TABLE 3-7
CALCULATION OF RISK BASED CONCENTRATIONS
VISITOR SCENARIO
Riverside Industrial Park Superfund Site
Newark, New Jersey

EXPOSURE EQUATIONS:

		Non Cancer	Non Cancer
RBC-ing nc =	=		THQ * AT nc * C2 * BW / EF * ED * IRs * FS* 1/RfD * C1
All Pathways RBC-total nc	=	1 / 1/RBC-ing nc + 1/RBC-derm nc + 1/RBC-inh nc	

Parameter		Description	Units	
		Child		
IRs	=	Ingestion rate of soil - child	mg/day	
AF	=	Soil adherence factor - child	mg/cm^2	
SA	=	Skin surface area - child	cm^2 / day	
EF	=	Exposure Frequency - child	days/yr	
ED	=	Exposure Duration - child	years	
ET	=	Exposure time outdoors - child	hours/day	
FS	=	Fraction soil contact at Site	unitless	
BW	=	Body Weight - child	kg	
PEF	=	Particulate Emission Factor	m^3/kg	
VF	=	Volatilization Factor	m^3/kg	Ch
ATc	=	Averaging Time - cancer	years	
ATnc	=	Averaging Time - noncancer	years	
		Adult		
IRsoila	=	Ingestion rate of soil - adult	mg/day	
AFsoila	=	Soil adherence factor - adult	mg/cm^2	
SAsoila	=	Skin surface area - adult	cm^2 / day	
EFa	=	Exposure Frequency - adult	days/yr	
EDa	=	Exposure Duration - adult	years	
Eta	=	Exposure time outdoors - adult	hours/day	
FS	=	Fraction soil contact at Site	unitless	
BWa	=	Body Weight - adult	kg	
PEF	=	Particulate Emission Factor	m^3/kg	
VF	=	Volatilization Factor	m^3/kg	Ch
ATc	=	Averaging Time - cancer	years	
ATnc	=	Averaging Time - noncancer	years	
		General Exposure Parameters		
THQ	=	Target Hazard Quotient	unitless	
TR	=	Target Cancer Risk	unitless	
ABSd	=	Dermal absorption factor	unitless	Ch
RBA	=	Relative Bioavailability Factor	%	Ch
GIABS	=	Gastrointestinal absorption fraction	%	Ch
RfD	=	Reference Dose	mg/kg-d	Ch
RfC	=	Reference Concentration	mg/m^3	(
CSF	=	Cancer Slope Factor	$(mg/kg\text{-}d)^{-1}$	(
IUR	=	Inhalation Unit Risk	$(mg/m^3)^{-1}$	(
C1	=	Units conversion factor 1	kg/mg	
C2	=	Units conversion factor 2	days/yr	
C3	=	Units conversion factor 3	hours/day	
RBC-total nc	=	Non cancer risk-based Soil Concentration	mg/kg	Ch
RBC-ing nc	=	Noncancer risk-based soil soncentration-incidental ingestion	mg/kg	Ch
RBC-derm nc	=	Non cancer risk-based Soil Concentration for dermal contact	mg/kg	Ch
RBC-inh nc	=	Non cancer risk-based Soil Concentration for inhalation	mg/kg	Ch

Chemical of Potential Concern	CAS	Toxicity Values				FS				HIDE	RBC -	
		RfD	RfC	CSF	IUR					1/VF+1/PEF	RI	
Metals												
Benzene	71-43-2					1.0E+00	0.0E+00	1.0E+00	1.3E+04		NC	NC
Trichloroethene (TCE)	79-01-6					1.0E+00	0.0E+00	1.0E+00	1.3E+04	7.6E-05	NC	NC

Take out all cancer-based, since don't need.

Value	Reference
200	USEPA 2014
0.2	USEPA 2014
2,373	USEPA 2014
52	Ramboll 2020
6	USEPA 2014
2	Ramboll 2020
1	Ramboll 2020
15	USEPA 2014
3.94E+09	Ramboll 2020 amboll 2021
ıemical-speci	Ramboll 2020
70	USEPA 1989
6	USEPA 1989
100	USEPA 2014
0.07	USEPA 2014
6,032	USEPA 2014
52	Professional judgment
20	USEPA 2014
2	Professional judgment
1	Professional judgment
80	USEPA 2014
3.94E+09	Ramboll 2020
ıemical-speci	Ramboll 2020
70	USEPA 1989
20	USEPA 1989
1	USEPA 1991
0.000001	USEPA 1991
ıemical-speci	USEPA 2004
ıemical-speci	USEPA 2012
ıemical-speci	USEPA 2004
ıemical-speci	ATSDR 2019
not available	(not available)
not available	(not available)
not available	(not available)
0.000001	Universal
365	Universal
24	Universal
ıemical-speci	Calculated
ıemical-speci	Calculated
ıemical-speci	Calculated
ıemical-speci	Calculated

Non Cancer[1]			RBC - Cancer						
BC-ing nc			Ingestion	Hide	Dermal	Hide	Inhalation	Hide	All
NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
NC	NC	NC	*		*		*		

Checked TCE noncancer - calcs are good.

Total Xylenes	1330-20-7					1.0E+00	0.0E+00	1.0E+00	1.4E+04	7.4E-05	NC	NC
Vinyl Chloride	75-01-4					1.0E+00	0.0E+00	1.0E+00	1.3E+04	7.9E-05	NC	NC
Semivolatile Organic Compounds (SVOCs)												
Benzo(a)anthracene	56-55-3	NA	NA	1.0E-01	6.0E-05	1.0E+00	1.3E-01	1.0E+00	8.9E+06	1.1E-07	NC	NC
Benzo(a)pyrene	50-32-8	3.0E-04	2.0E-06	1.0E+00	6.0E-04	1.0E+00	1.3E-01	1.0E+00	3.1E+07	3.2E-08	1.6E+02	6.3E-03
Benzo(b)fluoranthene	205-99-2	NA	NA	1.0E-01	6.0E-05	1.0E+00	1.3E-01	1.0E+00	5.6E+06	1.8E-07	NC	NC
Dibenz(a,h)anthracene	53-70-3	NA	NA	1.0E+00	6.0E-04	1.0E+00	1.3E-01	1.0E+00	2.7E+08	3.9E-09	NC	NC
Naphthalene	91-20-3	2.0E-02	3.0E-03	NA	3.4E-05	1.0E+00	1.3E-01	1.0E+00	3.5E+04	2.8E-05	1.1E+04	9.5E-05
Metals												
Arsenic	7440-38-2					1.0E+00	3.0E-02	6.0E-01	NA		NC	NC
Copper	7440-50-8	0.001	NA	NA	NA	1.00	0.00	1.00	NA	0.00		
Hexavalent Chromium	18540-29-9					2.5E-02	0.0E+00	1.0E+00	NA	2.5E-10	NC	NC
Iron	7439-89-6					1.0E+00	0.0E+00	1.0E+00	NA	2.5E-10	NC	NC
Lead	7439-92-1									**		
Manganese	7439-96-5					1.0E+00	NA	1.0E+00	NA	2.5E-10	NC	NC
PCBs												
Aroclor 1260	11096-82-5					1.0E+00	1.4E-01	1.0E+00	9.5E+05	1.1E-06	NC	NC
Aroclor 1262	37324-23-5					#N/A	1.4E-01	1.0E+00	9.5E+05	1.1E-06	NC	NC

Notes:

NA = not available.
NC = not calculated.

[1] Risk-based concentrations were not calculated for the dermal contact and inhalation of dust exposure pathways. This is because there is no dermal absorption factor or inhalation toxicity value available for copper.

Cancer-based concentrations were also not calculated, since copper is not classified as a carcinogen.

References:

Ramboll 2020. Final Baseline Human Health Risk Assessment, Riverside Industrial Park Superfund Site. Newark, New Jersey. March 25, 2020.
ATSDR 2019. Minimal Risk Levels. RfD is the intermediate minimal risk level (0.01 mg/kg/day) with a subchronic to chronic uncertainty factor of 10, per USEPA Region 2 (Ramboll, 2020).
USEPA 2014. Memorandum: Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. February 6, 2014. Office of Solid Waste and Emergency Response. OSWER Directive 9200.1-120.
USEPA 1991. United States Environmental Protection Agency. Risk Assessment Guidance for Superfund Volume I. Human Health Evaluation Manual (Part B, Development of Risk-based Preliminary Remediation Goals). EPA/540/R-92/003. Washington D.C., December 1991.
USEPA 1989. Risk Assessment Guidance for Superfund, Human Health Evaluation Manual, Part A, Interim Final, OSWER Directive 9285.701A. Office of Solid Waste and Emergency Response, USEPA, Washington D.C., December.

	NC		NC		NC	NC	NC	NC	NC		NC
	NC		NC		NC	NC	NC	NC	NC		NC
	NC		NC		*		*		*		*
	NC		NC		*		*		*		*
	NC		NC		*		*		*		*
	NC		NC		*		*		*		*
	NC		NC		NC	NC	NC	NC	2.3E+05	4.3E-06	2.3E+05
	NC		NC		NC	NC	NC	NC	NC		NC
526					NC	NC	NC	NC	NC	NC	NC
NC	NC	NC	NC	NC	*		*		*		*
NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC

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Comment:
why is there no inhalation RBC for benzene?

TABLE 3-12
CALCULATION OF RISK BASED CONCENTRATIONS
INDOOR WORKER SCENARIO
Vapor Intrusion - Soil to Indoor Air

Riverside Industrial Park Superfund Site
Newark, New Jersey

EXPOSURE EQUATIONS:

Inhalation of Indoor Air:

$$IA\ nc = \frac{THQ * AT\ nc * C2}{EF * ED * ET * (1/C3) * (1/RfC)} \qquad IA\ c = \frac{TR * ATc * C2}{IUR * (1/C3) * ED * EF * ET}$$

Target Soil Gas Concentration :

$$Csg\ (noncancer\ and\ cancer) = \frac{IA\ nc\ or\ IA\ c}{alpha}$$

Risk-based Soil Concentration:

$$RBC\ (noncancer\ and\ cancer) = (Csg\text{-}noncancer\ or\ Csg\text{-}cancer\ )/\ [C1\ /\ (Kd\ /\ H') + (\theta w\ /\ H'*\rho b) + (\theta a\ /\rho b)\ ]$$

Parameter		Description	Units	Value	Reference
EF	=	Exposure Frequency - adult	days/yr	250	USEPA 2014
ED	=	Exposure Duration - adult	years	25	USEPA 2014
ET	=	Exposure time indoors - adult	hours/day	8	USEPA 2014
ATc	=	Averaging Time - cancer	years	70	USEPA 1989
ATnc	=	Averaging Time - noncancer	years	25	USEPA 1989
THQ	=	Target Hazard Quotient	unitless	1	USEPA 1991
TR	=	Target Cancer Risk	unitless	0.000001	USEPA 1991
RfC	=	Reference Concentration	mg/m^3	Chemical-specific	See Ramboll 2020
IUR	=	Inhalation Unit Risk	$(mg/m^3)^{-1}$	Chemical-specific	See Ramboll 2020
C1	=	Units conversion factor 1	L/m^3	1000	Universal
C2	=	Units conversion factor 2	days/yr	365	Universal
C3	=	Units conversion factor 3	hours/day	24	Universal
IA-nc	=	Indoor Air Concentration - noncancer	mg/m^3		
IA-c	=	Indoor Air Concentration - cancer	mg/m^3		
Csg-noncancer	=	Target soil gas concentration - noncancer	mg/m^3		
Csg-cancer	=	Target soil gas concentration - cancer	mg/m^3		
RBC-noncancer	=	Soil risk-based concentration - noncancer	mg/kg	Chemical-specific	Calculated Values
RBC-cancer	=	Soil risk-based concentration - cancer	mg/kg		
Alpha	=	Soil gas - Indoor Air Attenuation Factor	unitless		
Kd	=	Soil-water partition coefficient (fraction organic carbon * Koc)	L/kg		
H'	=	Henry's Law constant	unitless		
θw	=	Water-filled soil porosity	unitless	0.055	
θa	=	Air-filled soil porosity	unitless	0.32	Values for sand; Ramboll, 2020
ρb	=	Dry soil bulk density	kg/L	1.66	

Chemical of Potential Concern	Toxicity Values		Alpha	IA-nc	IA-c	Csg - Noncancer	Csg - Cancer	Kd	H'	RBC - Noncancer THQ = 1	RBC- Cancer ILCR = 10-6	RBC- Cancer ILCR = 10-5	RBC- (ILCR =
	RFC	IUR				Inhalation	Inhalation			Inhalation	Inhalation	Inhalation	Inhal
Volatile Organic Compounds (VOCs)													
Trichloroethene (TCE)	2.0E-03	4.1E-03	2.9E-04	8.8E-03	3.0E-03	3.1E+01	1.0E+01	3.4E-01	2.4E-01	5.3E-02	1.80E-02	1.8E-01	1.8E
Total Xylenes	1.0E-01	NA	2.9E-04	4.4E-01	NC	1.5E+03	NC	7.7E-01	2.0E-01	6.5E+00	NC	NC	N
Naphthalene	3.0E-03	3.4E-02	2.9E-04	1.3E-02	3.6E-04	4.6E+01	1.3E+00	4.0E+00	8.3E-03	2.2E+01	6.2E-01	6.2E+00	6.2E

Notes:

Ramboll 2020. Final Baseline Human Health Risk Assessment, Riverside Industrial Park Superfund Site. Newark, New Jersey. March 25, 2020.

USEPA 2014. Memorandum: Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. February 6, 2014. Office of Solid Waste and Emergency Response. OSWER Directive 9200.1-120.

USEPA 1991. United States Environmental Protection Agency. Risk Assessment Guidance for Superfund Volume I. Human Health Evaluation Manual (Part B, Development of Risk-based Preliminary Remediation Goals). EPA/540/R-92/003. Washington D.C., December 1991

USEPA 1989. Risk Assessment Guidance for Superfund, Human Health Evaluation Manual, Part A, Interim Final, OSWER Directive 9285.701A. Office of Solid Waste and Emergency Response, USEPA, Washington D.C., December.

NA = not available.

NC = not calculated.

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