4E-07	1.50E+00	3.00E-04	3.8E-07	12.8%	2.5E-03	11.5%
Barium	1700	4.6E-05	1.3E-04	NA	7.00E-02	NA	NA	1.9E-03	8.9%
Chromium (total)	516	1.4E-05	4.0E-05	NA	3.00E-03	NA	NA	1.3E-02	62.7%
Manganese	320	8.6E-06	2.5E-05	NA	1.40E-01	NA	NA	1.8E-04	0.8%
Nickel	62.1	1.7E-06	4.9E-06	NA	2.00E-02	NA	NA	2.4E-04	1.1%
Thallium	2.1	5.6E-08	1.6E-07	NA	6.60E-05	NA	NA	2.5E-03	11.6%
TEQ-Dioxins/Furans	0.00037	9.9E-12	2.9E-11	1.50E+05	NA	1.5E-06	49.7%	NA	NA
					Total	3.0E-06	100%	2.1E-02	100%

RISK ASSESSMENT SPREADSHEET - INCIDENTAL INGESTION OF SOIL

SITE NAME: AREA C, HOUSATONIC BOAT CLUB
LOCATION: FERRY CREEK, STRATFORD, CT
EXPOSURE SCENARIO: WETLAND/MARSH RECEPTOR - ADULT CTE ✓
MEDIA: SURFACE SOIL
DATE: FEBRUARY 25, 2000

HAZARD INDICES AND INCREMENTAL CANCER RISKS ARE CALCULATED BY THIS SPREADSHEET.
EXPOSURES THROUGH INCIDENTAL INGESTION OF SOIL ARE CONSIDERED.
ASSUMPTIONS ARE OUTLINED BELOW.

RELEVANT EQUATION: $\text{Intake} = \frac{Cs \times IR \times CF \times FI \times EF \times ED}{BW \times AT}$

WHERE:			
	Cs = :		Concentration in soil (mg/kg)
	IR = :	50	Soil Ingestion Rate (mg/day)
	CF = :	1.0E-06	Conversion Factor (kg/mg)
	FI = :	1	Fraction from contaminated source (unitless)
	EF = :	20	Exposure Frequency (days/year) ✓
	ED = :	7	Exposure Duration (years)
	BW = :	70	Body Weight (kg)
	ATc = :	25,550	Averaging time for carcinogenic exposures (days)
	ATn = :	2,555	Averaging time for noncarcinogenic exposures (days)

Unit Dose		
Lifetime Chronic Daily Int	3.9E-09	kg-soil/kg-wt/day
Chronic Daily Intake = :	3.9E-08	kg-soil/kg-wt/day

RISK ASSESSMENT SPREADSHEET - INCIDENTAL INGESTION OF SOIL (PAGE TWO)

SITE NAME: AREA C, HOUSATONIC BOAT CLUB
LOCATION: FERRY CREEK, STRATFORD, CT
EXPOSURE SCENARIO: WETLAND/MARSH RECEPTOR - ADULT CTE
MEDIA: SURFACE SOIL
DATE: FEBRUARY 25, 2000

CHEMICAL	Cs (mg/kg)	Lifetime Chronic Daily Intake (mg/kg/day)	Chronic Daily Intake (mg/kg/day)	Cancer Slope Factor $(mg/kg/day)^{-1}$	Reference Dose (mg/kg/day)	Lifetime Cancer Risk	Percent Cancer Risk	Hazard Quotient	Percent Hazard Quotient
Benzo(a)anthracene	1.7	6.7E-09	6.7E-08	7.30E-01	NA	4.9E-09	1.2%	NA	NA
Benzo(b) fluoranthene	2.3	9.0E-09	9.0E-08	7.30E-01	NA	6.6E-09	1.7%	NA	NA
Benzo(a)pyrene	1.7	6.7E-09	6.7E-08	7.30E+00	NA	4.9E-08	12.3%	NA	NA
Dibenzo(a,h)anthracene	0.5	2.0E-09	2.0E-08	7.30E+00	NA	1.4E-08	3.6%	NA	NA
Indeno(1,2,3-cd)pyrene	1.4	5.5E-09	5.5E-08	7.30E-01	NA	4.0E-09	1.0%	NA	NA
Aroclor, total	11	4.3E-08	4.3E-07	1.00E+00	NA	4.3E-08	10.9%	NA	NA
Antimony	3.7	1.4E-08	1.4E-07	NA	4.00E-04	NA	NA	3.6E-04	3.4%
Arsenic	9.5	3.7E-08	3.7E-07	1.50E+00	3.00E-04	5.6E-08	14.1%	1.2E-03	11.5%
Barium	1700	6.7E-06	6.7E-05	NA	7.00E-02	NA	NA	9.5E-04	8.9%
Chromium (total)	516	2.0E-06	2.0E-05	NA	3.00E-03	NA	NA	6.7E-03	62.7%
Manganese	320	1.3E-06	1.3E-05	NA	1.40E-01	NA	NA	8.9E-05	0.8%
Nickel	62.1	2.4E-07	2.4E-06	NA	2.00E-02	NA	NA	1.2E-04	1.1%
Thallium	2.1	8.2E-09	8.2E-08	NA	6.60E-05	NA	NA	1.2E-03	11.6%
TEQ-Dioxins/Furans	0.00037	1.4E-12	1.4E-11	1.50E+05	NA	2.2E-07	55.1%	NA	NA
					Total	3.9E-07	100%	1.1E-02	100%

TETRA TECH NUS, INC. **CALCULATION WORKSHEET**

CLIENT: Raymark - Ferry Creek	JOB NUMBER: 7491
SUBJECT: Direct Dermal Contact with Soil - Wetland/Marsh Receptor (Adult)	
BASED ON: RAGs 1989	DRAWING NUMBER:
BY: JMM / CHECKED BY: RJV	APPROVED BY: / DATE: 3/27/00

Purpose: To calculate carcinogenic and noncarcinogenic risk for the Wetland/Marsh Receptor - Adult via direct dermal contact with site soils

Relevant equation:

$$\text{Absorbed dose (mg/kg-day)} = \frac{Cs \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT}$$

where:

Cs = Chemical concentration in soil (mg/kg)
CF = Conversion Factor (kg/mg)
SA = Skin surface available for contact (cm^2/event)
AF = Soil to Skin adherence factor (mg/cm^2)
ABS = Absorption factor (unitless)
EF = Exposure Frequency (events/year)
ED = Exposure Duration (years)
BW = Bodyweight (kg)
ATN = Averaging Time for noncarcinogenic exposures (days)
ATC = Averaging Time for carcinogenic exposures (days)

and

Reasonable Maximum Exposure (RME)		Central Tendency Exposure (CTE)	
Cs	chemical specific (mg/kg)	Cs	chemical specific (mg/kg)
CF	1.0E-6 (kg/mg)	CF	1.0E-6 (kg/mg)
SA	5,700 (cm^2/event)	SA	5,700 (cm^2/event)
AF	0.3 (mg/cm^2)	AF	0.04 (mg/cm^2)
ABS	chemical specific (unitless)	ABS	chemical specific (unitless)
EF	20 (events/year)	EF	20 (events/year)
ED	24 (years)	ED	7 (years)
BW	70 (kg)	BW	70 (kg)
ATN	8760 (days)	ATN	2,555 (days)
ATC	25,550 (days)	ATC	25,550 (days)

TETRA TECH NUS, INC. **CALCULATION WORKSHEET** PAGE 2 OF 3

CLIENT Raymark - Ferry Creek	JOB NUMBER 7491
SUBJECT Direct Dermal Contact with Soil - Wetland/Marsh Receptor (Adult)	
BASED ON RAGs 1989	DRAWING NUMBER
BY JMM / CHECKED BY RJV	APPROVED BY / DATE 3/27/00

Absorbed dose of arsenic at a concentration of 9.5 mg/Kg in Area C, surface soil under the RME assumptions:

RME Noncarcinogenic Absorbed Dose (mg/Kg-day) $= \frac{9.5(mg/Kg) \times 1.0E^{-6}(mg/Kg) \times 5{,}700(cm^2/event) \times 0.3\,mg/cm^2 \times 0.03 \times 20\,events/yr \times 24\,yr}{70(Kg) \times 8760(days)}$

$= \boxed{3.81\ E^{-7}\ mg/Kg\text{-}day}$ ✓

RME Carcinogenic Absorbed Dose (mg/Kg-day) $= \frac{9.5(mg/Kg) \times 1.0E^{-6}(mg/Kg) \times 5700(cm^2/event) \times 0.3\,mg/(cm^2) \times 0.03 \times 20\,events/yr \times 24\,years}{70(Kg) \times 25{,}550(days)}$

$= \boxed{1.31\ E^{-7}\ mg/Kg\text{-}day}$ ✓

Then incremental Cancer Risk (ICR) and Hazard Quotient (HQ) are calculated via the following equations:

ICR (unitless) = Carcinogenic Absorbed Dose (mg/Kg-day) × Cancer Slope Factor (CSF) (Kg/mg-day)

HQ (unitless) = $\frac{\text{noncarcinogenic Absorbed Dose (mg/Kg-day)}}{\text{Reference Dose (RfD) (mg/Kg-day)}}$

Where the CSF of Arsenic = $1.5\ E^{+0}$ and the RfD of arsenic = $3.0E^{-4}$

ICR Arsenic (unitless) $= 1.31\ E^{-7}(mg/Kg\text{-}day) \times 1.5E^{+0}(Kg/mg\text{-}day) = \boxed{2.0\ E^{-7}}$ ✓ RME

HQ arsenic (unitless) $= \frac{3.81\ E^{-7}\ mg/Kg\text{-}day}{3.0\ E^{-4}\ mg/Kg\text{-}day} = \boxed{1.3\ E^{-3}}$ RME ✓

TETRA TECH NUS, INC. CALCULATION WORKSHEET

CLIENT Raymark-Ferry Creek	JOB NUMBER 7491
SUBJECT Direct Dermal Contact w/ Soil/Wetland/Marsh Receptor (Adult)	
BASED ON	DRAWING NUMBER
BY JMM / CHECKED BY RLP	APPROVED BY / DATE 3/27/00

Absorbed dose of arsenic at a concentration of 9.5 mg/kg in Area C, surface soil, under the CTE assumption:

CTE Noncarcinogenic Absorbed Dose (mg/kg-day) $= \dfrac{9.5(mg/kg) \times 1.0E^{-6}(kg/mg) \times 5700(cm^2/event) \times 0.04(mg/cm^2) \times 0.03 \times 20\ events/year \times 7\ years}{70(kg) \times 2{,}555\ days}$

$= \boxed{5.09E^{-8}\ mg/kg\text{-}day}$ ✓

CTE Carcinogenic Absorbed Dose (mg/kg-day) $= \dfrac{9.5(mg/kg) \times 1.0E^{-6}(kg/mg) \times 5700(cm^2/event) \times 0.04(mg/cm^2) \times 0.03 \times 20\ events/year \times 7\ years}{70(kg) \times 25{,}550(days)}$

$= \boxed{5.09E^{-9}\ mg/kg\text{-}day}$ ✓

ICR arsenic (unitless) $= 5.09E^{-9}(mg/kg\text{-}day) \times 1.5E^{10}\ kg/mg\text{-}day = \boxed{7.6E^{-9}}$ CTE ✓

HQ arsenic (unitless) $= \dfrac{5.09E^{-8}\ mg/kg\text{-}day}{3.0E^{-4}\ mg/kg\text{-}day} = \boxed{1.7E^{-4}}$ CTE ✓

Reference

USEPA 1989. Risk Assessment Guidance for Superfund Volume I Human Health Evaluation Manual (PART A) Interim Final OSWER EPA/540/1-89/002.

RISK ASSESSMENT SPREADSHEET - DIRECT DERMAL CONTACT WITH SOIL

SITE NAME: AREA C, HOUSATONIC BOAT CLUB
LOCATION: FERRY CREEK, STRATFORD, CT
EXPOSURE SCENARIO: WETLAND/MARSH RECEPTOR - ADULT RME ✓
MEDIA: SURFACE SOIL
DATE: FEBRUARY 25, 2000

HAZARD INDICES AND INCREMENTAL CANCER RISKS ARE CALCULATED BY THIS SPREADSHEET.
EXPOSURES THROUGH DERMAL CONTACT WITH SOIL ARE CONSIDERED.
ASSUMPTIONS ARE OUTLINED BELOW.

RELEVANT EQUATION:

$$\text{AbsorbedDose} = \frac{Cs \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT}$$

Where:

Cs = :		Concentration in soil (mg/kg)
CF = :	1.0E-06	Conversion factor (kg/mg) ✓
SA = :	5,700	Skin surface available for contact (cm^2/event) ✓
AF = :	0.3	Soil to skin adherence factor (mg/cm^2) ✓
ABS = :		Absorption factor (unitless)
EF = :	20	Exposure frequency (events/year) ✓
ED = :	24	Exposure duration (years)
BW = :	70	Body weight (kg)
ATc = :	25,550	Averaging time for carcinogenic exposures (days)
ATn = :	8,760	Averaging time for noncarcinogenic exposures (days)

Unit Dose
Lifetime Chronic Daily Intake 4.6E-07 kg-soil/kg-wt/day
Chronic Daily Intake = : 1.3E-06 kg-soil/kg-wt/day

RISK ASSESSMENT SPREADSHEET - DIRECT DERMAL CONTACT WITH SOIL (PAGE TWO)

SITE NAME: AREA C, HOUSATONIC BOAT CLUB
LOCATION: FERRY CREEK, STRATFORD, CT
EXPOSURE SCENARIO: WETLAND/MARSH RECEPTOR - ADULT RME
MEDIA: SURFACE SOIL
DATE: FEBRUARY 25, 2000

CHEMICAL	✓ Cs (mg/kg)	ABS (unitless)	Lifetime Chronic Daily Intake (mg/kg/day)	Chronic Daily Intake (mg/kg/day)	Cancer Slope Factor $(mg/kg/day)^{-1}$	Reference Dose (mg/kg/day)	Lifetime Cancer Risk	Percent Cancer Risk	Hazard Quotient	Percent Hazard Quotient
Benzo(a)anthracene	1.7	0.13	1.01E-07	2.96E-07	7.30E-01	NA	7.4E-08	2.1%	NA	NA
Benzo(b) fluoranthene	2.3	0.13	1.37E-07	4.00E-07	7.30E-01	NA	1.0E-07	2.8%	NA	NA
Benzo(a)pyrene	1.7	0.13	1.01E-07	2.96E-07	7.30E+00	NA	7.4E-07	20.8%	NA	NA
Dibenzo(a,h)anthracene	0.5	0.13	2.98E-08	8.70E-08	7.30E+00	NA	2.2E-07	6.1%	NA	NA
Indeno(1,2,3-cd)pyrene	1.4	0.13	8.35E-08	2.44E-07	7.30E-01	NA	6.1E-08	1.7%	NA	NA
Aroclor, total	11	0.14	7.07E-07	2.06E-06	2.00E+00	NA	1.4E-06	39.6%	NA	NA
Antimony	3.7	NA	NA	NA	NA	6.00E-05	NA	NA	NA	NA
Arsenic	9.5	0.03	1.31E-07	3.81E-07	1.50E+00	3.00E-04	2.0E-07	5.5%	1.3E-03	100.0%
Barium	1700	NA	NA	NA	NA	4.90E-03	NA	NA	NA	NA
Chromium (total)	516	NA	NA	NA	NA	7.50E-05	NA	NA	NA	NA
Manganese	320	NA	NA	NA	NA	8.40E-03	NA	NA	NA	NA
Nickel	62.1	NA	NA	NA	NA	8.00E-04	NA	NA	NA	NA
Thallium	2.1	NA	NA	NA	NA	6.60E-05	NA	NA	NA	NA
TEQ-Dioxins/Furans	0.00037	0.03	5.09E-12	1.49E-11	1.50E+05	NA	7.6E-07	21.4%	NA	NA
						Total	3.6E-06	100%	1.3E-03	100%

RISK ASSESSMENT SPREADSHEET - DIRECT DERMAL CONTACT WITH SOIL

SITE NAME: AREA C, HOUSATONIC BOAT CLUB
LOCATION: FERRY CREEK, STRATFORD, CT
EXPOSURE SCENARIO: WETLAND/MARSH RECEPTOR - ADULT CTE
MEDIA: SURFACE SOIL
DATE: FEBRUARY 25, 2000

HAZARD INDICES AND INCREMENTAL CANCER RISKS ARE CALCULATED BY THIS SPREADSHEET.
EXPOSURES THROUGH DERMAL CONTACT WITH SOIL ARE CONSIDERED.
ASSUMPTIONS ARE OUTLINED BELOW.

RELEVANT EQUATION:

$$\text{AbsorbedDose} = \frac{Cs \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT}$$

Where:

Cs = :		Concentration in soil (mg/kg)
CF = :	1.0E-06	Conversion factor (kg/mg)
SA = :	5,700	Skin surface available for contact (cm^2/event)
AF = :	0.04	Soil to skin adherence factor (mg/cm^2)
ABS = :		Absorption factor (unitless)
EF = :	20	Exposure frequency (events/year)
ED = :	7	Exposure duration (years)
BW = :	70	Body weight (kg)
ATc = :	25,550	Averaging time for carcinogenic exposures (days)
ATn = :	2,555	Averaging time for noncarcinogenic exposures (days)

Unit Dose
Lifetime Chronic Daily Intake 1.8E-08 kg-soil/kg-wt/day
Chronic Daily Intake = : 1.8E-07 kg-soil/kg-wt/day

RISK ASSESSMENT SPREADSHEET - DIRECT DERMAL CONTACT WITH SOIL (PAGE TWO)

SITE NAME: AREA C, HOUSATONIC BOAT CLUB
LOCATION: FERRY CREEK, STRATFORD, CT
EXPOSURE SCENARIO: WETLAND/MARSH RECEPTOR - ADULT CTE
MEDIA: SURFACE SOIL
DATE: FEBRUARY 25, 2000

CHEMICAL	Cs (mg/kg)	ABS (unitless)	Lifetime Chronic Daily Intake (mg/kg/day)	Chronic Daily Intake (mg/kg/day)	Cancer Slope Factor $(mg/kg/day)^{-1}$	Reference Dose (mg/kg/day)	Lifetime Cancer Risk	Percent Cancer Risk	Hazard Quotient	Percent Hazard Quotient
Benzo(a)anthracene	1.7	0.13	3.94E-09	3.94E-08	7.30E-01	NA	2.9E-09	2.6%	NA	NA
Benzo(b) fluoranthene	2.3	0.13	5.34E-09	5.34E-08	7.30E-01	NA	3.9E-09	3.5%	NA	NA
Benzo(a)pyrene	1.7	0.13	3.94E-09	3.94E-08	7.30E+00	NA	2.9E-08	25.9%	NA	NA
Dibenzo(a,h)anthracene	0.5	0.13	1.16E-09	1.16E-08	7.30E+00	NA	8.5E-09	7.6%	NA	NA
Indeno(1,2,3-cd)pyrene	1.4	0.13	3.25E-09	3.25E-08	7.30E-01	NA	2.4E-09	2.1%	NA	NA
Aroclor, total	11	0.14	2.75E-08	2.75E-07	1.00E+00	NA	2.7E-08	24.7%	NA	NA
Antimony	3.7	NA	NA	NA	NA	6.00E-05	NA	NA	NA	NA
Arsenic	9.5	0.03	5.09E-09	5.09E-08	1.50E+00	3.00E-04	7.6E-09	6.9%	1.7E-04	100.0%
Barium	1700	NA	NA	NA	NA	4.90E-03	NA	NA	NA	NA
Chromium (total)	516	NA	NA	NA	NA	7.50E-05	NA	NA	NA	NA
Manganese	320	NA	NA	NA	NA	8.40E-03	NA	NA	NA	NA
Nickel	62.1	NA	NA	NA	NA	8.00E-04	NA	NA	NA	NA
Thallium	2.1	NA	NA	NA	NA	6.60E-05	NA	NA	NA	NA
TEQ-Dioxins/Furans	0.00037	0.03	1.98E-13	1.98E-12	1.50E+05	NA	3.0E-08	26.7%	NA	NA
						Total	1.1E-07	100%	1.7E-04	100%

TETRA TECH NUS, INC. **CALCULATION WORKSHEET**

CLIENT: Raymark - Ferry Creek	JOB NUMBER: 7491 -
SUBJECT: Incidental Ingestion of Soil - Frequent Recreational User (Child)	
BASED ON: RAGs 1989	DRAWING NUMBER:
BY: gMM / CHECKED BY: RH	APPROVED BY: / DATE: 3/24/00

Purpose: To calculate carcinogenic and noncarcinogenic risk for the frequent recreational user - Child via the ingestion of site soil.

Relevant Equation:

$$\text{Intake (mg/Kg-day)} = \frac{Cs \times IR \times CF \times FI \times EF \times ED}{BW \times AT}$$

where:

Cs = Chemical concentration in soil (mg/Kg)
IR = Soil ingestion Rate (mg/day)
CF = Conversion Factor (Kg/mg)
FI = Fraction ingested from contaminated source (unitless)
EF = Exposure frequency (days/year)
ED = Exposure duration (years)
BW = Body weight (Kg)
AT_N = Averaging time for noncarcinogenic exposures (days)
AT_C = Averaging time for carcinogenic exposures (days)

Reasonable Maximum Exposure (RME)		Central Tendency Exposure (CTE)	
Cs	Chemical specific (mg/Kg)	Cs	Chemical specific (mg/Kg)
IR	200 mg/day	IR	100 mg/day
CF	1.0 E-6 Kg/mg	CF	1.0 E-6 Kg/mg
FI	1 unitless	FI	1 unitless
EF	90 days/year	EF	90 days/year
ED	6 years	ED	2 years
BW	15 Kg	BW	15 Kg
ATc	25,550 days	ATc	25,550 days
ATn	2190 days	ATn	730 days

TETRA TECH NUS, INC. **CALCULATION WORKSHEET** PAGE 2 OF 3

CLIENT Raymark - Ferry Creek	JOB NUMBER 7491
SUBJECT Incidental Ingestion of Soil Frequent Recreational User (Child)	
BASED ON RAGs 1989	DRAWING NUMBER
BY JMM / CHECKED BY RJK	APPROVED BY / DATE 3/24/00

Intake of Arsenic at a concentration of 23.3 mg/kg in Area F, Sediment/wetland material under RME Assumption

RME Noncarc. Intake (mg/kg-day) $= \frac{23.3\,mg/kg \times 200\,mg/day \times 1.0E^{-6}\,kg/mg \times 1 \times 90\,days/year \times 6\,years}{15\,kg \times 2190\,days}$

$= \boxed{7.66\,E^{-5}\,mg/kg\text{-}day}$ ✓

RME Carcin. Intake (mg/kg-day) $= \frac{23.3\,mg/kg \times 200\,mg/day \times 1.0E^{-6}\,kg/mg \times 1 \times 90\,days/year \times 6\,years}{15\,kg \times 25{,}550\,days}$

$= \boxed{6.57\,E^{-6}\,mg/kg\text{-}day}$ ✓

Then Incremental Cancer Risk (ICR) and Hazard Quotient (HQ) are calculated via the following equations:

ICR (unitless) = Carcinogenic intake (mg/kg-day) × Cancer Slope Factor (CSF) (kg/mg-day)

HQ (unitless) $= \frac{\text{noncarcinogenic intake (mg/kg-day)}}{\text{Reference Dose (RfD) (mg/kg-day)}}$

Where the CSF for As = 1.5 1.5E+0 and the RfD = 3.0E-4

ICR Arsenic (unitless) = $6.57E^{-6}\,mg/kg\text{-}day \times 1.5E^{+0}\,kg/mg\text{-}day = \boxed{9.8E^{-6}}$ ✓

HQ Arsenic (unitless) $= \frac{7.66E^{-5}\,mg/kg\text{-}day}{3.0E^{-4}\,mg/kg\text{-}day} = \boxed{2.6E^{-1}}$ ✓

TETRA TECH NUS, INC. **CALCULATION WORKSHEET**

CLIENT Raymark Ferry Creek		JOB NUMBER	
SUBJECT Incidental Ingestion of Soil - Frequent Recreational Uses (Child)			
BASED ON RAGS 1989		DRAWING NUMBER	
BY JMM	CHECKED BY KJV	APPROVED BY	DATE 3/24/00

Intake of arsenic at a concentration of 7.8 mg/kg in Area F, sediment/wetland material under CTE assumptions

CTE Noncarc. Intake (mg/kg-day) $= \frac{7.8\,mg/kg \times 100\,\frac{mg}{day} \times 1.0E^{-6}\,\frac{kg}{mg} \times 1 \times 90\,\frac{days}{yr} \times 2\,years}{15\,kg \times 730\,days}$

$= \boxed{1.28\,E^{-5}\,mg/kg\text{-}day}$ ✓

CTE Carcin. Intake (mg/kg-day) $= \frac{7.8\,mg/kg \times 100\,\frac{mg}{day} \times 1.0E^{-6}\,\frac{kg}{mg} \times 1 \times 90\,\frac{days}{yr} \times 2\,years}{15\,kg \times 25{,}550\,days}$

$= \boxed{3.66\,E^{-7}\,mg/kg\text{-}day}$ ✓

Then ICR and HQ are calculated for As CTE:

ICR CTE As (unitless) $= 3.66E^{-7}\,mg/kg\text{-}day \times 1.5E^{+0}\,kg/mg\text{-}day = \boxed{5.5\,E^{-7}}$ ✓

HQ CTE As (unitless) $= \frac{1.28E^{-5}\,mg/kg\text{-}day}{3.0\,E^{-4}\,mg/kg\text{-}day} = \boxed{4.3\,E^{-2}}$ ✓

Reference

USEPA Dec. 1989. Risk Assessment Guidance for Superfund Volume I. Human Health Evaluation Manual (Part A) Interim Final OSWER EPA 540/1-89/002.

RISK ASSESSMENT SPREADSHEET - INCIDENTAL INGESTION OF SOIL

SITE NAME: AREA F, SELBY POND
LOCATION: FERRY CREEK, STRATFORD, CT
EXPOSURE SCENARIO: FREQUENT RECREATIONAL USER - CHILD - RME
MEDIA: SEDIMENT/WETLAND MATERIAL
DATE: FEBRUARY 10, 2000

HAZARD INDICES AND INCREMENTAL CANCER RISKS ARE CALCULATED BY THIS SPREADSHEET.
EXPOSURES THROUGH INCIDENTAL INGESTION OF SOIL ARE CONSIDERED.
ASSUMPTIONS ARE OUTLINED BELOW.

RELEVANT EQUATION: $\text{Intake} = \frac{Cs \times IR \times CF \times FI \times EF \times ED}{BW \times AT}$

WHERE:			
	Cs = :		Concentration in soil (mg/kg)
	IR = :	200	Soil Ingestion Rate (mg/day)
	CF = :	1.0E-06	Conversion Factor (kg/mg)
	FI = :	1	Fraction from contaminated source (unitless)
	EF = :	90	Exposure Frequency (days/year)
	ED = :	6	Exposure Duration (years)
	BW = :	15	Body Weight (kg)
	ATc = :	25,550	Averaging time for carcinogenic exposures (days)
	ATn = :	2,190	Averaging time for noncarcinogenic exposures (days)

Unit Dose		
Lifetime Chronic Daily Int	2.8E-07	kg-soil/kg-wt/day
Chronic Daily Intake = :	3.3E-06	kg-soil/kg-wt/day

RISK ASSESSMENT SPREADSHEET - INCIDENTAL INGESTION OF SOIL (PAGE TWO)

SITE NAME: AREA F, SELBY POND
LOCATION: FERRY CREEK, STRATFORD, CT
EXPOSURE SCENARIO: FREQUENT RECREATIONAL USER - CHILD - RME
MEDIA: SEDIMENT/WETLAND MATERIAL
DATE: FEBRUARY 10, 2000

CHEMICAL	Cs (mg/kg)	Lifetime Chronic Daily Intake (mg/kg/day)	Chronic Daily Intake (mg/kg/day)	Cancer Slope Factor $(mg/kg/day)^{-1}$	Reference Dose (mg/kg/day)	Lifetime Cancer Risk	Percent Cancer Risk	Hazard Quotient	Percent Hazard Quotient
Benzo(a)anthracene	1.9	5.4E-07	6.2E-06	7.30E-01	NA	3.9E-07	0.8%	NA	NA
Benzo(a)pyrene	4.5	1.3E-06	1.5E-05	7.30E+00	NA	9.3E-06	19.1%	NA	NA
Benzo(b)fluoranthene	2.8	7.9E-07	9.2E-06	7.30E-01	NA	5.8E-07	1.2%	NA	NA
Dibenzo(a,h)anthracene	0.52	1.5E-07	1.7E-06	7.30E+00	NA	1.1E-06	2.2%	NA	NA
Indeno(1,2,3-cd)pyrene	1.3	3.7E-07	4.3E-06	7.30E-01	NA	2.7E-07	0.6%	NA	NA
Arsenic	23.3	6.6E-06	7.7E-05	1.50E+00	3.00E-04	9.8E-06	20.3%	2.6E-01	55.8%
Barium	154	4.3E-05	5.1E-04	NA	7.00E-02	NA	NA	7.2E-03	1.6%
Cadmium	17.5	4.9E-06	5.8E-05	NA	1.00E-03	NA	NA	5.8E-02	12.6%
Chromium (total)	374	1.1E-04	1.2E-03	NA	2.00E-02	NA	NA	6.1E-02	13.4%
Mercury	2.2	6.2E-07	7.2E-06	NA	3.00E-03	NA	NA	2.4E-03	0.5%
Vanadium	97.2	2.7E-05	3.2E-04	NA	7.00E-03	NA	NA	4.6E-02	10.0%
Zinc	2550	7.2E-04	8.4E-03	NA	3.00E-01	NA	NA	2.8E-02	6.1%
TEQ-Dioxins/Furans	0.00064	1.8E-10	2.1E-09	1.50E+05	NA	2.7E-05	55.8%	NA	NA
					Total	4.8E-05	100%	4.6E-01	100%

RISK ASSESSMENT SPREADSHEET - INCIDENTAL INGESTION OF SOIL

SITE NAME: AREA F, SELBY POND
LOCATION: FERRY CREEK, STRATFORD, CT
EXPOSURE SCENARIO: FREQUENT RECREATIONAL USER - CHILD - CTE
MEDIA: SEDIMENT/WETLAND MATERIAL
DATE: FEBRUARY 10, 2000

HAZARD INDICES AND INCREMENTAL CANCER RISKS ARE CALCULATED BY THIS SPREADSHEET.
EXPOSURES THROUGH INCIDENTAL INGESTION OF SOIL ARE CONSIDERED.
ASSUMPTIONS ARE OUTLINED BELOW.

RELEVANT EQUATION: $\text{Intake} = \frac{Cs \times IR \times CF \times FI \times EF \times ED}{BW \times AT}$

WHERE:			
	Cs = :		Concentration in soil (mg/kg)
	IR = :	100	Soil Ingestion Rate (mg/day)
	CF = :	1.0E-06	Conversion Factor (kg/mg)
	FI = :	1	Fraction from contaminated source (unitless)
	EF = :	90	Exposure Frequency (days/year)
	ED = :	2	Exposure Duration (years)
	BW = :	15	Body Weight (kg)
	ATc = :	25,550	Averaging time for carcinogenic exposures (days)
	ATn = :	730	Averaging time for noncarcinogenic exposures (days)

Unit Dose		
Lifetime Chronic Daily Int:	4.7E-08	kg-soil/kg-wt/day
Chronic Daily Intake = :	1.6E-06	kg-soil/kg-wt/day

RISK ASSESSMENT SPREADSHEET - INCIDENTAL INGESTION OF SOIL (PAGE TWO)

SITE NAME: AREA F, SELBY POND
LOCATION: FERRY CREEK, STRATFORD, CT
EXPOSURE SCENARIO: FREQUENT RECREATIONAL USER - CHILD - CTE
MEDIA: SEDIMENT/WETLAND MATERIAL
DATE: FEBRUARY 10, 2000

CHEMICAL	Cs (mg/kg)	Lifetime Chronic Daily Intake (mg/kg/day)	Chronic Daily Intake (mg/kg/day)	Cancer Slope Factor $(mg/kg/day)^{-1}$	Reference Dose (mg/kg/day)	Lifetime Cancer Risk	Percent Cancer Risk	Hazard Quotient	Percent Hazard Quotient
Benzo(a)anthracene	0.84	3.9E-08	1.4E-06	7.30E-01	NA	2.9E-08	1.6%	NA	NA
Benzo(a)pyrene	1.2	5.6E-08	2.0E-06	7.30E+00	NA	4.1E-07	22.3%	NA	NA
Benzo(b)fluoranthene	1.1	5.2E-08	1.8E-06	7.30E-01	NA	3.8E-08	2.0%	NA	NA
Dibenzo(a,h)anthracene	0.38	1.8E-08	6.2E-07	7.30E+00	NA	1.3E-07	7.1%	NA	NA
Indeno(1,2,3-cd)pyrene	0.63	3.0E-08	1.0E-06	7.30E-01	NA	2.2E-08	1.2%	NA	NA
Arsenic	7.8	3.7E-07	1.3E-05	1.50E+00	3.00E-04	5.5E-07	29.8%	4.3E-02	59.2%
Barium	39.6	1.9E-06	6.5E-05	NA	7.00E-02	NA	NA	9.3E-04	1.3%
Cadmium	4.3	2.0E-07	7.1E-06	NA	1.00E-03	NA	NA	7.1E-03	9.8%
Chromium (total)	90.4	4.2E-06	1.5E-04	NA	2.00E-02	NA	NA	7.4E-03	10.3%
Mercury	0.77	3.6E-08	1.3E-06	NA	3.00E-03	NA	NA	4.2E-04	0.6%
Vanadium	43.9	2.1E-06	7.2E-05	NA	7.00E-03	NA	NA	1.0E-02	14.3%
Zinc	607	2.9E-05	1.0E-03	NA	3.00E-01	NA	NA	3.3E-03	4.6%
TEQ-Dioxins/Furans	0.000094	4.4E-12	1.5E-10	1.50E+05	NA	6.6E-07	36.0%	NA	NA
					Total	1.8E-06	100%	7.2E-02	100%

TETRA TECH NUS, INC. **CALCULATION WORKSHEET**

CLIENT: Raymark - Ferry Creek	JOB NUMBER: 7491
SUBJECT: Direct Dermal Contact with Soil - Frequent Recreational User (Child)	
BASED ON: RAGs 1989	DRAWING NUMBER:
BY: JMM / CHECKED BY: RJF	APPROVED BY: / DATE: 3/27/00

Purpose: To calculate carcinogenic and noncarcinogenic risk for the child frequent recreational user via direct dermal contact with soil.

Relevant equation:

$$\text{Absorbed dose (mg/kg-day)} = \frac{Cs \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT}$$

where:

Cs = Chemical concentration in soil (mg/kg)
CF = Conversion Factor (kg/mg)
SA = Skin surface available for contact (cm^2/event)
AF = Soil to skin adherence factor (mg/cm^2)
ABS = Absorption factor (unitless)
EF = Exposure Frequency (events/year)
ED = Exposure Duration (years)
BW = Bodyweight (kg)
AT_N = Averaging Time for noncarcinogenic exposures (days)
AT_C = Averaging Time for carcinogenic exposures (days)

and

Reasonable Maximum Exposure (RME)		Central Tendency Exposure CTE	
Cs	chemical specific (mg/kg)	Cs	chemical specific (mg/kg)
CF	1.0E-6 (kg/mg)	CF	1.0E-6 (kg/mg)
SA	2,900 (cm^2/event)	SA	2,900 (cm^2/event)
AF	1.0 (mg/cm^2)	AF	0.20 (mg/cm^2)
ABS	chemical specific (unitless)	ABS	chemical specific (unitless)
EF	90 (events/year)	EF	90 (events/year)
ED	6 (years)	ED	2 (years)
BW	15 (kg)	BW	15 (kg)
AT_N	2,190 (days)	AT_N	730 (days)
AT_C	25,550 (days)	AT_C	25,550 (days)

CLIENT Raymark - Ferry Creek	JOB NUMBER 7491
SUBJECT Direct Dermal Contact with Soil	
BASED ON RAGS 1989	DRAWING NUMBER
BY JMM / CHECKED BY RJ	APPROVED BY / DATE 3/27/00

Absorbed dose of arsenic at a concentration of 23.3 mg/Kg for Area F, Sediment/wetland Material under the Reasonable Maximum exposure (RME) assumptions is calculated

RME

Noncarcinogenic Absorbed Dose (mg/Kg-day) $= \frac{23.3(mg/Kg) \times 1.0E^{-6}(Kg/mg) \times 2{,}900(cm^2/event) \times .03 \times 90 events/yr \times 6 yrs}{15(Kg) \times 2{,}190(days)}$

$= \boxed{3.33E^{-5} mg/Kg\text{-}day}$ ✓

RME Carcinogenic Absorbed Dose (mg/Kg-day) $= \frac{23.3(mg/Kg) \times 1.0E^{-6}(Kg/mg) \times 2{,}900(cm^2/event) \times .03 \times 90 events/yr \times 6 yrs}{15(Kg) \times 25{,}550(days)}$

$= \boxed{2.86E^{-6} mg/Kg\text{-}day}$ ✓

Then Incremental Cancer Risk (ICR) and Hazard Quotient (HQ) are calculated via the following equations;

ICR (unitless) = Carcinogenic Absorbed Dose (mg/Kg-day) × Cancer Slope Factor (CSF) (Kg/mg-day)

HQ (unitless) = $\frac{\text{Noncarcinogenic Absorbed Dose (mg/Kg-day)}}{\text{Reference Dose (RfD) (mg/Kg-day)}}$

Where the CSF of Arsenic = $1.5E^{+0}$ and the RfD of arsenic = $3.0E^{-4}$

ICR Arsenic (unitless) $= \frac{2.86E^{-6}}{mg/Kg\text{-}day} \times \frac{1.5E^{+0}}{Kg/mg\text{-}day} = \boxed{4.3E^{-6} \text{ RME}}$ ✓

HQ arsenic (unitless) $= \frac{3.33E^{-5} mg/Kg\text{-}day}{3.0E^{-4} mg/Kg\text{-}day} = \boxed{1.1E^{-1} \text{ RME}}$ ✓

TETRA TECH NUS, INC. **CALCULATION WORKSHEET**

CLIENT: Raymark-Ferry Creek	JOB NUMBER: 7491
SUBJECT: Direct Dermal Contact w/ Soil	
BASED ON:	DRAWING NUMBER:
BY: JMM / CHECKED BY: KJP	APPROVED BY: / DATE: 3/27/00

Absorbed dose of arsenic at a concentration of 7.8 mg/kg for Area F, sediment/wetland under the CTE assumptions is calculated:

CTE

Noncarcinogenic Absorbed Dose (mg/kg-day)

$$= \frac{7.8(mg/kg) \times 1.0E^{-6}(kg/mg) \times 2900(cm^2/event) \times 0.20(mg/cm^2) \times 0.03 \times 90 \frac{events}{yr} \times 2 yrs}{15 kg \times 730 days}$$

$$= \boxed{2.23E^{-6} \text{ mg/kg-day}}$$ ✓

CTE Carcinogenic Absorbed Dose (mg/kg-day)

$$= \frac{7.8(mg/kg) \times 1.0E^{-6}(kg/mg) \times 2900(cm^2/event) \times 0.20(mg/cm^2) \times 0.03 \times 90 \frac{events}{yr} \times 2 yrs}{15 kg \times 25,550 days}$$

$$= \boxed{6.37E^{-8} \text{ mg/kg-day}}$$ ✓

ICR arsenic (unitless) $= \underset{(mg/kg\text{-}day)}{6.37E^{-8}} \times \underset{(kg/mg\text{-}day)}{1.5E^{+0}} = \boxed{9.6E^{-8}}$ ✓

HQ arsenic (unitless) $= \frac{2.23E^{-6} \text{ mg/kg-day}}{3.0E^{-4} \text{ mg/kg-day}} = \boxed{7.4E^{-3}}$ ✓

Reference

USEPA 1989. Risk Assessment Guidance for Superfund Volume I Human Health Evaluation Manual (PART A) Interim Final OSWER EPA/540/1-89/002.

RISK ASSESSMENT SPREADSHEET - DIRECT DERMAL CONTACT WITH SOIL

SITE NAME: AREA F, SELBY POND
LOCATION: FERRY CREEK, STRATFORD, CT
EXPOSURE SCENARIO: FREQUENT RECREATIONAL USER - CHILD - RME
MEDIA: SEDIMENT/WETLAND MATERIAL
DATE: FEBRUARY 10, 2000

HAZARD INDICES AND INCREMENTAL CANCER RISKS ARE CALCULATED BY THIS SPREADSHEET.
EXPOSURES THROUGH DERMAL CONTACT WITH SOIL ARE CONSIDERED.
ASSUMPTIONS ARE OUTLINED BELOW.

RELEVANT EQUATION:

$$\text{Absorbed Dose} = \frac{Cs \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT}$$

Where:

Cs = :		Concentration in soil (mg/kg)
CF = :	1.0E-06	Conversion factor (kg/mg)
SA = :	2,900	Skin surface available for contact (cm^2/event)
AF = :	1.0	Soil to skin adherence factor (mg/cm^2)
ABS = :		Absorption factor (unitless)
EF = :	90	Exposure frequency (events/year)
ED = :	6	Exposure duration (years)
BW = :	15	Body weight (kg)
ATc = :	25,550	Averaging time for carcinogenic exposures (days)
ATn = :	2,190	Averaging time for noncarcinogenic exposures (days)

Unit Dose
Lifetime Chronic Daily Intake = 4.1E-06 kg-soil/kg-wt/day
Chronic Daily Intake = : 4.8E-05 kg-soil/kg-wt/day

RISK ASSESSMENT SPREADSHEET - DIRECT DERMAL CONTACT WITH SOIL (PAGE TWO)

SITE NAME: AREA F, SELBY POND
LOCATION: FERRY CREEK, STRATFORD, CT
EXPOSURE SCENARIO: FREQUENT RECREATIONAL USER - CHILD - RME
MEDIA: SEDIMENT/WETLAND MATERIAL
DATE: FEBRUARY 10, 2000

CHEMICAL	Cs (mg/kg)	ABS (unitless)	Lifetime Chronic Daily Intake (mg/kg/day)	Chronic Daily Intake (mg/kg/day)	Cancer Slope Factor $(mg/kg/day)^{-1}$	Reference Dose (mg/kg/day)	Lifetime Cancer Risk	Percent Cancer Risk	Hazard Quotient	Percent Hazard Quotient
Benzo(a)anthracene	1.9	0.13	1.01E-06	1.18E-05	7.30E-01	NA	7.4E-07	1.9%	NA	NA
Benzo(a)pyrene	4.5	0.13	2.39E-06	2.79E-05	7.30E+00	NA	1.7E-05	46.1%	NA	NA
Benzo(b)fluoranthene	2.8	0.13	1.49E-06	1.74E-05	7.30E-01	NA	1.1E-06	2.9%	NA	NA
Dibenzo(a,h)anthracene	0.52	0.13	2.76E-07	3.22E-06	7.30E+00	NA	2.0E-06	5.3%	NA	NA
Indeno(1,2,3-cd)pyrene	1.3	0.13	6.91E-07	8.06E-06	7.30E-01	NA	5.0E-07	1.3%	NA	NA
Arsenic	23.3	0.03	2.86E-06	3.33E-05	1.50E+00	3.00E-04	4.3E-06	11.3%	1.1E-01	40.0%
Barium	154	NA	NA	NA	NA	4.90E-03	NA	NA	NA	NA
Cadmium	17.5	0.01	7.15E-07	8.34E-06	NA	5.00E-05	NA	NA	1.7E-01	60.0%
Chromium (total)	374	NA	NA	NA	NA	5.00E-04	NA	NA	NA	NA
Mercury	2.2	NA	NA	NA	NA	2.10E-04	NA	NA	NA	NA
Vanadium	97.2	NA	NA	NA	NA	1.80E-04	NA	NA	NA	NA
Zinc	2550	NA	NA	NA	NA	3.00E-01	NA	NA	NA	NA
TEQ-Dioxins/Furans	0.00064	0.03	7.85E-11	9.15E-10	1.50E+05	NA	1.2E-05	31.1%	NA	NA
						Total	3.8E-05	100.0%	2.8E-01	100.0%

RISK ASSESSMENT SPREADSHEET - DIRECT DERMAL CONTACT WITH SOIL

SITE NAME: AREA F, SELBY POND
LOCATION: FERRY CREEK, STRATFORD, CT
EXPOSURE SCENARIO: FREQUENT RECREATIONAL USER - CHILD - CTE
MEDIA: SEDIMENT/WETLAND MATERIAL
DATE: FEBRUARY 10, 2000

HAZARD INDICES AND INCREMENTAL CANCER RISKS ARE CALCULATED BY THIS SPREADSHEET.
EXPOSURES THROUGH DERMAL CONTACT WITH SOIL ARE CONSIDERED.
ASSUMPTIONS ARE OUTLINED BELOW.

RELEVANT EQUATION:

$$\text{Absorbed Dose} = \frac{Cs \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT}$$

Where:			
	Cs = :		Concentration in soil (mg/kg)
	CF = :	1.0E-06	Conversion factor (kg/mg)
	SA = :	2,900	Skin surface available for contact (cm^2/event)
	AF = :	0.20	Soil to skin adherence factor (mg/cm^2)
	ABS = :		Absorption factor (unitless)
	EF = :	90	Exposure frequency (events/year)
	ED = :	2	Exposure duration (years)
	BW = :	15	Body weight (kg)
	ATc = :	25,550	Averaging time for carcinogenic exposures (days)
	ATn = :	730	Averaging time for noncarcinogenic exposures (days)

Unit Dose
Lifetime Chronic Daily Intake = 2.7E-07 kg-soil/kg-wt/day
Chronic Daily Intake = : 9.5E-06 kg-soil/kg-wt/day

RISK ASSESSMENT SPREADSHEET - DIRECT DERMAL CONTACT WITH SOIL (PAGE TWO)

SITE NAME: AREA F, SELBY POND
LOCATION: FERRY CREEK, STRATFORD, CT
EXPOSURE SCENARIO: FREQUENT RECREATIONAL USER - CHILD - CTE
MEDIA: SEDIMENT/WETLAND MATERIAL
DATE: FEBRUARY 10, 2000

CHEMICAL	Cs (mg/kg)	ABS (unitless)	Lifetime Chronic Daily Intake (mg/kg/day)	Chronic Daily Intake (mg/kg/day)	Cancer Slope Factor $(mg/kg/day)^{-1}$	Reference Dose (mg/kg/day)	Lifetime Cancer Risk	Percent Cancer Risk	Hazard Quotient	Percent Hazard Quotient
Benzo(a)anthracene	0.84	0.13	2.97E-08	1.04E-06	7.30E-01	NA	2.2E-08	3.2%	NA	NA
Benzo(a)pyrene	1.2	0.13	4.25E-08	1.49E-06	7.30E+00	NA	3.1E-07	45.2%	NA	NA
Benzo(b)fluoranthene	1.1	0.13	3.90E-08	1.36E-06	7.30E-01	NA	2.8E-08	4.1%	NA	NA
Dibenzo(a,h)anthracene	0.38	0.13	1.35E-08	4.71E-07	7.30E+00	NA	9.8E-08	14.3%	NA	NA
Indeno(1,2,3-cd)pyrene	0.63	0.13	2.23E-08	7.81E-07	7.30E-01	NA	1.6E-08	2.4%	NA	NA
Arsenic	7.8	0.03	6.37E-08	2.23E-06	1.50E+00	3.00E-04	9.6E-08	13.9%	7.4E-03	47.6%
Barium	39.8	NA	NA	NA	NA	4.90E-03	NA	NA	NA	NA
Cadmium	4.3	0.01	1.17E-08	4.10E-07	NA	5.00E-05	NA	NA	8.2E-03	52.4%
Chromium (total)	90.4	NA	NA	NA	NA	5.00E-04	NA	NA	NA	NA
Mercury	0.77	NA	NA	NA	NA	2.10E-04	NA	NA	NA	NA
Vanadium	43.9	NA	NA	NA	NA	1.80E-04	NA	NA	NA	NA
Zinc	607	NA	NA	NA	NA	3.00E-01	NA	NA	NA	NA
TEQ-Dioxins/Furans	0.000094	0.03	7.68E-13	2.69E-11	1.50E+05	NA	1.2E-07	16.8%	NA	NA
						Total	6.9E-07	100.0%	1.6E-02	100.0%

TETRA TECH NUS, INC. **CALCULATION WORKSHEET**

CLIENT Raymark - Ferry Creek		JOB NUMBER	
SUBJECT Incidental Ingestion of soil - Frequent Recreational User (adult)			
BASED ON RAGs 1989		DRAWING NUMBER	
BY JMM	CHECKED BY [illegible]	APPROVED BY	DATE 3/24/00

Purpose: To calculate carcinogenic and noncarcinogenic risk for the adult frequent recreational user via incidental ingestion of soil

Relevant Equations:

$$\text{Intake (mg/Kg-day)} = \frac{Cs \times IR \times CF \times FI \times EF \times ED}{BW \times AT}$$

where:

Cs = Concentration in soil (mg/Kg)
IR = Soil ingestion rate (mg/day)
CF = Conversion Factor (Kg/mg)
FI = Fraction ingested from contaminated source (unitless)
EF = Exposure Frequency (days/year)
ED = Exposure Duration (years)
BW = Body weight (Kg)
AT_N = averaging time for noncarcinogenic exposures (days)
AT_C = Averaging time for carcinogenic exposures (days)

(RME) Reasonable Maximum Exposure		(CTE) Central Tendency Exposure	
Cs	Chemical specific (mg/Kg)	Cs	Chemical specific (mg/Kg)
IR	100 (mg/day)	IR	50 (mg/day)
CF	$1.0E^{-6}$ (Kg/mg)	CF	$1.0E^{-6}$ (Kg/mg)
FI	1 (unitless)	FI	1 (unitless)
EF	90 days/yr	EF	90 days/yr
ED	24 years	ED	7 years
BW	70 Kg	BW	70 Kg
ATc	25,500 days	ATc	25,550 days
AT_n	8,760 days	AT_n	2,555 days

TETRA TECH NUS, INC. CALCULATION WORKSHEET

CLIENT Raymark - Ferry Creek	JOB NUMBER
SUBJECT Incidental ingestion of soil - Frequent Recreational Uses (adult)	
BASED ON RAGs 1989	DRAWING NUMBER
BY JMM / CHECKED BY [illegible]	APPROVED BY / DATE 3/24/00

Intake of arsenic at a concentration of 23.3 mg/kg in Area F wetland sediment material under RME assumption

RME Noncan. Intake of arsenic (mg/kg-day) $= \frac{23.3\,mg/kg \times 100\,mg/day \times 1.0E^{-6}\,kg/mg \times 1 \times 90\,days/yr \times 24\,years}{70\,kg \times 8760\,days}$

$= \boxed{8.21\,E^{-6}\,mg/kg\text{-}day}$ ✓

RME Carcin. Intake of Arsenic (mg/kg-day) $= \frac{23.3\,mg/kg \times 100\,mg/day \times 1.0E^{-6}\,kg/mg \times 1 \times 90\,days/yr \times 24\,years}{70\,kg \times 25{,}550\,days}$

$= \boxed{2.81\,E^{-6}\,mg/kg\text{-}day}$ ✓

Then incremental Cancer Risk (ICR) and Hazard Quotient (HQ) are calculated via the following equations:

ICR (unitless) = carcinogenic intake (mg/kg-day) × Cancer Slope Factor (CSF) (kg/mg-day)

HQ (unitless) = $\frac{\text{noncarcinogenic intake (mg/kg-day)}}{\text{Reference Dose (RFD) (mg/kg-day)}}$

When the CSF for arsenic = $1.5E^{+0}$ and the RFD = $3.0E^{-4}$

ICR Arsenic (unitless) = $2.81E^{-6}\,mg/kg\text{-}day \times 1.5E^{+0}\,kg/mg\text{-}day = \boxed{4.2E^{-6}}$ ✓ RME

HQ Arsenic (unitless) = $\frac{8.21E^{-4}\,mg/kg\text{-}day}{3.0E^{-4}\,mg/kg\text{-}day} = \boxed{2.7E^{-2}}$ ✓

TETRA TECH NUS, INC. CALCULATION WORKSHEET

CLIENT Raymark Ferry Creek	JOB NUMBER 7491
SUBJECT Incidental ingestion of soil - Frequent Recreational User - (adult)	
BASED ON RAGs 1989	DRAWING NUMBER
BY JMM / CHECKED BY RJF	APPROVED BY / DATE 3/24/00

Intake of arsenic at a concentration of 7.8 mg/kg in sediment/wetland material from area F under CTE exposures

CTE Noncarc. Intake (mg/kg-day) $= \frac{7.8\ mg/kg \times 50\ mg/day \times 1.0E^{-6}\ kg/mg \times 1 \times 90\ days/year \times 7\ years}{70\ kg \times 2{,}555\ days}$

$= \boxed{1.37\ E^{-6}\ mg/kg\text{-}day}$ ✓

CTE Carcin Intake (mg/kg-day) $= \frac{7.8\ mg/kg \times 50\ mg/day \times 1.0E^{-6}\ kg/mg \times 1 \times 90\ days/year \times 7\ years}{70\ kg \times 25{,}550\ days}$

$= \boxed{1.37\ E^{-7}\ mg/kg\text{-}day}$ ✓

and the ICR and HQ for CTE exposures to arsenic in sed/wet material

ICR Arsenic (unitless) $= 1.37\ E^{-7}\ mg/kg\text{-}day \times 1.5\ E^{+0}\ kg/mg\text{-}day = \boxed{2.1\ E^{-7}}$ CTE ✓

HQ Arsenic (unitless) $= \frac{1.37\ E^{-6}\ mg/kg\text{-}day}{3.0\ E^{-4}\ mg/kg\text{-}day} = \boxed{4.6\ E^{-3}}$ CTE ✓

Reference

USEPA Dec. 1989 Risk Assessment Guidance for Superfund Volume 1. Human Health Evaluation Manual (Part A) Interim Final. OSWER EPA/540/1-89/002.

RISK ASSESSMENT SPREADSHEET - INCIDENTAL INGESTION OF SOIL

SITE NAME: AREA F, SELBY POND
LOCATION: FERRY CREEK, STRATFORD, CT
EXPOSURE SCENARIO: FREQUENT RECREATIONAL USER - ADULT - RME
MEDIA: SEDIMENT/WETLAND MATERIAL
DATE: FEBRUARY 10, 2000 ✓

HAZARD INDICES AND INCREMENTAL CANCER RISKS ARE CALCULATED BY THIS SPREADSHEET.
EXPOSURES THROUGH INCIDENTAL INGESTION OF SOIL ARE CONSIDERED.
ASSUMPTIONS ARE OUTLINED BELOW.

RELEVANT EQUATION: $\text{Intake} = \frac{Cs \times IR \times CF \times FI \times EF \times ED}{BW \times AT}$

WHERE:			
	Cs = :		Concentration in soil (mg/kg)
	IR = :	100	Soil Ingestion Rate (mg/day)
	CF = :	1.0E-06	Conversion Factor (kg/mg)
	FI = :	1	Fraction from contaminated source (unitless)
	EF = :	90	Exposure Frequency (days/year) ✓
	ED = :	24	Exposure Duration (years)
	BW = :	70	Body Weight (kg)
	ATc = :	25,550	Averaging time for carcinogenic exposures (days)
	ATn = :	8,760	Averaging time for noncarcinogenic exposures (days)

Unit Dose
Lifetime Chronic Daily Int: 1.2E-07 kg-soil/kg-wt/day
Chronic Daily Intake = : 3.5E-07 kg-soil/kg-wt/day

RISK ASSESSMENT SPREADSHEET - INCIDENTAL INGESTION OF SOIL (PAGE TWO)

SITE NAME: AREA F, SELBY POND
LOCATION: FERRY CREEK, STRATFORD, CT
EXPOSURE SCENARIO: FREQUENT RECREATIONAL USER - ADULT - RME
MEDIA: SEDIMENT/WETLAND MATERIAL
DATE: FEBRUARY 10, 2000

CHEMICAL	Cs (mg/kg)	Lifetime Chronic Daily Intake (mg/kg/day)	Chronic Daily Intake (mg/kg/day)	Cancer Slope Factor $(mg/kg/day)^{-1}$	Reference Dose (mg/kg/day)	Lifetime Cancer Risk	Percent Cancer Risk	Hazard Quotient	Percent Hazard Quotient
Benzo(a)anthracene	1.9✓	2.3E-07	6.7E-07	7.30E-01	NA	1.7E-07	0.8%	NA	NA
Benzo(a)pyrene	4.5✓	5.4E-07	1.6E-06	7.30E+00	NA	4.0E-06	19.1%	NA	NA
Benzo(b)fluoranthene	2.8✓	3.4E-07	9.9E-07	7.30E-01	NA	2.5E-07	1.2%	NA	NA
Dibenzo(a,h)anthracene	0.52✓	6.3E-08	1.8E-07	7.30E+00	NA	4.6E-07	2.2%	NA	NA
Indeno(1,2,3-cd)pyrene	1.3✓	1.6E-07	4.6E-07	7.30E-01	NA	1.1E-07	0.6%	NA	NA
Arsenic	23.3✓	2.8E-06	8.2E-06	1.50E+00	3.00E-04	4.2E-06	20.3%	2.7E-02	30.9%
Barium	154✓	1.9E-05	5.4E-05	NA	7.00E-02	NA	NA	7.7E-04	0.9%
Cadmium	17.5✓	2.1E-06	6.2E-06	NA	1.00E-03✓	NA	NA	6.2E-03	7.0%
Chromium (total)	374✓	4.5E-05	1.3E-04	NA	3.00E-03	NA	NA	4.4E-02	49.5%
Mercury	2.2✓	2.7E-07	7.7E-07	NA	3.00E-04	NA	NA	2.6E-03	2.9%
Vanadium	97.2✓	1.2E-05	3.4E-05	NA	7.00E-03	NA	NA	4.9E-03	5.5%
Zinc	2550✓	3.1E-04	9.0E-04	NA	3.00E-01	NA	NA	3.0E-03	3.4%
TEQ-Dioxins/Furans	0.00064✓	7.7E-11	2.3E-10	1.50E+05	NA	1.2E-05	55.8%	NA	NA
					Total	2.1E-05	100%	8.9E-02	100%

RISK ASSESSMENT SPREADSHEET - INCIDENTAL INGESTION OF SOIL

SITE NAME: AREA F, SELBY POND
LOCATION: FERRY CREEK, STRATFORD, CT
EXPOSURE SCENARIO: FREQUENT RECREATIONAL USER - ADULT - CTE
MEDIA: SEDIMENT/WETLAND MATERIAL
DATE: FEBRUARY 10, 2000

HAZARD INDICES AND INCREMENTAL CANCER RISKS ARE CALCULATED BY THIS SPREADSHEET.
EXPOSURES THROUGH INCIDENTAL INGESTION OF SOIL ARE CONSIDERED.
ASSUMPTIONS ARE OUTLINED BELOW.

RELEVANT EQUATION: $\text{Intake} = \frac{Cs \times IR \times CF \times FI \times EF \times ED}{BW \times AT}$

WHERE:

Cs = :		Concentration in soil (mg/kg)
IR = :	50	Soil Ingestion Rate (mg/day)
CF = :	1.0E-06	Conversion Factor (kg/mg)
FI = :	1	Fraction from contaminated source (unitless)
EF = :	90	Exposure Frequency (days/year)
ED = :	7	Exposure Duration (years)
BW = :	70	Body Weight (kg)
ATc = :	25,550	Averaging time for carcinogenic exposures (days)
ATn = :	2,555	Averaging time for noncarcinogenic exposures (days)

Unit Dose		
Lifetime Chronic Daily Int	1.8E-08	kg-soil/kg-wt/day
Chronic Daily Intake = :	1.8E-07	kg-soil/kg-wt/day

RISK ASSESSMENT SPREADSHEET - INCIDENTAL INGESTION OF SOIL (PAGE TWO)

SITE NAME: AREA F, SELBY POND
LOCATION: FERRY CREEK, STRATFORD, CT
EXPOSURE SCENARIO: FREQUENT RECREATIONAL USER - ADULT - CTE
MEDIA: SEDIMENT/WETLAND MATERIAL
DATE: FEBRUARY 10, 2000

CHEMICAL	Cs (mg/kg)	Lifetime Chronic Daily Intake (mg/kg/day)	Chronic Daily Intake (mg/kg/day)	Cancer Slope Factor $(mg/kg/day)^{-1}$	Reference Dose (mg/kg/day)	Lifetime Cancer Risk	Percent Cancer Risk	Hazard Quotient	Percent Hazard Quotient
Benzo(a)anthracene	0.84	1.5E-08	1.5E-07	7.30E-01	NA	1.1E-08	1.6%	NA	NA
Benzo(a)pyrene	1.2	2.1E-08	2.1E-07	7.30E+00	NA	1.5E-07	22.3%	NA	NA
Benzo(b)fluoranthene	1.1	1.9E-08	1.9E-07	7.30E-01	NA	1.4E-08	2.0%	NA	NA
Dibenzo(a,h)anthracene	0.38	6.7E-09	6.7E-08	7.30E+00	NA	4.9E-08	7.1%	NA	NA
Indeno(1,2,3-cd)pyrene	0.63	1.1E-08	1.1E-07	7.30E-01	NA	8.1E-09	1.2%	NA	NA
Arsenic	7.8	1.4E-07	1.4E-06	1.50E+00	3.00E-04	2.1E-07	29.8%	4.6E-03	37.4%
Barium	39.6	7.0E-07	7.0E-06	NA	7.00E-02	NA	NA	1.0E-04	0.8%
Cadmium	4.3	7.6E-08	7.6E-07	NA	1.00E-03	NA	NA	7.6E-04	6.2%
Chromium (total)	90.4	1.6E-06	1.6E-05	NA	3.00E-03	NA	NA	5.3E-03	43.3%
Mercury	0.77	1.4E-08	1.4E-07	NA	3.00E-03	NA	NA	4.5E-05	0.4%
Vanadium	43.9	7.7E-07	7.7E-06	NA	7.00E-03	NA	NA	1.1E-03	9.0%
Zinc	607	1.1E-05	1.1E-04	NA	3.00E-01	NA	NA	3.6E-04	2.9%
TEQ-Dioxins/Furans	0.000094	1.7E-12	1.7E-11	1.50E+05	NA	2.5E-07	36.0%	NA	NA
					Total	6.9E-07	100%	1.2E-02	100%

TETRA TECH NUS, INC. CALCULATION WORKSHEET PAGE 1 OF 3

CLIENT Raymark - Ferry Creek	JOB NUMBER 7491
SUBJECT Direct Dermal Contact with Soil - Frequent Recreational User (Adult)	
BASED ON RAGs 1989	DRAWING NUMBER
BY JMM / CHECKED BY RH	APPROVED BY / DATE 3/24/00

Purpose: To calculate carcinogenic and noncarcinogenic risk for the frequent recreational user (adult) via direct dermal contact with site soils

Relevant Equation:

$$\text{Absorbed Dose (mg/kg-day)} = \frac{Cs \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT}$$

where:

Cs = chemical concentration in soil (mg/kg)
CF = Conversion Factor (kg/mg)
SA = Skin surface available for contact (cm^2/event)
AF = Soil to Skin adherence factor (mg/cm^2)
ABS = Absorption factor (unitless)
EF = Exposure Frequency (event/year)
ED = Exposure Duration (years)
BW = Body weight (kg)
ATn = Averaging time for noncarcinogen (days)
ATc = Averaging time for carcinogen (days)

and

Reasonable Maximum Exposure (RME)		Central Tendency Exposure (CTE)	
Cs	Chemical specific (mg/kg)	Cs	Chemical specific (mg/kg)
CF	$1.0E^{-6}$ kg/mg	CF	$1.0E^{-6}$ kg/mg
SA	5700 cm^2/event	SA	5700 cm^2/event
AF	0.3 mg/cm^2	AF	0.04 mg/cm^2
ABS	Chemical specific (unitless)	ABS	Chemical specific (unitless)
EF	90 event/year	EF	90 event/year
ED	24 years	ED	7 years
BW	70 kg	BW	70 kg
ATc	25,550 days	ATc	25,550 days
ATn	8,760 days	ATn	2,555 days

TETRA TECH NUS, INC. **CALCULATION WORKSHEET**

CLIENT Raymark - Ferry Creek	JOB NUMBER 7491
SUBJECT Direct Dermal Contact with Soil Frequent Recreational User - (adult)	
BASED ON RAGs 1989	DRAWING NUMBER
BY JMM / CHECKED BY RH	APPROVED BY / DATE 3/24/00

Absorbed dose of arsenic at a concentration of 23.3 mg/Kg in Area F, Sediment/Wetland Material, under the RME assumptions

RME Noncarc. Absorbed dose (mg/Kg-day)

$$= \frac{23.3\,mg/Kg \times 1.0E^{-6}\,Kg/mg \times 5700\,cm^2/event \times 0.3\,mg/cm^2 \times 0.03 \times 90\,events/yr \times 24\,years}{70\,Kg \times 8{,}760\,days}$$

$$= \boxed{4.21\,E^{-6}\,mg/Kg\text{-}day}$$ ✓

RME Carcin Absorbed dose (mg/Kg-day)

$$= \frac{23.3\,mg/Kg \times 1.0E^{-6}\,Kg/mg \times 5700\,cm^2/event \times 0.3\,mg/cm^2 \times 0.03 \times 90\,events/yr \times 24\,years}{70\,Kg \times 25{,}550\,days}$$

$$= \boxed{1.44\,E^{-6}\,mg/Kg\text{-}day}$$ ✓

Then incremental ~~Ca~~ Cancer Risk (ICR) and Hazard Quotient (HQ) are calculated via the following equations:

ICR (unitless) = Carcinogenic absorbed dose (mg/Kg-day) × Cancer Slope Factor (CSF) (Kg/mg-day)

HQ (unitless) = $\frac{\text{noncarcinogenic absorbed dose (mg/Kg-day)}}{\text{Reference Dose (RfD) (mg/Kg-day)}}$

Where the CSF for arsenic = $1.5E^{+0}$ and the RfD = $3.0\,E^{-4}$

ICR arsenic RME (unitless) = $1.44\,E^{-6}$ mg/Kg-day × 1.5^{+0} Kg/mg-day = $\boxed{2.2\,E^{-6}}$ ✓

HQ arsenic RME (unitless) = $\frac{4.21\,E^{-6}\,(mg/Kg\text{-}day)}{3.0E^{-4}\,(mg/Kg\text{-}day)}$ = $\boxed{1.4\,E^{-2}}$ ✓

TETRA TECH NUS, INC. CALCULATION WORKSHEET

CLIENT Raymark - Ferry Creek	JOB NUMBER 7491
SUBJECT Direct Dermal Contact with Soil - Frequent Recreational Uses (adults)	
BASED ON RAGs 1989	DRAWING NUMBER
BY JMM / CHECKED BY KK	APPROVED BY / DATE 3/24/00

Absorbed Dose of Arsenic at a concentration of 7.8 mg/kg in area F, Sediment/wetland material, under the CTE assumption

CTE Noncarc. Absorbed Dose mg/kg-day

$$= \frac{7.8\,mg/kg \times 1.0E^{-6}\,kg/mg \times 5700\,cm^2/event \times 0.04\,mg/cm^2 \times 0.03 \times 90\,events/yr \times 7\,yrs}{70\,kg \times 2{,}555\,days}$$

$$= \boxed{1.88\,E^{-7}\,mg/kg\text{-}day}$$ ✓

CTE Carcin. Absorbed Dose mg/kg-day

$$= \frac{7.8\,mg/kg \times 1.0E^{-6}\,kg/mg \times 5700\,cm^2/event \times 0.04\,mg/cm^2 \times 0.03 \times 90\,events/yr \times 7\,yrs}{70\,kg \times 25{,}550\,days}$$

$$= \boxed{1.88\,E^{-8}\,mg/kg\text{-}day}$$ ✓

The ICR and HQ for As is then calculated

ICR Arsenic CTE (unitless) $= 1.88E^{-8}\,mg/kg\text{-}day \times 1.5\,kg/mg\text{-}day = \boxed{2.8\,E^{-8}}$ CTE ✓

HQ Arsenic CTE (unitless) $= \frac{1.88\,E^{-7}\,mg/kg\text{-}day}{3.0\,E^{-4}\,mg/kg\text{-}day} = \boxed{6.3\,E^{-4}}$ CTE ✓

Reference

USEPA 1989. Risk Assessment Guidance for Superfund Volume I Human Health Evaluation Manual (Part A) Interim Final. OSWER EPA 540/1-89/002

RISK ASSESSMENT SPREADSHEET - DIRECT DERMAL CONTACT WITH SOIL

SITE NAME: AREA F, SELBY POND
LOCATION: FERRY CREEK, STRATFORD, CT
EXPOSURE SCENARIO: FREQUENT RECREATIONAL USER - ADULT - RME
MEDIA: SEDIMENT/WETLAND MATERIAL
DATE: FEBRUARY 10, 2000

HAZARD INDICES AND INCREMENTAL CANCER RISKS ARE CALCULATED BY THIS SPREADSHEET.
EXPOSURES THROUGH DERMAL CONTACT WITH SOIL ARE CONSIDERED.
ASSUMPTIONS ARE OUTLINED BELOW.

RELEVANT EQUATION:

$$\text{AbsorbedDose} = \frac{Cs \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT}$$

Where:			
	Cs = :		Concentration in soil (mg/kg)
	CF = :	1.0E-06	Conversion factor (kg/mg)
	SA = :	5,700	Skin surface available for contact (cm^2/event) ✓
	AF = :	0.3	Soil to skin adherence factor (mg/cm^2) ✓
	ABS = :		Absorption factor (unitless)
	EF = :	90	Exposure frequency (events/year) ✓
	ED = :	24	Exposure duration (years)
	BW = :	70	Body weight (kg)
	ATc = :	25,550	Averaging time for carcinogenic exposures (days)
	ATn = :	8,760	Averaging time for noncarcinogenic exposures (days)

Unit Dose
Lifetime Chronic Daily Intake = 2.1E-06 kg-soil/kg-wt/day
Chronic Daily Intake = : 6.0E-06 kg-soil/kg-wt/day

RISK ASSESSMENT SPREADSHEET - DIRECT DERMAL CONTACT WITH SOIL (PAGE TWO)

SITE NAME: AREA F, SELBY POND
LOCATION: FERRY CREEK, STRATFORD, CT
EXPOSURE SCENARIO: FREQUENT RECREATIONAL USER - ADULT - RME
MEDIA: SEDIMENT/WETLAND MATERIAL
DATE: FEBRUARY 10, 2000

CHEMICAL	Cs (mg/kg)	ABS (unitless)	Lifetime Chronic Daily Intake (mg/kg/day)	Chronic Daily Intake (mg/kg/day)	Cancer Slope Factor $(mg/kg/day)^{-1}$	Reference Dose (mg/kg/day)	Lifetime Cancer Risk	Percent Cancer Risk	Hazard Quotient	Percent Hazard Quotient
Benzo(a)anthracene	1.9 ✓	0.13	5.10E-07	1.49E-06	7.30E-01	NA	3.7E-07	1.9%	NA	NA
Benzo(a)pyrene	4.5 ✓	0.13	1.21E-06	3.52E-06	7.30E+00	NA	8.8E-06	46.1%	NA	NA
Benzo(b)fluoranthene	2.8 ✓	0.13	7.52E-07	2.19E-06	7.30E-01	NA	5.5E-07	2.9%	NA	NA
Dibenzo(a,h)anthracene	0.52 ✓	0.13	1.40E-07	4.07E-07	7.30E+00	NA	1.0E-06	5.3%	NA	NA
Indeno(1,2,3-cd)pyrene	1.3 ✓	0.13	3.49E-07	1.02E-06	7.30E-01	NA	2.5E-07	1.3%	NA	NA
Arsenic	23.3 ✓	0.03	1.44E-06	4.21E-06	1.50E+00	3.00E-04	2.2E-06	11.3%	1.4E-02	40.0%
Barium	154 ✓	NA	NA	NA	NA	4.90E-03	NA	NA	NA	NA
Cadmium	17.5 ✓	0.01	3.61E-07	1.05E-06	NA	5.00E-05	NA	NA	2.1E-02	60.0%
Chromium (total)	374 ✓	NA	NA	NA	NA	7.50E-05	NA	NA	NA	NA
Mercury	2.2 ✓	NA	NA	NA	NA	2.10E-05	NA	NA	NA	NA
Vanadium	97.2 ✓	NA	NA	NA	NA	1.80E-04	NA	NA	NA	NA
Zinc	2550 ✓	NA	NA	NA	NA	3.00E-01	NA	NA	NA	NA
TEQ-Dioxins/Furans	0.00064 ✓	0.03	3.97E-11	1.16E-10	1.50E+05	NA	5.9E-06	31.1%	NA	NA
						Total	1.9E-05	100.0%	3.5E-02	100.0%

RISK ASSESSMENT SPREADSHEET - DIRECT DERMAL CONTACT WITH SOIL

SITE NAME: AREA F, SELBY POND
LOCATION: FERRY CREEK, STRATFORD, CT
EXPOSURE SCENARIO: FREQUENT RECREATIONAL USER - ADULT - CTE
MEDIA: SEDIMENT/WETLAND MATERIAL
DATE: FEBRUARY 10, 2000

HAZARD INDICES AND INCREMENTAL CANCER RISKS ARE CALCULATED BY THIS SPREADSHEET.
EXPOSURES THROUGH DERMAL CONTACT WITH SOIL ARE CONSIDERED.
ASSUMPTIONS ARE OUTLINED BELOW.

RELEVANT EQUATION:

$$\text{Absorbed Dose} = \frac{Cs \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT}$$

Where:

Cs = :		Concentration in soil (mg/kg)
CF = :	1.0E-06	Conversion factor (kg/mg)
SA = :	✓5,700	Skin surface available for contact (cm^2/event)
AF = :	✓0.04	Soil to skin adherence factor (mg/cm^2)
ABS = :		Absorption factor (unitless)
EF = :	✓90	Exposure frequency (events/year)
ED = :	7	Exposure duration (years)
BW = :	70	Body weight (kg)
ATc = :	25,550	Averaging time for carcinogenic exposures (days)
ATn = :	2,555	Averaging time for noncarcinogenic exposures (days)

Unit Dose

Lifetime Chronic Daily Intake =	8.0E-08	kg-soil/kg-wt/day
Chronic Daily Intake = :	8.0E-07	kg-soil/kg-wt/day

RISK ASSESSMENT SPREADSHEET - DIRECT DERMAL CONTACT WITH SOIL (PAGE TWO)

SITE NAME: AREA F, SELBY POND
LOCATION: FERRY CREEK, STRATFORD, CT
EXPOSURE SCENARIO: FREQUENT RECREATIONAL USER - ADULT - CTE
MEDIA: SEDIMENT/WETLAND MATERIAL
DATE: FEBRUARY 10, 2000

CHEMICAL	Cs (mg/kg)	ABS (unitless)	Lifetime Chronic Daily Intake (mg/kg/day)	Chronic Daily Intake (mg/kg/day)	Cancer Slope Factor $(mg/kg/day)^{-1}$	Reference Dose (mg/kg/day)	Lifetime Cancer Risk	Percent Cancer Risk	Hazard Quotient	Percent Hazard Quotient
Benzo(a)anthracene	0.84 ✓	0.13	8.77E-09	8.77E-08	7.30E-01	NA	6.4E-09	3.2%	NA	NA
Benzo(a)pyrene	1.2 ✓	0.13	1.25E-08	1.25E-07	7.30E+00	NA	9.1E-08	45.2%	NA	NA
Benzo(b)fluoranthene	1.1 ✓	0.13	1.15E-08	1.15E-07	7.30E-01	NA	8.4E-09	4.1%	NA	NA
Dibenzo(a,h)anthracene	0.38 ✓	0.13	3.97E-09	3.97E-08	7.30E+00	NA	2.9E-08	14.3%	NA	NA
Indeno(1,2,3-cd)pyrene	0.63 ✓	0.13	6.58E-09	6.58E-08	7.30E-01	NA	4.8E-09	2.4%	NA	NA
Arsenic	7.8 ✓	0.03	1.88E-08	1.88E-07	1.50E+00	3.00E-04	2.8E-08	13.9%	6.3E-04	47.6%
Barium	39.6 ✓	NA	NA	NA	NA	4.90E-03	NA	NA	NA	NA
Cadmium	4.3 ✓	0.01	3.45E-09	3.45E-08	NA	5.00E-05	NA	NA	6.9E-04	52.4%
Chromium (total)	90.4 ✓	NA	NA	NA	NA	7.50E-05	NA	NA	NA	NA
Mercury	0.77 ✓	NA	NA	NA	NA	2.10E-05	NA	NA	NA	NA
Vanadium	43.9 ✓	NA	NA	NA	NA	1.80E-04	NA	NA	NA	NA
Zinc	607 ✓	NA	NA	NA	NA	3.00E-01	NA	NA	NA	NA
TEQ-Dioxins/Furans	0.000094 ✓	0.03	2.26E-13	2.26E-12	1.50E+05	NA	3.4E-08	16.8%	NA	NA
						Total	2.0E-07	100.0%	1.3E-03	100.0%

TETRA TECH NUS, INC. **CALCULATION WORKSHEET**

CLIENT: Raymark - Ferry Creek	JOB NUMBER: 7491
SUBJECT: Dietary Ingestion of fish - Local Fisher	
BASED ON: Rags 1989	DRAWING NUMBER:
BY: JMM / CHECKED BY: RJF	APPROVED BY: / DATE: 3/27/00

Purpose: To calculate noncarcinogenic and carcinogenic risk for the local fisher via ingestion of fish.

Relevant equation:

$$\text{Intake (mg/kg-day)} = \frac{C \times IR \times CF \times FI \times EF \times ED}{BW \times AT}$$

where

C = Concentration in fish (mg/kg)
IR = biota ingestion Rate (mg/day)
CF = Conversion Factor (kg/mg)
FI = Fraction of soil from contaminated source (unitless)
EF = Exposure frequency (days/year)
ED = Exposure duration (years)
BW = Body weight (kg)
ATn = Averaging time for noncarcinogenic exposures (days)
ATc = Averaging time for carcinogenic exposures (days)
and

Reasonable Maximum Exposure (RME)		Central Tendency Exposure (CTE)	
C	chemical specific	C	chemical specific
IR	0.054 (kg/meal)	IR	0.0095 (kg/meal)
CF	NA*	CF	NA*
FI	1 (unitless)	FI	1 (unitless)
EF	365 (meals/year)	EF	365 (meals/year)
ED	30 (years)	ED	9 (years)
BW	70 (kg)	BW	70 (kg)
ATc	25,550 (days)	ATc	25,550 (days)
ATn	10,950 (days)	ATn	3,285 (days)

* NA = not applicable (for this receptor)

TETRA TECH NUS, INC. **CALCULATION WORKSHEET** PAGE 2 OF 3

CLIENT: Raymark - Ferry Creek	JOB NUMBER: 7491
SUBJECT: Incidental Ingestion of Fish - Local Fisher	
BASED ON: RAGs 1989	DRAWING NUMBER:
BY: gmm / CHECKED BY: RLP	APPROVED BY: / DATE: 3/27/00

Intake of 4,4'-DDT at a concentration of 0.00007 mg/kg in area F in the American Eel under RME assumption:

RME Noncarcinogenic Intake (mg/kg-day) of 4,4'DDT $= \dfrac{0.00007\left(\frac{mg}{kg}\right) \times 0.054\left(\frac{kg}{meal}\right) \times 1 \times 365 \frac{meals}{year} \times 30 \text{ years}}{70(kg) \times 10,950 \text{ (days)}}$

$= \boxed{5.40E^{-8} \text{ mg/kg-day}}$ ✓

RME Carcinogenic Intake (mg/kg-day) of 4,4'-DDT $= \dfrac{0.00007\left(\frac{mg}{kg}\right) \times 0.054\left(\frac{kg}{meal}\right) \times 1 \times 365 \frac{meals}{year} \times 30 \text{ years}}{70(kg) \times 25,550 \text{ (days)}}$

$= \boxed{2.31E^{-8} \text{ mg/kg-day}}$ ✓

Then Incremental Cancer Risk (ICR) and Hazard Quotient (HQ) are calculated with the following equations:

ICR (unitless) = Carcinogenic Intake (mg/kg-day) x Cancer Slope Factor (CSF) (kg/mg-day)

HQ (unitless) = $\dfrac{\text{Noncarcinogenic intake}}{\text{Reference Dose}}$ $\dfrac{\text{mg/kg-day}}{\text{mg/kg-day}}$

where the CSF for 4,4'-DDT = $3.4E^{-1}$ and RFD for 4,4-DDT = $5.0E^{-4}$

ICR 4,4'-DDT (unitless) = $2.31E^{-8}$ mg/kg-day x $3.4E^{-1}$ kg/mg-day = $\boxed{7.9E^{-9}}$ RME ✓

HQ 4,4'-DDT (unitless) $= \dfrac{5.4E^{-8} \text{ mg/kg-day}}{5.0E^{-4} \text{ mg/kg-day}} = \boxed{1.1E^{-4}}$ RME ✓

CLIENT: Raymark - Ferry creek	JOB NUMBER:
SUBJECT: Incidental Ingestion of fish - Local Fisher	
BASED ON: RAGs 1989	DRAWING NUMBER:
BY: JMM / CHECKED BY: RJK	APPROVED BY: / DATE: 3/27/00

Intake of 4,4-DDT at a concentration of 0.000049 mg/kg in Area F, in the american Eel under CTE assumptions.

CTE Noncarcinogenic Intake (mg/kg-day) $= \dfrac{0.000049 \frac{mg}{kg} \times 0.0095 \frac{kg}{meal} \times 1 \times 365 \frac{meals}{year} \times 9 \text{ years}}{70 (kg) \times 3{,}285 \text{ (days)}}$

$= \boxed{6.65\ E^{-9} \text{ mg/kg-day}}$ ✓

CTE Carcinogenic Intake (mg/kg-day) $= \dfrac{0.000049 \frac{mg}{kg} \times 0.0095 \frac{kg}{meal} \times 1 \times 365 \frac{meals}{year} \times 9 \text{ years}}{70 (kg) \times 25{,}550 \text{ days}}$

$= \boxed{8.55\ E^{-10} \text{ mg/kg-day}}$ ✓

then ICR and HQ are calculated for 4,4'-DDT where the

ICR 4,4-DDT (unitless) $= 8.55\ E^{-10}$ mg/kg-day $\times$ $3.4\ E^{-1}$ kg/mg-day $= \boxed{2.9\ E^{-10}}$ CTE ✓

HQ 4,4'-DDT (unitless) $= \dfrac{6.65\ E^{-9} \text{ mg/kg-day}}{5.0\ E^{-4} \text{ mg/kg-day}} = \boxed{1.3\ E^{-5}}$ CTE ✓

References

USEPA Dec. 1989. Risk Assessment Guidance for Superfund Volume 1 Human Health Evaluation Manual (Part A) Interim Final. OSWER EPA/540/1-89/002.

RISK ASSESSMENT SPREADSHEET - INGESTION OF FISH

SITE NAME: AREA F, SELBY POND
LOCATION: FERRY CREEK, STRATFORD, CT
XPOSURE SCENARIO: LOCAL FISHER - RME
MEDIA: AMERICAN EELS
DATE: FEBRUARY 10, 2000 ✓

HAZARD INDICES AND INCREMENTAL CANCER RISKS ARE CALCULATED BY THIS SPREADSHEET.
EXPOSURES THROUGH INGESTION OF FISH ARE CONSIDERED.
ASSUMPTIONS ARE OUTLINED BELOW.

RELEVANT EQUATION: $Intake = \frac{Cf \times IR \times Fl \times EF \times ED}{BW \times AT}$

WHERE:

Cf = :		Chemical concentration in fish (mg/kg)
IR = :	0.054	Ingestion Rate (Kg/meal)
Fl = :	1	Fraction from contaminated source (unitless)
EF = :	365	Exposure Frequency (meals/year)
ED = :	30	Exposure Duration (years)
BW = :	70	Body Weight (kg)
ATc = :	25,550	Averaging time for carcinogenic exposures (days)
ATn = :	10,950	Averaging time for noncarcinogenic exposures (days)

Unit Dose
Lifetime Chronic Daily I 3.31E-04 kg-fish/kg-wt/day
Chronic Daily Intake = : 7.71E-04 kg-fish/kg-wt/day

RISK ASSESSMENT SPREADSHEET - INGESTION OF FISH (PAGE TWO)

SITE NAME: AREA F, SELBY POND
LOCATION: FERRY CREEK, STRATFORD, CT
XPOSURE SCENARIO: LOCAL FISHER - RME
MEDIA: AMERICAN EELS
DATE: FEBRUARY 10, 2000

CHEMICAL	Cf (mg/kg)	Lifetime Chronic Daily Intake (mg/kg/day)	Chronic Daily Intake (mg/kg/day)	Cancer Slope Factor $(mg/kg/day)^{-1}$	Reference Dose (mg/kg/day)	Lifetime Cancer Risk	Percent Cancer Risk	Hazard Quotient	Percent Hazard Quotient
4,4'-DDD	0.00032	1.1E-07	2.5E-07	2.40E-01	NA	2.5E-08	5.2%	NA	NA
4,4'-DDE	0.00039	1.3E-07	3.0E-07	3.40E-01	NA	4.4E-08	8.9%	NA	NA
4,4'-DDT	0.00007	2.3E-08	5.4E-08	3.40E-01	5.00E-04	7.9E-09	1.6%	1.1E-04	16.9%
Aldrin	0.0000016	5.3E-10	1.2E-09	1.70E+01	3.00E-05	9.0E-09	1.8%	4.1E-05	6.4%
Aroclor, total	0.00054	1.8E-07	4.2E-07	2.00E+00	NA	3.6E-07	72.5%	NA	NA
Dieldrin	0.000011	3.6E-09	8.5E-09	1.60E+01	5.00E-05	5.8E-08	11.8%	1.7E-04	26.5%
Heptachlor epoxide	0.0000054	1.8E-09	4.2E-09	9.10E+00	1.30E-05	1.6E-08	3.3%	3.2E-04	50.1%
					Total	4.9E-07	100.0%	6.4E-04	100.0%

RISK ASSESSMENT SPREADSHEET - INGESTION OF FISH

SITE NAME: AREA F, SELBY POND
LOCATION: FERRY CREEK, STRATFORD, CT
XPOSURE SCENARIO: LOCAL FISHER - CTE
MEDIA: AMERICAN EELS
DATE: FEBRUARY 10, 2000

HAZARD INDICES AND INCREMENTAL CANCER RISKS ARE CALCULATED BY THIS SPREADSHEET.
EXPOSURES THROUGH INGESTION OF FISH ARE CONSIDERED.
ASSUMPTIONS ARE OUTLINED BELOW.

RELEVANT EQUATION: $Intake = \frac{Cf \times IR \times FI \times EF \times ED}{BW \times AT}$

WHERE:			
	Cf = :		Chemical concentration in fish (mg/kg)
	IR = :	0.0095	Ingestion Rate (Kg/meal)
	FI = :	1	Fraction from contaminated source (unitless)
	EF = :	365	Exposure Frequency (meals/year)
	ED = :	9	Exposure Duration (years)
	BW = :	70	Body Weight (kg)
	ATc = :	25,550	Averaging time for carcinogenic exposures (days)
	ATn = :	3,285	Averaging time for noncarcinogenic exposures (days)

Unit Dose
Lifetime Chronic Daily Ir 1.74E-05 kg-fish/kg-wt/day
Chronic Daily Intake = : 1.36E-04 kg-fish/kg-wt/day

RISK ASSESSMENT SPREADSHEET - INGESTION OF FISH (PAGE TWO)

SITE NAME: AREA F, SELBY POND
LOCATION: FERRY CREEK, STRATFORD, CT
XPOSURE SCENARIO: LOCAL FISHER - CTE
MEDIA: AMERICAN EELS
DATE: FEBRUARY 10, 2000

CHEMICAL	Cf (mg/kg)	Lifetime Chronic Daily Intake (mg/kg/day)	Chronic Daily Intake (mg/kg/day)	Cancer Slope Factor $(mg/kg/day)^{-1}$	Reference Dose (mg/kg/day)	Lifetime Cancer Risk	Percent Cancer Risk	Hazard Quotient	Percent Hazard Quotient
4,4'-DDD	0.00017 ✓	3.0E-09	2.3E-08	2.40E-01	NA	7.1E-10	4.4%	NA	NA
4,4'-DDE	0.00027 ✓	4.7E-09	3.7E-08	3.40E-01	NA	1.6E-09	10.0%	NA	NA
4,4'-DDT	0.000049 ✓	8.6E-10	6.7E-09	3.40E-01	5.00E-04	2.9E-10	1.8%	1.3E-05	24.4%
Aldrin	0.0000011 ✓	1.9E-11	1.5E-10	1.70E+01	3.00E-05	3.3E-10	2.0%	5.0E-06	9.1%
Aroclor, total	0.00034 ✓	5.9E-09	4.6E-08	2.00E+00	NA	1.2E-08	73.9%	NA	NA
Dieldrin	0.000006 ✓	1.0E-10	8.1E-10	1.60E+01	5.00E-05	1.7E-09	10.4%	1.6E-05	29.9%
Heptachlor epoxide	0.0000019 ✓	3.3E-11	2.6E-10	9.10E+00	1.30E-05	3.0E-10	1.9%	2.0E-05	36.5%
					Total	1.6E-08	100.0%	5.4E-05	100.0%