

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Contaminant	Tetrachloroethene	from Level 1
Target Concentration	C _T 1.00E-02	mg/l from Level 1

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Approach for simulating vertical dispersion:

Simulate vertical dispersion in 1 direction

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to pollutants in all phases (e.g. field derived value)

Initial contaminant concentration in groundwater at plume core	C ₀	2.30E+00	mg/l	See contaminant specific input table
Half life for degradation of contaminant in water	t _{1/2}	1.00E+03	days	See contaminant specific input table
Calculated decay rate	λ	6.93E-04	days ⁻¹	See inputs & justification table
Width of plume in aquifer at source (perpendicular to flow)	Sz	5.00E+00	m	See inputs & justification table
Plume thickness at source	Sy	3.80E+00	m	See inputs & justification table
Saturated aquifer thickness	da	3.80E+00	m	See inputs & justification table
Bulk density of aquifer materials	ρ	1.60E+00	g/cm ³	See inputs & justification table
Effective porosity of aquifer	n	1.50E-01	fraction	See inputs & justification table
Hydraulic gradient	i	3.77E-02	fraction	See inputs & justification table
Hydraulic conductivity of aquifer	K	9.80E-01	m/d	See inputs & justification table
Distance to compliance point	x	2.50E+02	m	See inputs & justification table
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	1.00E+100	days	time variant options only
Parameters values determined from options				
Partition coefficient	Kd	4.58E+00	l/kg	see options
Longitudinal dispersivity	αx	2.50E+01	m	see options
Transverse dispersivity	αz	2.50E-01	m	see options
Vertical dispersivity	αy	1.00E-09	m	see options

Dispersed plume thickness exceeds aquifer thickness! Reduce vertical dispersivity

Calculated Parameters

Groundwater flow velocity	v	2.46E-01	m/d
Retardation factor	Rf	4.98E+01	fraction
Decay rate used	λ	6.93E-04	d ⁻¹
Rate of contaminant flow due to retardation	u	4.94E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C _{0D}	2.32E-07	mg/l
Attenuation factor (one way vertical dispersion, COICED)	AF	9.91E+06	

Remedial Targets

Remedial Target	9.91E+04	mg/l	For comparison with measured groundwater concentration.
Domenico - Steady state			
Distance to compliance point	250	m	
Concentration of contaminant at compliance point	C _{0D} /C ₀	2.32E-07	mg/l Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target.
The recommended value for time when calculating the remedial target is 9.9E+99.

Select Method for deriving Partition Co-efficient (using pull down menu)

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient

Kd | l/kg |

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer

foc 1.70E-02 | fraction |

Organic carbon partition coefficient

Koc 2.69E+02 | l/kg |

Entry for ionic organic chemicals (option)

Sorption coefficient for related species

K_{oc,i} | l/kg |

Sorption coefficient for ionised species

K_{oc,i} | l/kg |

pH value

pKa | fraction |

acid dissociation constant

Fraction of organic carbon in aquifer

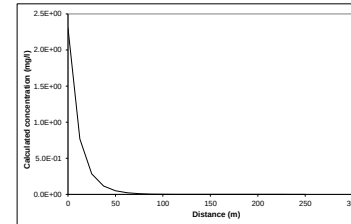
Kd 4.58E+00 | l/kg |

Soil water partition coefficient

Define dispersivity (click brown cell and use pull down list)

User defined values for dispersivity

		Enter value	Calc value Xu & Eckstein	m
Longitudinal dispersivity	ax	2.50E+01	2.50E+01	6.88E-09
Transverse dispersivity	az	2.50E-01	2.50E-09	6.88E-01
Vertical dispersivity	ay	1.00E-09	1.00E-01	6.88E-09
Note values of dispersivity must be > 0				
For calculated value, assumes $\alpha_x = 0.1 \cdot x$, $\alpha_z = 0.01 \cdot x$, $\alpha_y = 0.001 \cdot x$				
Xu & Eckstein (1995) report $\alpha_x = 0.83(\log_{10}x)^{2.114}$; $\alpha_z = \alpha x/10$, $\alpha_y = \alpha x/100$ are assumed				



Note graph assumes plume disperses vertically in one direction only. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Note

This sheet calculates the Level 3 remedial target for groundwater, based on the distance to the receptor or compliance located down hydraulic gradient of the source. Three solution methods are included, the preferred option is Ogata Banks.

By setting a long travel time it will give the steady state solution, which should be used to calculate remedial targets.

The measured groundwater concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used

Site being assessed: Kingsley Road
Completed by: Shauna McLoughlin
Date: #####
Version: 0.01

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Contaminant	Trichloroethene	from Level 1
Target Concentration	C _T 1.00E-02	mg/l from Level 1

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Approach for simulating vertical dispersion:

Simulate vertical dispersion in 1 direction

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to pollutants in all phases (e.g. field derived value)

Initial contaminant concentration in groundwater at plume core	C ₀	2.28E-01	mg/l	See contaminant specific input table
Half life for degradation of contaminant in water	t _{1/2}	1.00E+03	days	See contaminant specific input table
Calculated decay rate	λ	6.93E-04	days ⁻¹	See inputs & justification table
Width of plume in aquifer at source (perpendicular to flow)	Sz	5.00E+00	m	See inputs & justification table
Plume thickness at source	Sy	3.80E+00	m	See inputs & justification table
Saturated aquifer thickness	da	3.80E+00	m	See inputs & justification table
Bulk density of aquifer materials	ρ	1.60E+00	g/cm ³	See inputs & justification table
Effective porosity of aquifer	n	1.50E-01	fraction	See inputs & justification table
Hydraulic gradient	i	3.77E-02	fraction	See inputs & justification table
Hydraulic conductivity of aquifer	K	9.80E-01	m/d	See inputs & justification table
Distance to compliance point	x	5.00E+01	m	See inputs & justification table
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	1.00E+100	days	time variant options only
Parameters values determined from options				
Partition coefficient	Kd	2.40E+00	l/kg	see options
Longitudinal dispersivity	α _x	5.00E+00	m	see options
Transverse dispersivity	α _z	5.00E-01	m	see options
Vertical dispersivity	α _y	1.00E-09	m	see options

Dispersed plume thickness exceeds aquifer thickness! Reduce vertical dispersivity

Calculated Parameters

Groundwater flow velocity	v	2.46E-01	m/d
Retardation factor	Rf	2.66E+01	fraction
Decay rate used	λ	6.93E-04	d ⁻¹
Rate of contaminant flow due to retardation	u	9.25E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C _{0D}	3.46E-03	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	AF	6.60E+01	

Remedial Targets

Remedial Target	6.60E-01	mg/l	For comparison with measured groundwater concentration.
Domenico - Steady state			
Distance to compliance point	50	m	
Concentration of contaminant at compliance point	C _{0D} /C ₀	3.46E-03	mg/l Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99.

Select Method for deriving Partition Co-efficient (using pull down menu)

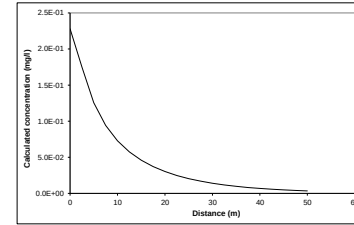
Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)	Kd		l/kg
Soil water partition coefficient			
Entry for non-polar organic chemicals (option)	foc	1.70E-02	fraction
Fraction of organic carbon in aquifer			
Organic carbon partition coefficient	Koc	1.41E+02	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	K _{oc,i}		l/kg
Sorption coefficient for ionised species	K _{oc,i}		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	2.40E+00	l/kg

Define dispersivity (click brown cell and use pull down list)

User defined values for dispersivity

		Enter value	Calc value Xu & Eckstein	m
Longitudinal dispersivity	ax	5.00E+00	5.00E+00	5.00E+00
Transverse dispersivity	az	5.00E-01	5.00E-01	2.98E-01
Vertical dispersivity	ay	1.00E-09	5.00E-02	2.98E-02
Note values of dispersivity must be > 0				
For calculated value, assumes ax = 0.1 * x, az = 0.01 * x, ay = 0.001 * x				
Xu & Eckstein (1996) report ax = 0.83(log10x) ^{0.114} ; az = ax/10, ay = ax/100 are assumed				



Note graph assumes plume disperses vertically in one direction only. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Note

This sheet calculates the Level 3 remedial target for groundwater, based on the distance to the receptor or compliance located down hydraulic gradient of the source. Three solution methods are included, the preferred option is Ogata Banks.

By setting a long travel time it will give the steady state solution, which should be used to calculate remedial targets.

The measured groundwater concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used

Site being assessed: Kingsley Road
Completed by: Shauna McLoughlin
Date: #####
Version: 0.01



R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Contaminant	Dichloroethene	from Level 1
Target Concentration	C _T	1.00E-02 mg/l from Level 1

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Approach for simulating vertical dispersion:

Simulate vertical dispersion in 1 direction

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to pollutants in all phases (e.g. field derived value)

Initial contaminant concentration in groundwater at plume core	C ₀	8.72E-01	mg/l	See contaminant specific input table
Half life for degradation of contaminant in water	t _{1/2}	3.00E+03	days	See contaminant specific input table
Calculated decay rate	λ	2.31E-04	days ⁻¹	See inputs & justification table
Width of plume in aquifer at source (perpendicular to flow)	Sz	5.00E+00	m	See inputs & justification table
Plume thickness at source	Sy	3.80E+00	m	See inputs & justification table
Saturated aquifer thickness	da	3.80E+00	m	See inputs & justification table
Bulk density of aquifer materials	ρ	1.60E+00	g/cm ³	See inputs & justification table
Effective porosity of aquifer	n	1.50E-01	fraction	See inputs & justification table
Hydraulic gradient	i	3.77E-02	fraction	See inputs & justification table
Hydraulic conductivity of aquifer	K	9.80E-01	m/d	See inputs & justification table
Distance to compliance point	x	2.50E+02	m	See inputs & justification table
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	1.00E+100	days	time variant options only

Parameters values determined from options

Partition coefficient	Kd	8.33E-01	l/kg	see options
Longitudinal dispersivity	ax	2.50E+01	m	see options
Transverse dispersivity	az	2.50E+00	m	see options
Vertical dispersivity	ay	1.00E-09	m	see options

Dispersed plume thickness exceeds aquifer thickness! Reduce vertical dispersivity

Calculated Parameters

Groundwater flow velocity	v	2.46E-01	m/d
Retardation factor	Rf	9.88E+00	fraction
Decay rate used	λ	2.31E-04	d ⁻¹
Rate of contaminant flow due to retardation	u	2.49E-02	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C _{0D}	7.06E-03	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	AF	1.24E+02	

Remedial Targets

Remedial Target	1.24E+00	mg/l	For comparison with measured groundwater concentration.
Domenico - Steady state			
Distance to compliance point	250	m	
Concentration of contaminant at compliance point	C _{0D} /C ₀	7.06E-03	mg/l Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99.

Select Method for deriving Partition Co-efficient (using pull down menu)

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)	Kd		l/kg
Soil water partition coefficient			
Entry for non-polar organic chemicals (option)	foc	1.70E-02	fraction
Fraction of organic carbon in aquifer		4.90E+01	l/kg
Organic carbon partition coefficient	Koc		l/kg
Entry for ionic organic chemicals (option)	K _{oc,i}		l/kg
Sorption coefficient for related species			
Sorption coefficient for ionised species	K _{oc,i}		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	8.33E-01	l/kg

Define dispersivity (click brown cell and use pull down list)

User defined values for dispersivity

Enter value	Calc value	Xu & Eckstein	m
2.50E+01	2.50E+01	6.80E+00	m
2.50E+00	2.50E+00	6.80E-01	m
1.00E-09	1.00E-09	6.80E-09	m

Longitudinal dispersivity

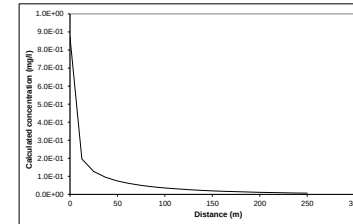
Transverse dispersivity

Vertical dispersivity

Note values of dispersivity must be > 0

For calculated value, assumes ax = 0.1 * x, az = 0.01 * x, ay = 0.001 * x

Xu & Eckstein (1996) report ax = 0.83(log₁₀x)^{0.114}; az = ax/10, ay = ax/100 are assumed



Note graph assumes plume disperses vertically in one direction only. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Note

This sheet calculates the Level 3 remedial target for groundwater, based on the distance to the receptor or compliance located down hydraulic gradient of the source. Three solution methods are included, the preferred option is Ogata Banks.

By setting a long travel time it will give the steady state solution, which should be used to calculate remedial targets.

The measured groundwater concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used

Site being assessed:	Kingsley Road
Completed by:	Shauna McLoughlin
Date:	#####
Version:	0.01



R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Contaminant	Vinyl Chloride	from Level 1
Target Concentration	5.00E-04	mg/l from Level 1

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state	Equations in HRA publication
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Approach for simulating vertical dispersion:

Simulate vertical dispersion in 1 direction

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to pollutants in all phases (e.g. field derived value)

Initial contaminant concentration in groundwater at plume core	C ₀	4.60E-02	mg/l	Maximum concentration
Half life for degradation of contaminant in water	t _{1/2}	5.00E+02	days	SP2-228 slowest half life Table 4.15
Calculated decay rate	λ	1.39E-03	days ⁻¹	
Width of plume in aquifer at source (perpendicular to flow)	Sz	5.00E+00	m	Red contours on contamination plan
Plume thickness at source	Sy	3.80E+00	m	Difference between siltstone and GW Level
Saturated aquifer thickness	da	3.80E+00	m	
Bulk density of aquifer materials	ρ	1.60E+00	g/cm ³	Sand
Effective porosity of aquifer	n	1.50E-01	fraction	
Hydraulic gradient	i	3.77E-02	fraction	(WS109 - WS101)/S2 GW m/AOD
Hydraulic conductivity of aquifer	K	9.80E-01	m/d	Geomean Slug tests
Distance to compliance point	x	5.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	1.00E+100	days	time variant options only

Parameters values determined from options

Partition coefficient	Kd	2.82E-01	l/kg	see options
Longitudinal dispersivity	αx	5.00E+00	m	see options
Transverse dispersivity	αz	5.00E-01	m	see options
Vertical dispersivity	αy	1.00E-09	m	see options

Dispersed plume thickness exceeds aquifer thickness! Reduce vertical dispersivity

Calculated Parameters

Groundwater flow velocity	v	2.46E-01	m/d
Retardation factor	Rf	4.01E+00	fraction
Decay rate used	λ	1.39E-03	d ⁻¹
Rate of contaminant flow due to retardation	U	6.14E-02	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C _{0D}	4.57E-03	mg/l
Attenuation factor (one way vertical dispersion, COICED)	AF	1.01E+01	

Select Method for deriving Partition Co-efficient (using pull down menu)

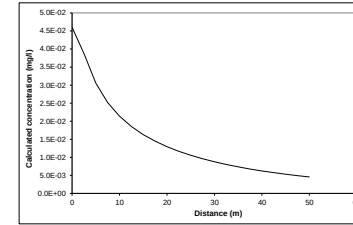
Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)	Kd		l/kg
Soil water partition coefficient			
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.70E-02	fraction
Organic carbon partition coefficient	Koc	1.66E+01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	K _{oc,1}		l/kg
Sorption coefficient for ionised species	K _{oc,i}		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	2.82E-01	l/kg

Define dispersivity (click brown cell and use pull down list)

User defined values for dispersivity

		Enter value	Calc value Xu & Eckstein	m
Longitudinal dispersivity	ax	5.00E+00	5.00E+00	2.98E+00
Transverse dispersivity	az	5.00E-01	5.00E-01	2.98E-01
Vertical dispersivity	ay	1.00E-09	5.00E-01	2.98E-02
Note values of dispersivity must be > 0				
For calculated value, assumes ax = 0.1 * x, az = 0.01 * x, ay = 0.001 * x				
Xu & Eckstein (1996) report ax = 0.83(log10x) ^{0.14} ; az = ax/10, ay = ax/100 are assumed				



Note graph assumes plume disperses vertically in one direction only. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Note

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By setting a long travel time it will give the steady state solution, which should be used to calculate remedial targets.

The measured groundwater concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used

Calculated concentrations for distance-concentration graph

Domenico - Steady state	
From calculation sheet	
Distance	Concentration
	mg/l
0	4.6E-02
2.5	3.87E-02
5.0	3.06E-02
7.5	2.52E-02
10.0	2.14E-02
12.5	1.85E-02
15.0	1.63E-02
17.5	1.45E-02
20.0	1.29E-02
22.5	1.17E-02
25.0	1.06E-02
27.5	9.60E-03
30.0	8.76E-03
32.5	8.01E-03
35.0	7.35E-03
37.5	6.76E-03
40.0	6.23E-03
42.5	5.75E-03
45.0	5.32E-03
47.5	4.92E-03
50.0	4.57E-03

Site being assessed:	Kingsley Road
Completed by:	Shauna McLoughlin
Date:	#####
Version:	0.01

Remedial Targets

Remedial Target	5.04E-03	mg/l	For comparison with measured groundwater concentration.
Domenico - Steady state			
Distance to compliance point	50	m	
Concentration of contaminant at compliance point	C _{0D} /C ₀	4.57E-03	mg/l Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99.