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TABLES

Table 2-1
RAGS Part D Standard Table 3.1
Medium-Specific Exposure Point Concentration Summary
Soils (0 to 2 feet bgs)
AOC FS-2

Scenario Time Frame: Current/Future Land Use
Medium: Soil
Exposure Medium: Surface Soil
Exposure Point: Soil 0-2 feet bgs

Chemical of Potential Concern (1)	Units	Arithmetic Mean	95% UCL of Lognormal Data	Maximum Detected Concentration	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure			Central Tendency		
							Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale	Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale
Semivolatile Organics												
BENZO(A)ANTHRACENE	µg/kg	318	540	760		µg/kg	540	95% UCL	(2)	NE	NE	NE
BENZO(A)PYRENE	µg/kg	251	382	600		µg/kg	382	95% UCL	(2)	NE	NE	NE
BENZO(B)FLUORANTHENE	µg/kg	373	598	790		µg/kg	598	95% UCL	(2)	NE	NE	NE
DIBENZ(A,H)ANTHRACENE	µg/kg	45	69	110	J	µg/kg	69	95% UCL	(2)	NE	NE	NE
INDENO(1,2,3-C,D)PYRENE	µg/kg	194	299	510		µg/kg	299	95% UCL	(2)	NE	NE	NE
Inorganics												
ARSENIC (TOTAL)	mg/kg	2.0	3.5	7.3		mg/kg	3.5	95% UCL	(2)	NE	NE	NE
Extractable Petroleum Hydrocarbons												
C11-C22 AROMATIC HYDROCARBONS	mg/kg	39	269	350		mg/kg	269	95% UCL	(2)	NE	NE	NE

Notes:

(1) Chemicals of potential concern are selected in Table 7-2 of the Final FS-2 Supplemental RI Report (AFCEE 2001b).
Data summary is based on samples collected from 0-2 feet bgs at locations 32BH0001 through 32BH0010.

(2) The EPC is the minimum of the maximum detected concentration and the 95% UCL if there are at least 10 samples; otherwise, the maximum detected concentration was used, per EPA Region I (EPA 1995. *Risk Updates*. No. 3. EPA Region I, New England, Waste Management Division).

Qualifier Definitions:

bgs = below ground surface
EPA = U.S. Environmental Protection Agency
EPC = exposure point concentration
J = estimated value
mg/kg = milligrams per kilogram
NE = not evaluated
UCL = upper confidence limit on the arithmetic mean
µg/kg = micrograms per kilogram

Table 2-2
RAGS Part D Standard Table 3.2
Medium-Specific Exposure Point Concentration Summary
Soils (0 to 10 feet bgs)
AOC FS-2

Scenario Time Frame: Future Land Use
Medium: Soil
Exposure Medium: Surface Soil
Exposure Point: Soil 0-10 feet bgs

Chemical of Potential Concern (1)	Units	Arithmetic Mean	95% UCL of Lognormal Data	Maximum Detected Concentration	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure			Central Tendency		
							Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale	Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale
Semivolatile Organics												
BENZO(A)ANTHRACENE	µg/kg	288	1857	2300		µg/kg	1857	95% UCL	(2)	NE	NE	NE
BENZO(A)PYRENE	µg/kg	222	1333	2000		µg/kg	1333	95% UCL	(2)	NE	NE	NE
BENZO(B)FLUORANTHENE	µg/kg	308	1888	2500		µg/kg	1888	95% UCL	(2)	NE	NE	NE
DIBENZ(A,H)ANTHRACENE	µg/kg	41	89	360	J	µg/kg	89	95% UCL	(2)	NE	NE	NE
INDENO(1,2,3-C,D)PYRENE	µg/kg	169	967	1600		µg/kg	967	95% UCL	(2)	NE	NE	NE
Inorganics												
ARSENIC (TOTAL)	mg/kg	1.8	3.8	7.3		mg/kg	3.8	95% UCL	(2)	NE	NE	NE
Extractable Petroleum Hydrocarbons												
C11-C22 AROMATIC HYDROCARBONS	mg/kg	20	18	350		mg/kg	350	Maximum	(3)	NE	NE	NE

Notes:

(1) Chemicals of potential concern are selected in Table 7-2 of the Final FS-2 Supplemental RI Report (AFCEE 2001b).
Data summary is based on samples collected from 0-10 feet bgs at locations 32BH0001 through 32BH0010.

(2) The EPC is the minimum of the maximum detected concentration and the 95% UCL if there are at least 10 samples; otherwise, the maximum detected concentration was used, per EPA Region I (EPA 1995. *Risk Updates.* No. 3. EPA Region I, New England, Waste Management Division).

(3) The data exhibit neither a normal nor a lognormal distribution. Therefore, the maximum detected concentration is selected as a conservative estimate of the EPC.

EPA = U.S. Environmental Protection Agency
EPC = exposure point concentration
feet bgs = feet below ground surface
J = estimated value
mg/kg = milligrams per kilogram
NE = not evaluated
UCL = upper confidence limit on the arithmetic mean
µg/kg = micrograms per kilogram

Table 2-3
RAGS Part D Standard Table 3.3
Medium-Specific Exposure Point Concentration Summary
Soils (0 to 20 feet bgs)
AOC FS-2

Scenario Time Frame: Future Land Use
Medium: Soil
Exposure Medium: Surface and Subsurface Soil
Exposure Point: Soil 0-20 feet bgs

Chemical of Potential Concern (1)	Units	Arithmetic Mean	95% UCL of Lognormal Data	Maximum Detected Concentration	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure			Central Tendency		
							Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale	Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale
Semivolatile Organics												
BENZO(A)ANTHRACENE	µg/kg	289	1150	4100		µg/kg	1150	95% UCL	(2)	NE	NE	NE
BENZO(A)PYRENE	µg/kg	204	612	2400		µg/kg	612	95% UCL	(2)	NE	NE	NE
BENZO(B)FLUORANTHENE	µg/kg	299	881	4200		µg/kg	881	95% UCL	(2)	NE	NE	NE
DIBENZ(A,H)ANTHRACENE	µg/kg	37	52	410		µg/kg	52	95% UCL	(2)	NE	NE	NE
INDENO(1,2,3-C,D)PYRENE	µg/kg	150	425	1800		µg/kg	425	95% UCL	(2)	NE	NE	NE
Inorganics												
ARSENIC (TOTAL)	mg/kg	1.6	4.3	7.3		mg/kg	4.3	95% UCL	(2)	NE	NE	NE
Extractable Petroleum Hydrocarbons												
C11-C22 AROMATIC HYDROCARBONS	mg/kg	21	15	360	J	mg/kg	360	Maximum	(3)	NE	NE	NE

Notes:

(1) Chemicals of potential concern are selected in Table 7-2 of the Final FS-2 Supplemental RI Report (AFCEE 2001b). Data summary is based on samples collected from 0-20 feet bgs at locations 32BH0001 through 32BH0010.

(2) The EPC is the minimum of the maximum detected concentration and the 95% UCL if there are at least 10 samples; otherwise, the maximum detected concentration was used, per EPA Region I (EPA 1995. *Risk Updates.* No. 3. EPA Region I, New England, Waste Management Division).

(3) The data exhibit neither a normal nor a lognormal distribution. Therefore, the maximum detected concentration is selected as a conservative estimate of the EPC.

EPA = U.S. Environmental Protection Agency
EPC = exposure point concentration
feet bgs = feet below ground surface
J = estimated value
mg/kg = milligrams per kilogram
NE = not evaluated
UCL = upper confidence limit on the arithmetic mean
µg/kg = micrograms per kilogram

Table 2-4
RAGS Part D Standard Table 2.3
Occurrence, Distribution and Selection of Chemicals of Potential Concern - Groundwater
AOC FS-2

Scenario Time Frame: CURRENT
Medium: GROUNDWATER
Exposure Medium: GROUNDWATER
Exposure Point: FS-2 WELLS

CAS Number	Chemical	Minimum Detected Concentration	Minimum Qualifier	Maximum Detected Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency No. of Detects per No. of Results	Range of Detection Limits	Concentration Used for Screening (Maximum)	Background Value	Screening Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Yes or No)	Rationale for COPC Yes Flag (Most Restrictive)
7429-90-5	ALUMINUM	125		125		µg/L	32MW1308	1 of 5	15.6 to 53.6	125	811	3.60+04 nc			No*	
7429-90-5T	ALUMINUM (TOTAL)	40.8	J	210		µg/L	02MW1202C	2 of 5	15.6 to 87.4	210	2215.4	3.70E+04 nc			No*	
7440-38-2	ARSENIC	5.4	J	5.4	J	µg/L	32MW1307	1 of 5	2.1 to 2.3	5.4J	5.4	4.50E-02 ca	50	SDWA, MMCL	Yes	Tox
7440-38-2T	ARSENIC (TOTAL)	7.5	J	7.5	J	µg/L	32MW1307	1 of 5	2.1 to 2.1	7.5J	7.5	4.50E-02 ca	50	SDWA, MMCL	Yes	Tox
7440-39-3	BARIUM	7	J	10.6	J	µg/L	02MW1202C	5 of 5	0.2 to 0.2	10.6J	58.5	2.60E+03 nc	2000	SDWA, MMCL	No	
7440-39-3T	BARIUM (TOTAL)	7.1	J	12.7	J	µg/L	02MW1202C	5 of 5	0.2 to 0.2	12.7J	63	2.60E+03 nc	2000	SDWA, MMCL	No	
7440-41-7T	BERYLLIUM (TOTAL)	0.14	J	0.14	J	µg/L	32MW1308	1 of 5	0.1 to 0.36	0.14J	0.6	7.30E+01 nc	4	SDWA, MMCL	No	
7440-70-2	CALCIUM	1580		5140		µg/L	02MW1202C	5 of 5	7.9 to 7.9	5140	9294.4				No*	
7440-70-2T	CALCIUM (TOTAL)	1540		5140		µg/L	02MW1202C	5 of 5	7.9 to 7.9	5140	10233.1				No*	
7440-47-3T	CHROMIUM, (TOTAL)	3.9	J	3.9	J	µg/L	02MW1202C	1 of 5	0.4 to 1.6	3.9J	7	1.10E+02 nc	100	SDWA, MMCL	No	
7440-47-3	CHROMIUM, TOTAL	1.8	J	1.8	J	µg/L	32MW1307	1 of 5	0.4 to 0.4	1.8J	2.2	1.10E+02 nc	100	SDWA, MMCL	No	
7440-48-4	COBALT	1.1	J	4.3	J	µg/L	32MW1308	3 of 5	0.6 to 1.3	4.3J	5.2	2.20E+03 nc			No*	
7440-48-4T	COBALT (TOTAL)	4.2	J	4.2	J	µg/L	32MW1308	2 of 5	0.6 to 1.5	4.2J	9.1	2.20E+03 nc			No*	
7440-50-8	COPPER	20.5		20.5		µg/L	32MW0003	1 of 5	0.8 to 0.8	20.5	20.5	1.40E+00 nc	1300	SDWA, MMCL	No	
7440-50-8T	COPPER (TOTAL)	1	J	1.4	J	µg/L	02MW1202C	2 of 5	0.8 to 0.8	1.4J	5.8	1.40E+00 nc	1300	SDWA, MMCL	No	
100-41-4	ETHYLBENZENE	11		11		µg/L	02MW12025	1 of 8	0.5 to 0.5	11		1.30E+03 nc	700	SDWA, MMCL	No	
7439-89-6	IRON	849		10100		µg/L	32MW1307	3 of 5	10.6 to 110	10100	10100	1.10E+04 nc			No*	
7439-89-6T	IRON (TOTAL)	294		10800		µg/L	32MW1307	4 of 5	10.6 to 260	10800	14860.5	1.10E+04 nc			No*	
7439-95-4	MAGNESIUM	1600		3550		µg/L	02MW1202C	5 of 5	23.2 to 23.2	3550	3859.8				No*	
7439-95-4T	MAGNESIUM (TOTAL)	1640		3790		µg/L	02MW1202C	5 of 5	23.2 t 23.2	3790	3984.5				No*	
7439-96-5	MANGANESE	7.7	J	164		µg/L	32MW1307	5 of 5	0.4 to 0.4	164	1896.6	8.80E+02 nc			No	
7439-96-5T	MANGANESE (TOTAL)	11.2		177		µg/L	32MW1307	5 of 5	0.4 to 0.4	177	1891	8.80E+02 nc			No	
7440-02-0T	NICKEL (TOTAL)	2.9	J	2.9	J	µg/L	02MW1202C	5 of 5	1.3 to 1.3	2.9J	5.2	7.30E+02 nc	100	MMCL	No	
7440-09-7	POTASSIUM	659	J	1980		µg/L	32MW1308	5 of 5	598 to 598	1980	4116.6				No*	
7440-09-7T	POTASSIUM (TOTAL)	902	J	1960		µg/L	32MW1308	5 of 5	598 to 598	1960	2607.9				No*	
7440-21-3	SILICON	4090		4830		µg/L	02MW1202C	5 of 5	35.3 to 35.3	4830	10093.2				No*	
7440-21-3T	SILICON (TOTAL)	4040		5020		µg/L	02MW1202C	5 of 5	35.3 to 35.3	5020	10543.9				No*	
7440-23-5	SODIUM	6890		9990		µg/L	02MW1202C	5 of 5	17.3 to 17.3	9990	26300		20000	MMCL	No*	
7440-23-5T	SODIUM (TOTAL)	7150		10400		µg/L	02MW1202C	5 of 5	17.3 to 17.3	10400	25100		20000	MMCL	No*	
XYLMP	M,P-XYLENE (SUM OF ISOMER	20		20		µg/L	02MW12025	1 of 8	0.5 to 0.5	20		1.40E+03 nc	10000	MMCL	No	
7440-66-6	ZINC	5.6	J	11		µg/L	32MW1308	3 of 5	0.5 to 7.8	11	50.5	1.10E+04 nc			No	
7440-66-6T	ZINC (TOTAL)	6.7		12.9		µg/L	32MW0003	3 of 5	0.5 to 12.8	12.9	78.5	1.10E+04 nc			No	

Table 2-4
RAGS Part D Standard Table 2.3
Occurrence, Distribution and Selection of Chemicals of Potential Concern - Groundwater
AOC FS-2

Notes:

Data Source: Jacobs Engineering Group Inc., (November 2000) Site Environmental Evaluation (SEE) database
Only the latest results with the most complete analyte lists were used if more than one sample was available.
Only normal, validated, non-rejected results for samples collected after 06 January 1996 are used.
All analytes detected in any SWOU well associated with FS-2, regardless of detection frequency, are shown.
The analyte concentration used for screening is the maximum detected result.
The ARAR is the lesser of Safe Drinking Water Act (SDWA) MCLs and Massachusetts Drinking Water MCLs (MMCL).
Screening toxicity value is EPA Region IX risk-based tap water standard.
COPC flag is Yes if screening result exceeds any of the background, screening toxicity, or ARAR concentrations.
COPC flag is Yes if there is no background, screening toxicity, or ARAR value to compare to.
Rationale for COPC Yes flag gives the most restrictive of the comparison values.
* Indicates that common cations (Al, Ca, Co, Fe, Mg, K, Na, Si) are presented for informational purposes and are not considered to be COPCs.
ca indicates a carcinogen as reported in EPA Region IX RBC table.
nc indicates a non-carcinogen as reported in EPA Region IX RBC table.
Screening toxicity value for hexavalent chromium shown.
Background values from SWOU remedial investigation.

Al = aluminum
ARAR = applicable or relevant and appropriate requirement
Ca = calcium
CAS = Chemical Abstract Service
Co = cobalt
COPC = chemical of potential concern
Fe = iron
J = estimated result
K = potassium
MCL = maximum contaminant level
Mg = magnesium
Na = sodium
No. = number
RAGS = *Risk Assessment Guidance for Superfund (RAGS): Volume I - Human Health Evaluation Manual (HHEM) (EPA 1989)*
RBC = risk-based concentration
Si = silicon
SWOU = Southwest Operable Unit
TBC = to be considered
Tox = measured value exceeded toxicity screening value
µg/L = micrograms per liter

Table 2-5
RAGS Part D Standard Table 1.0
Selection of Exposure Pathways
AOC FS-2

Scenario Time Frame	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current and Future	Soil	Soils	FS-2	Recreational User	Adolescent	Ingestion Dermal Inhalation of VOCs/particulates	On-Site	Quant	The site is currently inactive, but access from within MMR is unrestricted. Recreational users, such as golfers, mountain bikers, and walkers, may access the site. Future recreational development of the site may occur, as it is adjacent to the MMR golf course.
Future	Soil	Soils	FS-2	Resident	Child / Adult	Ingestion Dermal Contact Inhalation of VOCs/particulates	On-Site	Quant	Although future site use has not been determined, the risk assessment considers future use of the site as a residential property to provide a conservative assessment of possible health risks associated with unspecified future use.
Future	Soil	Soils	FS-2	Construction/ Utility Worker	Adult	Ingestion Dermal Inhalation of VOCs/particulates	On-Site	Quant	The land use of this area is currently inactive and for MMR is considered military. However, short-term construction/utility activities may occur in the future.
Current and Future	Soil	Soils	FS-2	Commercial/ Industrial Site Worker	Adult	Ingestion Dermal Inhalation of VOCs/particulates	On-Site	None	The land use of this area is currently inactive and for MMR is considered military. Although future land use at MMR has not been fully established, this area is not suitable for commercial/industrial development based on its historical military use.
Current and Future	Groundwater	Groundwater	Aquifer - Tap Water	On-Site Receptor / Future Resident	Child / Adult	Ingestion Dermal Contact Inhalation of VOCs	On-Site	Quant	The land use of this area is currently inactive and for MMR is considered military. Although future land use at MMR has not been fully established, a residential use has been used for evaluating risk. SWOU RI groundwater data indicate that concentrations present in FS-2 groundwater do not exceed drinking water standards. With no COCs or discernable plumes identified for FS-2 groundwater, it was concluded that there are no unacceptable risks to human health associated with future residential exposure to FS-2 groundwater.
Future	Groundwater	Groundwater	Aquifer - Tap Water	Off-Site Receptor / Future Resident	Child / Adult	Ingestion Dermal Contact Inhalation of VOCs	Off-Site	Quant	The SWOU RI groundwater data indicate that concentrations present in FS-2 groundwater do not exceed drinking water standards. With no COCs or discernable plumes identified for FS-2 groundwater, it was concluded that there are no unacceptable risks to human health associated with future residential exposure to FS-2 groundwater.

Notes:

COC = chemical of concern
FS-2 = Fuel Spill-2
MMR = Massachusetts Military Reservation
Quant = quantitative
RI = remedial investigation
SWOU = Southwest Operable Unit
VOC = volatile organic compound

Table 2-6
RAGS Part D Standard Table 4.1
Values Used for Daily Intake Calculations - Trespasser
AOC FS-2

Scenario Time Frame: Current/Future Land Use
Medium: Soil
Exposure Medium: Surface Soil
Exposure Points: Soil 0-2 feet bgs
Receptor Population: Trespasser
Receptor Age: Adolescent (7 through 17 years)

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Css	Chemical Concentration in Surface Soil	µg/g	See EPC Table	See EPC Table	NE	NE	
	CF	Conversion Factor	g/µg	1.00E-06	--	NE	NE	Intake Ingestion = Css x IR x FI x CF x EF x ED
	IR	Ingestion Rate of Surface Soil	mg/day	100	EPA, 1994	NE	NE	BW x AT
	FI	Fraction Ingested from Source	%	100%	(2)	NE	NE	
	EF	Exposure Frequency	days/year	138	(1)	NE	NE	
	ED	Exposure Duration	years	11	(1)	NE	NE	
	BW	Body Weight	kg	45	EPA, 1997	NE	NE	
	AT-C	Averaging Time (Cancer)	days	25,550	EPA, 1989	NE	NE	
	AT-N	Averaging Time (Non-Cancer)	days	4,015	EPA, 1989	NE	NE	
Dermal	Css	Chemical Concentration in Surface Soil	µg/g	See EPC Table	See EPC Table	NE	NE	
	CF	Conversion Factor	g/µg	1.00E-06	--	NE	NE	Intake Dermal = DA event x SA x EF x ED
	AF	Adherence Factor	mg/cm^2	0.20	EPA, 1999; (3)	NE	NE	BW x AT
	AbF	Absorption Factor	%	chemical-specific	EPA, 1999; (5)	NE	NE	
	SA	Skin Surface Area Available for Contact	cm^2	3,431	EPA, 1992; (4)	NE	NE	
	EF	Exposure Frequency	days/year	138	(1)	NE	NE	Where:
	ED	Exposure Duration	years	11	(1)	NE	NE	DAevent = Css x AF x AbF x CF
	BW	Body Weight	kg	45	EPA, 1997	NE	NE	
	AT-C	Averaging Time (Cancer)	days	25,550	EPA, 1989	NE	NE	
	AT-N	Averaging Time (Non-Cancer)	days	4,015	EPA, 1989	NE	NE	
Inhalation	CA	Chemical Concentration in Air	µg/m^3	See Equation	See Equation	NE	NE	
	PEF	Particulate Emission Factor	kg/m^3	1.32E+09	EPA, 1996	NE	NE	Intake Inhalation = CA x ET x EF x ED
	ET	Exposure Time	hours/day	2	(2)	NE	NE	24 hour/day x AT
	EF	Exposure Frequency	days/year	138	(1)	NE	NE	
	ED	Exposure Duration	years	11	(1)	NE	NE	Where:
	AT-C	Averaging Time (Cancer)	days	25,550	EPA, 1989	NE	NE	CA = Soil EPC x 1/PEF x 1000 µg/mg
	AT-N	Averaging Time (Non-Cancer)	days	4,015	EPA, 1989	NE	NE	

(1) Four days per week during April through November. Exposure duration is 11 years for ages 7 through 17.
(2) Value is assumed.
(3) See Exhibit 3.3 of EPA, 1999. Value based on: Children Playing in wet soil (geometric mean for wet soil).
(4) Skin surface area is 25% of the whole body surface for males ages 7 through 17 (EPA, 1999).
(5) See Exhibit 3.4 of EPA, 1999. Published AbF values for the COPCs evaluated in this risk assessment are as follows:
Arsenic: 0.03; PAHs: 0.13; the AbF for PAHs is used as a surrogate AbF for C11-C22 aromatic EPH.

EPA, 1989 (December). *Risk Assessment Guidance for Superfund (RAGS)*, Volume 1, Human Health Evaluation Manual (Part A). EPA-540/1-89-002 (interim final). Office of Emergency and Remedial Response, Washington, DC.
EPA, 1992. *Dermal Exposure Assessment: Principles and Applications*. EPA-600/8-91/011F. Office of Health and Environmental Assessment.
EPA, 1994 (August). *Risk Updates No. 2*; USEPA Region I, Waste Management Division. Values from Attachment 2 to Risk Updates No. 2.
EPA, 1996 (May). *Soil Screening Guidance: Technical Background Document*. EPA/540/R-95/128.
EPA, 1997 (August). *Exposure Factors Handbook*, Volume 1. EPA-600/P-95/002Fa. Office of Research and Development, Washington, DC.
EPA, 1999. *Risk Assessment Guidance for Superfund*, Volume 1, Human Health Evaluation Manual (Part E) Interim Guidance. EPA-540/R-99-005. Office of Solid Waste and Emergency Response, Washington, DC.

cm^2 = square centimeters
CT = central tendancy
EPA = U.S. Environmental Protection Agency
EPC = exposure point concentration
EPH = extractable petroleum hydrocarbon
g/µg = grams per microgram
kg = kilograms
kg/m^3 = kilograms per cubic meter
mg/cm^2 = milligrams per square centimeter
NE = not evaluated
PAH = polyaromatic hydrocarbon
RME = reasonable maximum exposure
µg/g = micrograms per gram
µg/m^3 = micrograms per cubic meter

Table 2-7
RAGS Part D Standard Table 4.2
Values Used for Daily Intake Calculations - Child Resident
AOC FS-2

Scenario Time Frame: Future Land Use
Medium: Soil
Exposure Medium: Surface Soil
Exposure Points: Soil 0-2 feet bgs; Soil 0-10 feet bgs
Receptor Population: Resident
Receptor Age: Child (1 through 6 years)

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Css	Chemical Concentration in Surface Soil	µg/g	See EPC Table	See EPC Table	NE	NE	
	CF	Conversion Factor	g/µg	1.00E-06	--	NE	NE	Intake Ingestion = Css x IR x FI x CF x EF x ED
	IR	Ingestion Rate of Surface Soil	mg/day	200	EPA, 1994	NE	NE	BW x AT
	FI	Fraction Ingested from Source	%	100%	(1)	NE	NE	
	EF	Exposure Frequency	days/year	150	EPA, 1994	NE	NE	
	ED	Exposure Duration	years	6	EPA, 1994	NE	NE	
	BW	Body Weight	kg	15	EPA, 1994	NE	NE	
	AT-C	Averaging Time (Cancer)	days	25,550	EPA, 1989	NE	NE	
	AT-N	Averaging Time (Non-Cancer)	days	2,190	EPA, 1989	NE	NE	
Dermal	Css	Chemical Concentration in Surface Soil	µg/g	See EPC Table	See EPC Table	NE	NE	
	CF	Conversion Factor	g/µg	1.00E-06	--	NE	NE	Intake Dermal = DA event x SA x EF x ED
	AF	Adherence Factor	mg/cm^2	0.2	EPA, 1999; (3)	NE	NE	BW x AT
	AbF	Absorption Factor	%	chemical-specific	EPA, 1999; (2)	NE	NE	
	SA	Skin Surface Area Available for Contact	cm^2	2,800	EPA, 1999; (3)	NE	NE	
	EF	Exposure Frequency	days/year	150	EPA, 1994	NE	NE	Where:
	ED	Exposure Duration	years	6	EPA, 1994	NE	NE	DAevent = Css x AF x AbF x CF
	BW	Body Weight	kg	15	EPA, 1994	NE	NE	
	AT-C	Averaging Time (Cancer)	days	25,550	EPA, 1989	NE	NE	
	AT-N	Averaging Time (Non-Cancer)	days	2,190	EPA, 1989	NE	NE	
Inhalation	CA	Chemical Concentration in Air	µg/m^3	See Equation	See Equation	NE	NE	
	PEF	Particulate Emission Factor	kg/m^3	1.32E+09	EPA, 1996	NE	NE	Intake Inhalation = CA x ET x EF x ED
	ET	Exposure Time	hours/day	8	(1)	NE	NE	24 hour/day x AT
	EF	Exposure Frequency	days/year	150	EPA, 1994	NE	NE	
	ED	Exposure Duration	years	6	EPA, 1994	NE	NE	Where:
	AT-C	Averaging Time (Cancer)	days	25,550	EPA, 1989	NE	NE	CA = Soil EPC x 1/PEF x 1000 µg/mg
	AT-N	Averaging Time (Non-Cancer)	days	2,190	EPA, 1989	NE	NE	

(1) Value is assumed.

(2) See Exhibit 3.4 of EPA, 1999. Published AbF values for the COPCs evaluated in this risk assessment are as follows: Arsenic: 0.03; PAHs: 0.13, the AbF for PAHs is used as a surrogate AbF for C11-C22 aromatic EPH.

(3) See Exhibit 3.5 of EPA, 1999.

EPA, 1989 (December). *Risk Assessment Guidance for Superfund (RAGS)*, Volume 1, Human Health Evaluation Manual (Part A). EPA-540/1-89-002 (interim final). Office of Emergency and Remedial Response, Washington, DC.

EPA, 1994 (August). *Risk Updates No. 2*; USEPA Region I, Waste Management Division. Values from Attachment 2 to Risk Updates No. 2.

EPA, 1996 (May). *Soil Screening Guidance: Technical Background Document*. EPA/540/R-95/128.

EPA, 1997 (August). *Exposure Factors Handbook*, Volume 1. EPA-600/P-95/002Fa. Office of Research and Development, Washington, DC.

EPA, 1999. *Risk Assessment Guidance for Superfund*, Volume 1, Human Health Evaluation Manual (Part E) Interim Guidance. EPA-540/R-99-005. Office of Solid Waste and Emergency Response, Washington, DC.

cm^2 = square centimeters
CT = central tendancy
EPA = U.S. Environmental Protection Agency
EPC = exposure point concentration
EPH = extractable petroleum hydrocarbon
g/µg = grams per microgram
kg = kilograms
kg/m^3 = kilograms per cubic meter
mg/cm^2 = milligrams per square centimeter
NE = not evaluated
PAH = polyaromatic hydrocarbon
RME = reasonable maximum exposure
µg/g = micrograms per gram
µg/m^3 = micrograms per cubic meter
µg/mg = micrograms per milligram

Table 2-8
RAGS Part D Standard Table 4.3
Values Used for Daily Intake Calculations - Adult Resident
AOC FS-2

Scenario Time Frame: Future Land Use
Medium: Soil
Exposure Medium: Surface Soil
Exposure Points: Soil 0-2 feet bgs; Soil 0-10 feet bgs
Receptor Population: Resident
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Css	Chemical Concentration in Surface Soil	µg/g	See EPC Table	See EPC Table	NE	NE	
	CF	Conversion Factor	g/µg	1.00E-06	--	NE	NE	Intake Ingestion = Css x IR x FI x CF x EF x ED
	IR	Ingestion Rate of Surface Soil	mg/day	100	EPA, 1994	NE	NE	BW x AT
	FI	Fraction Ingested from Source	%	100%	(1)	NE	NE	
	EF	Exposure Frequency	days/year	150	EPA, 1994	NE	NE	
	ED	Exposure Duration	years	24	EPA, 1994	NE	NE	
	BW	Body Weight	kg	70	EPA, 1994	NE	NE	
	AT-C	Averaging Time (Cancer)	days	25,550	EPA, 1989	NE	NE	
	AT-N	Averaging Time (Non-Cancer)	days	8,760	EPA, 1989	NE	NE	
Dermal	Css	Chemical Concentration in Surface Soil	µg/g	See EPC Table	See EPC Table	NE	NE	
	CF	Conversion Factor	g/µg	1.00E-06	--	NE	NE	Intake Dermal = DA event x SA x EF x ED
	AF	Adherence Factor	mg/cm^2	0.07	EPA, 1999; (3)	NE	NE	BW x AT
	AbF	Absorption Factor	%	chemical-specific	EPA, 1999; (2)	NE	NE	
	SA	Skin Surface Area Available for Contact	cm^2	5,700	EPA, 1999; (3)	NE	NE	
	EF	Exposure Frequency	days/year	150	EPA, 1994	NE	NE	Where:
	ED	Exposure Duration	years	24	EPA, 1994	NE	NE	DAevent = Css x AF x AbF x CF
	BW	Body Weight	kg	70	EPA, 1994	NE	NE	
	AT-C	Averaging Time (Cancer)	days	25,550	EPA, 1989	NE	NE	
	AT-N	Averaging Time (Non-Cancer)	days	8760	EPA, 1989	NE	NE	
Inhalation	CA	Chemical Concentration in Air	µg/m^3	See Equation	See Equation	NE	NE	
	PEF	Particulate Emission Factor	kg/m^3	1.32E+09	EPA, 1996	NE	NE	Intake Inhalation = CA x ET x EF x ED
	ET	Exposure Time	hours/day	8	(1)	NE	NE	24 hour/day x AT
	EF	Exposure Frequency	days/year	150	EPA, 1994	NE	NE	
	ED	Exposure Duration	years	24	EPA, 1994	NE	NE	Where:
	AT-C	Averaging Time (Cancer)	days	25,550	EPA, 1989	NE	NE	CA = Soil EPC x 1/PEF x 1000 µg/mg
	AT-N	Averaging Time (Non-Cancer)	days	8,760	EPA, 1989	NE	NE	

(1) Value is assumed.

(2) See Exhibit 3.4 of EPA, 1999. Published AbF values for the COPCs evaluated in this risk assessment are as follows: Arsenic: 0.03; PAHs: 0.13; the AbF for PAHs is used as a surrogate AbF for C11-C22 aromatic EPH.

(3) See Exhibit 3.5 of EPA, 1999.

EPA, 1989 (December). *Risk Assessment Guidance for Superfund (RAGS)*, Volume 1, Human Health Evaluation Manual (Part A). EPA-540/1-89-002 (interim final). Office of Emergency and Remedial Response, Washington, DC.

EPA, 1994 (August). *Risk Updates No. 2*; USEPA Region I, Waste Management Division. Values from Attachment 2 to Risk Updates No. 2.

EPA, 1996 (May). *Soil Screening Guidance: Technical Background Document*. EPA/540/R-95/128.

EPA, 1997 (August). *Exposure Factors Handbook*, Volume 1. EPA-600/P-95/002Fa. Office of Research and Development, Washington, DC.

EPA, 1999. *Risk Assessment Guidance for Superfund*, Volume 1, Human Health Evaluation Manual (Part E) Interim Guidance. EPA-540/R-99-005. Office of Solid Waste and Emergency Response, Washington, DC.

cm^2 = square centimeters
CT = central tendancy
EPA = U.S. Environmental Protection Agency
EPC = exposure point concentration
EPH = extractable petroleum hydrocarbon
g/µg = grams per microgram
kg = kilograms
kg/m^3 = kilograms per cubic meter
mg/cm^2 = milligrams per square centimeter
NE = not evaluated
PAH = polyaromatic hydrocarbon
RME = reasonable maximum exposure
µg/g = micrograms per gram
µg/m^3 = micrograms per cubic meter
µg/mg = micrograms per milligram

Table 2-9
RAGS Part D Standard Table 4.4
Values Used for Daily Intake Calculations - Construction Worker
AOC FS-2

Scenario Time Frame: Future
Medium: Soil
Exposure Medium: Surface and Subsurface Soil
Exposure Points: Soil 0-10 feet bgs; Soil 0-20 feet bgs
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Parameter	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Csu	Chemical Concentration in Subsurface Soil	µg/g	See EPC Table	See EPC Table	NE	NE	
	CF	Conversion Factor	g/µg	1.00E-06	--	NE	NE	Intake Ingestion = Csu x IR x FI x CF x EF
	IR	Ingestion Rate of Subsurface Soil	mg/day	200	EPA, 1999a	NE	NE	x ED x BW x AT
	FI	Fraction Ingested from Source	%	100%	(1)	NE	NE	
	EF	Exposure Frequency	days/year	250	(2)	NE	NE	
	ED	Exposure Duration	years	0.5	(2)	NE	NE	
	BW	Body Weight	kg	70	EPA, 1994	NE	NE	
	AT-C	Averaging Time (Cancer)	days	25,550	EPA, 1989	NE	NE	
	AT-N	Averaging Time (Non-Cancer)	days	183	EPA, 1989	NE	NE	
Dermal	Csu	Chemical Concentration in Subsurface Soil	µg/g	See EPC Table	See EPC Table	NE	NE	
	CF	Conversion Factor	g/µg	1.00E-06	--	NE	NE	Intake Dermal = DA event x SA x EF x ED
	AF	Adherence Factor	mg/cm^2	0.2	EPA, 1999b (3)	NE	NE	x BW x AT
	AbF	Absorption Factor	%	chemical-specific	EPA, 1999b (4)	NE	NE	
	SA	Skin Surface Area Available for Contact	cm^2	5,700	EPA, 1999b (5)	NE	NE	
	EF	Exposure Frequency	days/year	250	(2)	NE	NE	Where:
	ED	Exposure Duration	years	0.5	(2)	NE	NE	DAevent = Csu x AF x AbF x CF
	BW	Body Weight	kg	70	EPA, 1994	NE	NE	
	AT-C	Averaging Time (Cancer)	days	25,550	EPA, 1989	NE	NE	
	AT-N	Averaging Time (Non-Cancer)	days	183	EPA, 1989	NE	NE	
Inhalation	CA	Chemical Concentration in Air	µg/m^3	See Equation	See Equation	NE	NE	
	PEF	Particulate Emission Factor	kg/m^3	1.32E+09	EPA, 1996	NE	NE	Intake Inhalation = CA x ET x EF x ED
	ET	Exposure Time	hours/day	8	(1)	NE	NE	24 hour/day x AT
	EF	Exposure Frequency	days/year	250	(2)	NE	NE	
	ED	Exposure Duration	years	0.5	(2)	NE	NE	Where:
	AT-C	Averaging Time (Cancer)	days	25,550	EPA, 1989	NE	NE	CA = Soil EPC x 1/PEF x 1000 µg/mg
	AT-N	Averaging Time (Non-Cancer)	days	183	EPA, 1989	NE	NE	

(1) Value is assumed.
(2) (5 workdays/week) X (50 weeks/year) = 250 days/year; it is assumed that construction activities occur each workday over a one-half year period.
(3) See Exhibit 3.3 of EPA, 1999. Value based on: Utility Workers (geometric mean value).
(4) See Exhibit 3.4 of EPA, 1999. Published AbF values for the COPCs evaluated in this risk assessment are as follows:
Arsenic: 0.03; PAHs: 0.13; the AbF for PAHs is used as a surrogate AbF for C11-C22 aromatic EPH.
(5) See Exhibit 3.5 of EPA, 1999. Value for Industrial Workers.

EPA, 1989 (December). *Risk Assessment Guidance for Superfund, (RAGS)* Volume 1, Human Health Evaluation Manual (Part A). EPA-540/1-89-002 (interim final). Office of Emergency and Remedial Response, Washington, DC.
EPA, 1994 (August). *Risk Updates No. 2*; USEPA Region I, Waste Management Division. Values from Attachment 2 to Risk Updates No. 2.
EPA, 1996 (May). *Soil Screening Guidance: Technical Background Document*. EPA/540/R-95/128.
EPA, 1997 (August). *Exposure Factors Handbook*, Volume 1. EPA-600/P-95/002Fa. Office of Research and Development, Washington, DC.
EPA, 1999. Value from "Frequently Asked Questions on the USEPA Adult Lead Model" (April), as recommended by USEPA Region I (EPA Comments on the *Draft Fuel Spill-2 Supplemental Remedial Investigation Report* dated October 2000).

cm^2 = square centimeters
CT = central tendancy
EPA = U.S. Environmental Protection Agency
EPC = exposure point concentration
EPH = extractable petroleum hydrocarbon
g/µg = grams per microgram
kg = kilograms
kg/m^3 = kilograms per cubic meter
mg/cm^2 = milligrams per square centimeter
NE = not evaluated
PAH = polyaromatic hydrocarbon
RME = reasonable maximum exposure
µg/g = micrograms per gram
µg/m^3 = micrograms per cubic meter
µg/mg = micrograms per milligram

Table 2-10
Non-Cancer Toxicity Data Summary
AOC FS-2 Soils

Pathway: Ingestion, Dermal

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD Value	Oral RfD Units	Dermal RfD	Dermal RfD Units	Primary Target Organ	Combined Uncertainty/ Modifying Factors	Sources of RfD: Target Organ	Dates of RfD: Target Organ
Semivolatile Organics									
Benzo(a)anthracene	chronic	--		--					
	subchronic	--		--					
Benzo(a)pyrene	chronic	--		--					
	subchronic	--		--					
Benzo(b)fluoranthene	chronic	--		--					
	subchronic	--		--					
Dibenzo(a,h)anthracene	chronic	--		--					
	subchronic	--		--					
Indeno(1,2,3-cd)pyrene	chronic	--		--					
	subchronic	--		--					
Inorganics									
Arsenic	chronic	3.0E-04	mg/kg/day	3.0E-04	mg/kg/day	Skin/Keratosis and hyperpigmentation	3	IRIS	Sept. 2000
	subchronic	3.0E-04	mg/kg/day	3.0E-04	mg/kg/day	Skin/Keratosis and hyperpigmentation	3	HEAST	FY 1997
TPH									
EPH	chronic	--		--					
	subchronic	--		--					
C11-C22 Aromatics	chronic	3.0E-02	mg/kg/day	3.0E-02	mg/kg/day	Kidney/Renal tubular pathology	3,000	DEP	(1)
	subchronic	3.0E-01	mg/kg/day	3.0E-01	mg/kg/day	Kidney/Renal tubular pathology	300	DEP	(1)

Pathway: Inhalation

Chemical of Potential Concern	Chronic/ Subchronic	Inhalation RfC	Inhalation RfC Units	Inhalation RfD	Inhalation RfD Units	Primary Target Organ	Combined Uncertainty/ Modifying Factors	Sources of RfC: RfD: Target Organ	Dates
Semivolatile Organics									
Benzo(a)anthracene	chronic	--		--					
	subchronic	--		--					
Benzo(a)pyrene	chronic	--		--					
	subchronic	--		--					
Benzo(b)fluoranthene	chronic	--		--					
	subchronic	--		--					
Dibenzo(a,h)anthracene	chronic	--		--					
	subchronic	--		--					
Indeno(1,2,3-cd)pyrene	chronic	--		--					
	subchronic	--		--					
Inorganics									
Arsenic	chronic	--		--					
	subchronic	--		--					
TPH									
EPH	chronic	--		--					
	subchronic	--		--					
C11-C22 Aromatics	chronic	7.1E-02	mg/m³	--		Kidney/Renal tubular pathology		DEP	
	subchronic	7.1E-02	mg/m³	--		Kidney/Renal tubular pathology		DEP	

Notes:
(1) Per DEP (1997), the value for pyrene (published in IRIS) is used to evaluate C11-C22 aromatics.
-- : no data available
DEP = Massachusetts Department of Environmental Protection (*Characterizing Risks Posed by Petroleum Contaminated Sites*. October 1997)
EPH = extractable petroleum hydrocarbons
HEAST= Health Effects Assessment Summary Tables: FY 1997
IRIS = Integrated Risk Information System: September 2000
mg/m^3 = milligrams per cubic meter
mg/kg/day = milligrams per kilogram per day
RfC = reference concentrations
RfD = reference dose
TPH = total petroleum hydrocarbons

Table 2-11
Cancer Toxicity Data Summary
AOC FS-2 Soils

Pathway: Ingestion, Dermal						
Chemical of Potential Concern	**Oral Cancer Slope Factor**	**Dermal Cancer Slope Factor**	**Slope Factor Units**	**Weight of Evidence/ Cancer Guideline Description**	**Source**	**Date**
Semivolatile Organics						
Benzo(a)anthracene	7.3E-01	7.3E-01	$(mg/kg/day)^{-1}$	B2	IRIS	September 2000
Benzo(a)pyrene	7.3E+00	7.3E+00	$(mg/kg/day)^{-1}$	B2	IRIS	September 2000
Benzo(b)fluoranthene	7.3E-01	7.3E-01	$(mg/kg/day)^{-1}$	B2	IRIS	September 2000
Dibenzo(a,h)anthracene	7.3E+00	7.3E+00	$(mg/kg/day)^{-1}$	B2	IRIS	September 2000
Indeno(1,2,3-cd)pyrene	7.3E-01	7.3E-01	$(mg/kg/day)^{-1}$	B2	IRIS	September 2000
Inorganics						
Arsenic	1.5E+00	1.5E+00	$(mg/kg/day)^{-1}$	A	IRIS	September 2000
TPH						
EPH	--	--		--		
C11-C22 Aromatics	--	--		D	DEP	

Pathway: Inhalation							
Chemical of Potential Concern	**Unit Risk**	**Units**	**Inhalation Cancer Slope Factor**	**Units**	**Weight of Evidence/ Cancer Guideline Description**	**Source**	**Date**
Semivolatile Organics							
Benzo(a)anthracene	8.9E-05	$(\mu g/m^3)^{-1}$	3.1E-01		B2	NCEA	October 1999
Benzo(a)pyrene	8.9E-04	$(\mu g/m^3)^{-1}$	3.1E+00		B2	NCEA	October 1999
Benzo(b)fluoranthene	8.9E-05	$(\mu g/m^3)^{-1}$	3.1E-01		B2	NCEA	October 1999
Dibenzo(a,h)anthracene	8.9E-04	$(\mu g/m^3)^{-1}$	3.1E+00		B2	NCEA	October 1999
Indeno(1,2,3-cd)pyrene	8.9E-05	$(\mu g/m^3)^{-1}$	3.1E-01		B2	NCEA	October 1999
Inorganics							
Arsenic	4.3E-03	$(\mu g/m^3)^{-1}$	1.5E+01	$(mg/kg/day)^{-1}$	A	IRIS	September 2000
TPH							
EPH	--		--		--		
C11-C22 Aromatics	--		--		D	DEP	

Notes:
-- : No information available
DEP = Massachusetts Department of Environmental Protection
EPH = extractable petroleum hydrocarbons
IRIS = Integrated Risk Information System
mg/kg/day = milligrams per kilogram per day
NCEA = National Center for Environmental Assessment
PAH = polynuclear aromatic hydrocarbon
TPH = total petroleum hydrocarbons
$\mu g/m^3$ = micrograms per cubic meter

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

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