I. S. A. F.

COMUNE DI ALBISOLA SUPERIORE (SV)

AREA GAVARRY – ALBISOLA SUPERIORE

INTEGRAZIONI AL DOCUMENTO DI ANALISI DI RISCHIO

ALFA COSTRUZIONI EDILI s.r.l.

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Doc. N. A06-013/R05-1
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I. S. A. F. – Ingegneria e Servizi Ambientali Ferro S.r.l.
Via Paleocapa 19 – 17100 Savona
C. F., P. IVA e Registro Imprese: 01314810092 – C. C. I. A. A. Savona REA N. 135423
Tel. 019-806914 - Fax 019-802027 – E-mail: isaf@isafsrl.it

In adempimento del procedimento avviato a seguito di quanto convenuto nella riunione del 27 Maggio 2011 del Collegio di Vigilanza dell'Accordo di Programma per la "rilocalizzazione della Soc. Gavarry S.p.a. dal Comune di Albisola Superiore a quello di Quiliano e recupero urbanistico delle aree dismesse", Alfa Costruzioni Edili ha presentato, in data 7 Novembre 2011, il Documento di Analisi di Rischio per l'area degli Stabilimenti Italiano Gavarry ad Albisola Superiore (SV), ai sensi dell'art. 242, comma 4 del D. Lgs. 152/06 s.m.i..

Nel corso di contatti informali con gli enti è emersa la richiesta di effettuare alcune analisi di rischio integrative, in particolare con riferimento ad esposizione ai vapori outdoor di un ricettore residenziale e all'inalazione di vapori indoor al secondo piano interrato, con riferimento al solo più piccolo locale esistente.

Si osserva preliminarmente che entrambe tali richieste sono prive di fondamento normativo e tecnico, in quanto:

a) le analisi di rischio vanno sviluppate con riferimento allo stato previsionale di destinazione delle aree, venendo eventualmente a fissare vincoli per lo sviluppo urbanistico delle aree stesse;
b) nel caso particolare, inoltre, poiché l'analisi di rischio è esclusivamente finalizzata alla verifica dell'assentibilità dello Strumento Urbanistico Attuativo in esame per l'area (nell'attuale destinazione vi è integrale conformità alle CSC per i suoli), il riferimento all'assetto previsto dallo SUA è intrinsecamente parte dell'intero procedimento, non solo dell'analisi di rischio;
c) lo SUA in esame prevede inequivocabilmente la realizzazione di un volume interrato in tutta l'area, cosicché non sussistono le condizioni per alcun percorso di esposizione a vapori outdoor;
d) l'ipotesi di un flusso orizzontale di vapori verso aree adiacenti non è ricompreso in alcuno degli schemi di esposizione nè nella norma ASTM (ASTM E2081-00, riapprovata nel 2010) né nei "Criteri Metodologici per l'Applicazione dell'Analisi di Rischio Assoluta ai Siti Contaminati2 di APAT (ora ISPRA), del resto coerentemente alla mobilità dei vapori che è di tipo verticale;
e) la dimensione del locale per l'analisi dei vapori indoor è conseguenza delle caratteristiche di potenziale diffusione degli stessi e, evidenziato che eventuali locali tecnici nei piani interrati non sono mai presidiati (quindi sede di possibili ricettori), non si può certo ritenere che le ordinarie chiusure dei box siano tali da costituire barriera alla diffusione dei vapori, che trovano, invece, limite alla loro diffusione nella compartimentazione antincendio, a cui si è fatto correttamente riferimento nell'individuazione della dimensione del locale interrato nel Documento di Analisi di Rischio.

Premesso, quindi, che le integrazioni richieste non trovano giustificazione e non possono essere in alcun modo motivo né di pronunce negative, né di richieste di integrazioni né di rinvii nel procedimento di cui all'articolo 242 citato, si è ritenuto di acconsentire ad un esercizio volto a valutare il rischio associato alle CSR presentate nel Documento di Analisi di Rischio ed a documentare che, anche con riferimento ad i due ulteriori percorsi di

esposizione ipotizzati dagli enti, il rischio rimane, comunque, al di sotto dei limiti ammissibili.

Tale esercizio è illustrato nel seguito del presente documento.

La metodologia generale di analisi di rischio e la modellazione della sorgente[1] sono quelli illustrati nel Documento di Analisi di Rischio. I percorsi di esposizione ulteriori considerati ed i relativi ricettori sono i seguenti:

- inalazione di vapori outdoor[2] da sottosuolo e falda per un recettore on-site di tipo residenziale;
- inalazione di vapori indoor da suolo e sottosuolo e falda per un recettore on-site di tipo residenziale in un locale[3] al secondo piano interrato[4].

Sono state condotte due analisi di rischio separate, rispettivamente per:

- esposizione ai vapori outdoor di un ricettore residenziale (analisi R5[5]);
- esposizione ai vapori indoor interrati di un ricettore residenziale (analisi R6), nel locale di ridotte dimensioni, come sopra specificato.

In particolare si è assunto, in via cautelativa:

- per l'analisi R5:
  - di considerare l'intera superficie[6] dell'area a contatto con il terreno potenzialmente contaminato (trascurando, quindi, la presenza di due piani interrati), assumendo pertanto che la potenziale contaminazione parta dal piano campagna;
  - di assumere la lunghezza della sorgente in direzione del vento pari alla massima lunghezza dell'area[7];
  - di assumere la larghezza della sorgente in direzione ortogonale alla direzione del vento pari alla massima larghezza dell'area 8direzione ortogonale a quella sopra considerata)[8];
- per l'analisi R6:
  - di considerare il box singolo[9] ubicato al secondo livello interrato, assumendo che la miscelazione dell'aria avvenga solo al suo interno, trascurando ogni scambio di aria con le zone adiacenti,
  - di considerare la superficie laterale del locale a contatto con il

[1] Tale modellazione è particolarmente cautelativa, in quanto assume una concentrazione uniforme, in tutto il sottosuolo considerato, pari al valore massimo.
[2] Nell'ipotesi, cautelativa, in cui non sia presente alcun edificio fuori terra o interrato che possa schermare la migrazione dei vapori outdoor.
[3] Nella sua configurazione più sfavorevole, e non realistica per il tipo di progetto edilizio in essere, pari ad un volume unico confinato, con una superficie minima e nella più sfavorevole situazione in cui abbia due pareti (considerabili come superfici filtranti per vapori) a contatto con il terreno potenzialmente contaminato.
[4] Con la frequenza di esposizione indicata nel Documento di Analisi di Rischio per i ricettori al secondo piano intetrrato.
[5] Per evitare sovrapposizioni di denominazione si è proseguita la numerazione delle analisi di rischio già agli atti.
[6] Pari a circa 8.500 metri quadrati.
[7] Pari a 115 metri.
[8] Pari a 72 metri.
[9] Con superficie pari a 21,4 metri quadrati.

terreno, anche quando presente l'intercapedine, per due lati[10].

A parte per quanto sopra riportato[11], i valori di tutti i parametri assunti come rappresentativi del sito ed utilizzati in input per le nuove ulteriori analisi di rischio sono gli stessi adottati per le analisi condotte nel Documento di Analisi di Rischio.

In Tabella 1 sono riepilogate le CSR, assunte come concentrazioni rappresentative della sorgente nelle due ulteriori analisi di rischio; nelle Appendici A e B sono riportati i tabulati delle analisi di rischio R5 e R6, sopra definite; in Tabella 2 sono riepilogati gli esiti di tali analisi di rischio, documentando che, anche negli irrealistici casi qui esaminati, il rispetto delle CSR è idoneo a mantenere il rischio entro limiti accettabili.

Infine, sempre a seguito di quanto emerso nei contatti informali, si precisa che l'approfondimento idrogeologico di cui al Paragrafo 4.1 del "Documento di Analisi di Rischio" sarà esteso sui diversi periodi stagionali, anche verificando la presenza e gli effetti dell'eventuale cuneo salino che raggiungesse l'area.

[10] Box d'angolo, con superficie laterale filtrante pari a 9,4 metri per l'altezza libera del locale (2,4 metri).
[11] E per quanto da esso implicato, come l'altezza di miscelazione nell'analisi R6 (risultante pari a 1,168 metri)

TABELLA 1
CSR

	CSR suolo [mg/kg]	CSR falda [µg/l]
Arsenico	10.000	10.000.000
Cobalto	10.000	-
Cromo Totale	10.000	-
Mercurio	10	10
Nichel	10.000	10.000
Stagno	10.000	-
Piombo	10.000	-
Zinco	10.000	-
Cloruro di Vinile	-	20
Trichloroethylene	-	10
Tetrachloroethylene	-	50

TABELLA 2
ESITI ANALISI DI RISCHIO

	CSR suolo [mg/kg]	CSR falda [mg/l]	Outdoor		box 2PI	
			Rc	Rt	Rc	Rt
Arsenico	1,0E+4	1,0E+4		0,0E+0		0,0E+0
Cobalto	1,0E+4	-		0,0E+0		0,0E+0
Cromo Totale	1,0E+4	-				
Mercurio	1,0E+1	1,0E-2		8,4E-1		3,7E-1
Nichel	1,0E+4	1,0E+4		0,0E+0		0,0E+0
Stagno	1,0E+4	-				
Piombo	1,0E+4	-				
Zinco	1,0E+4	-				
Cloruro di Vinile	-	2,0E-2	1,7E-7	4,5E-4	7,5E-7	2,0E-3
Trichloroethylene	-	1,0E-2	4,8E-9	3,1E-4	2,1E-8	1,4E-3
Tetrachloroethylene	-	5,0E-2	1,3E-7	1,5E-3	5,6E-7	6,6E-3
Rischio Cumulato			**3,0E-7**	**8,4E-1**	**1,3E-6**	**3,8E-1**
Rc: rischio cancerogeno; limite 10-6 per singolo contaminante e 10-5 per rischio cumulato Rt: rischio tossico; limite 1						

APPENDICE A

Tabulati Analisi di Rischio R5

Main Screen

RBCA Tool Kit for Chemical Releases
Version 2.52 © 2009 GSI Environmental Inc.

1. Project Information

Site Name:	Gavarry Outdoor suolo-falda		
Location:	Albisola		
Completed By:	GF		
Date:	06-ott-11	Job ID:	A06-013

2. Which Type of RBCA Analysis?

?

○ **Tier 1** — Risk-Based Screening Levels

◉ **Tier 2/3** — Site-Specific Target Levels

3. Calculation Options

?

Affects which input data are required

☑ ***Baseline Risks (Forward mode)***

☑ ***RBCA Cleanup Levels (Backward mode)***

○ Individual Constituent Risk Goals Only
◉ Individual and Cumulative Risk Goals

☐ Apply Source Depletion Algorithm
Time to Future Exposure 0 *(yr)*

4. RBCA Evaluation Process

Prepare Input Data
Data Complete? (■= yes, ■= no)

- ■ Exposure Pathways
- ■ Constituents of Concern (COCs)
- ■ Transport Models
- ■ Soil Parameters
- ■ GW Parameters
- ■ Air Parameters

Review Output

- Exposure Flowchart
- COC Chem. Parameters
- Input Data Summary
- User-Spec. COC Data...
- Transient Domenico Analysis...
- Baseline Risks...
- Cleanup Levels...

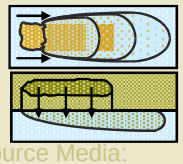
5. Commands and Options

New Site	Load Data...	Save Data As...	User Chemical Database
Set Units	Print Sheet	Print Report	
Help		Quit	

Exposure Pathway Identification

Site Name: Gavarry Outdoor suolo-falda
Location: Albisola
Compl. By: GF
Job ID: A06-013 Date: d-ott-yy

1. Groundwater Exposure



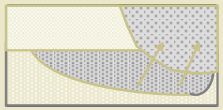
Groundwater Ingestion/ Surface Water Impact

	On-site	Off-site1	Off-site2
Receptor:	None	None	None
Distance:	0	0	0 (m)

Source Media:
- ☐ Affected Groundwater
- ☐ Affected Soils Leaching to Groundwater

Option:
- ☐ Apply MCL value as ingestion RBEL (backward mode only)

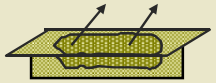
GW Discharge to Surface Water Exposure



- ☐ Swimming
- ☐ Fish Consumption
- ☐ Specified Water Quality Criteria

Enter Criteria

2. Surface Soil Exposure



Combined Exposure

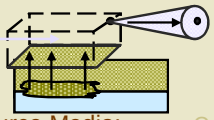
	On-site
Receptor:	None
Construction Worker	☐

Source Media:
- ☐ Direct Ingestion
- ☐ Dermal Contact
- ☐ Inhalation (vol+part)
- ☐ Vegetable Ingestion

Veg Options

Option:
- ☐ Apply UK (CLEA) SGV as soil concentration limit

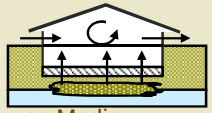
3. Air Exposure



Volatilization and Particulates to Outdoor Air Inhalation

	On-site	Off-site1	Off-site2
Receptor:	Res.	None	None
Distance:	0	0	0 (m)

Source Media:
- Construction worker ☐
- ☑ Affected Soils--Volatilization to Ambient Outdoor Air
- ☑ Affected Groundwater--Volatilization to Ambient Outdoor Air
- ☐ Affected Surface Soils--Particulates to Ambient Outdoor Air



Volatilization to Indoor Air Inhalation

	On-site	Off-site1	Off-site2
Receptor:	None	None	None
Distance:	0	0	0 (m)

Source Media:
- ☐ Affected Soils--Volatilization to Enclosed Space
- ☐ Affected Soils Leaching to GW--Volatilization to Enclosed Space
- ☐ Affected Groundwater--Volatilization to Enclosed Space

Bldg Options

4. Commands and Options

Main Screen | Print Sheet | Set Units | *Help*

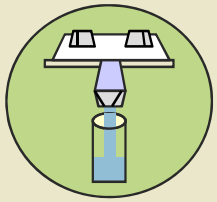
Exposure Factors & Target Risks | Exposure Flowchart

Exposure Factors and Target Risk Limits

Site Name: Gavarry Outdoor suolo-falda
Location: Albisola
Compl. By: GF
Job ID: A06-013 Date: d-ott-yy

1. Exposure Parameters

	Residential Receptors			Commerical Receptors		User Defined
	Child	Adolescent	Adult	Adult	Construc.	
Averaging time, carcinogens (yr)	70					-
Averaging time, non-carcinogens (yr)	6	12	30	25	1	-
Body weight (kg)	15	35	70	70	70	-
Exposure duration (yr)	6	12	30	25	1	-
Averaging Time for Vapor Flux (yr)	30			30	30	-
Exposure frequency (d/yr)	350			250	180	-
Dermal exposure freq. (d/yr)	350			250	180	-
Seasonal-avg skin surface area (cm^2/d)	2023	2023	3160	3160	3160	-
Soil dermal adherence factor (mg/cm^2)	0,5	0,5	0,5	0,5	0,5	-
Water ingestion rate (L/d)	1	1	2	1	1	-
Soil ingestion rate (mg/d)	200	200	100	50	100	-
Swimming exposure time (hr/event)	1	3	3			
Swimming event frequency (events/yr)	12	12	12			
Swimming water ingestion rate (L/hr)	0,5	0,5	0,05			
Skin surface area, swimming (cm^2)	3500	8100	23000			
Fish consumption rate (kg/d)	0,025	0,025	0,025			
Vegetable ingestion rate (kg/d)						
Above-ground vegetables	0,002	0,002	0,006			
Below-ground vegetables	0,001	0,001	0,002			
Contaminated fish fraction (-)	1					



2. Age Adjustment for Carcinogens

(residential receptor only)

	Adjustment Factor	
☑ Seasonal skin surface area, soil contact	1022,26	(cm^2-yr/kg)
☑ Water ingestion	1,08571	(mg-yr/L-day)
☑ Soil ingestion	165,714	(mg-yr/kg-day)
☑ Swimming water ingestion	4,56	(L/kg)
☑ Skin surface area, swimming	80640	(cm^2-yr/kg)
☑ Fish consumption	0,02286	(kg-yr/kg-day)
☑ Below-ground vegetable ingestion	0,38	(kg-yr/kg-day)
☑ Above-ground vegetable ingestion	0,88	(kg-yr/kg-day)

3. Non-Carcinogenic Receptor

(residential receptor only)

Child

4. Target Health Risk Limits

	Individual	Cumulative
Target Cancer Risk (Carcinogens)	1,0E-6	1,0E-5
Target Hazard Quotient/Index (non-Carc.)	1,0E+0	1,0E+0

5. Commands and Options

Return to Exposure Pathways

Use/Set Default Values

Print Sheet

Help

Site Name: Gavarry Outdoor suolo-falda | Job ID: A06-013
Location: Albisola | Date: d-ott-yy
Compl. By: GF

Commands and Options

Main Screen | Print Sheet | *Help*

Source Media Constituents of Concern (COCs)

Apply Raoult's Law ?

Selected COCs ?

COC Select: Add/Insert, Delete
Sort List: Top, MoveUp, Bottom, MoveDown

Representative COC Concentration ?

Selected COCs	Groundwater Source Zone (Enter Directly / Enter Site Data) (mg/L)	note	Soil Source Zone (Enter Directly / Enter Site Data) (mg/kg)	note	Mole Fraction in Source Material (-)
Arsenic	1,0E+4		1,0E+4		
Cobalt	0,0E+0		1,0E+4		
Chromium (III) (total chromium)	0,0E+0		1,0E+4		
Mercury	1,0E-2		1,0E+1		
Nickel	1,0E+4		1,0E+4		
Tin	0,0E+0		1,0E+4		
Lead (inorganic)	0,0E+0		1,0E+4		
Zinc	0,0E+0		1,0E+4		
Vinyl chloride	2,0E-2		0,0E+0		
Trichloroethylene	1,0E-2		0,0E+0		
Tetrachloroethylene	5,0E-2		0,0E+0		

View Chemical Parameters

Transport Modeling Options

Site Name: Gavarry Outdoor suolo-falda Job ID: A06-013
Location: Albisola Date: d-ott-yy
Compl. By: GF

1. Vertical Transport, Surface Soil Column

Outdoor Air Volatilization Factors

- ○ Surface soil volatilization model only — ASTM Model
- ◉ Combination surface soil/Johnson & Ettinger models
  - Thickness of surface soil zone: 1,00 *(m)*
- ○ User-specified VF from other model — Enter VF Values

Indoor Air Volatilization Factors

- ○ Johnson & Ettinger model for soil and groundwater volatilization
- ○ Johnson & Ettinger for soil, Mass Flux model for groundwater
- ○ User-specified VF from other model — Enter VF Values

Soil-to-Groundwater Leaching Factor

- ○ ASTM Model
  - ☐ Apply Soil Attenuation Model (SAM) — Enter Decay Rates
  - ☐ Allow first-order biodecay
- ○ User-specified LF from other model — Enter LF Values

Modeling Options

- ☐ Disable Mass Balance Limit
- ☐ Apply Dual Equilibrium Desorption Model

2. Lateral Air Dispersion Factor

	Off-site 1	Off-site 2	
○ 3-D Gaussian dispersion model			
○ User-Specified ADF	1,00E+0	1,00E+0	*(-)*

3. Groundwater Dilution Attenuation Factor

Calculate DAF using Domenico Model

- ○ Domenico equation with dispersion only (no biodegradation)
- ○ Domenico equation first-order decay — Enter Decay Rates
- ○ Modified Domenico equation using electron acceptor superposition — Enter Site Data

Biodegradation Capacity: NC *(mg/L)*

— or —

User-Specified DAF Values

- ○ DAF values from other model or site data — Enter DAF Values

4. Chemical Decay and Source Depletion

Enter Decay Rates
Enter Source Mass

5. Commands and Options

Main Screen | **Print Sheet** | ***Help***

Site-Specific Soil Parameters

Site Name: Gavarry Outdoor suolo-falda | Job ID: A06-013
Location: Albisola | Date: d-ott-yy
Compl. By: GF

1. Soil Source Zone Characteristics

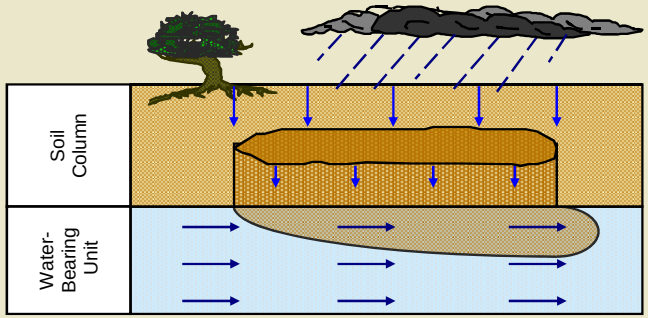
Hydrogeology

Depth to water-bearing unit	3,09	(m)
Capillary zone thickness	0,09	(m)
Soil column thickness	3	(m)

Affected Soil Zone

Depth to top of affected soils	0	(m)
Depth to base of affected soils	16,5	(m)
Length of affected soil parallel to assumed GW flow direction	45	(m)

	Res/Com	Construction	
Affected soil area	2025		(m^2)
Length of affected soil parallel to assumed wind direction	115	45	(m)



2. Surface Soil Column

Predominant USCS Soil Type

Enter Directly

	Vadose Zone	Capillary Fringe	
Volumetric water content	0,163	0,163	(-)
Volumetric air content	0,207	0,207	(-)
Total porosity	0,37		(-)
Dry bulk density	1,77		(kg/L)
Vertical hydraulic conductivity	621		(cm/d)
Vapor permeability	1,00E-13		(m^2)
Capillary zone thickness	0,09		(m)

Net Rainfall Infiltration

Net infiltration estimate	30	(cm/yr)
or	*or*	
Average annual precipitation	0	(cm/yr)

Enter Directly

Partitioning Parameters

Fraction organic carbon - entire soil column	0,00262	(-)
Fraction organic carbon - root zone	0,01	(-)
Soil/water pH	7,29	(-)

3. Commands and Options

Main Screen | Use/Set Default Values | Print Sheet
Set Units | | Help

Site-Specific Groundwater Parameters

Site Name: Gavarry Outdoor suolo-falda | Job ID: A06-013
Location: Albisola | Date: d-ott-yy
Compl. By: GF

1. Water-Bearing Unit

Hydrogeology

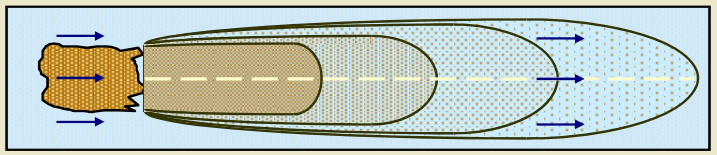
Groundwater Darcy velocity	6,9E+0	(cm/d)
Groundwater seepage velocity	1,8E+1	(cm/d)
or — Calculate	or	
Hydraulic conductivity	6,9E+2	(cm/d)
Hydraulic gradient	0,01	(-)
Effective porosity	0,38	(-)

Sorption

Fraction organic carbon--saturated zone	0,001	(-)
Groundwater pH	6,2	(-)

2. Groundwater Source Zone

Groundwater plume width at source	72	(m)
Plume (mixing zone) thickness at source	2	(m)
Calculate	or	
Saturated thickness	2	(m)
Length of source zone	45	(m)



3. Groundwater Dispersion

Model: ASTM Default

	GW Ingestion		GW to Indoor Air		
	Off-site 1	Off-site 2	Off-site 1	Off-site 2	
Distance to GW receptors	0	0	0	0	(m)
Calculate					
Longitudinal dispersivity	0	0	0	0	(m)
Transverse dispersivity	0	0	0	0	(m)
Vertical dispersivity	0	0	0	0	(m)

4. Groundwater Discharge to Surface Water

	Off-site 2	
Distance to GW/SW disharge point	NA	(m)
Plume width at GW/SW discharge	0	(m)
Plume thickness at GW/SW discharge	0	(m)
Surface water flowrate at GW/SW discharge	0,0E+0	(m^3/s)

5. Commands and Options

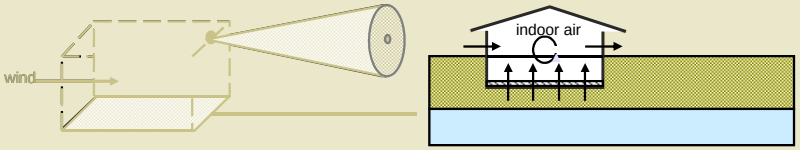
Main Screen | Use/Set Default Values | Print Sheet
Set Units | | Help

Site-Specific Air Parameters

Site Name: Gavarry Outdoor suolo-falda	Job ID: A06-013
Location: Albisola	Date: d-ott-yy
Compl. By: GF	

1. Outdoor Air Pathway

	Off-site 1	Off-site 2	
Dispersion in Air			
Distance to offsite air receptor	0	0	(m)
Horizontal dispersivity	0	0	(m)
Vertical dispersivity	0	0	(m)
Air Source Zone			
Air mixing zone height	2		(m)
Ambient air velocity in mixing zone	2,25		(m/s)
Inverse mean conc. [Q/C term]	79,25		
Particulate Emissions	Model: ASTM Model		
Particulate Emission Factor	0		(kg/m^3)
or			
Areal particulate emission flux	6,9E-14		(g/cm^2/s)
Fraction vegetative cover	0,5		(-)
Mean annual air velocity @ 7 m	4,8		
Equivalent 7m air vel. threshold	11,32		(m/s)
Windspeed function [F(x) term]	0,223841466		(-)



2. Indoor Air Pathway

	Residential	Commercial	
Building volume/area ratio	1,99	3	(m)
Foundation area	3500	70	(m^2)
Foundation perimeter	300	34	(m)
Building air exchange rate	1,4E-4	2,3E-4	(1/s)
Depth to bottom of foundation slab	7,5	0,15	(m)
Convective air flow through cracks	0,0E+0	0,0E+0	(m^3/s)
Foundation thickness	0,4		(m)
Foundation crack fraction	0,01		(-)
Volumetric water content of cracks	0,12		(-)
Volumetric air content of cracks	0,26		(-)
Indoor/Outdoor differential pressure	0		(g/cm/s^2)
Building Volume	451	451	(m^3)
Building Width Perpendicular to GW flow	9,61	9,61	(m)
Building Length Parallel to GW flow	9,61	9,61	(m)
Saturated Soil Zone Porosity	0,38		(-)
Vertical Dispersivity	0,006		(m)
Groundwater Seepage Velocity	1,8E+01		(cm/d)

3. Commands and Options

Main Screen | Use/Set Default Values | Print Sheet

Set Units | Help

RBCA SITE ASSESSMENT

TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

OUTDOOR AIR EXPOSURE PATHWAYS ■ **(Checked if Pathway is Complete)**

SURFACE SOILS (0 - 1 m):
VAPOR INHALATION

Constituents of Concern	1) Source Medium: Soil Conc. (mg/kg)	2) NAF Value (m^3/kg) Receptor: On-site (0 m) Residential	On-site (0 m) Construction Worker	Off-site 1 (0 m) None	Off-site 2 (0 m) None	3) Exposure Medium Outdoor Air: POE Conc. (mg/m^3) (1) / (2): On-site (0 m) Residential	On-site (0 m) Construction Worker	Off-site 1 (0 m) None	Off-site 2 (0 m) None
Arsenic *	1,0E+4	Error							
Cobalt *	1,0E+4	Error							
Chromium (III) (total chromium) *	1,0E+4	Error							
Mercury *	1,0E+1	3,8E+4				2,6E-4			
Nickel *	1,0E+4	Error							
Tin *	1,0E+4	Error							
Lead (inorganic) *	1,0E+4	Error							
Zinc *	1,0E+4	Error							
Vinyl chloride *	0,0E+0	1,3E+3				0,0E+0			
Trichloroethylene *	0,0E+0	1,4E+3				0,0E+0			
Tetrachloroethylene *	0,0E+0	1,3E+3				0,0E+0			

NOTE: NAF = Natural attenuation factor POE = Point of exposure

Site Name: Gavarry Outdoor suolo-falda
Site Location: Albisola
Completed By: GF

Date Completed: d-ott-yy
Job ID: A06-013

RBCA SITE ASSESSMENT

TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

OUTDOOR AIR EXPOSURE PATHWAYS

SURFACE SOILS (0 - 1 m):
VAPOR INHALATION (cont'd)

Constituents of Concern	4) Exposure Multiplier (EFxED)/(ATx365) (unitless)				5) Average Inhalation Exposure Concentration (mg/m^3) (3) X (4)			
	On-site (0 m)		Off-site 1 (0 m)	Off-site 2 (0 m)	On-site (0 m)		Off-site 1 (0 m)	Off-site 2 (0 m)
	Residential	Construction Worker	None	None	Residential	Construction Worker	None	None
Arsenic *	4,1E-1							
Cobalt *	4,1E-1							
Chromium (III) (total chromium) *	9,6E-1							
Mercury *	9,6E-1				2,5E-4			
Nickel *	4,1E-1							
Tin *	9,6E-1							
Lead (inorganic) *	9,6E-1							
Zinc *	9,6E-1							
Vinyl chloride *	4,1E-1				0,0E+0			
Trichloroethylene *	4,1E-1				0,0E+0			
Tetrachloroethylene *	4,1E-1				0,0E+0			

* = Chemical with user-specified data

NOTE: AT = Averaging time (days) EF = Exposure frequency (days/yr) ED = Exposure duration (yr)

Site Name: Gavarry Outdoor suolo-falda
Site Location: Albisola
Completed By: GF

Date Completed: d-ott-yy
Job ID: A06-013

RBCA SITE ASSESSMENT

TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

OUTDOOR AIR EXPOSURE PATHWAYS ■ **(Checked if Pathway is Complete)**

SUBSURFACE SOILS (1 - 16,5 m):

VAPOR INHALATION

Constituents of Concern	1) Source Medium	2) NAF Value (m^3/kg) Receptor			3) Exposure Medium Outdoor Air: POE Conc. (mg/m^3) (1) / (2)		
	Soil Conc. (mg/kg)	On-site (0 m) Residential	Off-site 1 (0 m) None	Off-site 2 (0 m) None	On-site (0 m) Residential	Off-site 1 (0 m) None	Off-site 2 (0 m) None
Arsenic *	1,0E+4	VFsamb					
Cobalt *	1,0E+4	VFsamb					
Chromium (III) (total chromium) *	1,0E+4	VFsamb					
Mercury *	1,0E+1	8,8E+4			1,1E-4		
Nickel *	1,0E+4	VFsamb					
Tin *	1,0E+4	VFsamb					
Lead (inorganic) *	1,0E+4	VFsamb					
Zinc *	1,0E+4	VFsamb					
Vinyl chloride *	0,0E+0	1,3E+3			0,0E+0		
Trichloroethylene *	0,0E+0	1,3E+3			0,0E+0		
Tetrachloroethylene *	0,0E+0	1,3E+3			0,0E+0		

NOTE: NAF = Natural attenuation factor POE = Point of exposure

Site Name: Gavarry Outdoor suolo-falda
Site Location: Albisola
Completed By: GF

Date Completed: d-ott-yy
Job ID: A06-013

RBCA SITE ASSESSMENT

TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

OUTDOOR AIR EXPOSURE PATHWAYS

SUBSURFACE SOILS (1 - 16,5 m):

VAPOR INHALATION (cont'd)

Constituents of Concern	4) Exposure Multiplier (EFxED)/(ATx365) (unitless)			5) Average Inhalation Exposure Concentration (mg/m^3) (3) X (4)		
	On-site (0 m) Residential	Off-site 1 (0 m) None	Off-site 2 (0 m) None	On-site (0 m) Residential	Off-site 1 (0 m) None	Off-site 2 (0 m) None
Arsenic *	4,1E-1					
Cobalt *	4,1E-1					
Chromium (III) (total chromium) *	9,6E-1					
Mercury *	9,6E-1			1,1E-4		
Nickel *	4,1E-1					
Tin *	9,6E-1					
Lead (inorganic) *	9,6E-1					
Zinc *	9,6E-1					
Vinyl chloride *	4,1E-1			0,0E+0		
Trichloroethylene *	4,1E-1			0,0E+0		
Tetrachloroethylene *	4,1E-1			0,0E+0		

NOTE: AT = Averaging time (days) EF = Exposure frequency (days/yr) ED = Exposure duration (yr)

Site Name: Gavarry Outdoor suolo-falda
Site Location: Albisola
Completed By: GF

Date Completed: d-ott-yy
Job ID: A06-013

RBCA SITE ASSESSMENT

TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

OUTDOOR AIR EXPOSURE PATHWAYS ■ **(Checked if Pathway is Complete)**

GROUNDWATER: VAPOR INHALATION

Exposure Concentration

Constituents of Concern	1) Source Medium: Groundwater Conc. (mg/L)	2) NAF Value (m^3/L) Receptor: On-site (0 m) Residential	Off-site 1 (0 m) None	Off-site 2 (0 m) None	3) Exposure Medium Outdoor Air: POE Conc. (mg/m^3) (1) / (2): On-site (0 m) Residential	Off-site 1 (0 m) None	Off-site 2 (0 m) None
Arsenic *	1,0E+4	zero Vfwamb					
Cobalt *	0,0E+0	zero Vfwamb					
Chromium (III) (total chromium) *	0,0E+0	zero Vfwamb					
Mercury *	1,0E-2	3,5E+3			2,9E-6		
Nickel *	1,0E+4	zero Vfwamb					
Tin *	0,0E+0	zero Vfwamb					
Lead (inorganic) *	0,0E+0	zero Vfwamb					
Zinc *	0,0E+0	zero Vfwamb					
Vinyl chloride *	2,0E-2	4,3E+2			4,7E-5		
Trichloroethylene *	1,0E-2	1,5E+3			6,7E-6		
Tetrachloroethylene *	5,0E-2	9,2E+2			5,4E-5		

NOTE: NAF = Natural attenuation factor POE = Point of exposure

Site Name: Gavarry Outdoor suolo-falda
Site Location: Albisola
Completed By: GF

Date Completed: d-ott-yy
Job ID: A06-013

RBCA SITE ASSESSMENT

TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

OUTDOOR AIR EXPOSURE PATHWAYS

GROUNDWATER: VAPOR INHALATION (cont'd)

Constituents of Concern	4) Exposure Multiplier (EFxED)/(ATx365) (unitless)			5) Average Inhalation Exposure Concentration (mg/m^3) (3) X (4)		
	On-site (0 m) Residential	Off-site 1 (0 m) None	Off-site 2 (0 m) None	On-site (0 m) Residential	Off-site 1 (0 m) None	Off-site 2 (0 m) None
Arsenic *	4,1E-1					
Cobalt *	4,1E-1					
Chromium (III) (total chromium) *	9,6E-1					
Mercury *	9,6E-1			2,7E-6		
Nickel *	4,1E-1					
Tin *	9,6E-1					
Lead (inorganic) *	9,6E-1					
Zinc *	9,6E-1					
Vinyl chloride *	4,1E-1			1,9E-5		
Trichloroethylene *	4,1E-1			2,8E-6		
Tetrachloroethylene *	4,1E-1			2,2E-5		

NOTE: AT = Averaging time (days) EF = Exposure frequency (days/yr) ED = Exposure duration (yr)

Site Name: Gavarry Outdoor suolo-falda
Site Location: Albisola
Completed By: GF

Date Completed: d-ott-yy
Job ID: A06-013

RBCA SITE ASSESSMENT

TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

OUTDOOR AIR EXPOSURE PATHWAYS

MAXIMUM PATHWAY EXPOSURE (mg/m^3)

Maximum average expsosure concentration from soil and groundwater routes.)

Constituents of Concern	On-site (0 m) Residential	On-site (0 m) Construction Worker	Off-site 1 (0 m) None	Off-site 2 (0 m) None
Arsenic *				
Cobalt *				
Chromium (III) (total chromium) *				
Mercury *	2,5E-4			
Nickel *				
Tin *				
Lead (inorganic) *				
Zinc *				
Vinyl chloride *	1,9E-5			
Trichloroethylene *	2,8E-6			
Tetrachloroethylene *	2,2E-5			

Site Name: Gavarry Outdoor suolo-falda
Site Location: Albisola
Completed By: GF

Date Completed: d-ott-yy
Job ID: A06-013

RBCA SITE ASSESSMENT

TIER 2 PATHWAY RISK CALCULATION

OUTDOOR AIR EXPOSURE PATHWAYS ■ **(Checked if Pathway is Complete)**

CARCINOGENIC RISK

Constituents of Concern	(1) Is Carcinogenic	(2) Maximum Carcinogenic Exposure (mg/m^3)				(3) Inhalation Unit Risk Factor (µg/m^3)^-1	(4) Individual COC Risk (2) x (3) x 1000			
		On-site (0 m)		Off-site 1 (0 m)	Off-site 2 (0 m)		On-site (0 m)		Off-site 1 (0 m)	Off-site 2 (0 m)
		Residential	Construction Worker	None	None		Residential	Construction Worker	None	None
Arsenic *	VERO			-	-	4,3E-3				
Cobalt *	VERO			-	-	2,8E-3				
Chromium (III) (total chromium) *	FALSO	-	-	-	-	-				
Mercury *	FALSO	-	-	-	-	-				
Nickel *	VERO			-	-	2,4E-4				
Tin *	FALSO	-	-	-	-	-				
Lead (inorganic) *	FALSO	-	-	-	-	-				
Zinc *	FALSO	-	-	-	-	-				
Vinyl chloride *	VERO	1,9E-5		-	-	8,8E-6	1,7E-7			
Trichloroethylene *	VERO	2,8E-6		-	-	1,7E-6	4,8E-9			
Tetrachloroethylene *	VERO	2,2E-5		-	-	5,7E-6	1,3E-7			

Total Pathway Carcinogenic Risk = **3,0E-7**

Site Name: Gavarry Outdoor suolo-falda
Site Location: Albisola

Completed By: GF
Date Completed: d-ott-yy

Job ID: A06-013

RBCA SITE ASSESSMENT

TIER 2 PATHWAY RISK CALCULATION

OUTDOOR AIR EXPOSURE PATHWAYS ■ **(Checked if Pathway is Complete)**

TOXIC EFFECTS

Constituents of Concern	(5) Maximum Toxicant Exposure (mg/m^3)				(6) Inhalation Reference Conc. (mg/m^3)	(7) Individual COC Hazard Quotient (5) / (6)			
	On-site (0 m)		Off-site 1 (0 m)	Off-site 2 (0 m)		On-site (0 m)		Off-site 1 (0 m)	Off-site 2 (0 m)
	Residential	Construction Worker	None	None		Residential	Construction Worker	None	None
Arsenic *	0,0E+0				1,1E-3	0,0E+0			
Cobalt *	0,0E+0				2,0E-5	0,0E+0			
Chromium (III) (total chromium) *					5,3E+0				
Mercury *	2,5E-4				3,0E-4	8,4E-1			
Nickel *	0,0E+0				7,0E-2	0,0E+0			
Tin *					2,1E+0				
Lead (inorganic) *					1,2E-1				
Zinc *					1,1E+0				
Vinyl chloride *	4,5E-5				1,0E-1	4,5E-4			
Trichloroethylene *	6,5E-6				2,1E-2	3,1E-4			
Tetrachloroethylene *	5,2E-5				3,5E-2	1,5E-3			

Total Pathway Hazard Index = **8,4E-1**

Site Name: Gavarry Outdoor suolo-falda
Site Location: Albisola

Completed By: GF
Date Completed: d-ott-yy

Job ID: A06-013

RBCA SITE ASSESSMENT | **Baseline Risk Summary-All Pathways**

Site Name: Gavarry Outdoor suolo-falda
Site Location: Albisola
Completed By: GF
Date Completed: d-ott-yy

BASELINE RISK SUMMARY TABLE

EXPOSURE PATHWAY	BASELINE CARCINOGENIC RISK: Individual COC Risk – Maximum Value	Individual COC Risk – Target Risk	Cumulative COC Risk – Total Value	Cumulative COC Risk – Target Risk	Risk Limit(s) Exceeded?	BASELINE TOXIC EFFECTS: Hazard Quotient – Maximum Value	Hazard Quotient – Applicable Limit	Hazard Index – Total Value	Hazard Index – Applicable Limit	Toxicity Limit(s) Exceeded?
OUTDOOR AIR EXPOSURE PATHWAYS										
■	1,7E-7	1,0E-6	3,0E-7	1,0E-5	☐	8,4E-1	1,0E+0	8,4E-1	1,0E+0	☐
INDOOR AIR EXPOSURE PATHWAYS										
☐	NA	NA	NA	NA	☐	NA	NA	NA	NA	☐
SOIL EXPOSURE PATHWAYS										
☐	NA	NA	NA	NA	☐	NA	NA	NA	NA	☐
GROUNDWATER EXPOSURE PATHWAYS										
☐	NA	NA	NA	NA	☐	NA	NA	NA	NA	☐
SURFACE WATER EXPOSURE PATHWAYS										
☐	NA	NA	NA	NA	☐	NA	NA	NA	NA	☐
CRITICAL EXPOSURE PATHWAY (Maximum Values From Complete Pathways)										
	1,7E-7	***1,0E-6***	***3,0E-7***	***1,0E-5***	☐	***8,4E-1***	***1,0E+0***	***8,4E-1***	***1,0E+0***	☐
	Outdoor Air		***Outdoor Air***			***Outdoor Air***		***Outdoor Air***		

APPENDICE B

Tabulati Analisi di Rischio R6

Main Screen

RBCA Tool Kit for Chemical Releases
Version 2.52 © 2009 GSI Environmental Inc.

1. Project Information

Site Name:	Gavarry Indoor 2PI CSR suolo-falda box		
Location:	Albisola		
Completed By:	GF		
Date:	06-ott-11	Job ID:	A06-013

2. Which Type of RBCA Analysis?

?

○ **Tier 1** — Risk-Based Screening Levels

◉ **Tier 2/3** — Site-Specific Target Levels

3. Calculation Options

?

Affects which input data are required

☑ ***Baseline Risks (Forward mode)***

☑ ***RBCA Cleanup Levels (Backward mode)***

○ Individual Constituent Risk Goals Only
◉ Individual and Cumulative Risk Goals

☐ Apply Source Depletion Algorithm
Time to Future Exposure 0 *(yr)*

4. RBCA Evaluation Process

Prepare Input Data

Data Complete? (■= yes, ■= no)

- ■ Exposure Pathways
- ■ Constituents of Concern (COCs)
- ■ Transport Models
- ■ Soil Parameters
- ■ GW Parameters
- ■ Air Parameters

Review Output

- Exposure Flowchart
- COC Chem. Parameters
- Input Data Summary
- User-Spec. COC Data...
- Transient Domenico Analysis...
- Baseline Risks...
- Cleanup Levels...

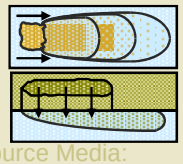
5. Commands and Options

New Site	Load Data...	Save Data As...	User Chemical Database
Set Units	Print Sheet	Print Report	
Help		Quit	

Exposure Pathway Identification

Site Name: Gavarry Indoor 2PI CSR suolo-falda box
Location: Albisola
Compl. By: GF
Job ID: A06-013 Date: d-ott-yy

1. Groundwater Exposure



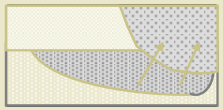
Groundwater Ingestion/ Surface Water Impact

	On-site	Off-site1	Off-site2
Receptor:	None	None	None
Distance:	0	0	0 (m)

Source Media:
- ☐ Affected Groundwater
- ☐ Affected Soils Leaching to Groundwater

Option:
- ☐ Apply MCL value as ingestion RBEL (backward mode only)

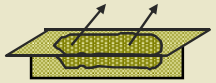
GW Discharge to Surface Water Exposure



- ☐ Swimming
- ☐ Fish Consumption
- ☐ Specified Water Quality Criteria

Enter Criteria

2. Surface Soil Exposure



Combined Exposure

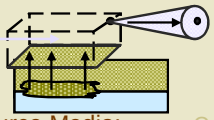
	On-site
Receptor:	None
Construction Worker	☐

Source Media:
- ☐ Direct Ingestion
- ☐ Dermal Contact
- ☐ Inhalation (vol+part)
- ☐ Vegetable Ingestion

Option:
- ☐ Apply UK (CLEA) SGV as soil concentration limit

Veg Options

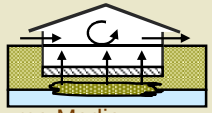
3. Air Exposure



Volatilization and Particulates to Outdoor Air Inhalation

	On-site	Off-site1	Off-site2
Receptor:	None	None	None
Distance:	0	0	0 (m)

Source Media:
- Construction worker ☐
- ☐ Affected Soils--Volatilization to Ambient Outdoor Air
- ☐ Affected Groundwater--Volatilization to Ambient Outdoor Air
- ☐ Affected Surface Soils--Particulates to Ambient Outdoor Air



Volatilization to Indoor Air Inhalation

	On-site	Off-site1	Off-site2
Receptor:	Res.	None	None
Distance:	0	0	0 (m)

Source Media:
- ☑ Affected Soils--Volatilization to Enclosed Space
- ☐ Affected Soils Leaching to GW--Volatilization to Enclosed Space
- ☑ Affected Groundwater--Volatilization to Enclosed Space

Bldg Options

4. Commands and Options

Main Screen | Print Sheet | Set Units | *Help*

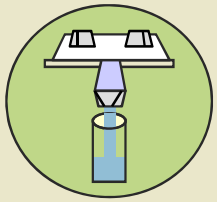
Exposure Factors & Target Risks | Exposure Flowchart

Exposure Factors and Target Risk Limits

Site Name: Gavarry Indoor 2PI CSR suolo-falda box
Location: Albisola
Compl. By: GF
Job ID: A06-013 Date: d-ott-yy

1. Exposure Parameters

	Residential Receptors			Commerical Receptors		User Defined
	Child	Adolescent	Adult	Adult	Construc.	
Averaging time, carcinogens (yr)	70					-
Averaging time, non-carcinogens (yr)	6	12	30	25	1	-
Body weight (kg)	15	35	70	70	70	-
Exposure duration (yr)	6	12	30	25	1	-
Averaging Time for Vapor Flux (yr)	30			30	30	-
Exposure frequency (d/yr)	30			250	180	-
Dermal exposure freq. (d/yr)	350			250	180	-
Seasonal-avg skin surface area (cm^2/d)	2023	2023	3160	3160	3160	-
Soil dermal adherence factor (mg/cm^2)	0,5	0,5	0,5	0,5	0,5	-
Water ingestion rate (L/d)	1	1	2	1	1	-
Soil ingestion rate (mg/d)	200	200	100	50	100	-
Swimming exposure time (hr/event)	1	3	3			
Swimming event frequency (events/yr)	12	12	12			
Swimming water ingestion rate (L/hr)	0,5	0,5	0,05			
Skin surface area, swimming (cm^2)	3500	8100	23000			
Fish consumption rate (kg/d)	0,025	0,025	0,025			
Vegetable ingestion rate (kg/d)						
Above-ground vegetables	0,002	0,002	0,006			
Below-ground vegetables	0,001	0,001	0,002			
Contaminated fish fraction (-)	1					



2. Age Adjustment for Carcinogens

(residential receptor only)

	Adjustment Factor	
☑ Seasonal skin surface area, soil contact	1022,26	(cm^2-yr/kg)
☑ Water ingestion	1,08571	(mg-yr/L-day)
☑ Soil ingestion	165,714	(mg-yr/kg-day)
☑ Swimming water ingestion	4,56	(L/kg)
☑ Skin surface area, swimming	80640	(cm^2-yr/kg)
☑ Fish consumption	0,02286	(kg-yr/kg-day)
☑ Below-ground vegetable ingestion	0,03257	(kg-yr/kg-day)
☑ Above-ground vegetable ingestion	0,07543	(kg-yr/kg-day)

3. Non-Carcinogenic Receptor

(residential receptor only)

Child

4. Target Health Risk Limits

	Individual	Cumulative
Target Cancer Risk (Carcinogens)	1,0E-6	1,0E-5
Target Hazard Quotient/Index (non-Carc.)	1,0E+0	1,0E+0

5. Commands and Options

Return to Exposure Pathways

Use/Set Default Values

Print Sheet

Help

Site Name: Gavarry Indoor 2PI CSR suolo-falda box | Job ID: A06-013
Location: Albisola | Date: d-ott-yy
Compl. By: GF

Commands and Options

Main Screen | Print Sheet | *Help*

Source Media Constituents of Concern (COCs)

Apply Raoult's Law ?

Selected COCs ?

COC Select: Add/Insert, Delete
Sort List: Top, MoveUp, Bottom, MoveDown

Representative COC Concentration ?

Selected COCs	Groundwater Source Zone (Enter Directly / Enter Site Data) (mg/L)	note	Soil Source Zone (Enter Directly / Enter Site Data) (mg/kg)	note	Mole Fraction in Source Material (-)
Arsenic	1,0E+4		1,0E+4		
Cobalt	0,0E+0		1,0E+4		
Chromium (III) (total chromium)	0,0E+0		1,0E+4		
Mercury	1,0E-2		1,0E+1		
Nickel	1,0E+4		1,0E+4		
Tin	0,0E+0		1,0E+4		
Lead (inorganic)	0,0E+0		1,0E+4		
Zinc	0,0E+0		1,0E+4		
Vinyl chloride	2,0E-2		0,0E+0		
Trichloroethylene	1,0E-2		0,0E+0		
Tetrachloroethylene	5,0E-2		0,0E+0		

View Chemical Parameters

Transport Modeling Options

Site Name: Gavarry Indoor 2PI CSR suolo-falda box Job ID: A06-013
Location: Albisola Date: d-ott-yy
Compl. By: GF

1. Vertical Transport, Surface Soil Column

Outdoor Air Volatilization Factors

- ○ Surface soil volatilization model only — ASTM Model
- ○ Combination surface soil/Johnson & Ettinger models
  - Thickness of surface soil zone: 1,00 *(m)*
- ○ User-specified VF from other model — Enter VF Values

Indoor Air Volatilization Factors

- ◉ Johnson & Ettinger model for soil and groundwater volatilization
- ○ Johnson & Ettinger for soil, Mass Flux model for groundwater
- ○ User-specified VF from other model — Enter VF Values

Soil-to-Groundwater Leaching Factor

- ○ ASTM Model
  - ☐ Apply Soil Attenuation Model (SAM) — Enter Decay Rates
  - ☐ Allow first-order biodecay
- ○ User-specified LF from other model — Enter LF Values

Modeling Options

- ☐ Disable Mass Balance Limit
- ☐ Apply Dual Equilibrium Desorption Model

2. Lateral Air Dispersion Factor

- ○ 3-D Gaussian dispersion model
- ○ User-Specified ADF

Off-site 1	Off-site 2	
1,00E+0	1,00E+0	*(-)*

3. Groundwater Dilution Attenuation Factor

Calculate DAF using Domenico Model

- ○ Domenico equation with dispersion only (no biodegradation)
- ○ Domenico equation first-order decay — Enter Decay Rates
- ○ Modified Domenico equation using electron acceptor superposition — Enter Site Data

Biodegradation Capacity: NC *(mg/L)*

— or —

User-Specified DAF Values

- ○ DAF values from other model or site data — Enter DAF Values

4. Chemical Decay and Source Depletion

Enter Decay Rates
Enter Source Mass

5. Commands and Options

Main Screen | **Print Sheet** | ***Help***

Site-Specific Soil Parameters

Site Name: Gavarry Indoor 2PI CSR suolo-falda box | Job ID: A06-013
Location: Albisola | Date: d-ott-yy
Compl. By: GF

1. Soil Source Zone Characteristics

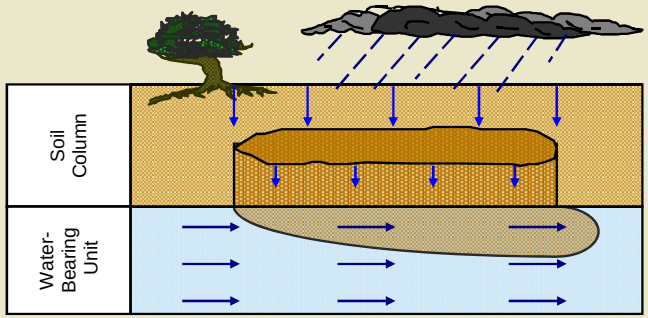
Hydrogeology

Depth to water-bearing unit	3,09	(m)
Capillary zone thickness	0,09	(m)
Soil column thickness	3	(m)

Affected Soil Zone

Depth to top of affected soils	0	(m)
Depth to base of affected soils	16,5	(m)
Length of affected soil parallel to assumed GW flow direction	45	(m)

	Res/Com	Construction	
Affected soil area	2025		(m^2)
Length of affected soil parallel to assumed wind direction	45	45	(m)



2. Surface Soil Column

Predominant USCS Soil Type

Enter Directly

	Vadose Zone	Capillary Fringe	
Volumetric water content	0,163	0,163	(-)
Volumetric air content	0,207	0,207	(-)
Total porosity	0,37		(-)
Dry bulk density	1,77		(kg/L)
Vertical hydraulic conductivity	621		(cm/d)
Vapor permeability	1,00E-13		(m^2)
Capillary zone thickness	0,09		(m)

Net Rainfall Infiltration

Net infiltration estimate	30,00	(cm/yr)
or	or	
Average annual precipitation	0	(cm/yr)

Enter Directly

Partitioning Parameters

Fraction organic carbon - entire soil column	0,00262	(-)
Fraction organic carbon - root zone	0,01	(-)
Soil/water pH	7,29	(-)

3. Commands and Options

Main Screen | Use/Set Default Values | Print Sheet
Set Units | | Help

Site-Specific Groundwater Parameters

Site Name: Gavarry Indoor 2PI CSR suolo-falda box | Job ID: A06-013
Location: Albisola | Date: d-ott-yy
Compl. By: GF

1. Water-Bearing Unit

Hydrogeology

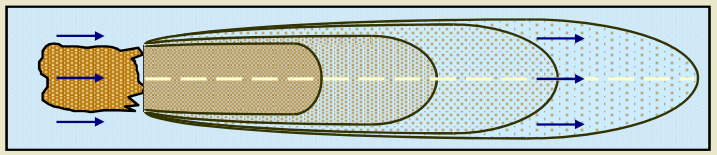
Groundwater Darcy velocity	6,9E+0	(cm/d)
Groundwater seepage velocity	1,8E+1	(cm/d)
or Calculate	*or*	
Hydraulic conductivity	6,9E+2	(cm/d)
Hydraulic gradient	0,01	(-)
Effective porosity	0,38	(-)

Sorption

Fraction organic carbon--saturated zone	0,001	(-)
Groundwater pH	6,2	(-)

2. Groundwater Source Zone

Groundwater plume width at source	142	(m)
Plume (mixing zone) thickness at source	2	(m)
Calculate	*or*	
Saturated thickness	2	(m)
Length of source zone	45	(m)



3. Groundwater Dispersion

Model: ASTM Default

	GW Ingestion		GW to Indoor Air	
	Off-site 1	Off-site 2	Off-site 1	Off-site 2
Distance to GW receptors	0	0	0	0 (m)
Calculate				
Longitudinal dispersivity	0	0	0	0 (m)
Transverse dispersivity	0	0	0	0 (m)
Vertical dispersivity	0	0	0	0 (m)

4. Groundwater Discharge to Surface Water

	Off-site 2	
Distance to GW/SW disharge point	NA	(m)
Plume width at GW/SW discharge	0	(m)
Plume thickness at GW/SW discharge	0	(m)
Surface water flowrate at GW/SW discharge	0,0E+0	(m^3/s)

5. Commands and Options

Main Screen | Use/Set Default Values | Print Sheet
Set Units | | *Help*

Site-Specific Air Parameters

Site Name: Gavarry Indoor 2PI CSR suolo-falda box | Job ID: A06-013
Location: Albisola | Date: d-ott-yy
Compl. By: GF

1. Outdoor Air Pathway

Dispersion in Air

	Off-site 1	Off-site 2	
Distance to offsite air receptor	0	0	(m)
Horizontal dispersivity	0	0	(m)
Vertical dispersivity	0	0	(m)

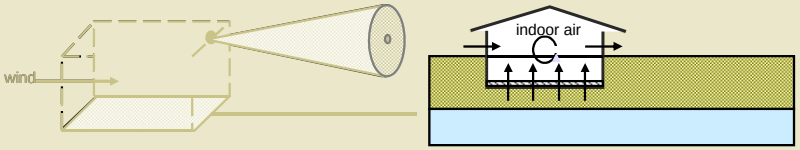
Air Source Zone

Air mixing zone height	2	(m)
Ambient air velocity in mixing zone	2,25	(m/s)
Inverse mean conc. [Q/C term]	79,25	

Particulate Emissions

Model: ASTM Model

Particulate Emission Factor	0	(kg/m^3)
or		
Areal particulate emission flux	6,9E-14	(g/cm^2/s)
Fraction vegetative cover	0,5	(-)
Mean annual air velocity @ 7 m	4,8	
Equivalent 7m air vel. threshold	11,32	(m/s)
Windspeed function [F(x) term]	0,223841466	(-)



2. Indoor Air Pathway

	Residential	Commercial	
Building volume/area ratio	1,168335	3	(m)
Foundation area	21,4	70	(m^2)
Foundation perimeter	18,8	34	(m)
Building air exchange rate	1,4E-4	2,3E-4	(1/s)
Depth to bottom of foundation slab	7,5	0,15	(m)
Convective air flow through cracks	0,0E+0	0,0E+0	(m^3/s)
Foundation thickness	0,4		(m)
Foundation crack fraction	0,01		(-)
Volumetric water content of cracks	0,12		(-)
Volumetric air content of cracks	0,26		(-)
Indoor/Outdoor differential pressure	0		(g/cm/s^2)
Building Volume	451	451	(m^3)
Building Width Perpendicular to GW flow	9,61	9,61	(m)
Building Length Parallel to GW flow	9,61	9,61	(m)
Saturated Soil Zone Porosity	0,38		(-)
Vertical Dispersivity	0,006		(m)
Groundwater Seepage Velocity	1,8E+01		(cm/d)

3. Commands and Options

Main Screen | Use/Set Default Values | Print Sheet
Set Units | | Help

RBCA SITE ASSESSMENT

TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

INDOOR AIR EXPOSURE PATHWAYS ■ **(Checked if Pathway is Complete)**

SOILS (0 - 16,5 m): VAPOR INTRUSION INTO BUILDINGS

Constituents of Concern	1) Source Medium Soil Conc. (mg/kg)	2) NAF Value (L/kg) Receptor On-site (0 m) Residential	3) Exposure Medium Indoor Air: POE Conc. (mg/m^3) (1) / (2) On-site (0 m) Residential	4) Exposure Multiplier (EFxED)/(ATx365) (unitless) On-site (0 m) Residential	5) Average Inhalation Exposure Concentration (mg/m^3) (3) X (4) On-site (0 m) Residential
Arsenic *	1,0E+4	zero VF		3,5E-2	
Cobalt *	1,0E+4	zero VF		3,5E-2	
Chromium (III) (total chromium) *	1,0E+4	zero VF		8,2E-2	
Mercury *	1,0E+1	7,4E+3	1,4E-3	8,2E-2	1,1E-4
Nickel *	1,0E+4	zero VF		3,5E-2	
Tin *	1,0E+4	zero VF		8,2E-2	
Lead (inorganic) *	1,0E+4	zero VF		8,2E-2	
Zinc *	1,0E+4	zero VF		8,2E-2	
Vinyl chloride *	0,0E+0	5,3E+0	0,0E+0	3,5E-2	0,0E+0
Trichloroethylene *	0,0E+0	9,8E+0	0,0E+0	3,5E-2	0,0E+0
Tetrachloroethylene *	0,0E+0	9,2E+0	0,0E+0	3,5E-2	0,0E+0

* = Chemical with user-specified data

NOTE: AT = Averaging time (days) EF = Exposure frequency (days/yr) ED = Exposure duration (yr) NAF = Natural attenuation factor POE = Point of exposure

Site Name: Gavarry Indoor 2PI CSR suolo-falda box
Site Location: Albisola
Completed By: GF

Date Completed: d-ott-yy
Job ID: A06-013

RBCA SITE ASSESSMENT

TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

INDOOR AIR EXPOSURE PATHWAYS ■ **(Checked if Pathway is Complete)**

GROUNDWATER: VAPOR INTRUSION INTO BUILDINGS

Exposure Concentration

	1) Source Medium	2) NAF Value (m^3/L) Receptor			3) Exposure Medium Indoor Air: POE Conc. (mg/m^3) (1) / (2)		
Constituents of Concern	Groundwater Conc. (mg/L)	On-site (0 m) Residential	Off-site 1 (0 m) None	Off-site 2 (0 m) None	On-site (0 m) None	Off-site 1 (0 m) None	Off-site 2 (0 m) None
Arsenic *	1,0E+4	zero VF					
Cobalt *	0,0E+0	zero VF					
Chromium (III) (total chromium) *	0,0E+0	zero VF					
Mercury *	1,0E-2	6,8E+1			1,5E-4		
Nickel *	1,0E+4	zero VF					
Tin *	0,0E+0	zero VF					
Lead (inorganic) *	0,0E+0	zero VF					
Zinc *	0,0E+0	zero VF					
Vinyl chloride *	2,0E-2	8,2E+0			2,4E-3		
Trichloroethylene *	1,0E-2	2,9E+1			3,5E-4		
Tetrachloroethylene *	5,0E-2	1,8E+1			2,8E-3		

NOTE: AT = Averaging time (days) EF = Exposure frequency (days/yr) ED = Exposure duration (yr) NAF = Natural attenuation factor POE = Point of exposure

RBCA SITE ASSESSMENT

TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

INDOOR AIR EXPOSURE PATHWAYS

GROUNDWATER: VAPOR INTRUSION INTO BUILDINGS

Constituents of Concern	4) Exposure Multiplier (EFxED)/(ATx365) (unitless)			5) Average Inhalation Exposure Concentration (mg/m^3) (3) X (4)		
	On-site (0 m) None	Off-site 1 (0 m) None	Off-site 2 (0 m) None	On-site (0 m) None	Off-site 1 (0 m) None	Off-site 2 (0 m) None
Arsenic *	3,5E-2					
Cobalt *	3,5E-2					
Chromium (III) (total chromium) *	8,2E-2					
Mercury *	8,2E-2			1,2E-5		
Nickel *	3,5E-2					
Tin *	8,2E-2					
Lead (inorganic) *	8,2E-2					
Zinc *	8,2E-2					
Vinyl chloride *	3,5E-2			8,5E-5		
Trichloroethylene *	3,5E-2			1,2E-5		
Tetrachloroethylene *	3,5E-2			9,9E-5		

* = Chemical with user-specified data

NOTE: AT = Averaging time (days) EF = Exposure frequency (days/yr) ED = Exposure duration (yr) NAF = Natural attenuation factor POE = Point of exposure

RBCA SITE ASSESSMENT

TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

INDOOR AIR EXPOSURE PATHWAYS ☐ **(Checked if Pathway is Complete)**

SOIL LEACHING TO GW- VAPOR INTRUSION INTO BUILDINGS

Exposure Concentration

Constituents of Concern	1) Source Medium Soil Conc. (mg/kg)	2) NAF Value (m^3/L) Receptor On-site (0 m) None	Off-site 1 (0 m) None	Off-site 2 (0 m) None	3) Exposure Medium Indoor Air: POE Conc. (mg/m^3) (1) / (2) On-site (0 m) None	Off-site 1 (0 m) None	Off-site 2 (0 m) None
Arsenic *	1,0E+4						
Cobalt *	1,0E+4						
Chromium (III) (total chromium) *	1,0E+4						
Mercury *	1,0E+1						
Nickel *	1,0E+4						
Tin *	1,0E+4						
Lead (inorganic) *	1,0E+4						
Zinc *	1,0E+4						
Vinyl chloride *	0,0E+0						
Trichloroethylene *	0,0E+0						
Tetrachloroethylene *	0,0E+0						

NOTE: AT = Averaging time (days) EF = Exposure frequency (days/yr) ED = Exposure duration (yr) NAF = Natural attenuation factor POE = Point of exposure

RBCA SITE ASSESSMENT

TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

INDOOR AIR EXPOSURE PATHWAYS

SOIL LEACHING TO GW- VAPOR INTRUSION INTO BUILDINGS

Constituents of Concern	4) Exposure Multiplier (EFxED)/(ATx365) (unitless)			5) Average Inhalation Exposure Concentration (mg/m^3) (3) X (4)		
	On-site (0 m) None	Off-site 1 (0 m) None	Off-site 2 (0 m) None	On-site (0 m) None	Off-site 1 (0 m) None	Off-site 2 (0 m) None
Arsenic *						
Cobalt *						
Chromium (III) (total chromium) *						
Mercury *						
Nickel *						
Tin *						
Lead (inorganic) *						
Zinc *						
Vinyl chloride *						
Trichloroethylene *						
Tetrachloroethylene *						

* = Chemical with user-specified data

NOTE: AT = Averaging time (days) EF = Exposure frequency (days/yr) ED = Exposure duration (yr) NAF = Natural attenuation factor POE = Point of exposure

Site Name: Gavarry Indoor 2PI CSR suolo-falda box
Site Location: Albisola
Completed By: GF

Date Completed: d-ott-yy
Job ID: A06-013

RBCA SITE ASSESSMENT

TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

INDOOR AIR EXPOSURE PATHWAYS

MAXIMUM PATHWAY EXPOSURE (mg/m^3)

(Maximum average exposure concentration from soil and groundwater routes.)

Constituents of Concern	On-site (0 m) Residential	Off-site 1 (0 m) None	Off-site 2 (0 m) None
Arsenic *			
Cobalt *			
Chromium (III) (total chromium) *			
Mercury *	1,1E-4		
Nickel *			
Tin *			
Lead (inorganic) *			
Zinc *			
Vinyl chloride *	8,5E-5		
Trichloroethylene *	1,2E-5		
Tetrachloroethylene *	9,9E-5		

RBCA SITE ASSESSMENT

TIER 2 PATHWAY RISK CALCULATION

INDOOR AIR EXPOSURE PATHWAYS ■ **(Checked if Pathway is Complete)**

CARCINOGENIC RISK

Constituents of Concern	(1) Carcinogenic Classification	(2) Maximum Carcinogenic Exposure (mg/m^3) On-site (0 m) Residential	(2) Off-site 1 (0 m) None	(2) Off-site 2 (0 m) None	(3) Inhalation Unit Risk Factor (µg/m^3)^-1	(4) Individual COC Risk (2) x (3) x 1000 On-site (0 m) Residential	(4) Off-site 1 (0 m) None	(4) Off-site 2 (0 m) None
Arsenic *	VERO		-	-	4,3E-3			
Cobalt *	VERO		-	-	2,8E-3			
Chromium (III) (total chromium) *	FALSO	-	-	-	-			
Mercury *	FALSO	-	-	-	-			
Nickel *	VERO		-	-	2,4E-4			
Tin *	FALSO	-	-	-	-			
Lead (inorganic) *	FALSO	-	-	-	-			
Zinc *	FALSO	-	-	-	-			
Vinyl chloride *	VERO	8,5E-5	-	-	8,8E-6	7,5E-7		
Trichloroethylene *	VERO	1,2E-5	-	-	1,7E-6	2,1E-8		
Tetrachloroethylene *	VERO	9,9E-5	-	-	5,7E-6	5,6E-7		

Total Pathway Carcinogenic Risk = **1,3E-6**

Site Name: Gavarry Indoor 2Pl CSR suolo-falda box
Site Location: Albisola
Completed By: GF

Date Completed: d-ott-yy
Job ID: A06-013

RBCA SITE ASSESSMENT

TIER 2 PATHWAY RISK CALCULATION

INDOOR AIR EXPOSURE PATHWAYS ■ **(Checked if Pathway is Complete)**

TOXIC EFFECTS

Constituents of Concern	(5) Maximum Toxicant Exposure (mg/m^3)			(6) Inhalation Reference Concentration (mg/m^3)	(7) Individual COC Hazard Quotient (5) / (6)		
	On-site (0 m) Residential	Off-site 1 (0 m) None	Off-site 2 (0 m) None		On-site (0 m) Residential	Off-site 1 (0 m) None	Off-site 2 (0 m) None
Arsenic *	0,0E+0	NC	NC	1,1E-3	0,0E+0		
Cobalt *	0,0E+0	NC	NC	2,0E-5	0,0E+0		
Chromium (III) (total chromium) *		NC	NC	5,3E+0			
Mercury *	1,1E-4	NC	NC	3,0E-4	3,7E-1		
Nickel *	0,0E+0	NC	NC	7,0E-2	0,0E+0		
Tin *		NC	NC	2,1E+0			
Lead (inorganic) *		NC	NC	1,2E-1			
Zinc *		NC	NC	1,1E+0			
Vinyl chloride *	2,0E-4	NC	NC	1,0E-1	2,0E-3		
Trichloroethylene *	2,9E-5	NC	NC	2,1E-2	1,4E-3		
Tetrachloroethylene *	2,3E-4	NC	NC	3,5E-2	6,6E-3		
Total Pathway Hazard Index =					**3,8E-1**		

Site Name: Gavarry Indoor 2PI CSR suolo-falda box
Site Location: Albisola
Completed By: GF

Date Completed: d-ott-yy
Job ID: A06-013

RBCA SITE ASSESSMENT | **Baseline Risk Summary-All Pathways**

Site Name: Gavarry Indoor 2PI CSR suolo-falda box
Site Location: Albisola
Completed By: GF
Date Completed: d-ott-yy

BASELINE RISK SUMMARY TABLE

	BASELINE CARCINOGENIC RISK					BASELINE TOXIC EFFECTS				
	Individual COC Risk		Cumulative COC Risk		Risk	Hazard Quotient		Hazard Index		Toxicity
EXPOSURE PATHWAY	Maximum Value	Target Risk	Total Value	Target Risk	Limit(s) Exceeded?	Maximum Value	Applicable Limit	Total Value	Applicable Limit	Limit(s) Exceeded?
OUTDOOR AIR EXPOSURE PATHWAYS										
☐	NA	NA	NA	NA	☐	NA	NA	NA	NA	☐
INDOOR AIR EXPOSURE PATHWAYS										
■	7,5E-7	1,0E-6	1,3E-6	1,0E-5	☐	3,7E-1	1,0E+0	3,8E-1	1,0E+0	☐
SOIL EXPOSURE PATHWAYS										
☐	NA	NA	NA	NA	☐	NA	NA	NA	NA	☐
GROUNDWATER EXPOSURE PATHWAYS										
☐	NA	NA	NA	NA	☐	NA	NA	NA	NA	☐
SURFACE WATER EXPOSURE PATHWAYS										
☐	NA	NA	NA	NA	☐	NA	NA	NA	NA	☐
CRITICAL EXPOSURE PATHWAY (Maximum Values From Complete Pathways)										
	7,5E-7	***1,0E-6***	***1,3E-6***	***1,0E-5***	☐	***3,7E-1***	***1,0E+0***	***3,8E-1***	***1,0E+0***	☐
	Indoor Air		***Indoor Air***			***Indoor Air***		***Indoor Air***		